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A COMPREHENSIVE STUDY ON IMAGE DEHAZING-A SURVEY

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ABSTRACT

In the recent years the processing of digital images participate a dominant role in the acquiring the information within the image. Even though images contain the information due to various hazards accusation of information standards are reduced. One of the main image hazards is haze that is captured along with the image. Haze diminishes the visual quality of the images which causes poor performance of image processing. To acquire the quality information from the image and upgrade the visual quality of image causes development of various dehazing mechanisms to remove the haze in the image. Due to various mechanisms available it becomes arduous to select a efficient strategy based on the application. In this work various recently developed strategies are studied. And detailed reviews of these mechanisms were accomplished along with challenges, utilization together with future scope of studied mechanism were also discussed in this work.

*Keywords***:** *Haze, Image dehazing, Digital Image Processing, Image Preprocessing.*

I. INTRODUCTION

A. Haze
Haze is defined as smoke, fog, dust and mist that occurred by the micro particles that exist within the air which degrades the visual quality by slightly concealing air or environment. In image, haze is phenomena that occurred naturally or artificially when image is captured in the hazy environment or can also be added to the image by using the hazing insertion mechanisms. Haze reduces the visual quality of the images as it conceals the environment which makes the identification of objects arduous. Along with this contrast and sharpness of the image is also diminished. Haze will be removed from the images by utilizing the dehazing mechanisms.

B. Image Dehazing
Removal of haze that is fog, mist and smoke from the hazy image to enhance the visual quality is called image dehazing. Image dehazing comes under the category of image enhancement. When image dehazing is applied on the image haze exist in the image will be removed to certain extent. If the haze is too low to process additive haze will be added into the image by hazing mechanisms [1].

Importance of Image Dehazing
Dehazing is utilized to enhance the aesthetic and artistic quality of images and videos. It is exploited to increase the contrast of images and videos. Along with this dehazing is implemented to enhance the visual quality, information of the image and visual perception.

Dehazing of Image Can Be Obtained By Three Mechanisms
1. By implementing image enhancements techniques:

a) By applying histogram equalization.

b) By applying Retinex method.

c) By applying frequency transformation.

Mechanism
Step1: Identification of region of haze in the image.

Step2: If haze is too low to process, artificial haze will be   added to image to process.

Step3: Haze will be removed by processing algorithm by pixel rearrangement and Contrast enhancement along with filters.

Step4: Dehazed image is obtained.

2. By Exploiting Image Fusion Techniques:
a) Applying Image fusion on single images.

b) Applying image fusion on multi spectral images.

Mechanism
Step1: Various hazed image of same source will be selected.

Step2: Regions in various images which have no or little haze will be chosen.

Step3: These are fused together to get non process image.

Step4: After processing final dehazed image is acquired.

3. With Image Restoration Techniques
a) By utilizing additional information methods.

b) By prior knowledge methods.

c) By using multiple image methods.

Mechanism
Step1: Hazed image will be dismantled.

Step2: Hazed region will be removed.

Step3: Image will be restored.

Step4: Dehazed image will be obtained.

Challenges Faced When Dehazing
To dehaze an image, first we need to identify the haze exists in the image. And dehazing should be applied with maximum perseverance of authentic information [2]. Along with these visual criteria like contrast, texture, object boundaries etc. should be preserved and enhanced. Complexity of image dehazing becomes arduous if other hazards are existed.

C. Applications of Image Dehazing
- Utilized in remote sensing algorithms.

- Exploited in object recognition algorithms.

- Exploited in underwater observation.

- Used in intelligent vehicle control algorithms.

- Implemented in data analysis in hazy, smog and fog environment.

- In satellite image process and analysis of images from mining regions.

- In image sharpening and weather analysis.

- Used in military applications.

In the following section 2 contains literature survey about latest method were discussed and section 3 contains research finding and future scope.

LITERATURE SURVEY
Deoyani Mujbaile and Dinesh Rojatkar [3] developed a mechanism for dehazing of images by utilizing Minimum white balance optimization. Mainly invoked to solve the common crisis of dehazing algorithm that is contrast changes and dense layer of haze in resultant dehazed image. Dynamic duplication dehaze system which developed on minimum white optimization is stated and utilized in this mechanism. This system combines some of the well known single image dehazing algorithms increase the quality of the resultant dehazed images from a single hazed image by exploiting adaptive histograms. From the resultant images one will be selected for the final output which has least white balance to get feasible result. It is stated that this mechanism have better performance, stability, increases the field of application, visual perception. Along with these contrast and radiance of the output enhanced to a certain limit.

Keping Wang et al.[4] proposed a single image dehazing algorithm which work on the principle of pyramid multi-scale interchanged conventional network. Proposed to solve the problems of atmospheric distribution

model like partial dehazing, color travesty, divergent image optimization and reconfiguration of output. Constructs peer to peer image dehazing network to know the mapping correspondence between hazy image and its clear image. This network implement descending attribute extraction block to acquire the attribute information of image that works on principle of Multi-channel chained architecture to construct the interpretation of attributes of subsequent corresponding layers in the block format. Multi-scale interchanged conventional network is used for reconstruction of dehazed image, attribute map is also constructed. It is stated that proposed algorithm have enhanced results in both dehazing and maintenance of visual color precision when compared to present state-of-the-art methods.

Vinay Kehar et al. [5] introduced a single image dehazing model by utilizing brightness channel prior which is dependent on Meta heuristics data for efficient dehazing. This model mainly invoked to eradicate the haze in image which has highest haze gradient and to ignore the performance of hyper parameters tuning. Along with gradient filter to enhance the transmission map. Initial parameters for BCP are achieved by general Sorting Genetic Algorithm and tuning of hyper parameter is done by NSGA. BCP have enhanced performance even with various range of haze degradation magnitude which does not lead to visible artifacts. And also proposed BCP have better performance than competitive dehazing models in various terms and attributes.

Gengqian Yang and Adrian N. Evans [6] developed single image dehazing strategy to process on resource constrained or restricted platform. This strategy is invoked to reduce the complexity of dehazing and increase the performances in individual system and platform. Further a newly developed dark Channel Prior-dependent algorithm is proposed for single image dehazing which have an enhanced atmospheric light detection method with a very low-complexity structural remodeling. Along with this undemanding peer-to-peer network is also proposed which eradicate loss of information and reduces the implementation burden by eradicate pooling and fully connecting layers. It is stated that resultant dehazed image from this algorithm can be compared with state-of-the-art techniques and also outperform them in both qualitative and quantitative analysis with significantly least complexity. And suitable to utilize in resource constrained and restricted platforms.

Cahyo Adhi Hartanto and Laksmita Rahadianti [7] develop a methodology for single image dehazing by utilizing deep learning techniques. In this methodology novelist architecture is proposed which is dependent on PDRNet by exploiting pyramid sensitive convolution, pre-processing, processing, post processing modules and awareness applications. Network is trained to eradicate L1 and intangible loss with the help of O-Haze dataset. Architecture's result is evaluated with SSIM, PSNR, and color variance along with psychovisual techniques for objective and subjective analysis respectively. This methodology utilize Pyramid sensitive convolution that exist in architecture to maintain spatial information over a wide range of receptive fields.

Jing Qin et al. [8] proposed a technique for single image dehazing by utilizing Sparse Contextual Representation. This technique is mainly developed for enhancement of image dehazing. Sparse representation is stated and processed for contextual conciliate tool to reduce the occurrence of block artifacts and halos that are generated by utilizing dark channel prior without implementing soft matting as the transfer is not always regular in a local region. By using proposed dictionary to flat an image and produce the sharp and accurate dehazed result. It is assed that after comparing the resultant dehazed image has a higher quality than the available state of the art methods along with light color, refined image structure and local information.

Wenjiang Jiao et al. [9] introduced a single image mixed dehazing methodology which is dependent on the numerical repetition model and DehazeNet. This is a mixed methodology which in obtain by the integration of physical model dependent methods and learning dependent methods to obtain refined, enhanced dehazed image. The image is first categorized based on the intensity of haze in the image to compute précised a tmospheric light to reconstruct haze free image. Later dark channel prior and DehazeNet are integrated and utilized to calculate the transformation to promote the final refined haze-free image which is close to the original. Then a numerical repetitive method to is implemented to optimize atmospheric light and transformation. It is stated that this technique have enhanced results than existing state of art methods in both artificial datasets and original datasets. It is also stated that even in the remote sensing datasets the results are up to visual standards.

Hong Xu Yuan et al. [10] introduce a dehazing mechanism for the foggy images which works on the long range dependence. This mechanism is to justify LRD of foggy images. In this mechanism the Hurst parameters of 1,000 foggy images within SOTS are calculated and discussed. This mechanism proposed Residual Dense Block Group (RDBG), which has enhanced long gaps among two Residual Dense Blocks to customize for LRD of foggy images. It is stated that Residual Dense Block Group significantly enhance the information in dehazing image in dense and thick fog. It is also stated that this mechanism reduce the occurrence of the artifacts and obstruction of resultant dehazing image.

Daosong Hu et al. [11] introduced a dehazing method for outdoor hazy image in rapid pace which depend on brightness and concentration of haze in the image. This mechanism works on the principle of HSV color space to reconstruct the visibility of regularized distribution model. It leads to control of miscomputing the transformation and atmospheric light. This mechanism utilizes brightness to compute global atmospheric light to reduce the effect of luminescent region in the image. Along with this a model is developed to compute concentration of scene by utilizing atmospheric distribution model, stretching function is utilized for rapid computation, to repetitive models are exploited for solving parameters. It is stated that this mechanism have enhanced dehazing along with low time to compute than the existing mechanism.

Won Young Chung et al. [12] developed a method for image dehazing by utilizing LiDAR constructed grayscale depth prior. This method is developed by utilizing a single channel grayscale depth image construction from a LiDAR point cloud 2D projection image. This method calculates the optimal distribution coefficients for numerous artificial hazy images and explains the relation between the optimal distribution coefficient and dark channels, linear regression is used find equation between them. Transformed image for dehazing is explained with distribution coefficient and a grayscale depth image which is generated from LiDAR 2D projection. Dehazing is implemented by utilizing the atmospheric distribution model by explained atmospheric light and transformation image. This method was quantitative and qualitative analysis is done by image quality parameters through simulators and SSIM showed 24% enhancement.

Usman Ali et al. [13] developed a algorithm for single image dehazing by utilizing robust homogenization. This algorithm is mainly invoked to solve the restricted robustness on outliers and to distinguish between initial and guidance transmission map by utilizing non convex energy function which is calculated by maximize-minimize algorithm. This algorithm generate enhanced transmission map were edge are preserved and generate enhanced haze free image with light colors on both artificial and real hazy images. It stated that the quantitative and qualitative analysis explains the effect of this algorithm and compared with the state-of-the-art strategy by utilizing SSIM, FADE and VLD.

Xiang Chen et al. [14] proposed a strategy for untangled deep image dehazing by utilizing effective disentanglement learning. This strategy divides the images into two categories depending on the haze relevant scattering. Contrastive learning is inserted to a CycleGAN framework to study disentangled relation by managing the constructed images to be associated with undiscovered factors. This strategy's CDD-GAN consist negative constructer to associative the encoder network to update and to generate collection of possible negative factors. Then these negative factors are trained one-to-one along with the backbone representation network to improve the biased data and increase the possibilities factor for disentanglement implemented by maximizing the main contrastive loss. It is asserted that extensive experiments on both artificial and real-world datasets explain that this method implemented favorably against existing untangled dehazing genesis.

II. RESEARCH FINDINGS
Images dehazing by exploiting Minimum [3] White Balance Optimization. This method can be implemented on hazy images of various dimensions.

Applications
1. Image dehazing on image that has object distortion, higher fog intensity.
2. Dehazing with optimized result.
3. Utilized in surveillance drone, cameras and aerial view capturing of landscapes.

Draw Backs
1. Completely dependent on white balance optimization.
2. As the dimensions of image increase, the time required to accomplish the dehazing will be increased.

Future Scope
Parallel implementation on large set of images, reducing time complexity, reducing the white balance optimization influence.

Single image dehazing method [4] works principle of pyramid multi-scale interchanged conventional network. This method maintains color fidelity.

Applications
1. Dehazing on both synthesized and natural haze image.
2. Can be utilized on low illuminated images.

3. Can be used in low illuminated area image capturing cameras.

Drawbacks

1. Dependent on atmospheric distribution model.

2. Require large set of data to train the network.

Future Scope

Multiple image dehazing, reducing space requirements, sintegration of CNN with other dehazing mechanisms.

Single image dehazing model [5] by utilizing brightness channel prior which is dependent on Meta heuristics data for efficient dehazing. This model can be performed even in large haze gradient.

Applications

1. Can be utilized on various contrast images.

2. Can be used in highly hazy images.

3. Can be used in underwater, space, climate observations.

Drawbacks

1. Require various resources and have high complexity.

2. Time required to implement is high.

Future Scope

Multiple image dehazing, reducing the implementation complexity and requirements, implementation with denoising.

Single image dehazing strategy to utilize [6] on resource constrained or restricted platform.

Applications:

1. Dehazing implementation on low resources platforms.

2. Dehazing implementation with low specifications.

Drawbacks

1. Low colour fidelity.

2. Cannot be implemented on multiple images.

Future Scope

Increasing the performance of dehazing, multiple image dehazing, increasing color fidelity.

Single image dehazing by utilizing deep [7] learning techniques. This technique can be implemented on various images with different haze metrics.

Applications

1. Dehazing on mining images.

2. Dehazing on low illuminated images.

3. Performing dehazing with preserving spatial information.

Drawbacks:

1. Require a large collections of training set to train the algorithm.

2. Require large collection of modules for processing of image.

3. Complexity to implement.

Future Scope

Implementation on multiple images, reducing implementation complexity and time, increasing the range of utilization.

Single image dehazing by utilizing [8] Sparse Contextual Representation.

Applications

1. Dehazing with smoothing and sharpening of image.

2. Dehazing implementation on rigid images.

Drawbacks

1. Require other algorithms for smoothing.

2. Have high complexity and resource requirement.

Future Scope:

Implementation on multiple images, adding denoising mechanisms, increasing color fidelity with less complexity.

Single image mixed dehazing [9] methodology which is dependent on the numerical repetition model and DehazeNet.

Applications

1. Can be implement on large variety of images.

2. Dehazing with both fidelity and preserving information.

Drawbacks

1. Complex integration of both physical and deep learning.

2. Require large amount of data and complex algorithm to integrate and implement.

Future Scope

Integration with other mechanisms, reducing complexity, increasing the effective by integrating image pre and post processing mechanics.

Dehazing mechanism for [10] the foggy images which works on the long range dependence.

Applications

1. Dehazing on higly mist and foggy images

2. Can be utilized in forest surveillance.

3. Can be utilized in remote sensing.

Drawbacks

1. Classification of region based on haze increases complexity

2. Estimation of transmission and atmospheric light is somewhat arduous.

Future Scope

Increasing the scope of application, mixing with filters, texture analysis of dehazed image.

Dehazing mechanism [11] for outdoor hazy image in rapid pace which depend on brightness and concentration of haze in the image

Applications

1. Rapid implementation of dehazing

2. Vehicle surveillance in hazy environment.

3. Dehazing for wide range of haze concentration

Drawbacks

1. Cannot perform well in low illuminate images.

2. Highly dependent on haze concentration and brightness.

Future Scope

Implementing on low illuminate image, implementation along with denoising and glare reduction.

Image dehazing by utilizing [12] LiDAR constructed grayscale depth prior

Applications

1. Can be used in robust environment.

2. Can be utilized in data in the image is sensitive.

Drawbacks

1. Complexity of LiDAR algorithm.

2. Require more resources to implement in real time.

Future Scope

Uitilization of filters, increasing the color fidelity, reducing the complexity and requirements.

Single image dehazing [13] by utilizing robust homogenization

Applications

1. Can be used in robust environment.

2. Can be implemented on rigid images.

3. Enhanced method for texture analysis.

Drawbacks

1. Robustness increases the complexity.

2. Have complex implementation for simple images.

Future Scope

Dehazing along with smoothness ehnacement, sharpness enhancement.

Untangled deep [14] image dehazing by utilizing effective disentanglement learning

Applications

1. Dehazing in both hazy and normal image.

2. Dehazing with large set of images.

Drawbacks

1. Impairing of hazy and normal images increase the complexity.

2. Implementation on less or no haze image is not up to standards.

Future Scope

Implementing with deep learning mechanisms, utilizing denoising mechanisms.

III. CONCLUSIONS

Increase in range of environment were a human can reach has leads to acquire the images from various sources. Even though image is obtained due to haze information exists in the image was reduced. Lead to utilization dehazing mechanisms. The research shows a passion to develop dehazing mechanisms by utilizing image restoration, image enhancement and image fusion dependent methodologies. Lead to increase in techniques. To give a details about the dehazing the statistical study of the assed dehazing methods was accomplished in this work. Every technique has its own advantages and applications. Some methods can be utilized in real time applications. The domain of dehazing has many scopes to advance in the future due its wide range of utility.

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E-COMMERCE CUSTOMERS BUYING BEHAVIOR ANALYSIS USING PYTHON

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ABSTRACT

Any business have at least two components i.e. sellers and buyers. Sellers are the entity who are selling the products, services, etc. and buyers are the consumers who consume the products, services, etc. The buying behavior of the buyers are very dynamic in nature and very difficult to predict. Buyers may be classified as offline buyers and online buyers. Online buyers purchase the products/services using e-commerce websites and payment is also made using online mode. Know your customer (KYC) methods is used by the companies for digitally and accurately record of the on-line journey of each customer. Ecommerce companies use KYC to serve to customers in more efficiently and accurately. Statistical methods are also applied on this digitally recorded data to understand the customer behavior and change the business accordingly. Customer behavior is very broad in nature, which includes buying behavior, searching behavior, browsing behavior, payment behavior, writing feedback behavior, product liking and disliking behavior, etc.. Customer buying behavior is highly personal activity and depends on many factors/situation related to customer like gender, financial background, marital status, mental level, having kids or not, locality, age, etc.. Therefore, it is very difficult to predict the customer buying behavior generally. A dataset related to online buying is used to identify and analyze the customer behavior using the python.

Keywords: Sellers, Buyers, Behavior, E-commerce, KYC, Python.

INTRODUCTION

Prediction of customer buying behavior is a challenging task. Customer buying behavior depends on many factors like customer nature, financial status, age, gender, marital status, having kids or not, number of kids, discount available, festival session, favorite day, favorite month, party occasion, spouse birthday, kids birthday, etc.. According to their convenience customers set some day and some months as favorite day and favorite months and he/she try to buy more on these days or months. A study on customer buying behavior is carried out on a secondary data. This dataset contains more than one lakh thirty thousand records and more than thirty attributes. Initially many attributes contain null values which lateron treated by removing and fill by relevant values by using some methods available in python. Finally a dataset containing no null values is prepared and used for analysis of customer buying behavior.

A study on gender, marital status, number of children, customer level, favorite day, favorite month is carried out from different angles. The graphs plotted between these attributes shows valuable information's which definitely helps a company to improve their business and fulfill the customer's needs also. It is observed that customers having more children buy more, females buy more than males, gender wise customers buy more on their favorite day and months, etc.Customers having more children are an asset to the firm selling products on-line. This type of customers wants to avail more discounts on the products to save money for future.

DATA USED

A secondary dataset contains more than 1, 30,000 records and more than 30 attributes is taken from github.com website. This dataset is analyzed from different angles by using python. The attribute names are self exploratory i.e. ID is the customers unique number, GENDER is the customers gender, MARITAL_STATUS is the marital status of the customer i.e. single or married, LT used at the beginning of attributes name stands for Last Transaction and FT used at the beginning of attributes name stands for First Transaction, TOT used at the beginning of attributes name stands for Total, CUST used at the beginning of attributes name stands for Customers, AVG used at the beginning of attributes name stands for Average, FAV used at the beginning of attributes name stands for Favorite.A complete record of this dataset is given as follows:

Attribute Names	Values
ID	364259
GENDER	FEMALE
MARITAL_STATUS	MARRIED
NO_OF_CHILDREN	0
LT_OCCASION	0

LT_OFFER_APPLIED	1
LT_QUANTITY	2
LT_AMOUNT	752260
FT_OCCASION	0
FT_QUANTITY	2
FT_OFFER_APPLIED	1
FT_AMOUNT	313995
TOT_TRANSACTIONS_OVERALL	4
CUST_LEVEL_OVERALL	Medium
TOT_TRANSACTION_AMOUNT_OVERALL	1218512
TOT_QUANTITY_OVERALL	6
TOT_DISCOUNT_OVERALL	49028
AVG_TRANSACTION_AMOUNT_OVERALL	304628
AVG_QUANTITY_OVERALL	1
AVG_DISCOUNT_OVERALL	12257
TOT_BIRTHDAY_PRODUCT	0
PREMIUM_PRODUCT	6
TOTAL_ANNIVERSARY_PRODUCT	2
TOTAL_OCASSION_PRODUCT	1.0
FAV_DAY	7
FAV_MONTH	7
AGE	56.0
CITY	DEHRADUN
STATE	UTTARAKHAND
RECENCY	430

This dataset is related to a festival session and contains more attributes. Therefore, it can be used to analyzed from different angles to extract useful information's about customer's behavior. During this study the data is analyzed mainly with respect to gender, marital status, and number of child's, total transaction amount, favorite day and months of the customers. Later on, data can be analyzed w.r.t. age, product types, recency, city and state of the customers.

METHOD

The first step to analyze any dataset is the treatment of null values available in dataset. The different method are applied to handle null values like numeric values may be replaced by mean, mode or median value of the column/attribute of the dataset. This method is not applicable to the categorical values, therefore categorical null values may be replaced among the set of most frequent values appeared in particular column randomly. Initially this dataset contains many null values, which is treated by deleting some unwanted attributes containing null values and by replacing other column's null values by frequently appeared values. The following is the details of attributes containing null values. The percentage of null values is also calculated by using following code in python.

column_having_missing_value = df.columns [df.isna ().any ()].tolist ()

Total_missing_count = []

For i in column_having_missing_value:

total_missing_count.append (sum (pd.isnull (df [str (i)])))

missing_dict = {'Missing_value_column_name':column_having_missing_value,'Total_missing_Values':

total_missing_count}

Print (missing_dict,'\n\n')

Missing_value_DF = pd.DataFrame (missing_dict)

Missing_value_DF ["Percentage of Missing Value"] = (Missing_value_DF ['Total_missing_Values'] / df.shape [0]) * 100

Print (Missing_value_DF.sort_values (by= ['Percentage of Missing Value'], ascending =False))

Missing_Value_Column_Name	Total_missing_Values	Percentage ofMissing Value
CHILD3GENDER	127267	96.11%
CHILD2GENDER	109981	83.05%
CHILD1GENDER	97444	73.59%
SPOUSEAGE	77588	58.59%
SPOUSE_DOB_DAYS_LEFT	77588	58.59%
ANNIVERSARY_DAYS_LEFT	69502	52.48%
TOTAL_OCASSION_PRODUCT	62877	47.48%
MARITAL_STATUS	43786	33.06%
STATE	34160	25.79%
AGE	28372	21.42%
DOB_DAYS_LEFT	28372	21.42%
CITY	26952	20.35%
GENDER	21887	16.52%

After null values treatment, bar graph is plotted on the whole data frame(df) values. The bottom of the graph shows name of attributes and top of the graph shows total number of records available in that attributes. All the attributes containing the same available record number i.e., 132414, which indicates that no null values are present in any attributes of the data frame (df).

Fig. 1

In the dataset favorite day and months are represented by number's i.e. 1,2,3,4,5,6,7,8,9,10,11,12.These numerical values are treated as continuous values by the software during analysis,therefore before analysis these numerical values must be converted to categorical values i.e. day 1 convert to "SUNDAY", day 2 to "MONDAY",day 3 to "TUESDAY", day 4 to "WEDNESDAY", day 5 to "THURSDAY", day 6 to "FRIDAY", day 7 to "SATURDAY. Similarly, month 1 convert to 'JANUARY', month 2 to 'FEBRUARY', month 3 to 'MARCH', month 4 to 'APRIL', month 5 to 'MAY', month 6 to 'JUNE', month 7 to 'JULY', month 8 to 'AUGUST', month 9 to 'SEPTEMBER', month 10 to 'OCTOBER', month 11 to:'NOVEMBER', month 12 to 'DECEMBER'.

The attributes 'Lt_Occasion', 'Lt_Offer_Applied', 'Ft_Occasion', 'Ft_Offer_Applied', 'Past_Diwali_Purchaser' contains the values 0 and 1. These values are also converted to categorical values as 0 replaced by 'N' and 1 replaced by 'Y'.After null values treatment and other operations of preprocessing has been completed on the dataset the dataset is ready for analysis.

A graph between marital status, number of children's and overall total transactional amount is plotted (fig. 2). The fig indicates that married customers having three child's purchase more than two children and one child. customers having one child or no child behaves the same in terms of overall total transaction amount. The unmarried customers having the total transaction amount at par with the customers having two children.
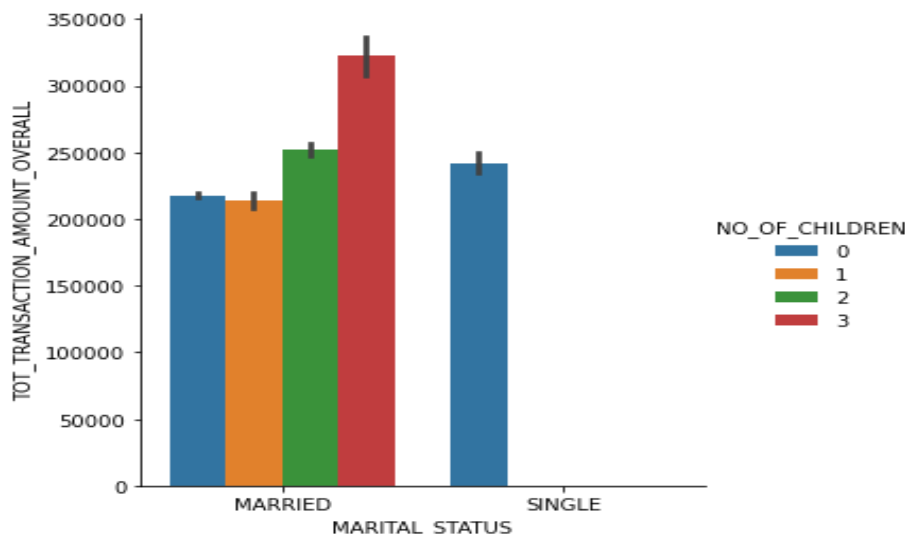
Fig. 2

The next graph plotted between gender of the customer, number of children of customers and overall total transaction value (fig. 3). The graph shows that male or female having three children's expend more amount purchase although females having three children's expend more amount on purchase than males having three children's. As a general observation females do more purchase and expend more amount on purchase than males. The graph also indicates that customers having three children, purchase more and spend more money than others.
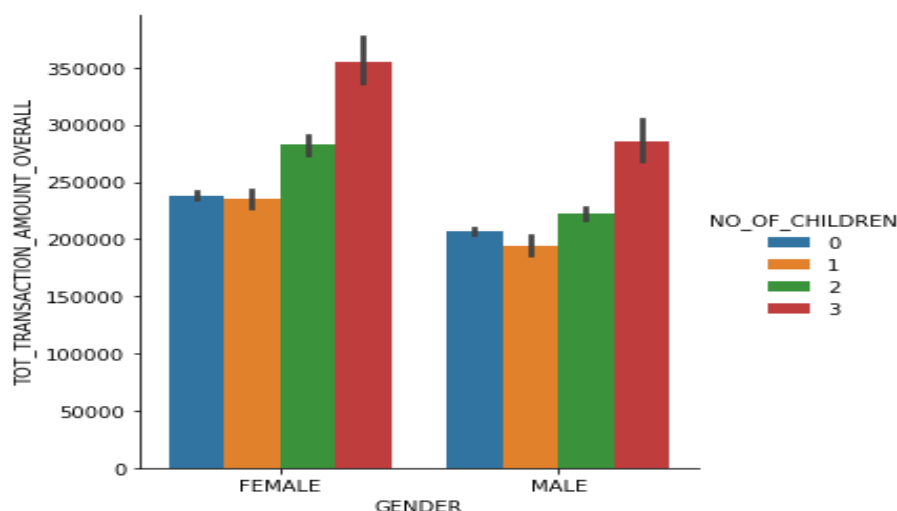
Fig. 3

The next graph plotted between customer level, number of children of customers and overall total transaction value (fig. 4).The customers having high customer level purchase more and expend more money on online buying, customers having low customer level purchase less and spend less money on online buying. Customers having medium customers level are lies within the range of low customer level and high customer levels. A graph between customer level, number of children and overall transaction value is plotted. The graph indicates that customers having two or three children expend more within their category than the customers having zero or one child. The purchase amount difference between high and medium level customers are four time than medium level customers which is a big difference and needs focus on it.
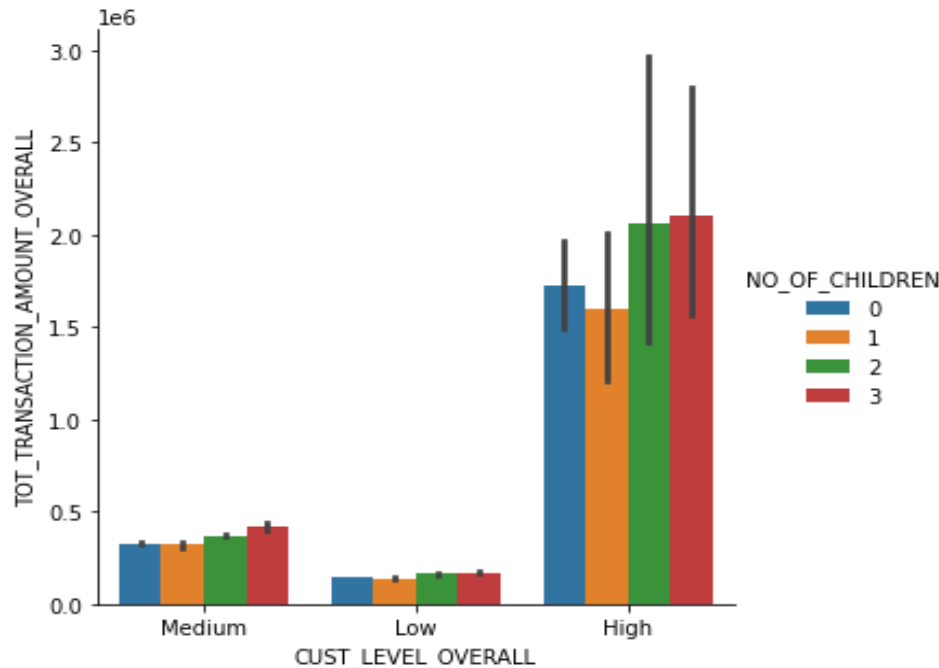
Fig. 4

Figure 5 which is the graph between overall customer level and number of children's customer have, shows that when customers move from no children to one child the customers buying level slightly goes down and when customers move from one child to two child than customers buying level slightly goes up and when customers move two children to three child the customers buying level significantly goes up an more purchase done by the customer. The number of children's have significant impact on customers buying level and buying behavior.
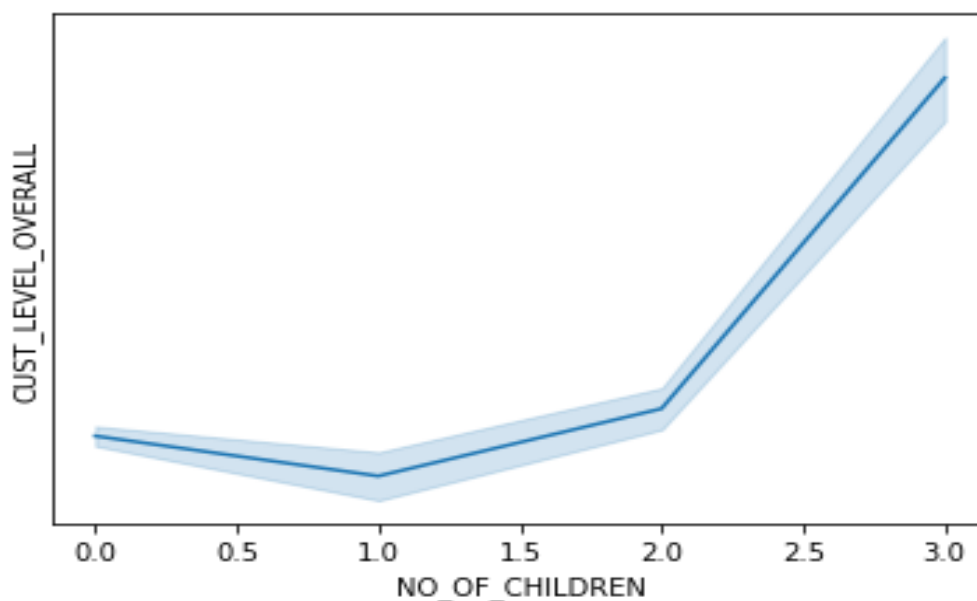
Fig. 5

Another graph plotted between number of children and number of items purchased by the customers (fig. 6). The graph is also indicating that customers having more child's purchase more items than the customers having less numbers of children.
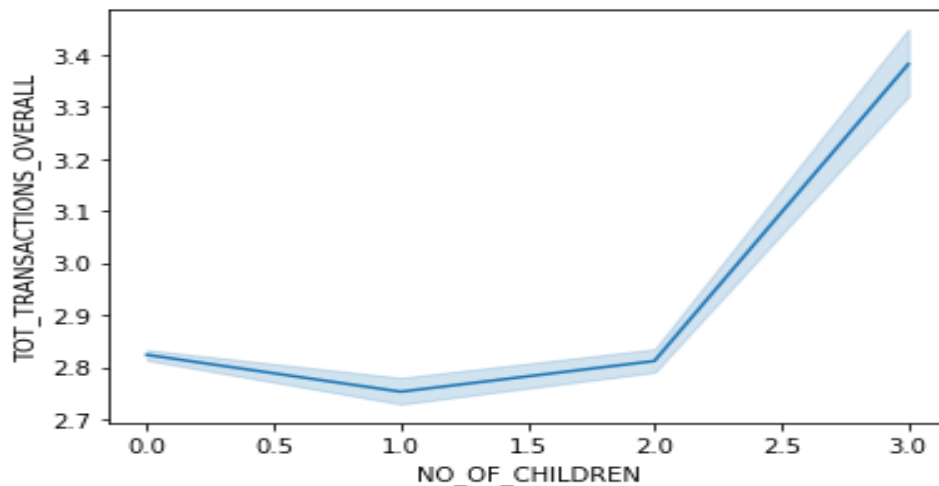
Fig. 6

Similarly, a graph between overall total discount availed by the customer and the number of children is plotted (fig. 7). This graph shows that customers having more children wants availed more discount. This is an important factor to firms who are selling products of services. Offering more discount will improve the business and Return on Investment (RoI) will also be improved.
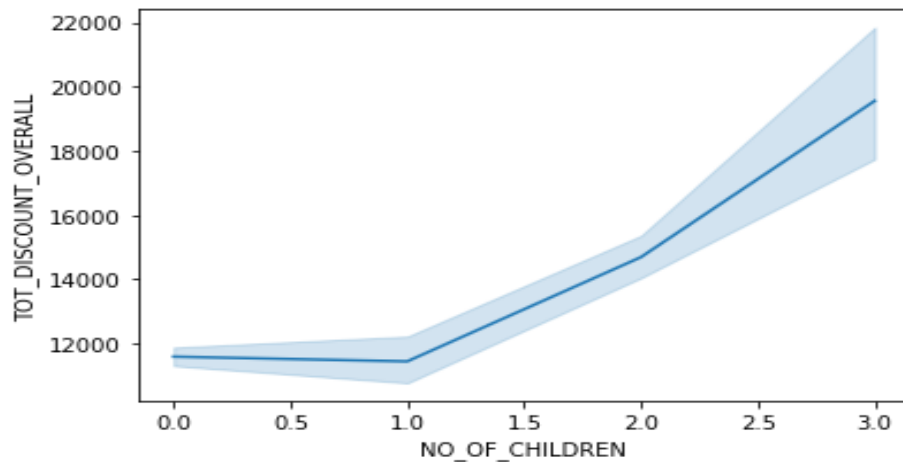
Fig. 7

Further a study is made on the favorite day, favorite month and gender of the customer's. A graph between favorite day, gender of customers and overall total transaction amount is plotted (fig. 8). The graph shows that female customers have only one favorite day on which they buy more and that day is Thursday. On other days female customers buy less and Tuesday is the less preferred day by female customers. On the other hand male customers have two favorite days on which they buy more and these days are Thursday and Friday. On other day male customers buy less and Wednesday & Monday are the less preferred day by the male customers.
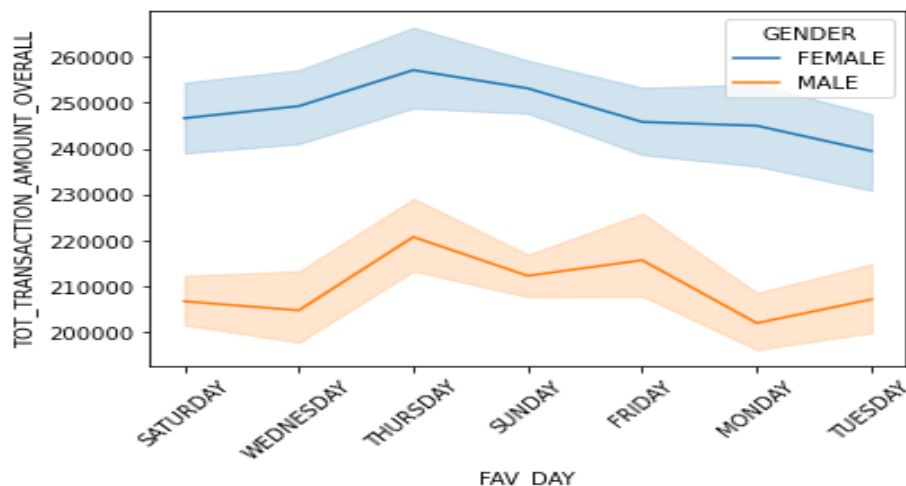
Fig. 8

Similarly, a graph between favorite months, gender of the customer and overall average transaction amount is plotted (fig. 9). The graph shows that October is the favorite month of all the customers irrespective of gender of customers. October is also a festival months, therefore customers (both male & female) buy more during this month. The March is the less preferred month of both male and female customers. During March month the salaried customers pay all taxes from their salaries, therefore this may be the reason that both male and female customers buy less during the month of March.
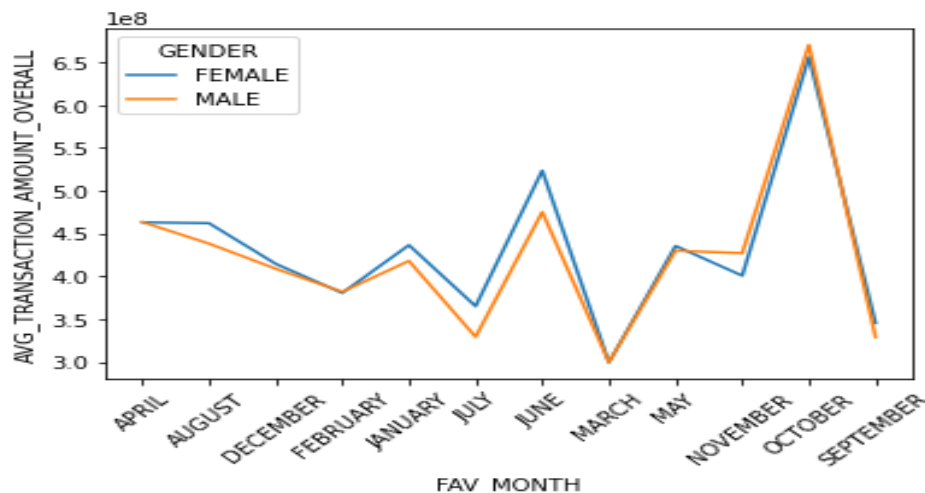
Fig. 9

CONCLUSION

A dataset taken from GitHub, related to customers on-line buying is analyzed from different angles like effect of customer gender on total transaction amount, effect of customers marital status on total transaction amount, effect of number of children on total transaction amount, relation between number of children and discount amount, relation between number of children and customer level, gender wise favorite day of the customers on which customers buy more, gender wise favorite months of the customer on which customers buy more.

It is found that personal attributes of the customers like gender, marital status, number of children, etc. have significant effect on customers buying behaviors. Female customer buys more than male customers. Female customers having no child or one child buy less than the female customers having two or three children. Female customers having three children buy more and have high customer level. Similarly, male customers having three children buy more than the male customers having no child or one child or two children. Tuesday is the favorite day of female customers and Tuesday & Friday are the favorite day of the male customers. October is the favorite month for both male and female customers and March is the month when both male and female customers buy less. Irrespective of customers gender, customers having more children wants to avail more discount to save the money.

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IMPORTANCE OF API AND ITS APPLICATIONS-A COMPREHENSIVE REVIEW

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ABSTRACT
API is a frame work activity acts as an interface between a language and OS. This frame work include many Number of library functions. Its construction differentiates from one language to another language Base on platform dependent and independent. .NET facilities construction of common API for different language being they are dependent (or) independent but reliability is not achieved. Now a day's artificial intelligence plays a key role in making decision in wide range of applications. Due to this development, it is essential to construct efficient API mechanism. Before implementing intelligent API, it is necessary to study basics of API. This paper concentrates on basic principles and comprehensive study of API frame works proposed by different researchers.

Keywords: API framework, Artificial Intelligence, .NET framework, Operating System, Programming Language, REST API.

1. INTRODUCTION

A. API Definition
An Application Programming Interface is a collection of functions, activities, assignments and plan of action that aid to develop an application software. It facilitates swap the information between module to module without reconstruction of module. It [1] clarifies software development, creation and invention by permitting applicants to swapping data freely and securely. It is a interface that admit both applications to swap each other.

For example: - a person watching a YouTube whenever notification served by a system the user can easily switchover from YouTube to served notification here API used as interface.

B. API History
❖ In 1940's Maurice Wilkes and David Wheeler both scientists worked on a segment software library in The Electronic Delay Storage Automatic Calculator (EDCAC).

❖ In the year 1951 Maurice Wilkes and David Wheeler proposed a book "the preparation of programs for an electronic digital computer" it mainly contains information relates to initial API construction as well as future scope to further enhancement.

❖ In 1968 the phrase" Application program interface" is the first document in an article called Data structures and techniques for isolated computer graphics presented in an American federation of information processing societies (AFIPS).

❖ The term API was found to the concept of database proposed by Chris Date in the year 1974 write an article called the relational database management system and network model.

❖ In the year 1990 Carl Malamud describe API was defined as a set of services available to a programmer for performing certain task.

❖ Architectural styles and the design of network-based software Architectures at university of California Irvine in the year 2000 Roy Thomas fielding outlined Representational state transfer (REST) proposed an idea of a "network-based Application programming interface" that contrasted with traditional "library-based" APIs.

C. API Design Principles
1) **Discoverable:** If customer unable to find the required information by exploiting API, then the existence of the API can be neglected. API should be developed so that in can be easily discoverable.

2) **Reusable:** Reusability is [1] the main property which decreases construction cost of a component where same properties are needed to reconstruct.

3) **Modular:** Modularity represents reuse of a module which has already created with set of functionalities here the creation of same functionalities not needed by using the reusable property.

4) **De-Coupled:** API may not depend on source, target and vice versa also that it is independent, which increases the cost.

5) **Governed:** APIs utilizes Harvard university information technology (HUIT) standards. This standard provides for security, access management and logging etc.

In the design of API following question may arise for a better construction

1. The API [2] wants to be noticeable, so that another one looking for data can discover it and know which kind of data it provides and how do you access the data?

2. The API can possible to reuse and reconstructed?

3. The API modular had their benefits for doing it more modular?

4. Is this API belongs to a system which may undergo a continuous change, or some other day can be replaced or they widely used? And also, there is a need to disassemble the target and source of this API?

5. Is these wants to implement Harvard university information technology (HUIT) standards for security, compliance, logging, monitoring, specific access controls and provisioning features? Does it want to be governed?

II. LITERATURE REVIEW

Y S.M. Hari Krishna and Rinki Sharma[3] done aSurvey on application programming interfaces in network function virtualization and software defined networks**.** In this digital era, service-oriented applications play a key role in business within the web. The business applications are having high impact when compared with other application. Web interfaces are very important in majority of applications essential in payments especially RPC method is following over a decade and REST is also using widely in such applications. This article proposes software define networks and network function virtualization domains usage in web interfaces.

Lars Buitinck et al. [4] proposed a API structured for machine learning software. Nowadays python become as popular in designing of Machine learning algorithms. Popularity is achieved due to its strength of libraries especially scikit-learn. This work concentrates on discussion of different design choices available in creation of machine learning algorithm as API interfaces using scikit-learn library. The main advantage of this library is inheriting information from the existing things. It is also necessary to discuss how the APIs of python libraries are very useful and consistent in experimenting different ML algorithms by substituting new definitions. The power of scikit learns is identified with great exposure in utilizing real time application.

Xianjun Chen et al. [5] developed a Restful API Architecture depends on the principles of Laravel Framework. In the heterogeneous system, environment utilization web services are most common for the purpose message communication and integration. After the SOAP paradigm restful API become as main stream in providing essential services for web. This work PHP and LARAVEL framework activities are essential things in development restful API. Finally, this work decision about problem during restful structure and its detail implementation.

A Heryandi [6] introduced application programming interface to monitor academic activities of a student by exploiting FCM. Triggering the student information to the parents is very important. Student academic activity monitoring many of the college and universities may not have accessibility with parents and vice versa. To avoid this gap an effective automatic monitoring and messaging passing system is very essential. The present work develops firebase cloud messaging technology to notify the student activity events without making delay.

Utkarsh Singh [7] proposed a REST API framework to develop and design web services.Rest stands for representational state transfer which is a kind of approach used to communicate the data in the web services development. It follows stateless model representation. When client requires any information, it has been processed by via API and response is provided by web server language. The services are rest not limited to cloud computing and internet of things. It may be utilized for any kind of micro services.

Michael Meng et al. [8] did documentation on API. Documentation is a key factor in evaluating the success of application programming interface. The documentation provides necessary information and flow of interface evaluation which able to understand the purpose of API. Sometimes the documentation itself not sufficient to understand the API. To overcome this problem proposed article presents a semi structured environment which helps to understand activities of API. In this method questionnaire, goals, strategy and resources mainly identified as primary sources and applied on API to identify the quality of it. Finally, the result work concentrates on evaluation of overall main features completeness of clarity and relevance of information to

maintain the API documentation clearer. Further this documentation may utilize by developer and working professionals for usage.

Chengcheng Wan et al. [9] implemented an automated testing of software which is processed by machine learning APIs. In this digital era, numbers of software applications are developing through machine learning tools to evaluate complex task. To perform such activities the effort of human needs more attention to collect relevant inputs to finalize the behavioural process of given task and compare it with human analysis. Even when task is under the process any misbehaviour is identified. It is essential to eliminate such kind of things by utilizing APIs along with ML procedures. The main intension this work is to generate an API which identifies misbehaviours and changes the activity of the code. Finally relevant judgement is expected from the proposed ML based API.

Supattra Puttinaovarat and Paramate Horkaew [10] developed an application programming interface to predict flood occurrence by using crowd sourcing data and geospatial big data. In this living environment, disasters are very common which are showing severity on human lives and also other living organisms. The most frequently happening disaster is flood. Due to unawareness of predicting the floods causing more damage with the available technology various flood forecasting methods are developed but they are unable to prevent them. Till manpower is needed to collect the previous information and process it to expect the flood arrivals. But in the Real time environment it is still not working out. Nowadays machine learning based algorithms are very useful in predicting such kind of natural disasters especially maximum likelihood classification radial based functions are utilizing in forecasting the natural disasters.

Diego Serrano and Eleni Stroulia [11] proposed an IDE for efficient REST API composition with the help of linked metadata called LRA workbench.Due to digitization access of web services are continuous increasing the time consuming and error pruning process is not automated still today. Data integration is very important. Nowadays linked data technologies, linked rest API methodologies provide description of various formats of web API. In general, unconventional graphs are common associated datasets. This works purposes LRA work bench methodology to provided subsequent conventional graph models with respect to associated datasets. Subsequently a study has done on LRA workbench development environment to evaluate structure complexity, time complexity, manual compositional of APIs.

III. RESEARCH FINDINGS

1) APIs are used to develop interface for various real time applications like natural disaster prediction.

2) REST architecture is mainly used for various API applications.

3) LARAVEL framework can enhance REST architecture.

4) Python libraries help in API construction with its inbuilt packages.

5) API is used construct web interfaces.

6) LRA workbench can be used to evaluate the APIs.

7) API can also be used in recent advances of technologies like machine learning, deep learning etc.

IV. RESEARCH CHALLENGES

1) Simplification of API interface becomes arduous.

2) API construction complexity increases as features increases.

3) Construction of interactive API time consuming and complex conversation trees are need.

4) Integration of APIs requires development.

5) Require different APIs for different application.

6) Portability of APIs is limited.

V. CONCLUSION

The overall study of literature says that the conceptual framework of API provides different kinds of web services variety no of applications are tested by various researchers. The throughput of API with machine learning algorithms being complex problem in a systematic position. The efficiency, simplicity, accessibility and reusability are the context consistently discussed throughout the survey. Composition interfaces are introduced to learn and accomplish complex task with in a small amount of time which has been proved in scikit-learn library usage. REST is the new kind of API development which replacing a remote procedural call.

Further SDN and NFV contribution providing micro services with higher quality. With this comprehensive study it is concluded that API framework designing and accessing not limited to particular domain extensibility. It is useful in various domains like sharing confidential information, providing security, enhancing the efficiency, understand the industry needs according to that changes are to be needed. Further development lifecycle of API is to be enhance according to the knowledge of domain.

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INDUSTRY 4.0 ON STRONG HOLDS OF LEAN MANUFACTURING

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ABSTRACT

Manufacturing industries have been in pursuit of driving value for their customers & keeping their businesses competitive by continuously reducing costs and improving quality. Lean has been popular paradigm since its emergence in Japan in 1980s. Industries all over the world have embraced it to reduce wastage in their processes. Three decades on, a new transformation paradigm has arrived by the name of Industry 4.0, which also promises to create business value but in different way by using nine new age technologies like Internet of things (IoT), Cloud, Bid Data, 3D printing to name a few. While both these paradigms have same goals, they follow different paths with different tools. This generates queries like is one paradigm better than the other or are they competitors or unrelated concepts. Industry 4.0 being new and lean being old there are doubts whether is Industry 4.0 replacing lean. Also, it is known that Industry 4.0 has been embraced at Strong holds of Lean past few years, it generates curiosity on how that integration looks like. This position paper gives an overview of how Industry 4.0 technologies have impacted lean tools. It also highlights how lean helps adoption of Industry 4.0 technologies. Some real-world examples of how lean tools are changing with new age technologies will help researchers & practitioners visualize the changes. A brief perspective on factors of adoption for Industry 4.0 would help technology practitioners & researchers build practical approaches.

Keywords: Lean Manufacturing, Industry 4.0, Lean Tools, Cyber physical systems.

1. INTRODUCTION

Lean Manufacturing which evolved in Japan in 1980s has been widely adopted by diverse industries across globe as a source of competitive advantage. With an unmatched focus on customer value, ruthless identification & elimination of waste, lean has enabled organizations to develop a reliable and profitable response to the evolving customer needs. Lean methodology has been known for its systemic use of lean tools which enable robust problem solving & continuous improvements. It has been a proven technique for many organizations to deliver best quality products at lowest cost, in shortest time by creating physical flow. The transformation technique lays on foundations of stable & standardized processes along with high morale of employees. Lean thinking has made production systems flexible & leaner given continuous elimination of various kinds of wastes.

Over the last one decade, 2011 to be precise, a new paradigm has emerged towards the transformation of manufacturing and business processes, which is primarily enabled by technology and data. This goes by the name of Industry 4.0 and is widely christened as the fourth industrial revolution also. The transformation here is enabled by the possibilities of creating smart networks of machines, products, components, people, and various nodes of supply chains (like production, transportation, material supply etc.), which thereby creates intelligent factories and an intelligent supply chain. Transformational business value creation is envisioned by through superior understanding of customer needs & the abilities to convert demand into supply on a real time basis. This results in quantum improvements on reliability, agility and profitability of manufacturing organizations & thereby makes businesses more competitive.

While both lean & Industry 4.0 enable profitability and growth for an organization, they surely have very different approaches towards value creation. Differences in their approach is logical given the multi -generation gap between the emergence of the two methodologies. As an example, lean focuses on visual management & proximity to people and operations, Industry 4.0 drives value through touchless interconnected processes. There are many such differences between the two, hence it creates curiosity as to how these practices are being looked at together now that they both exist. Do the organizations see any one of them superior to other, or do they see them as independent or inter dependent entities? Also, it is known that many organizations who were on the forefront of lean have already embraced industry 4.0. It again generates curiosity on have they looked at the two, what have been the factors of adoption at their end? Authors of this paper developed a systemic literature review to answer below research questions:

- Which lean tools have been most impacted by industry 4.0 technologies

- Which of the nine industry 4.0 technologies have had highest adoptions in Lean.

- How do organizations & practitioners view Industry 4.0 and lean together; do they seem them as competitors or enablers

- What have been the factors of adoption for those who have seen synergies between lean & Industry 4.0

This paper is structured in five sections. After providing an introduction, Section two of the paper outlines the methodology used for this study. An extensive literature review will be presented in section three. Basis literature review research questions will be answered in section four. This will be followed by discussion of key points in section five.

2. REVIEW OF LITERATURE

2.1 About Lean – History, Principles & Tools
Satolo, E. G.et al. (2020) provide a foundational perspective of the lean production systems. After the Second World War, Toyota Production System (TPM) emerged in the Japanese automobile industry. It was a new production model which enabled them to produce more with lowest possible resources & hence lesser cost by a razor-sharp focus on waste elimination. However, the lean production system came into existence only in late 1980s, when a research project was conducted at the Massachusetts Institute of Technology (MIT) to study the Japanese Toyota manufacturing model. Japan was clearly giving the American automotive industry a big run for its money. The study was carried out by means of extensive interviews of workers, unions, suppliers, and government bodies. It concluded that the reason of Toyota & other Japanese companies outclassing their western competitors was attributed to the Toyota Production System

2.2 About Industry 4.0 – History, Principles & the Technologies
Frédéric Rosin et.al (2020) highlight a technology driven paradigm is knocking the doors of all industries, even the traditional lean strong holds. The new paradigm known as industry 4.0 offers unique opportunities to the organizations to transform their agility, profitability & their capabilities to deal with variability in demand. Key enablers are inter- connectivity of products, equipment & people towards heightened levels of decision making and ultimately fulfilment of customer needs. Using cyber physical systems across end-to-end supply chain, new heights of operational excellence can be now achieved. Instant communication between machines, objects & people make manufacturing systems more flexible to product changes and more responsive to unexpected events.

2.3 Lean & Industry 4.0 together – Competitors Vs Enablers
Varela L et.al (2019) researched the influence of the two production philosophies – Lean Manufacturing (LM) & Industry 4.0 (I4.0) around the three pillars of sustainability – social, economic & environmental. Their study was focused on industrial companies situated in Portugal & Spain. Results revealed that lean manufacturing wasn't strongly correlated with any of the sustainability pillars, while Industry 4.0 showed good correlation with all three pillars of sustainability. While the results were not aligned with the initial expectations, authors argue that lean's correlation might be low since lean as a philosophy focuses more on current state of a unit & doesn't show much concern to the global, integrative, and transformative vision of a company at large. Strong correlation between sustainability & I4.0 might be an indicative of the situation that companies now have a better appreciation of holistic impact of I4.0 on sustainability.

2.4 Factors of adoption of Industry 4.0 in Lean Organizations
Frédéric Rosin et.al (2020) mention that focus on customer value, standardization of process & relentless elimination of waste are the foundations of lean. Strong implementation of these three aspects, results in de-complexification of products & processes, thereby paves way for a smoother implementation of industry4.0. Lean implementations also involve strong change management on people side, this too ensures organizational readiness for industry 4.0, since employees are already conducive to change

3. RESULTS OF RESEARCH QUESTIONS

3.1 Which lean tools have been most impacted by industry 4.0 technologies?
From the various research papers reviewed and analyzed in this study, authors narrowed down to 12 lean tools which seem to be the most widely used. These are 5S, Value Stream mapping (VSM), Andon, Just in Time (JIT), Kaizen, Single minute exchange of dies (SMED), Kanban, Heijunka, Jidoka, Standard work, Total Productive Maintenance (TPM) and Visual Management. Total of 89 data points have been generated for analyzing which of these lean tools have been most impacted by industry 4.0 technologies. Results of this as

shown in Fig 3 highlight VSM (Value Stream Mapping), Kaizen & Kanban to be the top 3 while Heijunka, TPM and 5S to be the bottom 3.
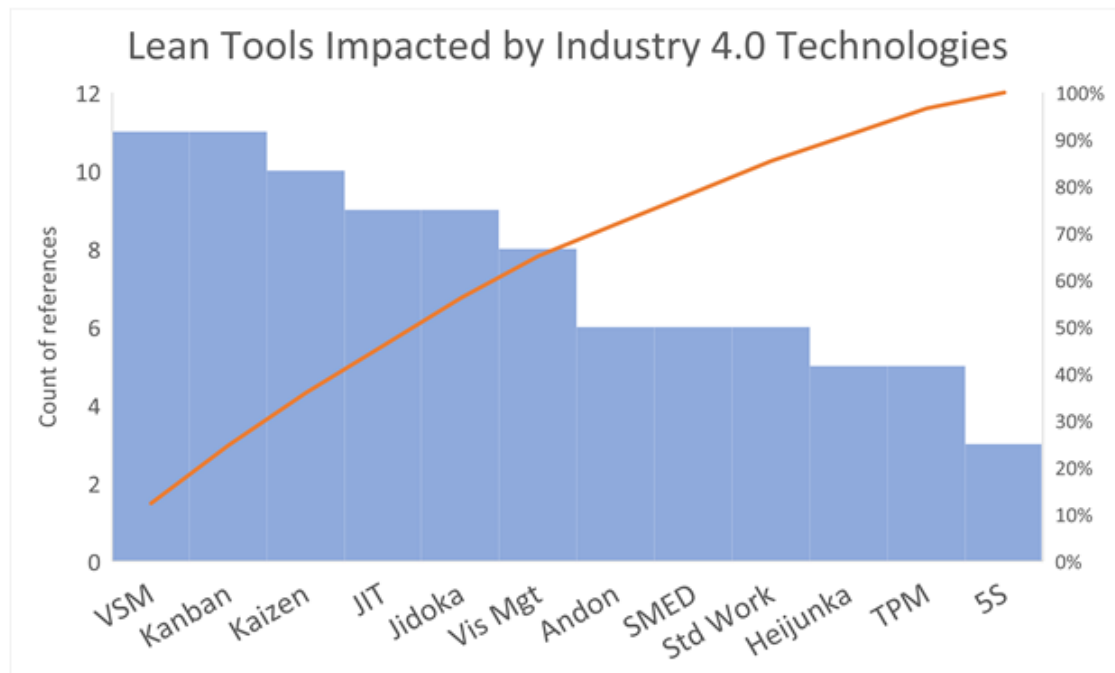
Fig 3: lean tools most impacted by industry 4.0 technologies

3.1.1 Examples of Lean tools impacted by Industry 4.0 technologies

It is evident from this literature survey that there are many lean tools which have now been enhanced or upgraded by using various Industry 4.0 technologies. To develop a better appreciation of how this integration is happening, authors have mapped out some real-world examples on how the most common 12 lean tools are now using Industry 4.0 technologies and how it is driving more value for organizations. Fig 4 captures various use cases (real world examples) & maps the linkages between Lean and Industry 4.0

Fig 4: Examples of lean tools impacted by industry 4.0 technologies basis Literature survey of this paper

Lean Tool	Industry 4.0 Technology	Use Case Details
5S	IoT, RFID	AI enabled shopfloor supervisions; RFID tagged parts ensure everything in place principle of 5S is abided by.
Andon	IoT	Smart Watches replace traditional Andon cords. Technicians receive alerts online issues on a real time basis which reduce the equipment down times.
	ioT	Smart machines can detect abnormalities & shoot out alerts for repairs on smart phones or screens.
	Horizontal & Vertical Integration	Real time alerts of anomalies or breakdowns to OEMs
Heijunka	Big Data	Mayr et al. (2018) mention the use of Anapro software, which smooths out production panning with big data
	Big Data	Workload of workstations is levelled out using generic algorithms & digital twins
Jidoka	IoT	Smart products communicate with equipment & can send alerts when wrong product gets chosen for production
	AR	Augmented reality is proposed by Kolberg and Zühlke (2015) and Mayr et al. (2018) to allow employees to obtain visual feedback if errors occur
	Robotics	Production errors can be detected & corrected by autonomous robots
JIT	Cloud, Horizontal & Vertical	Cloud computing & mobile computing devices can replace e-mail communications with suppliers. This transparency avoids outages and improves supplier relationships

	Integration	
	Robotics	In a case analyzed from the Wittenstein Company, an integrated system with production and automated guided vehicles (AGVs) determine the milk-run system-based transport interval through real- time demand
	3D	3D printing allows of prototypes to quickly test if modular elements can meet customers requirement
Kaizen	Simulation	Simulation enables rapid modelling on possible configurations which can result in lower scraps, material usages, meeting lean motto of "do more with less "
Kanban	IoT	Physical Kanbans get replaced by e-Kanbans. Missing & empty bins get recognized by smart sensors
	Horizontal & Vertical Integration	iBin comes with optical order systems. A camera detects the charging level of bin and reports wireless the status to an inventory control system. Additionally, iBins sends orders automatically to supplier
	Robotics	AGV empower the supply of materials to workstations and supermarket managed through Kanban
Poka Yoke	IOT	Defects can be detected and eliminated real time by deploying optical sensors on critical to quality points
	IOT, Cloud, Big data	With the use of sensors & machine learning, machines can on their own adjust to irregularities
	AR, IOT	AR and head-mounted displays can be used to achieve zero-error picking
SMED	Robotics	Plug'n'Produce enables Single Minute Exchange of Die (SMED) method into whole production lines.
	3D	Additive manufacturing enables setup time reduction since varying workpieces can be produced with minimum setup times
	IOT	RFID adoption allows to recognize the die and set all the relative parameters up
Std Work	AR	Smart operator gets information about processing cycle time via augmented reality
	Robotics	Wang et al. (2017) offer autonomous robot applications, namely a picking robot (Boudella, Sahin, and Dallery 2018) and a corobot that works in conjunction with an operator (Wang et al. 2017), which helps standardize work procedures
TPM	IOT, Cloud, Big Data	With interconnected man & machines, advanced sensors, analytics preventive maintenance upgrades to a zone of predictive maintenance
	AR, VR	Combination of virtual reality (VR) and augmented reality (AR) as well as head-mounted displays facilitates training as well as maintenance instructions remotely
	IOT, Cloud, Big data	Virtual commissioning contributes to a fast start-up curve as digital twins allow a realistic simulation of production plants
Visual Management	Big Data	Zhong et al. (2015, 2016) use big data to extract relevant information from the large amount of data collected by the sensors distributed in the production system
	Big Data	Production line KPIs can be displayed real time on digital dashboards. This reduces transactional load, drives accuracy of data
VSM	IoT, Horizontal & Vertical Integration	Smart products can collect process data for analysis during & postproduction. Also, data collection for the Value Stream Mapping (VSM) gets much simplified & accurate
	IOT, Cloud, Big Data	Machine learning and data analytics support the creation of a value stream design. Target states are generated automatically and validated before implementation
	IoT, RFID	Main disadvantage of VSM is its static behavior, this can be overcome by the implementation of I4.0 solutions

3.2 Which of the nine industry 4.0 technologies have had highest adoption in lean?

Total of 57 data points have been generated for analyzing which of the nine Industry 4.0 technologies have been adopted most, taking the top 12 identified lean tools in this study as a reference. Results of this as shown in Fig 5 highlight IoT, Cloud & Big data to be the top 3 while Robotics, Cybersecurity & 3D printing happen to be the bottom 3.
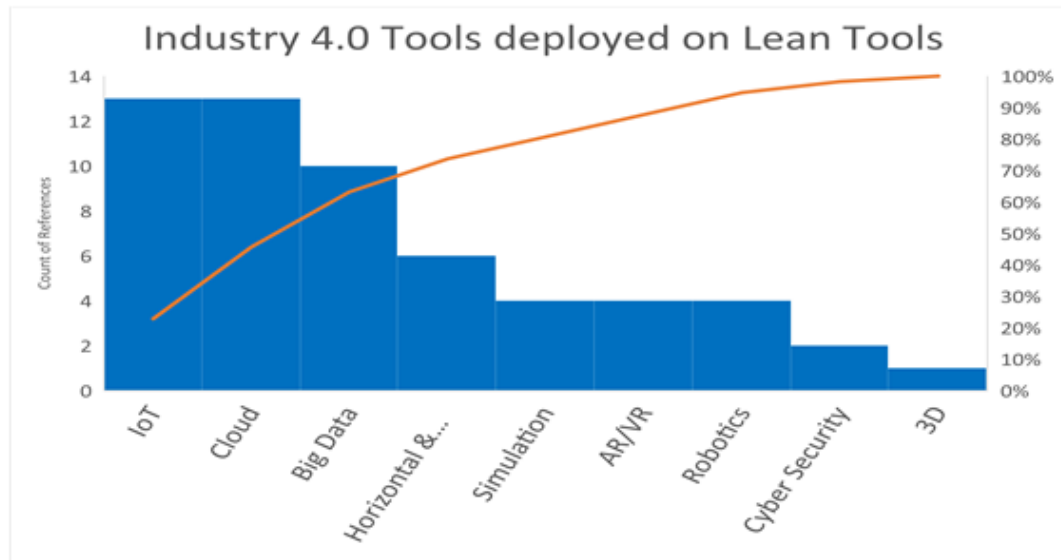
Fig 5: Industry 4.0 Tools most deployed in Lean

3.3 How do organizations & practitioners view Industry 4.0 and lean together; do they see them as competitors, enablers, or standalone entities?

The literature reviewed in this paper brings out multiple comparisons & perspectives related to lean & industry 4.0, which have been very relevant for the purpose of this study. Various researchers have compared the two paradigms broadly on below aspects –

- **Goals & Objectives**

A. Mayr et.al (2018) highlighted complexity reduction & improvement in productivity and flexibility as the common goals of both Lean & Industry 4.0

- **Value Creation Approach**

Christopher et.al (2018) highlighted two fundamental differences between lean management & Industry 4.0. First - Lean typically is a world of methods & aims enabling a continuous flow with least possible waste. Industry 4.0 on the other hand is not based on methods; enabler for value creation there is technology. Second – Lean management believes in implementing methods by employees themselves and encourages continuous improvement by employees at the points of value creation. On the contrary, employee involvement may not be high at implementation stage in industry 4.0

- **Specific Limitations**

DennisKolberg et.al (2015) have argued that lean follows fixed sequence of production and fixed cycle times & as such is not suitable for making personalized products & also products with short product life cycles [1]. Varela L et.al (2019) compared the influence of Lean Manufacturing (LM) & Industry 4.0 (I4.0) around the three pillars of sustainability – social, economic & environmental. They concluded that lean manufacturing wasn't strongly correlated with any of the sustainability pillars, while Industry 4.0 showed good correlation with all three pillars of sustainability

- **Similarities**

DennisKolberg et.al (2015) quote Ohno, father of lean, speaking about the principle of autonomation. Ohno had postulated that processes should be automated wherever possible but then supervised by employees. This clearly extends up to the industry 4.0 technologies also where in humans supported by new age technologies take the same role. Authors have further highlighted that both lean & Industry 4.0 aim for modular structures with low levels of complexities, thereby showing a clear preference for decentralized systems. A. Mayr et.al (2018) highlighted that both lean manufacturing & industry 4.0 focus on a pivotal role of employees though in different ways.

- **Differences**

Sven-Vegard Bueret.al (2021) have argued that Lean promotes autonomy to employees, decentralized control, simplicity, and transparency of processes. Information Technology on the contrast focuses on creating single versions of truth by generating centralized databases.

- **Perspectives on Co-Existence**

Bruno G. et.al (2016) brought out that industry 4.0 will not compete with lean or make it obsolete. They opined both manufacturing systems will generate mutual dependencies and have their specific areas of application with respect to product variability & volumes. For a high-volume low mix portfolio, Industry 4.0 scores while for a low volume high mix portfolio Lean Single piece f might still be more suitable. Sachin Kamble et.al (2020) confirmed industry 4.0 as an enabler for lean manufacturing. Implementation of the new age technologies make a factory smart & helps organization overcome barriers of lean implementation. [5] Sven-Vegard Bueret.al (2021) concluded upon a strong correlation between length of lean implementation & digitization maturity. Organizations which have been embracing lean for a long time find it more beneficial and simpler to embrace Industry 4.0. Their research further highlighted the point that while lean and digitalization add value when implemented individually, the value creation gets magnified when both are implemented together. [16] Maria Pia Ciano et.al (2021) have highlighted strong interdependency between the two paradigms. Authors have argued that if a company doesn't apply lean principles before embracing new age technologies, the results would be just an automation or digitization of existing wastes.

Below inferences have been drawn out related to objectives of this study –

- **Are the Two Paradigms "Competing" With Each Other?**

While there are multiple differences highlighted & argued between Lean & industry 4.0, there are very few arguments among scholars & practitioners about the two paradigms competing against each other. Recommendations can be seen on one paradigm being more suitable compared to another & that is in context of business situations. Authors of this paper also conclude that the two paradigms do not really compete, it's just that one might be more relevant over the other given the business scenarios.

- **Are the Two Paradigms' "Enablers" to Each Other?**

Literature review brings out overwhelming similarities between the two paradigms in terms of their goals & objectives while also highlighting stark differences in the value creation approach of the two systems. Authors of this paper reach to a conclusion that there are strong synergies which exist between the systems and a purposeful implementation of both will result in amplified value creation. Organizations which have embraced lean, can make themselves more productive by acquiring advanced problem-solving capabilities which come with Industry 4.0. Also, organizations who want to embrace industry 4.0 will deeply benefit if lean fundamentals are also parallelly looked at. Authors of this paper hence see the two paradigms' enablers to each other.

3.4 What have been the factors of adoption for those who have seen synergies between lean & Industry 4.0?

Literature review presented in this paper has helped authors converge upon the factors of adoption into three broad Pillars – People, Process & Performance.

- **People Factors**

First, technology solutions should keep people at the center. These solutions get adopted if they add value to the users by simplifying their work & enabling faster decision making for them. Second, lean implementations usually involve strong change management on people side, this ensures organizational readiness for industry 4.0, since employees are already conducive to change. Lastly, human factors are critical since significant changes occur on shop floors when there is a penetration of technology; workers or operators surely need higher order skills on technology. Conventional operators need to upgrade to "knowledge workers" in the integrated world of lean & industry 4.0 & hence will need investments from their organizations.

- **Process Factors**

First, Industry 4.0 adoption is faster & more effective in organizations where lean implementation is in matured states. It is because such organizations have simpler & more standardized workflows, reduced to essential work only. Second, Practicing & sustaining lean has been a practical challenge for most organizations since work instructions & procedures as defined by lean are not always followed by workers. Industry 4.0 bridges this gap with real time sustaining mechanisms & this becomes a significant factor of adoption.

- **Performance Factors**

Industry 4.0 solutions are perceived to come up with high investments. users find acceptance in areas where there are cost savings & traditional lean practices are not fulfilling today's requirements. Organizations are required to assess performance beyond financials on two other dimensions which are social & environmental. For a successful integration of industry 4.0 with lean manufacturing, practitioners should outlay impact of smart products & smart processes on all three dimensions of sustainable organizational performance.

4. CONCLUSION

Manufacturing industries have been in pursuit of improving quality, product availabilities, inventories & lead times to remain competitive in business. Lean has been an extremely effective paradigm since 1980s & organizations who embraced it continue doing so it till date, though sustenance remains a challenge. Industry 4.0 is a newer paradigm and that too offers value unlocks in areas where lean adds value. With a multi-generational gap of 3 decades between the two paradigms, there are clear differences in their approach even though similar aspects of business can be impacted by them. Lean drives continuous reduction in wastages using lean tools and methods, whereas Industry 4.0 drives quantum improvements by touchless & intelligent processes using new age technologies.

While analyzing how researchers & practitioners see Lean & Industry 4.0 together, authors found very limited evidence of a competing view between the two. There haven't been examples where Industry 4.0 tools are shown substituting lean tools. However, there are many examples where lean tools have been improvised using industry 4.0 technologies. Many real-world examples have been captured in this paper to illustrate this point.

Authors have found strong views which bring out lean & Industry 4.0 as enablers for each other. Industry 4.0 is a relatively new concept. Acceptance of it comes very different in an organization which has implemented lean Vs that which hasn't. Penetration & acceptance of Industry 4.0 is far higher in matured Lean organizations compared to non-lean ones. It is because lean drives simplification and standardization of processes. It also eliminates all non-value adding activities (NVAs) from various processes, which sets up a robust foundation for Industry 4.0. Also, people mind set in lean organizations is far more receptive to change compared to non-lean ones, which again makes it easier for Industry 4.0 to make inroads.

Integration of lean & Industry 4.0 is evident. Having said this, not all lean tools have changed equally with this integration and nor have all nine Industry 4.0 technologies penetrated the lean world equally. This specific research highlights three most impacted lean tools to be Value Stream Mapping (VSM), Kanban & Kaizen. The industry 4.0 technologies which have been most adopted in lean are IoT, Cloud & Big Data.

Industry 4.0 being the new paradigm offers significant opportunities to drive improvements across various parts of supply chain, beyond manufacturing. Authors conclude three important factors of adoption if an organization choses to embrace Industry 4.0 – (a) People factors – Simplify People's work , proactively upgrade their skills , have a strong change management (b) Process Factors – Simplification & Standardization of processes is an important pre-requisite , automation of transactional activities drives continuity to lean tools , (c) Performance Factors – Value creation shouldn't be confined to financial factors only like ROI, it should cover social and environmental factors also to make the impact holistic.

Lastly, while integration of lean tools with industry 4.0 seems very promising, there seems to be a paucity of active frameworks which can enable digitization the lean tools & enhance their effectiveness with new age technologies. This aspect can surely be an area for further research.

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A SURVEY ON DIFFERENT METHODS FOR MEDICINAL PLANTS IDENTIFICATION AND CLASSIFICATION SYSTEM

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ABSTRACT

Medicinal herbs are getting popular in the pharma industry because they have minimal side effects and become less expensive than contemporary pharmaceuticals. Several people have indicated a strong interest in the topic of automated medicinal plant identification as a result of these findings. There are numerous ways to make headway toward creating a robust classifier that can consistently identify therapeutic plants on an actual justification. This study discusses the efficacy and dependability of several machine learning methods that have been used in past few years to classify plants using images of their leaves. Additionally, analyses of their benefits and drawbacks are provided. The paper offers the image processing algorithms used to recognise leaves and recover important leaf properties for a few machine learning methods. These machine learning algorithms' efficiency in classifying leaf images based on common plant characteristics, such as form, vein, texture, and a combination of several other factors, is divided into three categories. The paper concludes with an overview of recent research and areas for future development in this area before looking at the publicly released leaf datasets for automated plant recognition.

Keywords: Medicinal herbs, Therapeutic plants, Image processing and Plant Images.

1. INTRODUCTION

Although healthcare technology has been created in large quantities for use in therapy, most developing nations now prefer traditional treatment due to the shortcomings of synthetic cannabinoids in the management of chronic disease. According to, medicinal plants make about a quarter of all internationally sold prescriptive drugs. Conventional medicines are frequently used in pharmaceutical firms. This is due to the benefits of medicinal herbs, which have fewer side effects and are significantly less expensive than produced drugs. Additionally, bioactive substances derived from herbal remedies such as phenolics, arytenoids, anthocyanins, and tocopherols function as antioxidants, anti-allergens, anti-inflammatory, antibacterial, and anti-hepatotoxic substances. [17,20]. Physically identifying herbal remedies, like other plant recognition, is challenging and time-consuming, but this is because there aren't enough expert opinions. Experts created several independent herb or foliage detection methods in order to overcome this situation, the bulk of which incorporated machine learning strategies. A branch of ai technologies called machine learning allows machines to recognise objects and draw conclusions without much to no human involvement. Machine learning has provided good detection, projection, and filtration results on a range of problems, including clinical diagnosis, financial analysis, predicting maintenance, and picture identification. Four categories of machine learning techniques are currently available: supervised, unsupervised, semi-supervised, and other. [11,14]. In supervised learning, the system makes decisions based on annotated input data, and the learning process is repeated until the model reaches the highest level of accuracy. Machine learning methods that can be trained utilising no labelled data are referred to as unsupervised learning. Some situations call for semi-supervised learning, where the algorithms are operated on both labelled and unlabelled data. This study discusses various promising and reliable machine learning methods that have lately been applied to classify plants or leaves. Additionally, research is done to weigh their advantages and disadvantages in order to decide how to improve future research[1]. This research project is divided into five sections: Section I examines the significance of systems for identifying medicinal plants; Section II reviews conventional methods for identifying leaves; Section III compares research strategies and discusses their advantages and disadvantages; Section IV examines conclusions from recent studies on plant identification; and Section V offers suggestions for plants identification's future advancement. The conclusion and work intended for the future are discussed in Section VII.

2. LITERATURE REVIEW

The numerous methods for classifying and recognising native herbs are described in this paper. In order to circumvent the issues that traditional classification algorithms have with identifying therapeutic herbs,

Kan et al [2017] suggested using photographs of plants leaves as the basis for an automated categorization strategy. The method first pre-processes photos of medicinal herb leaves, then generates 10 shape features (SF) and 5 texture features (TF), and last classifies medicinal herb leaves using a support vector machine (SVM). Twelve different medicinal foliar photos were classified using the classifier method, with a mean positive outcome of 93.3%. The results show that categorising medicinal plants automatically is doable by using multi-

feature extraction from leaf images in conjunction with SVM. The article offers a helpful theoretical framework for the research and development of classification models for medicinal plants.

Alimboyong et al. [2018] proposed a technique based on computer vision to identify the homeopathic herb species found in India's Western Ghats. The proposed method employs a combination of SURF and HOG features extracted from leaf pictures, and also a classification using a k-NN classifier. Researchers have also produced results that seem acceptable for creating apps for practical usage.

Prasad and Singh [2017] built an information sharing method employing deep qualities to explain the actual leaf images, from object identification to plant genetic studies. Studies have proven that such in-depth characteristics work better at identifying plant species than the standard methods. The study showed a brand-new, efficient approach for collecting leaves. The VGG-16 feature map is created by translating the picture into a lab colour space that is free of any specific technology. This feature map is re-projected to PCA subspace to improve species identification efficiency. For the purpose of proving durability, the study uses two different kinds of plant leaves.

To extract features from images, Turkoglu and Hanbay [2019] used image processing techniques like colour, vein properties, Fourier Descriptors (FD), and Gray-Level Co-occurrence Matrix (GLCM) methods. Research suggests using features gathered from leaves that have been cut into two or four sections rather than gathering attributes for the complete leaf. The effectiveness of each attribute extortion strategy is calculated separately and collectively using the Extreme Learning Machines (ELM) classifier. The suggested strategy was examined using the Flavia leaf database. The effectiveness of the suggested method was assessed using 10-fold cross-validation, which was then compared and tallied with methods from other works. The outcomes of the suggested strategy were assessed to be 99.10% on the Fluvial Leaf Database as well.

According to textural qualities, Naresh and Nagendraswamy [2016] suggested a symbolic system for identifying plant leaves. Modified local binary patterns (MLBP) have been proposed to recover textural data from plant leaves. Same types of plants can have varying leaf textures depending on the plant's maturity, age, and habitat. As a result, the clustering concept is used to select a large number of class representatives, and intra-cluster variations are tracked by interim valued kind metaphorical characteristics. The categorisation is made simpler by using a simple nearest neighbour classifier. The newly formed UoM Medicinal Plant Database, along with the publicly available Flavia, Foliage, and Swedish plant leaf databases, were used extensively for research. Values obtained using the proposed design are compared to results obtained using existing techniques. Even on this artificial database, studies using the Outex database have produced interesting results.

wei Tan, et al [2018] D-Leaf suggested a cutting-edge CNN-based strategy. To pre-process the leaf images and extract the properties, three different Convolutional Neural Network (CNN) algorithms—pre-trained AlexNet, fine-tuned AlexNet, and D-Leaf—were employed. The Support Vector Machine (SVM), Artificial Neural Network (ANN), k-Nearest-Neighbor (k-NN), Nave-Bayes (NB), and CNN machine learning methods were used to categorise these qualities. For the benchmark, morphological characteristics were calculated using a conventional morphometric method based on Sobel segmented veins. The D-Leaf model achieved a testing accuracy of 94.88% in compared to the AlexNet (93.26%) and fine-tuned AlexNet (95.54%) modelsAdditionally, CNN models beat conventional morphometric evaluations (66.55%). The properties obtained using CNN are discovered to follow the ANN classifier model well.

Grinblat et al. [2016] suggested using a deep convolutional neural network (CNN) In order to solve the problem of recognising plants from their leaf vein patterns. The three unique species of legumes—white bean, red bean, and soybean—are the writers' main areas of attention. Modern pipelines frequently use CNNs, which do away with the requirement for specially designed feature extractors. Furthermore, this deep learning model significantly boosts the effectiveness of the pipeline indicated before. shows that the design level achieves the claimed accuracy better. Finally, the created designs can be examined using a simple visualisation tool to identify intriguing texture features.

Ghasab et al. [2015] suggested a smart approach that employs ant colony optimization (ACO) as an attribute decision-making mechanism in order to identify different herb species from their leaf photos. For the purpose of identifying specific species, the ACO approach is utilised to delve deeper into the attribute search space and find the most discriminating features. The leaf pictures are used to extract a number of potential attributes, such as shape, morphology, texture, and colour, in order to build a features search space. The selected features are used by the support vector machine (SVM) to classify the species. To show the system's performance, about 2050 leaf photos were collected from the FCA and Flavia plant collections. The ACO-based method had an

accuracy rate of 95.53%, according to the study's , demonstrating the viability of using the recommended approach for classifying various plant species.

Siravenha and Carvalho [2015] suggested a method for categorising and recognizing plants based on the shape of their leaves that looks at the contour-centroid distance's discriminating power in the Fourier frequency domain while ensuring some invariance (like rotation and scale). The effect of feature selection methods on categorization accuracy is also looked at. A feed forward neural network and a group of feature vectors in the principal components space were combined to achieve the accuracy of 97.45%.

Based on the geometry of their leaves, Zhao et al. [2015] suggested a novel method for classifying plants. Contrary to other studies that concentrated on simple leaves, the recommended approach can correctly detect both simple and compound leaves. Introduce a brand-new feature that keeps track of both global and local shape information separately so that they can be analysed independently while being categorised. Additionally, they assert that when comparing two leaf people, it is preferable to "count" the number of various shape patterns rather than precisely replicate the extorted shape features. The proposed counting-based shape identifier in addition to being efficient in terms of computation and storage, but it also provides discrimination for categorization. Studies on five separate datasets of leaf images demonstrate that the system outperforms cutting-edge approaches in terms of accuracy rate, performance, and storage needs.

Sabu et al. [2017] suggested a computer vision approach for identifying ayurvedic medicinal plant species found in India's Western Ghats. The proposed method employs a set of SURF and HOG features extracted from leaf pictures, as well as a classification using a k-NN classifier. Investigations have produced results that seem to be sufficient for creating apps with practical applications.

Priyankara and Withanage [2015] developed a leaf image-based plant classification approach by combining SIFT features with a Bag of Word (BOW) framework and a Support Vector Machine (SVM) classifier. The algorithm's accuracy rate was 96.48% after training on 20 different species. According to the results, an Android application was developed that communicates with the server and enables users to search for plant species via images of plant leaves that were taken using a smartphone.

Ekerolu and Nan [2016] developed a smart identification model that recognises and categorises 27 different types of leaves using a back propagation neural network. With a classification result of 97.2%, the findings show that the designed system performs better than fresh studies.

Elhariri, et al. [2014] developed a categorization strategy relying on Random Forests (RF) and Linear Discriminate Analysis (LDA) techniques for detecting distinct types of plants. The proposed approach consists of three stages: pre-processing, feature extraction, and categorization. Since many different plant species have distinctive leaves, the categorization method used in this research is focused on the herbs leaves. Leaves can be distinguished from each other by characteristics such shape, colour, texture, and border. The Uci Repository provided the database for these testing, which includes a variety of plant species with up to 340 picture data per species. This was applied to both the training and testing datasets using 10-fold cross-validation. Form, first order texture, the Gray Level Co-occurrence Matrix (GLCM), HSV colour moments, and vein features were combined to provide LDA a classification performance of 92.65% compared to RF's 88.82%.

Lee, et al. (2017) discovered From raw forms of input data, Convolutional Neural Networks (CNN) are employed to extract useful leaf qualities, and a Deconvolutional Network (DN) technique is utilised to learn more about the chosen features. Give a few unexpected results to consider: (2) Examine multi-level representation in leaf data, illuminating the hierarchical conversion of features from lower to higher level of abstraction, corresponding to species categories. (1) Different orders of venation are superior displayed features contrasting with outline shape. Show that the results are consistent with the hierarchical botanical descriptions of leaf characteristics. The findings yield insights into the creation of unique hybrid attribute extraction algorithms that have the potential to further enhance the classification accuracy of plant classification techniques.

Table 1: Conclusions drawn from the Current Research

Authors	Methods	Merits	Demerits
Elhariri, et al [2014]	Random Forests	Accurate results	Ineffective for real-time predictions
Priyankara and Withanage [2015]	Support Vector Machine(SVM)	Produces improved recognition performance	Does not suitable for large data

Siravenha and Carvalho [2015]	Feed forward neural network	Achieved higher accuracy	Approximation of a solution
Zhao et al [2015]	Counting-based shape descriptor	Computationally fast and storage cheap.	Does not used leaf texture feature
Ghasab et al [2015]	SVM	Achieved Higher accuracy	Does not suitable for more number of data
Şekeroğlu and İnan [2016]	Back propagation neural network	Reduces the error rate	Time consuming
Grinblat et al [2016]	Convolutional neural network	obtained and understood the relevant vein patterns	Higher computational complexity
Naresh and Nagendraswamy [2016]	SNN	Produces better recognition performance	Couldn't integrate attributes of additional techniques such as flower, fruit/bark
Sabu et al [2017]	K-NN classifier	Better performance	Need to use other classifier with various feature extraction models
Lee et al [2017]	Convolutional neural network	Improved recognition	Does not tested with real time data
Prasad and Singh [2017]	PCA	Robustness	Very expensive
Kan et al [2017]	Support vector machine	classifier offers accurate results	Leaf vein features and edge features are not considered
Alimboyong et al [2018]	K-NN	classifier adequate for constructing apps for real world usage	Time consuming
wei Tan, et al [2018]	CNN	Flexible	Need to include more tropical plant species
Turkoglu and Hanbay [2019]	ELM	Higher accuracy	Need to improve performance ratios with other feature extraction models

3. INFERENCES FROM RECENT WORKS

There are thousands of tree species on the earth, the majority of which possess medicinal value. However, some are hazardous to humans, some are at risk of extinction. In addition to being an essential resource for people, plants also form the base of several food chains. In attempt to utilize and preserve plants, accurate study and classification are essential. The ability of a skilled botanist to identify unknown plants significantly relies on their natural knowledge. As a matter of fact, numerous studies have been conducted to aid in the timely identification of herbs using their physical characteristics. The algorithms developed up to this point use a higher number of operations to automate the process of automatic classification, despite the fact that the approaches are nearly similar. The steps include cleaning the collected leaves, determining their unique characteristics, categorizing the leaves, creating the dataset, training for classification, and finally evaluating the results. Although leaves are the most common technique to identify plants, an automated procedure might also use stems, flowers, petals, seeds, or the entire plant. Unwanted content may be present in the data and must be removed from the source data in order to improve the quality of the data. Additionally, the data may contain a greater number of attributes, making identification more difficult. Furthermore, categorization can benefit from advanced machine learning models.

4. SOLUTION

Plants have a significant impact on human existence and the welfare of the global populace. Food, raw materials, medicines, and other requirements are mostly obtained from them. Since then, specific plants have gained notoriety for being used as a specialised remedy for a specific disease or illness. Most people are aware of their usefulness and are eager to learn more about how to use particular plants to cure particular ailments. Until now, a variety of plants, especially those used in herbal therapy, have had a significant influence on human health all over the world. Some pre-processing models can be added employing noise reduction, edge detection, the advanced models to first identify those plants. Then, in order to save time, important feature selection will be done using optimization-based feature selection. After that, classification will be performed using better machine learning-based models.

5. RESULTS AND DISCUSSION

This section explains the experimental results of the suggested model. Here, experimental results for Swedish Leaf testing database identification utilising developed model are shown using MATLAB 2013b to implement the proposed medical plant recognition and classification model. To demonstrate the efficiency of the LBP-SVM methodology, a comparison with a number of contemporary and competitive K-NN classifiers was made. then randomly divided the database into two pieces. The first half is used for testing, and the second half is used for training. 53 examples of each species were chosen for training, and the remaining 22 photos were used for comparison testingMetrics that are Tested Recall is defined as the ratio of acquired appropriate cases to the total number of pertinent instances. Therefore, knowledge and the relevance metric are necessary for both precision and recall.

Greater recall suggests that the approach obtained numerous suitable results. Mathematically, recall is defined to be as below:

$$\text{Recall} = \frac{TP}{TP+FN} \qquad (1)$$

The proportion of acceptable instances between obtained situations is how precision is defined. Large precision demonstrates that the procedure got far more appropriate results than improper ones. Precision is defined as below:

$$\text{Precision} = \frac{TP}{TP+FP} \qquad (2)$$

One parameter for assessing classification techniques is accuracy. In simpler terms, accuracy is the percentage of the forecasting method that is accurate. For two-class categorization, accuracy is computed with regard to positives and negatives as below:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \qquad (3)$$

Here TP = True Positives, TN = True Negatives, FP = False Positives, and FN = False Negatives.

Figure 1: Comparison of Classification methods and Results of Precision
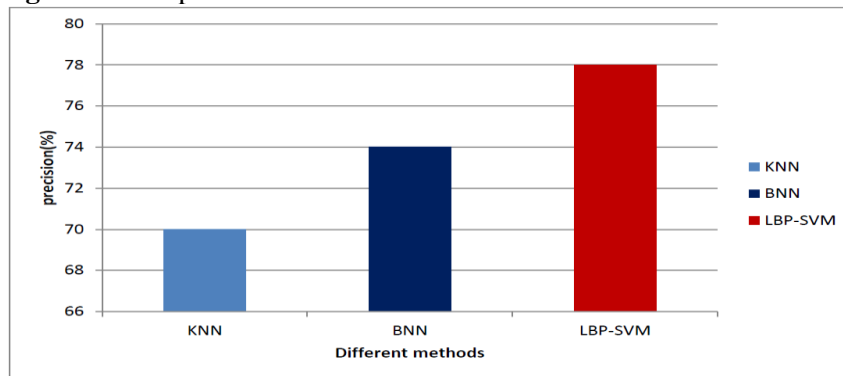
The chart compares the suggested LBP-SVM with the current KNN and BNN in terms of accuracy performance. 1. Based on results, it is determined that the recommended LBP-SVM model offers a higher precision result of 78%, compared to the existing KNN and BNN models, which only yield 70% and 74%, respectively.

Figure 2: Recall Results vs. Classification Methods
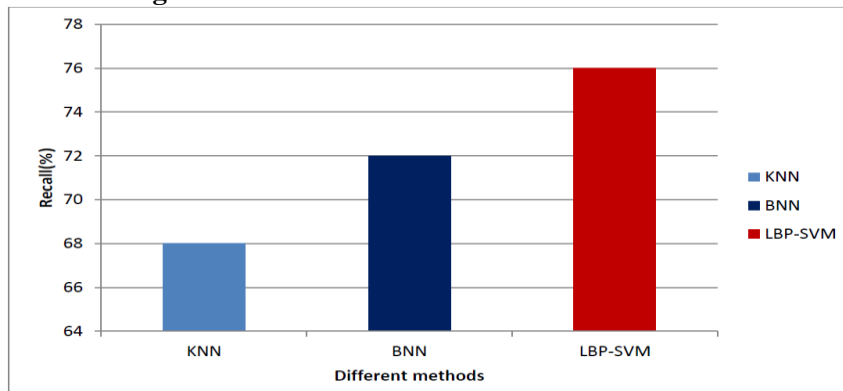
Figure 2 compares the suggested LBP-SVM to the current KNN and BNN in terms of recall performance. By conclusion, it can be said that the suggested LBP-SVM method yields greater recall outcomes (76%), whereas the conventional KNN and BNN models yield, respectively, just 68% and 72%.

Figure 3: Comparing Classification models and Results of Accuracy
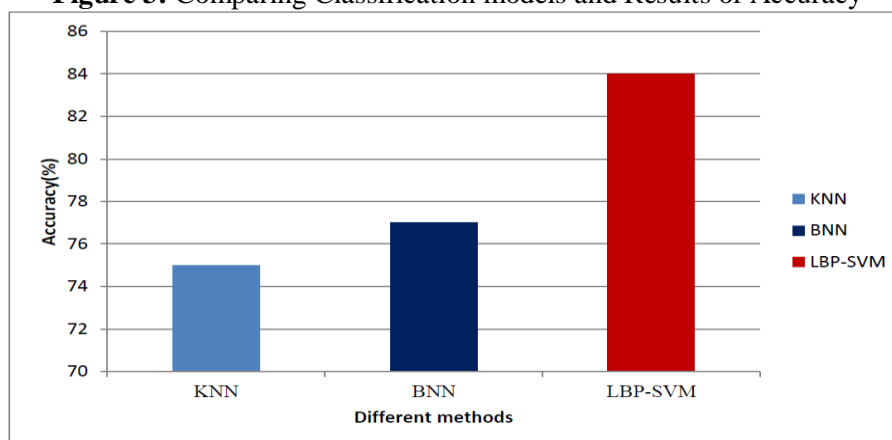
Accuracy vs. Classification (Figure 3) The following figure compares suggested LBP-SVM performance to current KNN and BNN performance: 3. accuracy concerns. The suggested LBP-SVM model offers greater accuracy results of 84%, while the existing KNN and BNN models provide, respectively, only 75% and 77%.

6. CONCLUSION AND FUTURE WORK

Human survival depends on plants. Indigenous peoples have used plants in particular as traditional medicinal for a long time. Clinicians frequently identify herbs based on years of personal sensory or olfactory experience. Herb identification based on scientific data has become much simpler thanks to latest advances in testing technologies. Many people benefit from this, especially those who are not accustomed to identifying herbs. Laboratory-based research also requires knowledge in sample repair and data interpretation for time-consuming procedures. Therefore, a quick and accurate technique of detecting plants is needed. Herbal identification is anticipated to benefit from the combination of computation and statistical examination. When it comes to recognising plants, this non invasive method will be preferable, especially for people who are unable to use costly analytical technology. This study examines various techniques for identifying herbs as well as their benefits and drawbacks. Improved machine learning classifiers with some preprocessing and feature selection models will be employed in next research in the field of species identification to address accuracy-related problems and increase performance.

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RFM TECHNIQUE FOR CUSTOMER SEGMENTATION: REALIZING THROUGH PYTHON CODE

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1. ABSTRACT
Customer segmentation plays very vital role for taking the decisions of optimising the Return on Investment (RoI) of any business. On the basis of customer segmentation an e-commerce business company frames their strategy to make of the most profit according to those segments. Those customers who are recognized as a high-value and frequent purchasers can be targeted with loyalty programs or special discounts. RFM analysis-based customer segmentation is an inordinate way to targeting the marketing.

In RFM analysis, a score for recency, frequency, and monetary value is assigned to each customer, and then a final RFM score is evaluated.

Most recent purchase is the criterion for Recency score, frequency score is based upon how many numbers of times the customers purchased. Higher score reflects the higher frequency.

Finally, an amount spent by a customer on the purchase is considered as a monetary and assigned a monetary score. Combining all these three scores, a final RFM score is calculated.

In this paper, analysis and customer segmentation are based upon a UK based e-commerce retailer companies' online transaction data from 01.12.2009 to 09.12.2011.

Keywords: RFM, Customer segmentation, k-means, Python, e-commerce

2. INTRODUCTION
Recency Frequency Monetary (RFM) model is the most widely used behaviour segmentation. All customers are presented by 555, 554, 553, ...,112, 111. The most beneficial customer group is assigned a value 555, whereas the worst customer group is assigned a value 111.

Due to fewer segmentation variables, this model is used extensively. Also, it is easy and simple to implement, and straightforward to understand for decision makers.

RFM model was proposed by Arthur M. Hughes. RFM model is based on the most common marketing axiom, the Pareto principle, which states that **"80% of your business comes from 20% of your customers"**.

Hughes (1994) presented that the importance (weight) of the three variables R, F and M is equal while Stone (1995) treated different weights for the RFM variables. The weight of each RFM variable depends on the characteristics of the industry.

K-means clustering algorithm is extensively used algorithm in CRM and marketing. This algorithm introduced by MacQueen (1967), can process large amounts of data quickly.

The primary objective of the study was to implement a segmentation strategy to identify different customer's groups with similar purchase patterns shown by customers. RFM-based customer segmentation technique is utilized for segmentation through the study using the python codes. The data/figures shown in tables in this paper are the output of the python code used in analysis of the study.

3. DATASET
The Online Retail data set includes the sales of an UK based online retail store of the period from 1/12/2009 to 09/12/2011 freely available on https://www.kaggle.com/. The "Online Retail" dataset is characterized by the following 08 attributes:

Invoice No: Invoice number is a unique number for every transaction occurred. Invoice number starts with C is a cancelled operation.

StockCode: Product code is a unique number for every product exist in store.

Description: Product name.

Quantity: Number of the products in the invoices have been sold is referred by Quantity.

InvoiceDate: Ttransaction's Invoice date.

UnitPrice: Product price.

CustomerID: Unique customer number.

Country: The name of the country where the customer lives.

4. Data Preparation and Pre-Processing
First ten rows of the data using "head" function:

	Invoice	StockCode	...	Customer ID	Country
					Table-01
0	536365	85123A	...	17850.0	United Kingdom
1	536365	71053	...	17850.0	United Kingdom
2	536365	84406B	...	17850.0	United Kingdom
3	536365	84029G	...	17850.0	United Kingdom
4	536365	84029E	...	17850.0	United Kingdom
5	536365	22752	...	17850.0	United Kingdom
6	536365	21730	...	17850.0	United Kingdom
7	536366	22633	...	17850.0	United Kingdom
8	536366	22632	...	17850.0	United Kingdom
9	536368	22960	...	13047.0	United Kingdom

Shape function tell us that there are 54190 rows and 08 columns in the dataset. Describe function tell us some basic statistics as count, mean, std, min, 25%, 50%, 75% and max, shown in following table-03:

Table-03

	Quantity	Price	Customer ID
Count	541910.000000	541910.000000	406830.000000
Mean	9.552234	4.611138	15287.684160
Std	218.080957	96.759765	1713.603074
Min	-80995.000000	-11062.060000	12346.000000
25%	1.000000	1.250000	13953.000000
50%	3.000000	2.080000	15152.000000
75%	10.000000	4.130000	16791.000000
Max	80995.000000	38970.000000	18287.000000

To check the missing observation of the dataset using the "is null function", shown in following table:

Table-04

Invoice	0
StockCode	0
Description	1454
Quantity	0
InvoiceDate	0
Price	0
Customer ID	135080
Country	0

First, we clean dataset by removing the missing observations from the dataset, using the function "dropna". Now we have 406830 rows in dataset. By the function nunique we came to know that there are 3896 unique items available in the dataset. Item wise in descending order are shown as follows, using the [Description"].Value-counts ()

Table-05

White Hanging Heart T-Light Holder	2070
Regency Cakestand 3 Tier	1905
Jumbo Bag Red Retrospot	1662
Assorted Colour Bird Ornament	1418
Party Bunting	1416
Antique Raspberry Flower Earrings	1
Wall Art,Only One Person	1

Gold/Amber Drop Earrings W Leaf	1
Incense Bazaar Peach	1
Pink Baroque Flock Candle Holder	1

Descending order of items sold quantity wise are shown as:

Table-06	
Description	**Quantity**
World War 2 Gliders Asstd Designs	53215
Jumbo Bag Red Retrospot	45066
Assorted Colour Bird Ornament	35314
White Hanging Heart T-Light Holder	34147
Pack Of 72 Retrospot Cake Cases	33409
Popcorn Holder	30504
Rabbit Night Light	27094
Mini Paint Set Vintage	25880
Pack Of 12 London Tissues	25321
Pack Of 60 Pink Paisley Cake Cases	24163

Removing the rows from dataset for those which transactions are cancelled.Now we have remains 397925 rows. Also removing the rows for which columns "Quantity" and "Price" have the -ve values. Now we have remains 397885 rows in dataset.

We have created a new columns "Total Price" for the purpose of monetary value, by multiply the "Price and Quantity". Now we have 397885 rows and 09 columns. 09 columns.

Calculating of RFM Metrics

Since maximum date of transaction is 09-12-2011, therefore, we calculate recency from 10-12-2011. Correlation and heatmap of the dataset are shown in following figure-01 and table-09.

Figure-01
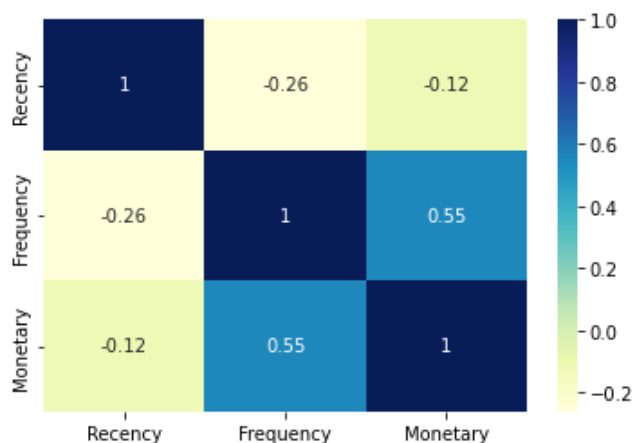
Capturing the cluster labels and cluster centroids, we get the following result.

Table-09		
	Num_Clusters	**Cluster_Errors**
0	1	3.505004e+11
1	2	1.176336e+11
2	3	5.512823e+10
3	4	3.522170e+10
4	5	2.098160e+10
5	6	1.412109e+10
6	7	1.031624e+10
7	8	6.970139e+09
8	9	5.450355e+09
9	10	4.086092e+09

Plotting the graphs between error and count of cluster shown in following figure-02.

Figure-02
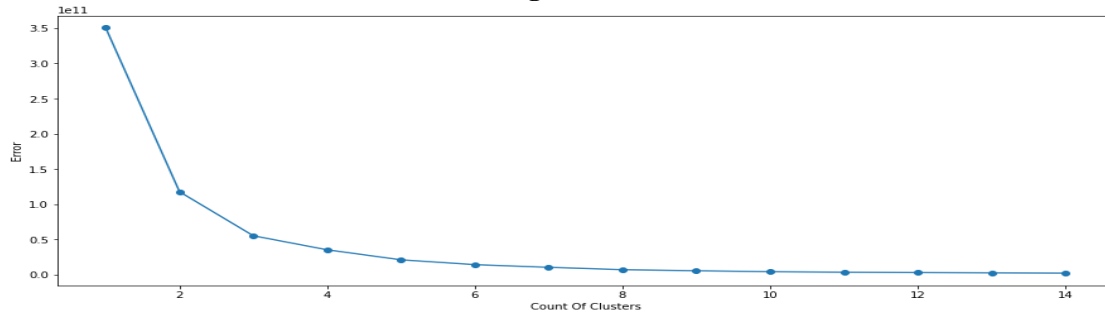
Calculating silhouette scores for 02 to 15 cluster we get the following values:

For 2 Clusters, The silhouette score is 0.9844890477261269

For 3 Clusters, The silhouette score is 0.9579526616883844

For 4 Clusters, The silhouette score is 0.9543151351092204

For 5 Clusters, The silhouette score is 0.8373987537332015

For 6 Clusters, The silhouette score is 0.7750376900030161

For 7 Clusters, The silhouette score is 0.73332141890852

For 8 Clusters, The silhouette score is 0.7321294945237423

For 9 Clusters, The silhouette score is 0.6735679186569941

For 10 Clusters, The silhouette score is 0.673992521720467

For 11 Clusters, The silhouette score is 0.6359349509744601

For 12 Clusters, The silhouette score is 0.6264706845195438

For 13 Clusters, The silhouette score is 0.6180098735304097

For 14 Clusters, The silhouette score is 0.6106586300038647

For 15 Clusters, The silhouette score is 0.6115826706947971

Using no of clusters as 04 we get the centroid as and the cluster centers as the tabel.

[2 0 0 ... 0 0 0]

Table-10		
[[9.26465116e+01	3.89488372e+00	1.43819457e+03]
[8.40000000e+00	6.50000000e+01	1.49828502e+05]
[3.00322581e+01	4.27741935e+01	4.63930139e+04]
[5.00000000e-01	6.65000000e+01	2.69931660e+05]]

First 10 rows of Clusterwise Recency, frequency and monetary are shown as:

Table-11				
Customer ID	**Recency**	**Frequency**	**Monetary**	**Clusters**
12347.0	2	7	4310.00	0
12348.0	75	4	1797.24	0
12349.0	18	1	1757.55	0
12350.0	310	1	334.40	0
12352.0	36	8	2506.04	0
12353.0	204	1	89.00	0
12354.0	232	1	1079.40	0
12355.0	214	1	459.40	0
12356.0	22	3	2811.43	0

Clusterwise number of counts are as follows:

Table-12	
0	4300
2	31
1	5
3	2

Basic Statistics of Recency, Frequency and Monetary are as:

Table-13								
	Count	Mean	Std	Min	25%	50%	75%	Max
Recency	4338.0	92.059474	100.012264	0.00	17.000	50.000	141.75	373.00
Frequency	4338.0	4.272015	7.697998	7.697998	1.000	2.000	5.00	209.00
Monetary	4338.0	2054.270609	8989.229895	3.75	307.415	674.485	1661.74	280206.02

On the scale of 01 to 05, we assign a value for each transaction to Recency, Frequency and Monetary like below.

Converting RFM Scores to Single Variable

On the basis of these scale, we get the recency score, frequency score and monitory score as in the following table:

Table-14						
Customer ID	Recency	Frequency	Monetary	Recency_Score	Frequency_Score	Monetary_Score
12346.0	325	1	77183.60	1	1	5
12347.0	2	7	4310.00	5	5	5
12348.0	75	4	1797.24	2	4	4
12349.0	18	1	1757.55	4	1	4
12350.0	310	1	334.40	1	1	2
12352.0	36	8	2506.04	3	5	5
12353.0	204	1	89.00	1	1	1
12354.0	232	1	1079.40	1	1	4
12355.0	214	1	459.40	1	1	2
12356.0	22	3	2811.43	4	3	5

Combining the value of Recency. Frequency and Monetary to form a single value of RFM Score.

Table-15	
Customer ID	
12346.0	115
12347.0	555
12348.0	244
12349.0	414
12350.0	112
12352.0	355
12353.0	111
12354.0	114
12355.0	112
12356.0	435

On the basis of descending order of monetary we have first ten rows as:

Table-16							
Customer ID	Recency	Frequency	Monetary	Recency_Score	Frequency_Score	Monetary_Score	RFM_SCORE
14646.0	1	73	280206.02	5	5	5	555
18102	0	60	25965	5	5	5	555

			7.30				
17450 .0	8	46	19455 0.79	5	5	5	555
14911 .0	1	201	14382 5.06	5	5	5	555
14156 .0	9	55	11737 9.63	5	5	5	555
17511 .0	2	31	91062. 38	5	5	5	555
16684 .0	4	28	66653. 56	5	5	5	555
14096 .0	4	17	65164. 79	5	5	5	555
13694 .0	3	50	65039. 62	5	5	5	555
15311 .0	0	91	60767. 90	5	5	5	555

Segmenting Customers Using RFM Score

Now we segment the customers data using RFM scores. First 10 rows looks line as:

Table-17

Customer ID	
12346.0	7
12347.0	15
12348.0	10
12349.0	9
12350.0	4
12352.0	13
12353.0	3
12354.0	6
12355.0	4
12356.0	12

Now we categorise the Unbeaten, Champs, Trustworthy, Prospective, Optimistic, Needs Heedfulness and Require Stimulating segment as per table-17 below, the first 10 rows looks like as in table-18.

Table-17

Rfm_Score_S >= 9	Unbeaten
Rfm_Score_S >= 8<9	Champs
Rfm_Score_S >= 7<8	Trustworthy
Rfm_Score_S >= 6<7	Prospective
Rfm_Score_S >= 5<6	Optimistic
Rfm_Score_S >= 4<5	Needs Heedfulness
else	Require Stimulating

Table-18

Customer Id	Recency	Frequency	Monetary	Recency_Score	Frequency_Score	Monetary_Score	Rfm_Score	Rfm_Score_S	Rfm_Level
12346.0	325	1	77183.60	1	1	5	115	7	Trustworthy
12347.0	2	7	4310.00	5	5	5	555	15	Unbeaten
12348.0	75	4	1797.24	2	4	4	244	10	Unbeaten
12349.0	18	1	1757.55	4	1	4	414	9	Unbeaten
12350.0	310	1	334.40	1	1	2	112	4	Needs Heedfulness

12352.0	36	8	2506.04	3	5	5	355	13	Unbeaten
12353.0	204	1	89.00	1	1	1	111	3	Require Stimulating
12354.0	232	1	1079.40	1	1	4	114	6	Potential
12355.0	214	1	459.40	1	1	2	112	4	Needs Heedfulness
12356.0	22	3	2811.43	4	3	5	435	12	Unbeaten

Now we calculate the average values for each RFM-Level and categorical data can be represented/visualised via tree map.

Table-19								
	Recency			**Frequency**			**Monetary**		
	Mean	**Count**	**Max**	**Mean**	**Count**	**Max**	**Mean**	**Count**	**Max**
RFM_Level									
Champs	85.1	376	313	2	376	6	676.9	376	9864.3
Needs Heedfulness	237.2	364	373	1	364	2	216.3	364	487.8
Optimistic	176.1	339	373	1.1	339	2	291.2	339	922.1
Prospective	122.8	422	373	1.3	422	3	383.4	422	1784.7
Require Stimulating	287.3	182	373	1	182	1	144.3	182	250
Trustworthy	97.2	384	372	1.6	384	5	705.4	384	77183.6
Unbeaten	35.2	2271	372	6.9	2271	209	3531.7	2271	280206

In case of large data, clean & informative insight from the data can be visualised using treemap. For treemap we have to install squarify, and using squarify we get the following graph:
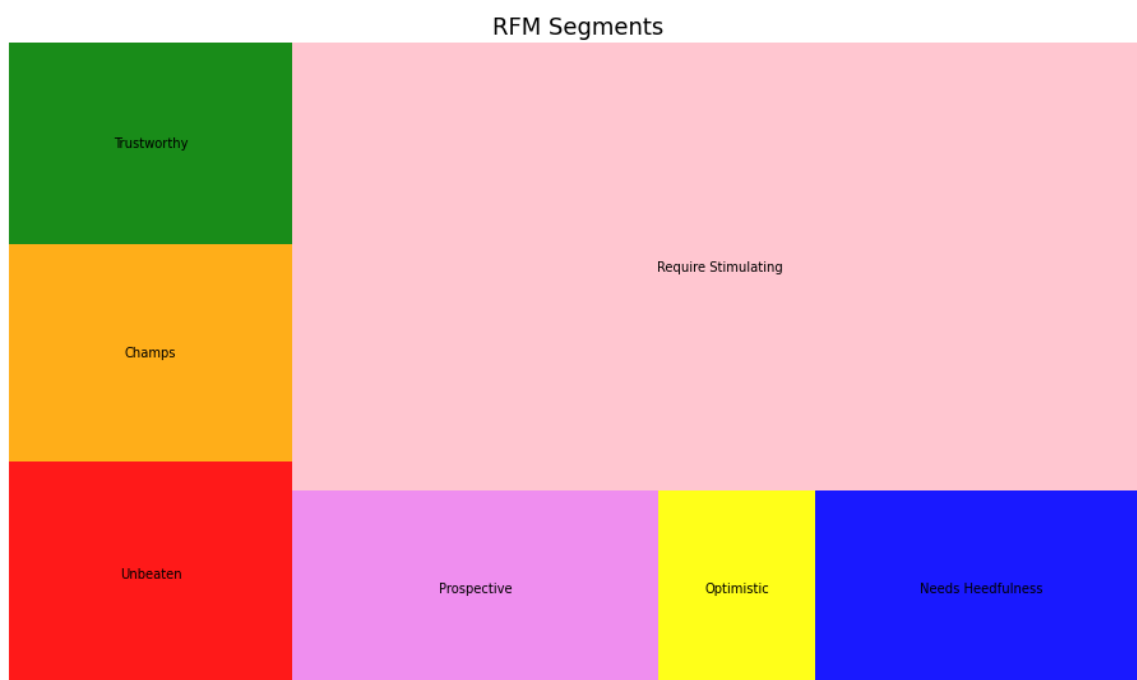
5. CONCLUSION

The major goal of this study was to use the RFM model to segment customers from a total of 54,190 online transaction occurred from 1/12/2009 to 09/12/2011 at a UK based retailer. Customers are segmented as Unbeaten, champs, Trustworthy, Prospective, Optimistic, Need Heedfulness and Require Stimulating as per squarify graph above. Company can make the best and different marketing strategy as per this segmentation of the customers.

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EPITOMIZE OF ELECTRIC SPRING FOR IMPROVEMENT OF POWER QUALITY FOR DEMAND SIDE MANAGEMENT

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ABSTRACT

A susceptible renewable energy source powered system originally used Electric Spring (ES), a revolutionary smart grid technology, to provide voltage and power stability. Voltage and power control has been suggested as a demand side management strategy. The deployment of an electric spring in connection with non-critical building loads, such as electric heaters, freezers, and central air conditioning systems. In this paper, a review has been done for electric spring. The current characteristics of the electric spring of voltage and power stability, a control scheme would be able to provide power factor correction of the system, voltage support, and power balancing for the key loads, such as the building's security system.

Keywords: Electric spring, power quality, critical load, load demand

1. INTRODUCTION

Only a limited number of countries, including India, have committed to raising the penetration of renewable energy sources to 20% [1-3] by 2020. Increased usage of these renewable energy sources in the main grid or distribution systems results in major stability problems [4-6], thus it must be handled delicately. Due to the unpredictable and intermittent nature of renewable energy sources, load management strategies rather than generation management are the only way to address stability challenges. One such option is demand side management (DSM), often known as demand dispatch. Various DSM techniques have been researched over the last three decades. All of these demand side management strategies either use a peak load reduction strategy. Figure 1 present the demand side management.
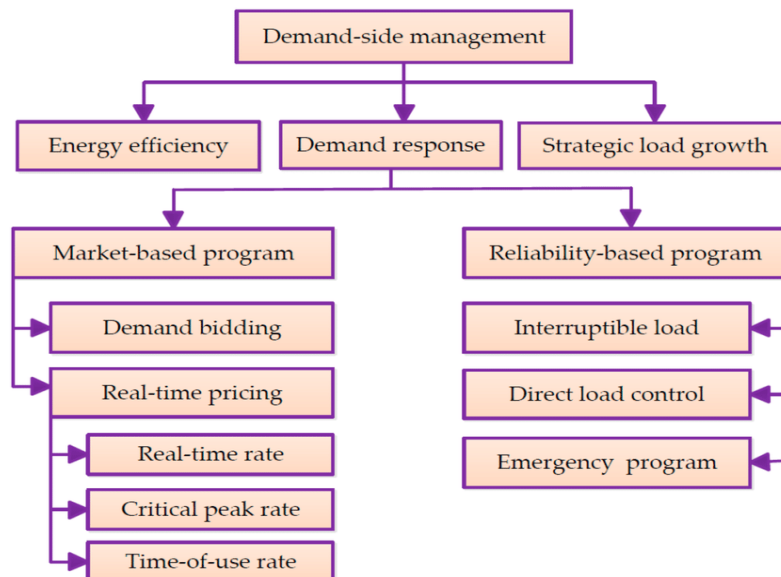

Figure 1: demand side management

Analogy between mechanical springs and ES [22] that incorporate various types of energy storage. One or more of these techniques, such as real-time pricing [10–12], scheduling [13– 15], or on-off control [16–17], of delay-tolerant loads, such as washing machines, provides Demand Side Management through load shaving. The most effective form of demand side management [18] for balancing load demand is battery storage, although it is quite expensive and has a short lifespan. The same waste's disposal is once again having major environmental problems. Only certain forms of information and communication technologies can be used to achieve all these Demand Side Management techniques (ICT). Another such technique for managing electrical loads remotely and intelligently depending on a certain tariff circumstance, or when the system's power requirements are very low, is the Internet of Things (IoT) [19]. All of these technologies have an additional cost to be paid in terms of signal traversal latency and hacker risk. It is somewhat intrusive in nature and restricts the end user's ability to use energy freely on a real-time basis.

According to the needs of the load, an electric spring is a custom power device, or power electronic converter, that is coupled in series with noncritical loads and operates with input feedback and output voltage control [20].

2. Generation of Electric Spring

A voltage source controlled by current can alternatively be thought of as an electric spring. According to the source of DC voltage present at the DC bus, electric springs can be categorized as follows:

1) 1st generation electric spring

2) 2nd generation electric spring: A battery is connected on DC bus [25].

3) 3rd generation electric spring: A bidirectional power electronic converter of appropriate type and of an appropriate configuration is connected on DC bus [25].

The first generation of electric springs is made up of a capacitor that is wired to a DC bus [21].Electric springs of this generation can only feed in or absorb reactive power and can function in any of the two modes listed below: inductive or negatively resistive. By suppressing line voltage, the inductive mode absorbs reactive power. By regulating the injected voltage over a range of 0° to 360°, an electric spring can source or sink both active and reactive power. On the other hand, the electric spring is sourcing actual power while it is in the negatively resistivephase. When the load current and the electric spring injecting the voltage are in quadrature, thecontrol of these electric springs can be designed to source or sink just reactive power at that angle, while handling both active and reactive power at any other angle. The noncritical load'svoltage and, consequently, its power flow are altered by the injection of voltage by an electricspring. The voltage that is available across the critical load is obtained by adding the voltages of the ES and noncritical loads algebraically. By varying the power of noncritical load, the voltage profile of critical load is kept constant and the grid is given voltage stability [22]. It isaccomplishing this in a way that is comparable to a mechanical spring, thus living up to its name, and in line with demand side management needs in order to achieve risk-limiting dispatch [23,24].

3. Compensation of Electric Spring

The whole mathematical model is derived in detail, together with a comprehensive ES steady-state analysis for various real and reactive power compensations. Various typical loads that arepartially or entirely mitigated by ES are discussed. A numerical example at the conclusion demonstrates how the ES is operated to accomplish a specific range of power sharing for compensatory reasons between the ES and the grid for various loads.

4. Basic working Principles of Electric Spring

In many contexts, ES functions similarly like a mechanical spring. While electric springs striveto sustain voltage, dampen electrical oscillations, and also have the ability to store electrical energy, mechanical springs are primarily employed to offer a mechanical support, store energy, and dampen mechanical oscillations. We can see how the equations for mechanical andelectrical springs are similar. The following force is applied to the actual mechanical spring:

$$F = -k * x \tag{1}$$

Where: ' k ' represents the spring constant and' 'is the displacement. While for the electricspring,

$$q = -C * V_{es} \tag{2}$$

Where: ' q ' is the charge stored in the capacitor with capacitance 'C ' and 'V_{es} ' is the voltage atthe terminal of the electric spring.

There is also similarity in stored energy equation where the energy stored in the mechanicalspring is:

$$E = \frac{1}{2} * k * x^2 \tag{3}$$

Where: ' E ' is the amount of energy stored, 'k ' is the material constant and ' x' is thedisplacement. While in the electric spring the energy stored is:

$$E = \frac{1}{2} * C * V_{es}^2 \tag{4}$$

Where "V" stands for the terminal voltage and "C" stands for capacitance. According to the spring position, there are typically three scenarios for the mechanical spring: When no force isapplied to the mechanical spring, it is in the neutral position, compressed position, and extendedposition. Similar to how three different ES processes can be compared to the mechanical springsituations shown in Figure 2.
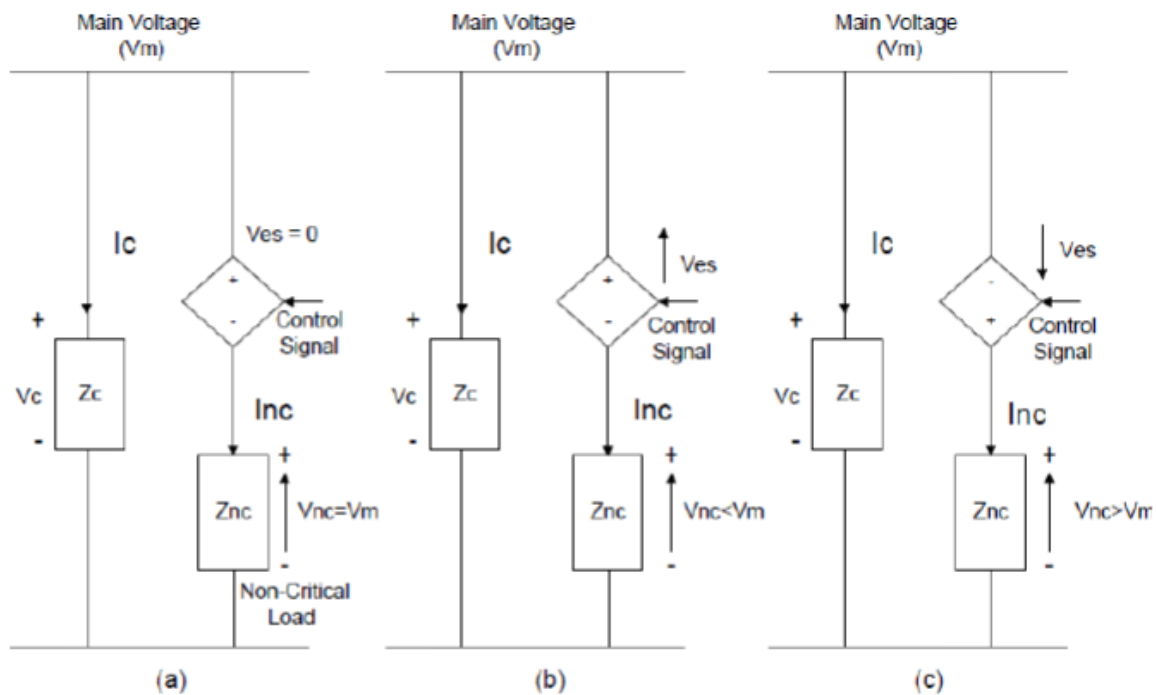

Figure 2: ES in three different phase (a) Neutral mode (2) inductive mode (3) capacitive mode

Where

Z_c & Z_{nc}: critical and non-critical loads respectively.

V_m: main voltage of the load bus.

V_{es}: voltage at the electric spring terminals.

V_C & V_{nc}: voltage of critical and non-critical loads respectively.

I_c & I_{NC}: current of critical and non-critical loads respectively.

There are two basic kinds of loads: essential loads, in which the voltage and power utilization must persist, and non-critical loads, in which the voltage may fluctuate within a specific rangeand consequently influence the non-critical load's power consumption. A novel combination of smart load, such as household appliances, is created by connecting an electric spring in serieswith non-critical load.

The electric spring in Figure 2 can be viewed as a source of controlled voltage. The mechanical spring's neutral state situation suggests that there is no applied force at all. As shown in Figure 2, the neutral position of ES indicates that its voltage, "V es," is zero and that the main voltage,

"V m," is at its nominal value (a). This indicates that the necessary amount of power is provided by renewable energy sources.

In the second scenario depicted in Figure 2 (b), the generated power is insufficient to cover the load since the main voltage is lower than the nominal value. The electric spring functions as a voltage booster in the capacitive mode to maintain the mains voltage at its nominal level and reduce the applied voltage across the connected non-critical load in series to use less actual power.

When the generated power exceeds the load demand in the third scenario depicted in Figure 2

(c) and the main voltage exceeds its nominal value, it is required to reduce the main voltage toits nominal value. In this instance, the electric spring performs an inductive mode voltage reduction function. The voltage of the in-series linked non-critical load is reduced, and as a result, the real power consumed is likewise reduced. When the resistive load is integrated in series with the ES, this voltage reduction of the non-critical load in capacitive mode is viewedas a constraint. When the ES runs in capacitive mode or inductive mode if the non-

critical load is inductive, the voltage of the non-critical load is increased. The electric spring's inductive and capacitive modes are two variations on the mechanical spring that can modify the displacement in either direction when a mechanical force is applied. According to the requirements of the device, non-critical load voltage may be increased or decreased within a defined range. The convenience of the user shouldn't be impacted by this variation.

CONCLUSION

By evaluating the available literature in this field, this paper discusses the theory, modelling, implementations, and restraints of an electric spring (ES). A specialised power device known as an ES (power electronic converter) is progressively becoming a prominent component of the smart grid. It is thought to be working under the impact of erratic, intermittent renewable energy sources and offers stability to the grid by managing actual and reactive power to renewable energy sources. Since ES is connected between the grid and the load, it can dampen the grid's oscillations. Based on the range of acceptable voltages, loads are divided. It somewhat corresponds to the demands of demand side management, and that too on a real-time basis. Review of the modelling, analysis, and control characteristics of electric springs.

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A STUDY ON DIFFERENT APPROACHES OF WORD SENSE DISAMBIGUATION FOR DIFFERENT INDIAN AND FOREIGN LANGUAGES

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ABSTRACT

A disambiguating method known as Word Sense Disambiguation (WSD) uses the words around the ambiguous word to determine which sense is most pertinent in the given context. The varied methods and tactics utilised to solve WSD problems in certain widely spoken Indian and foreign languages were covered in this paper. Depending on the types of the materials available and how well they fit with the language's nature, different strategies or approaches are used. Same approaches with different techniques and algorithms are also employed depending on the nature and the type of the languages. Because of differences in data size and language characteristics, it has been found that a single technique does not produce the same accuracy when employed on various groups of languages. Comparative studies among the different approaches used in Indian and foreign languages are also further discussed. Different evaluation metrics like precison, recall, F-score etc are used across different language as per the accuracy calculation is concerned. The uncertainty that exists in many kinds of Indian and foreign languages needs to be pleasantly resolved by selecting an acceptable approach with an effective method.

Keywords: Word Sense Disambiguation, Ambiguity, Natural Language Processing, WordNet

INTRODUCTION

Speaking or writing, or expressing one's thoughts in any other way requires the use of an organised linguistic system. Any language may occasionally have words with several meanings, which can cause confusion and misinterpretation. There are three categories of lexical ambiguities: (i) Polysemy ambiguity: This refers to a word or phrase that has more than one meaning yet is connected to another. (ii) Homonymy ambiguity: This refers to the use of a term or phrase with numerous senses that are wholly unconnected to one another. (iii) Categorical ambiguity: This refers to a word or phrase with more than one meaning but diverse grammatical meanings[17]. Humans are capable of determining the appropriate meaning of a word in light of the context in which it is used. However, until some rule-based characteristics are incorporated into the computers' memory, they will not be able to handle such a situation[21]. How one word is used in a human or machine context, knowledge of the word is essential to determining its proper meaning. Word Sense Disambiguation (WSD) is a method for separating vague words into their most pertinent senses by using the words around the equivocal word[4, 25]. Finding the proper meaning of a term behind an argument is assisted by syntactic, positional, and contextual factors[2]. A specific word in a phrase can be disambiguated, or the whole word can be (All Word Sense Disambiguation). There are three main approaches of WSD:

- **Knowledge based approach:** Knowledge-based NLP systems will also define and execute the text and the conceptual domain using their various techniques to address NLP difficulties like confusion resolution[27], which are necessary for understanding text meaning. Any small amount of information can be viewed as a collection of cues, including the words used, their tone, their arrangement, etc. [3]. There are numerous knowledge-based methodologies that rely primarily on knowledge resources like collocations, WordNet, thesaurus, ontology, etc. [5]. Additionally, for the sake of disambiguation, grammar rules, hand-coded rules, explicit lexical information, etc. may be employed. One of the most well-known knowledge-based algorithms, the Lesk algorithm, operates by determining the number of times a word occurs more than once in a context[6].

- **Machine learning based approach:** The corpus proof is the primary source that this strategy uses. The model, which is a probabilistic/statistical model, is often trained using labelled or unlabelled corpora. The classifier's primary responsibility in this case is to learn the features that are needed to retrieve and assign the proper meaning of the term in the example phrase. Three different machine learning-based methodologies exist:

a) Supervised Techniques: With hand-labeled, sense-annotated data sets, this approach is effective[1]. The data are trained and then classifier is applied. Neural Networks, decision trees, decision lists, and Naive Bayes are examples of supervised WSD methods[22].

b) Unsupervised Techniques: The word senses are generated from word clusters, and the newly derived cluster is then searched for new instances of the word. Context clustering, co-occurrence graphs, word clustering, and other unsupervised WSD techniques are included[22].

c) Semi – supervised Techniques: In this method, a reduced data collection that only contains the essential details can be utilised to teach the system important traits. In some cases, this method performs better than unsupervised methods.

- **Hybrid approach:** The above two mentioned approaches are used together in this approach. Dictionary data which are machine readable are used to correlate the relations among the senses and the corpus.

WSD applications include speech recognition, machine translation, information extraction, lexicography, parsing, information retrieval, automatic text summarization, hypertext navigation, classification of documents, spelling correction, reference resolution etc[4, 11, 22,30].

The paper is organised as follows: Section 2 gives the insights of the literature review in WSD. Section 3 elaborates the details about the various WSD evaluation metrics for measuring the system and last section deals about the conclusion.

LITERATURE REVIEW
Numerous researchers in WSD have produced impressive works in a variety of languages.

Foreign Languages
Mohannad AlMousa et.al[18] examined an English WSD system using SCSMM thereby recording the maximum sentence context by preserving the internal word order. Further, a study on different aspects like rate of ambiguity, size of sentence, granularity were also discussed. Farag Ahmed and Andreas Nurnberger[13] used a methodology to deal with ambiguity of Arabic words based on statistical co-occurrence. The user query phrases, topic context, and word inflection forms were used to pick features. The cohesion of the Arabic words and a unique similarity score were utilised to translate the word into its accurate English meaning. Myung Yun Kang et al.[25] suggested a brand-new supervised model with sense space incorporated for disambiguating Korean language. The huge training set was used for a ten-fold cross validation after the design was trained with a baseline frequency of 5 (five). Boon Peng Yap et.al[10] developed a Neural Network based English WSD system which excellently well by using the resources available in WordNet but ignored the combination of gloss and context. Ali Saeed et.al [15] created a unique benchmark Urdu corpus by to carry out all word sense disambiguation. The created dataset will be extremely effective because the annotation of the uncertain word was allocated following the consolidation of the results from the three observers. The accuracy of the corpus was further improved using a voting-based approach. Manish Kumar et.al[24] developed a WSD system that disambiguate the inputted sentence using the surrounding words information using the WordNet data. Here, the raw inputted data is converted into useable data by adding the additional information like POS, subject, object etc. which allow the classifier to disambiguate the ambiguous word contained in the sentence. Nyein Thwet Thwet Aung et al. [16] employed a Myanmar WSD system by using a concurrent dataset of Myanmar and English to handle word ambiguity. The machine translation method between Myanmar and English was improved using the newly built module. Tang Shancheng et al. [14] created a WSD system which uses TextCNN, TextLSTM, and TextMultiTask instances. When compared to the other best practises currently in use, it was found that there was an improvement of 11.48%. Alok Ranjan et al. [21] utilising both supervised and unsupervised methods determine the appropriate meaning of words based on real-world circumstances. In order to determine the proper meaning of the unfamiliar word, it presented a mixed methodology that included the "Modified Lesk" and "Bag-of-Words" methodologies.

Table 1: Implication of various Approaches used in different Foreign languages

Authors & Year	Language Used	Approaches / Techniques	Merits	Demerits
Boon Peng Yap et.al(2020)	English	Machine Learning Approach (Supervised Technique)	Excellent WSD system.	Ignored context gloss combination
Ali Saeed, Rao et.al(2008)	Urdu	Knowledge Based Approach	Clear representation of data and methods with great level of presentation.	Used limited data resource with very low accuracy rate of 57.71%.
Nyein Thwet Thwet Aung	Myanmar	Machine Learning Approach	Achieved a great accuracy of 89% considering the	Apply bag – of – words features to noun and verb

et.al(2011)		(Supervised Technique)	limited resource available.	words only.
Tang Shancheng et.al(2018)	Chinese	Machine Learning Approach (Supervised Technique)	Deals with all ambiguity types and minimises feature extraction process.	Relatively small data size.
Myung Yun Kang et.al(2018)	Korean	Machine Learning Approach (Supervised Technique)	Word2Vec's CBOW architecture was utilised. Carry out sense embedding and evaluation of it.	Hybrid Space model cannot perform evenly on micro and macro precision.
Farag Ahmed et.al(2019)	Arabic	Machine Learning Approach (Supervised Technique)	Arabic's unique linguistic characteristics were taken into account. Choose the optimal features for the data training.	Many-sensed words were not taken into consideration, creating a significant gap.
Manish Kumar et.al(2020)	English	Knowledge Based Approach	Reduces comparison steps	Uses only 50 ambiguous words with 2000 example sentences.
Mohannad AlMousa et.al(2021)	English	Hybrid Approach	Outperformed existing system	Cannot handle sentences with less word and cannot point to the topic of the document.
Alok Ranjan et.al(2015)	English	Hybrid Approach	Slight improvement in performance from the existing system	Used too lengthy steps

Indian Languages

Arindam Roy et al.[28] created a straightforward yet efficient Nepali WSD algorithm to address the issue of ambiguity in the Nepali language that include overlap-based, conceptual distance-based and semantic-based techniques. This algorithm demonstrated how metaphysical distance-based and semantic-based techniques were utilised to dramatically improve the efficiency of the algorithm when compared to the coincide approach. Alok Ranjan Pal et al. [22] used the Naive Bayes probabilistic model as a starting point for sense classification when a supervised technique is used for word meaning disambiguation in the Bangla language. The Bengali text corpus was first normalised and the Naive Bayes criteria were then applied. P. Iswarya and V. Radha's[18] employed unsupervised learning method to deal with the very ambiguous word using clustering and POS. With this method, the best k-value in the k-cluster may be automatically selected and a sense collocation dictionary can be created. In this case, POS taggers were employed to disambiguate the word senses, and the clustering and sense collocation dictionaries were used to improve the overall efficiency of the system. Purabi Kalita et al.[7] used the Walker algorithm in conjunction with a customized version of the Assamese WordNet to disambiguate Assamese words. By including an element called FEATURE, which specifies the subject category or the word domain, Assamese WordNet was modified. To make the extraction process and Walker Algorithm execution easier, the WordNet data were encoded in XML format. According to the result obtained, the system's accuracy out shadowed the old method by 1.86%. Sruthi Sankar K P et.al[11] advocated an unsupervised learning algorithm to distinguish between different word senses using context matching. A dataset was compiled from numerous Malayalam web data and the training examples included the majority of co-occurring words as well as collocations. In order to clarify the confusing word, seed sets and sense clusters produced from the database were used. Richard Laishram et al. [12] made the first attempt of developing a Word Sense Disambiguation system in the Manipuri language based on a decision tree. Ttraditional positional along with context-based features were merged and using CART technique the classifier is trained. Himdweep Walia et al. [8] employed a supervised technique for word sense disambiguation in the Gurmukhi language. For determining the k-nearest neighbour in relation to the provided test vector, the distance between the test sets was calculated to create two lists. A unique cross validation called 5-fold was implemented to evaluate the operation of the system. Manisha Gupta et al.[23] present an answer by conducting a study on Hindi WSD system using Hindi WordNet to decipher the word senses. The definition of the ambiguous words, along with the ten words around them, were produced and enhanced for the intention of disambiguation using a modified

LESK technique. Anidhya Athaiya et.al[20] developed a Supervised Hindi WSD system using Genetic algorithm using Hindi WordNet data. The developed system is very flexible that there are rooms for expandability to Hybrid approach.

Table 2: Implication of various Approaches used in different Indian languages

Authors & Year	Language Used	Approaches / Techniques	Merits	Demerits
Manisha Gupta et.al(2013)	Hindi	Knowledge Based Approach	Valuing each and every word in the sentences by taking 10 as window size.	Work mainly on the dictionary's glosses length. Of noun, verbs and adjectives.
Gauri Dhopavkar et.al(2015)	Marathi	Knowledge Based Approach	Well designed rules and accuracy is satisfactory	Disambiguate only word level ambiguity.
Himdweep Walia et.al(2018)	Gurmukhi	Machine Learning Approach (Supervised Technique)	Satisfactory result	Small data size.
Alok Ranjan Pal et.al(2015)	Bengali	Machine Learning Approach (Supervised Technique)	Improved performance with the usage of lemmatization and bootstrapping.	Further better algorithm can be applied to increase the performance of the system
Richard Laishram et.al (2014)	Manipuri	Machine Learning Approach (Supervised Technique)	Employed the decision tree approach, which is most effective for agglutinative languages like Manipuri. The sense of the word was captured using conventional placement and context-based characteristics.	Small data size with non - unicode font.
P. Iswarya and V Radha(2016)	Tamil	Machine Learning Approach (Unsupervised Technique)	Collocation and clustering were employed to boost performance. Processing speed improved.	Reduce performance due to the lack of context word tagging and collocation.
Sruthi Sankar K P et.al(2017)	Malayalam	Machine Learning Approach (Unsupervised Technique)	Very simple but very effective	Small data size and all word senses may not have been covered by the generation of seed sets and sense clusters.
Purabi Kalita et.al(2015)	Assamese	Knowledge Based Approach	Improve accuracy rate.	Limited to noun and adjective phrases.
Anidhya Athaiya et.al(2018)	Hindi	Machine Learning Approach (Supervised Technique)	Improve accuracy and further expandability to Hybrid approach is there.	Limited to noun words only.
Arindam Roy et.al(2014)	Nepali	Knowledge Based Approach	Used mixed different concepts of Overlap, conceptual distance & semantic graph thereby giving good performance.	Performance can be improved and word coverage can be expanded to verb also.

Figure 1: Comparison of usage of different approaches based on the size of the data sources

Figure 1 shows that different approaches were used depending on the availability of the resources in a particular language. Supervised approaches are the most widely used approach for an average data source language.

EVALUATION METRICS
Performance measurements were used to assess how successfully a computer taught itself through the process of machine learning, which entails training computers how to teach themselves how to solve problems. Depending on the problem's nature, the right approach should be taken. The accuracy of the outcomes a designed system generates is a good indicator of its efficacy. So, the majority of the systems that have been developed evaluate effectiveness in terms of accuracy. Accuracy establishes an assessment of reality that is unbiased and free of errors. Additionally, several proposed systems quantify their effectiveness using precision, recall, and F-Score[31, 7, 25]. F1-score assessment metrics, which perform best for classes with uneven distributions, have also been seen in some systems[16, 21].

CONCLUSION
Based on the amount of data availability and how well they matched the language's characteristics, various approaches were used. The majority of knowledge-based methods have been found to be resource constrained, while machine learning techniques have shown to be more accurate than the previous approach[18]. For Indian languages, which are morphologically rich, uncommon WSD systems were available[13, 28, 18]. For languages with small dataset, knowledge based approached is mainly used while machine learning approaches are mainly used for language with average or large data sets. It has been noted that the identical method does not produce the same accuracy when used with different types of languages. Therefore, it is necessary to select an acceptable method and strategy in order to conveniently resolve the discrepancy that exists in many types of Indian languages and foreign languages.

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KEDAIREKA'S MATCHING FUND PROGRAM BUILDS KALOLING VILLAGE INTO A DIGITAL VILLAGE

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ABSTRACT

Kaloling Village is one of the most prominent villages in Bantaeng Regency. This village has twice represented South Sulawesi Province in winning the President of the Republic of Indonesia award in the industrial and food crop categories. However, currently Kaloling Village is still constrained by the internet network, thus hampering business development and marketing of the products of the Kaloling Village community. The Kedaireka Matching Fund program by the University of Bosowa, the Ministry of Education and Culture together with the Local Government of Kaloling Village aims to improve internet network access by using a network amplifier so that Kaloling Village becomes a Digital Village. The method used in this Kedaireka Matching Fund activity is to collaborate with universities as proposers in collaboration with the village government, industry and the community in Kaloling Village by installing ten signal amplifier units for all hamlets in Kaloling Village. The results of the activity show that the installation of these ten signal amplifier units provides great benefits for the people of Kaloling Village to access the internet, making it easier for communication and business development. With this program, Kaloling Village, which used to be known as a village with poor signal and isolation, has become a digital village that can access various information and the world. The weakness of this program is that it must be supported by network quotas and regular maintenance, thus requiring additional funds to ensure the sustainability of the program.

Keywords: digital village, signal booster, internet network.sustainability

1. INTRODUCTION

Kaloling Village is a village that has very abundant potential, both in terms of natural potential and human resource potential. This abundant potential has not been fully empowered by the community optimally to improve the welfare of the village community so that the PAD of Kaloling Village is relatively low. Economic potential such as; Small and medium-sized industrial enterprises owned by the village have not been managed properly and optimally. This is due to the ability, mindset, education is still low and community productivity and touch of technology have not been used optimally so that small and medium enterprises in Kaloling village have not developed. Various businesses have been developed in this village such as agriculture, animal husbandry and plantations, SMEs building village businesses, village farmer groups developing cattle, developing cocoa plantations, brick business, carpentry, welding and various other productive businesses. However, these businesses have not been managed properly so that the income received by the community is relatively low, moreover, Kaloling Village is known as a village with internet connectivity difficulties.

It is hoped that the independent-campus shop program will create collaboration between universities, students, the community and the government of Kaloling Village in developing businesses, farmer groups, women farmers, the economy (small and medium enterprises/industry) in Kaloling Village in a professional manner through empowering village resources. to improve community welfare and create independence in Kaloling Village, Gantarangkeke District, Bantaeng Regency, especially in the perspective of modern production and marketing management with the help of information technology and internet networks. This digital village program is intended as a collaboration program implemented in Kaloling Village to address the gap in the flow of information in the village by utilizing communication technology devices and information advice in improving integrated community services.

This study is intended to analyze the role of digital villages and strengthening village SMEs in improving community welfare while reducing crime rates and social vulnerability, reducing unemployment due to Covid 19, increasing public awareness of the importance of business development, creating village independence through increasing income, improving village community welfare, build a sustainable village business/industrial competitive advantage, empower the potential of village resources in improving the village economy, create a smart Kaloling Village as a leading village in Bantaeng Regency, build a national and international scale business/industrial sector by building a digital village.

2. LITERATURE REVIEW

2.1 Digital Village

The development of technology and information became bright after Indonesia and even the world as a whole was hit by the Covid-19 Pandemic, also strengthened by the entry of the industrial revolution era 4.0 (Nugroho et al., 2020; Mulianingsih, 2021). This requires all elements of society and development tools including villages to improve the transformation from activities that have been based offline to online. The pressing need for the use of the internet network is expanding not only in urban areas but also in villages (Wahab, 2016; Nugroho and Nugraha, 2020; Sudirman et al., 2020).

A digital village is intended as a village that integrates village services with digital, and provides efficient and effective information presentation so that information is conveyed quickly and accurately (Ardhana, 2019). The development of information technology and internet networks has spread to almost all parts of Indonesia, both urban and rural, through the internet people can exchange information quickly without having to meet face to face (Imaniawan & Wati, 2017). Thus, the implementation of digital villages is a challenge in itself in advancing villages in Indonesia (Subiakto, 2013).

Village digitization is certainly not an easy matter, it requires support from various parties, both village officials and the village community as a whole. The village community is not a technology literate campus community, but the village community has various limitations such as: low community knowledge and competence, the average community is in a weak economic condition, inadequate and equitable health quality, limited access to financial institutions, limited access to marketing. not yet extensive and various other limitations (Susanto et al., 1992; Cintamulya, 2015).

2.2 Potential for Digital Village Development in Kaloling Village

Currently, the number of villages that have been connected to the internet has reached 82.36% or 69,126 villages (Fakhri, 2019). However, the results of using the internet in villages have not been maximized due to the condition of the people who have not fully mastered the internet, so the role of the internet to improve people's welfare has not been too influential (Tømte and Hatlevik, 2011; Nugroho and Chowdhury, 2015; Nugroho and Ali, 2020). Another reason for the low role of the internet is the low level of education in rural communities (Vito and Krisnani, 2015).

Efforts to optimize the use of the internet in villages can be carried out with various efforts, such as: (1) training and counseling related to the importance of the internet and how to use the internet for more innovative and productive purposes, (2) increasing awareness of rural communities through socialization and competition in the field of education. village internet to stimulate the spirit of rural communities in using the internet.

We can see the digital village development model in Figure 1 below:
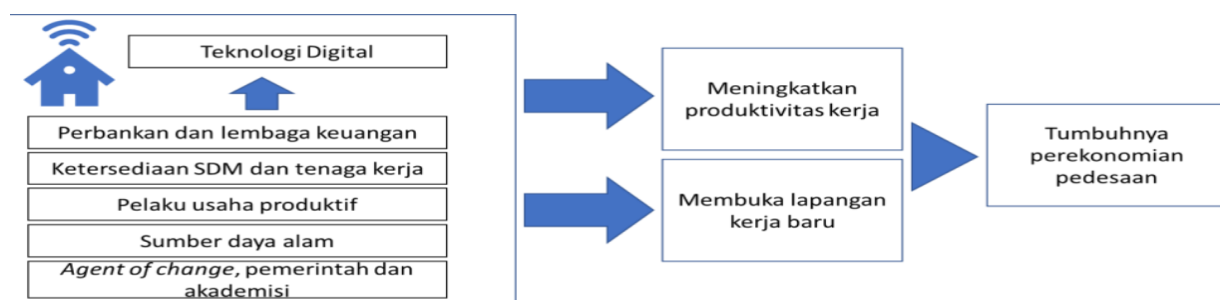

Figure 1. Digital Village Development Model. Source: Nugroho, 2020

Based on Figure 1 above, the village development model can be carried out in the following stages: (a) Natural resources, business actors, human resources, financial institutions and village officials must be able to collaborate and synergize to be well managed based on information technology with conduct training, socialization, counseling and regulations, (b) build awareness in people's lives that information technology will improve great marketing capabilities, improve organizational reputation with information via the internet, (c) with information technology can open up business opportunities by expanding business and increasing the number of production volumes, (d) opening up business opportunities and increasing the absorption of more labor through business innovation and opening new business areas, and (e), increasing the synergy between business actors and the community to improve people's welfare. (f) the community can build easy and cheap internet network-based relationships (ICT Magazine, 2015).

3. RESEARCH METHOD
This research method was carried out qualitatively with the following steps:

a. Observing and collecting data on the problems and potentials of Kaloling Village, Gantarangkeke District, Bantaeng Regency as the location for program implementation.

b. Conduct coordination meetings with the local government and the community as actors in the manufacture of (1) Moringa leaf teabags (2) environmentally friendly modern cow cages (3) modern, environmentally friendly chicken farms (4) lightweight bricks, environmentally friendly practitioners (5) hydraulic environmentally friendly polyfusion electric welding machine (6) environmentally friendly corn cultivation technology innovation (7) digital technology innovation and satellite imagery (9) internet management that will become a partner for the design of the shop (10) e-commerce development.

c. Conduct socialization to the community and formulate problems by involving elements of stakeholders, to obtain input to get out of the problems faced by the Tamai group community, Women Tani as a home industry group that manages the food industry.

d. Prepare administrative equipment, training schedule, schedule for procurement of raw materials, assistance for women farmer groups, MSMEs, BUMDes.

e. Providing information technology-based financial, management, administration training.

4. RESULTS
4.1 Overview of Kaloling Village
Kaloling Village is one of several villages located in the Gantarangkeke District Government, Bantaeng Regency, this area is located east of the Bantaeng Regency Capital, the distance from the District Capital is $\pm$ 5 Km and the distance from the Regency Capital is $\pm$ 18 Km. If using a motorized vehicle, the distance to the District City is $\pm$ 15 minutes, and $\pm$ 30 minutes to the Regency Capital. Kaloling Village has an area of 11,147,323 Km², with an altitude of 180 MDPL, with productive land such as rice fields, plantations, which are divided into 8 Hamlets.

The boundaries of Kaloling Village are as follows:

To the north   : Patallassang Village with Lembang Gantarangkeke Village

To the east   : Bajiminasa Village

On the west side   : Kuncio Village and Gantarangkeke Village

To the south   : Borong Loe Village with Papan Loe Village

Figure 2. Map of Kaloling Village. Source: BKKBN, 2017

In general, the economic condition of Kaloling Village is mostly supported by the plantation and agricultural sectors, and the rest comes from outside the village and in general the people of Kaloling Village make a living as owner farmers, sharecroppers, civil servants, entrepreneurs, stone masons, carpenters, drivers, foot traders. five and farm and construction workers as well as several residents who migrated out of the area to earn a living.

4.2 Increasing the Capacity of Kaloling Village's Human Resources

Bantaeng Regency prioritizes human resource development rather than physical development. Therefore, the Bantaeng Regency government focuses on providing training and capacity building in the field of business that the community has been involved in so far to improve the skills and abilities of the community in their respective fields. The direction of the program is to be able to contribute in increasing efforts to achieve the economic welfare of the community. Especially in this era of digitalization, the impossible becomes possible. So it takes assistance to the community to make more creative reasoning emerge.

Training is an effort that is carried out in a directed and continuous manner to improve quality and capacity in order to improve the competence of human resources of Village Communities and MSME entrepreneurs. An entrepreneur needs various foundations of knowledge, business skills being two sides. On the one hand, it can provide adequate provisions before starting a business, while on the other hand, it can make people careful in starting a new business.

According to Saparuddin as the Head of the SME Division of the Bantaeng Regency Cooperative, SME and Trade Office said that;

"Bantaeng Regency currently prioritizes human resource development rather than physical development, such as providing training and capacity building in the business sector."

Operator/technician training is provided to the people of Kaloling Village to improve the skills (soft skills) and expertise of operators/technicians in operating various agricultural equipment correctly and safely and gain expertise in equipment maintenance and repair to support the welfare of the village community. This training was given to the Kaloling Village community consisting of village government officials, farmer groups, and BUMDES. The material is delivered in a structured manner by combining material and practice on campus, even the participants are asked to operate agricultural equipment in the right field. This is to provide participants with skills related to how to operate these practical tools.

In addition to operator/technical staff training, this activity also provides start-up training and making business legalities to MSME actors. Start-up training and business legality are provided by the people of Kaloling Village to improve community skills in mastering technological devices and utilize these skills to improve the quality of Kaloling Village's human resources.

Online marketing techniques for MSME and BUMDES managers in Kaloling Village are a breakthrough for Kaloling Village. Online marketing training was given to MSME and BUMDES managers in Kaloling village to become a provision to enter the wider world of marketing. Online marketing, which is better known now as digital marketing language, does not provide space restrictions for business people, so that the reach of their marketing area can be wider. An additional program provided in an effort to increase the capacity of Kaloling Village's human resources is the registration of businesses managed by the Kaloling Village community to obtain a Business Identification Number (NIB). This is part of the legality of the business and later as a reference in receiving business benefits in the future. This NIB was given by the Office of Cooperatives, SMEs and Trade of Bantaeng Regency.

Furthermore, this training activity was followed by direct practical activities using the Kaloling Village BUMDes website for marketing MSME businesses that were collected in BUMDes or Kaloling Village E-commerce. This activity is one of the promotional events for the products produced by the Kaloling Village SMEs which can be presented on the Kaloling Village BUMDes website.

4.3 Installation of Signal Amplifiers in Kaloling Village

In an effort to increase the strength of the internet network in Kaloling Village, which has been complained by the community as an area that has difficulty signaling, ten signal amplifier units were installed to analyze the effect of the presence of a signal amplifier in Kaloling Village. Signal amplifiers are installed in every hamlet in Kaloling Village, except at the Village Hall, 2 units are installed, so the total signal amplifier installation is 10 points..

Happiness colored the activities of the Kaloling Village community and Kaloling Village staff because their village was able to access the internet and could do business development through digital marketing. The people of Kaloling Village are proud because their village has turned into a digital village and is very beneficial to the community.

According to Rano Muros as the Secretary of Kaloling Village as well as being an admin and regulating the use of the wifi network in Kaloling Village:

"We hope that the residents of Kaloling Village can take advantage of this facility to improve their welfare"

This signal booster installation activity uses a Telkomsel product, namely the 4G LTE signal booster network. Signal strength with this application is very good because it can generate signals up to 14 levels so that people can feel comfortable in looking for signals. Other considerations that are used as the basis for installing a signal booster are the initial and final installation costs, hosting and domains.

5. DISCUSSION

The education and training provided to the Kaloling Village community, especially SMEs and BUMDES actors, has a very positive impact on increasing the human resource capacity of the Kaloling Village Community. With the approach of education and training provided to the community, it has made a positive contribution in improving the skills and skills of the community to use various technology tools in the village.

Operator/technician training carried out in Kaloling Village had positive impacts such as; (1) there is an increase in the skills (soft skills) of operators/technicians in operating various correct and safe agricultural equipment, (2) improvement of skills, expertise and work safety for operators/technicians. With this training, the people of Kaloling Village will no longer have difficulty finding technical personnel/operators for agricultural equipment such as hand tractors, machine tractors and others, so that it becomes easier for the community to cultivate their rice fields or farms. The constraints so far felt by the community with the shortage of agricultural equipment operators have hampered the work of farmers, but this training provides a solution for the fulfillment of agricultural equipment operators.

The start-up training has also helped the people of Kaloling Village to increase the understanding of the people of Kaloling Village to use digital marketing applications. The results of this study indicate that there is an increase in the understanding of the people of Kaloling Village with online marketing, so that every product produced by MSMEs in Kaloling Village has been able to penetrate the market in urban areas. The obstacles experienced so far by MSME actors with limited market share can finally be solved with useful knowledge from this training. This training is expected to be able to improve the business of the Kaloling Village community so that it can help the community to increase their sales turnover and increase profits and the welfare of the Kaloling Village community. In addition, in this training the community is also provided with provisions to facilitate the proposal for a Business Identification Number (NIB). With this NIB, MSME entrepreneurs have the opportunity to improve their marketing network and can open access to capital services from financial institutions in the Bantaeng area or from other areas.

The installation of 10 signal amplifier units in Kaloling Village also provides great benefits for the people of Kaloling Village to access the internet, making it easier for them to communicate and develop their businesses. With this program, Kaloling Village, which used to be known as a village that had difficulty signaling and was isolated, became a digital village that could access various information and the world..

6. CONCLUSION

The warungreka program organized by the government in collaboration with universities and local governments has made a positive contribution to improving the welfare of the community. This can be seen from the activities carried out in Kaloling Village by the research team and the village government with a variety of activities that are very productive and provide positive value to the community.

The results of the activity show that the training of agricultural equipment operators/technicians in Kaloling Village has increased the number of workers who are able to operate agricultural equipment as well as being able to perform maintenance on these tools. This has a positive impact on the community's need for agricultural equipment operators or technicians, so that the people of Kaloling Village can improve their performance in managing their agricultural land.

We can also see the same thing from start-up training activities and assistance in making business legalities in Kaloling Village, which have also had a positive impact. This activity is able to improve the skills of the Kaloling Village community in using digital marketing to market MSME products in Kaloling Village, so that market share constraints that have been a complaint of MSME actors in Kaloling Village can be overcome with digital marketing which can increase market share up to urban area. The turnover of MSME actors in Kaloling Village can increase with a new marketing pattern introduced by the Kedaireka research team.

Likewise, the installation of ten signal amplifier units has provided great benefits for the people of Kaloling Village to access the internet. The people of Kaloling Village can find it easy to communicate and develop business. With this program, Kaloling Village, which used to be known as a village with poor signal and

isolation, has become a digital village that can access various information and the world. The weakness of this program is that it must be supported by network quotas and regular maintenance, thus requiring additional funds to ensure the sustainability of the program.

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ETHNIC DIVERSITY AND INCLUSION POLITICS AMONG NORTH EAST INDIA'S TRIBAL COMMUNITIES

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ABSTRACT

In a multi-ethnic country like India, integrating differing realities around various communities and areas has occupied policymakers since the establishment of the Indian state. The tribes of the Northeast have long wrestled with the issue of adjusting to new politico-legal and administrative systems that would reduce conflict and improve social, political, and economic fairness. The region, distinguished by its own cultural mosaic, is home to numerous tribes, each with its own identity, traditions, and social systems. This paper examines the benefits and drawbacks of diversity, with a focus on the complexities of encouraging inclusion within a framework that respects and honours the various cultural traditions of all cultures. It investigates the colonial and postcolonial legacies and wars that have shaped these groups and their current political landscape. Issues of representation, cultural preservation, and socioeconomic development are all addressed, as are current efforts and legislation to promote diversity. The purpose of this study is to help policymakers and scholars interested in North East India's ongoing development and identity discourse by sharing insights acquired by analyzing the relationship between ethnic diversity and inclusion politics. This study emphasizes the complexities and limitations of inclusive policies in meeting the needs of communities with diverse racial and ethnic compositions. It examined the framework of a federal organization and highlighted how people have dealt with the benefits and limitations of self-government.

Keywords: Ethnic diversity, inclusion politics, tribal communities, north east India, cultural heritage, identity dynamics

1. INTRODUCTION

Northeast India has a well-deserved reputation for radicalism, insurgency, and ethnic violence—both at home and abroad [1]. The region saw the emergence of numerous extremist groups that threatened the integrity and sovereignty of the Indian state. In the rich tapestry of India's cultural landscape, the North East region stands as a mosaic of diverse ethnicities, each contributing to the vibrant fabric of the nation. Among the numerous communities that call this region home, the tribal communities of North East India hold a distinctive and integral place. This study delves into the intricate dynamics of ethnic diversity and inclusion politics within the tribal communities of North East India, unraveling the historical threads that have shaped their socio-political landscape [2].

Amidst the emerald embrace of the Himalayas and the verdant tapestry of lush rainforests, North East India pulsates with the symphony of over 200 tribal communities. Each, a distinct melody in this harmonious chorus, weaves a tale of vibrant cultures, ancient traditions, and languages as diverse as the landscapes they inhabit. This region, nestled at the crossroads of South and Southeast Asia, is a kaleidoscope of ethnicities, a testament to the enduring power of human diversity. Yet, beneath the breathtaking panorama lies a labyrinth of complex challenges, where the politics of inclusion for these communities becomes a delicate dance amidst historical shadows and contemporary struggles.

For centuries, the tribal communities of North East India have walked a tightrope between the allure of integration and the sting of marginalization [3]. The promise of the Indian Constitution, etched with ideals of equality and inclusivity, often clashes with the harsh realities of underrepresentation and overlooked vulnerabilities. Political spaces, where decisions shape destinies, frequently echo with the voices of dominant groups, leaving the concerns of tribes relegated to the periphery. Development initiatives, though well-meaning, can inadvertently trample upon cultural sensitivities and disrupt delicate ecological balances, leaving communities adrift in the wake of misplaced progress. The very systems meant to empower can, at times, become instruments of alienation, leading to a simmering frustration that threatens to spill over into unrest.

The quest for inclusion, therefore, transcends mere policy pronouncements and demands a nuanced understanding of the intricate tapestry of tribal societies. It necessitates acknowledging the profound significance of each community's unique identity, woven from threads of ancestral wisdom, distinct languages, and deeply embedded customs. The Garos of Meghalaya, with their matrilineal social structure and vibrant

dance forms, stand in stark contrast to the Apatani of Arunachal Pradesh, known for their facial tattoos and intricate rice cultivation practices [4]. Each community, a sovereign island within the larger archipelago of North East India, deserves respect for its distinct cultural autonomy and self-governance structures.

This pursuit of autonomy, however, often collides with the realities of power dynamics. The Sixth Schedule of the Indian Constitution, envisioned as a bridge between tribal aspirations and national governance, can sometimes morph into a bureaucratic labyrinth, with resource allocation and decision-making power remaining elusive. Traditional councils, steeped in the wisdom of elders and customary practices, face the constant challenge of navigating their authority within the larger web of state and national structures. The yearning for a voice in shaping their own destinies becomes a relentless drumbeat, echoing through valleys and resounding in the hearts of every tribal elder and youth [5].

Inclusion cannot be achieved solely through top-down pronouncements; it must blossom from the fertile ground of community empowerment. Strengthening tribal political representation through reserved seats and community-based initiatives is not a mere gesture, but a vital step towards amplifying their voices in the corridors of power [6]. Decentralizing power and resources, ensuring capacity building for tribal councils, and recognizing their leadership as legitimate partners in decision-making processes are not optional add-ons, but fundamental pillars of an inclusive future.

Yet, the path to inclusion is not paved with smooth stones. Internal conflicts within communities, fueled by historical grievances and competing visions for the future, can fracture unity and stall progress. External pressures from powerful groups, driven by economic interests or political ideologies, can threaten the delicate balance of cultural autonomy and environmental integrity. And the ever-present specter of bureaucratic hurdles, red tape, and unfulfilled promises can erode trust and dampen the fire of hope.

Despite these challenges, the landscape of inclusion is dotted with the footprints of unwavering determination and hopeful initiatives. The rise of young tribal leaders, vocal and unafraid to challenge the status quo, injects fresh energy into the movement for equity. The growing awareness of tribal rights, amplified by the efforts of dedicated activists and civil society organizations, resonates with a powerful call for justice. And the burgeoning collaborations between communities, transcending borders and language barriers, build bridges of understanding and solidarity, paving the way for a future where inclusivity is not a slogan, but a lived reality.

North East India's tapestry of tribal communities pulsates with the rhythm of ancient wisdom and fervent dreams of a just future. To truly understand this region, we must move beyond the superficial gloss and delve into the labyrinthine complexities of its struggles and aspirations. Inclusion cannot be a one-time act of charity, but a sustained commitment to recognize, respect, and empower the diverse voices that weave the very fabric of this vibrant land [7]. Only then can the mosaic of mountains and movements, of traditions and triumphs, reveal its true brilliance, a testament to the enduring power of human diversity and the transformative potential of a truly inclusive India.

2. ETHNIC DIVERSITY IN NORTH EAST INDIA
North East India is a vibrant tapestry of ethnic diversity, where over 200 distinct communities weave together a rich cultural landscape. This region, often referred to as the "Seven Sisters" and with brother state of Sikkim, is home to people of Tibeto-Burman, Indo-Iranian, and Austroasiatic descent, each with their unique traditions, languages, and customs [8].

Fig. 1: Map of North East India

Source: https://www.thenevibes.com/unveiling-indias-northeast-breaking-the-shackles-of-neglect

HERE'S A GLIMPSE INTO SOME OF THE MAJOR ETHNIC GROUPS

1. Arunachal Pradesh: Land of the Monpa, Apatani, and Adi Tribes

Arunachal Pradesh, nestled in the Eastern Himalayas, known as land of dawnlit mountains, is a treasure trove of ancient traditions and vibrant tribal communities. The Monpas, known for their colorful prayer flags fluttering in the mountain breeze, revere nature and celebrate life through vibrant festivals like Tawang Torgya. The Nyishis, who traditionally wear cane helmets surmounted by the crest of a Hornbill beak known as pudum, famous for their warrior agility is the largest tribe. The Apatani, distinguished by their distinctive facial tattoos, are skilled farmers and weavers, while the Adi tribes showcase their rich heritage through their energetic dances and colorful attire. Distinguished by their distinctive facial tattoos, the Apatani revere nature and celebrate life through vibrant festivals like Dree, Myoko etc, where the ground trembles beneath the rhythmic stomping of tattooed feet [9].

Fig. 2: Arunachal Pradesh People

Source: https://www.indiatravel.app/wp-content/uploads/2024/09/Nyishi-Tribe-300x180.png

2. Nagaland: Land of the Angamis, Lothas, and Konyaks etc.

Nagaland, the land of the headhunters, now known as land of festivals, is a mosaic of fierce warriors and rich cultural heritage. Out of seventeen major tribes, the Angamis, known for their impressive Morungs (communal houses), are skilled woodcarvers and storytellers. The Lothas, renowned for their warrior spirit, showcase their cultural pride through their vibrant festivals and colorful attire. The Konyaks, with their distinctive hornbill-feather headgear, are skilled hunters and farmers, their traditions deeply rooted in their connection to nature. Comprising over 16 tribes, the Nagas are renowned for their warrior spirit and rich cultural heritage. Each tribe has its own distinct language, dress, and traditions, but they share a common bond of community and respect for nature [10].

Fig. 3: Nagaland people

Sources: https://easternroutes.com/northeast-india/nagaland/traditional-festival/

3. Mizoram: Land of the Mizos (Lushai)

Mizoram, the land of the Lushai people, is renowned for its breathtaking beauty and vibrant musical traditions. The Mizos, with their colorful Puanchi shawls and infectious love for music, celebrate their matriarchal society through energetic dances like Cheraw. Their traditional bamboo houses and intricate bamboo handicrafts showcase their skilled craftsmanship and deep connection to nature. Also known as the Lushai people, the Mizos are known for their love of music and their colorful "puanchi" shawls. Their society is traditionally matriarchal, and their vibrant dances and songs are a testament to their rich cultural heritage [11].

Fig. 4: Mizoram people

Source: https://www.wikiwand.com/en/articles/Mizo_people#/media/Mizo_people|File:

4. Meghalaya: Land of the Khasis, Jaintias, and Garos

Meghalaya, the land of the clouds, is home to the Khasis, renowned for their entrepreneurial spirit and awe-inspiring their entrepreneurial spirit and awe-inspiring "living root bridges" woven from the roots of banyan trees. Their matrilineal society forms the bedrock of their vibrant culture, reflected in their colorful attire and captivating festivals like Nongkrem Dance. The Jaintias, skilled basket weavers and farmers, add a touch of serenity to the region's landscape. The Garos, with their rich storytelling traditions and energetic dances like Wangala, celebrate their connection to nature and community. These matrilineal people from Meghalaya are known for their entrepreneurial spirit and their unique "living root bridges." They are skilled weavers and farmers, and their traditional attire is a riot of colors and intricate designs [12].

Fig. 5: Meghalaya people

Sources: https://www.kipepeo.in/festivals-of-meghalaya/

5. Assam: Home to the Ahoms, Bodos, and Dimasa Kacharis

Assam, the heart of the Northeast, is a land steeped in history and vibrant traditions. The Ahoms, who once ruled the region, left behind a legacy of majestic architecture and rich cultural practices. The Bodos, known for their colorful Bihu festival celebrating spring, are skilled farmers and weavers. The Dimasa Kacharis, once headhunters, have transformed into skilled artisans, their wood carvings whispering tales of their rich past. The largest ethnic group in the region, the Assamese are known for their warmth and hospitality. Their rich literary tradition includes the epic "Mahabharata," and their Bihu festival is a joyous celebration of spring [13].

Fig. 6: Assamese people and other tribes of Assam.

Sources: https://www.outofboundstours.com/tribes-northeast-india/

6. Manipur: Home to the Meiteis, Tangkhuls, and Kukis

Manipur, the land of dance and theatre, is home to the Meiteis, renowned for their graceful Manipuri classical dance form. The Tangkhuls, with their vibrant festivals like Lui-Ngai-Ni, celebrate life and nature. The Kukis, known for their skilled craftsmanship and rich folklore, add a unique thread to the cultural tapestry of Manipur. The Meiteis of Manipur are known for their love of dance and theater. Their classical Manipuri dance is a graceful and expressive art form, and their colorful festivals like Lai Haraoba and Yaoshang are a visual treat [14].

Fig. 7: Kukis of Manipur.

Source: https://www.indianetzone.com/tribes_manipur

7. Tripura: Home to the Tripuris, Reang, and Chakmas

Tripura, the land of ancient temples and serene lakes, is home to the Tripuris, known for their rich folklore and vibrant festivals like Hojagiri. The Reang tribe, with their colorful attire and energetic dances, add a unique flavor to the region's cultural landscape. The Chakmas, with their love for music and storytelling, celebrate their heritage through festivals like Chakma Rangdania [15].

Fig. 8: Tripura People

Sources: https://www.tripuraonline.in/guide/tribes-of-tripura

This is just a glimpse of the incredible diversity that North East India has to offer. Each ethnic group brings its own unique flavor to the region, creating a cultural mosaic that is both vibrant and harmonious.

Beyond the major groups, there are countless smaller communities, each with its own story to tell. From the Apatani tribe of Arunachal Pradesh with their distinctive facial tattoos to the Dimasa Kacharis of Assam known for their headhunting past, the region is a treasure trove of cultural riches.

The ethnic diversity of North East India is not just a source of pride for the region, but also a valuable asset for the entire country. It is a reminder of the power of tolerance and understanding, and it serves as a bridge between different cultures and traditions.

3. POLITICS OF INCLUSION IN NORTH EAST INDIA

The "Politics of Inclusion" in North East India refers to the complex interplay of policies, governance structures, and societal dynamics aimed at integrating diverse ethnic communities within the broader framework of the Indian nation-state [16]. This region, comprising eight states with a multitude of indigenous tribes and ethnic groups, has been historically characterized by unique cultural, linguistic, and social identities. The politics of inclusion strives to address historical grievances, empower marginalized communities, and foster a sense of belonging within the diverse tapestry of North East India [17].

One of the key aspects of the politics of inclusion is the recognition and accommodation of the unique identities and aspirations of various ethnic groups. The region has witnessed movements seeking autonomy and self-determination, driven by the desire to preserve cultural heritage and address historical injustices. In response, political frameworks and administrative structures have been developed to provide a degree of autonomy to these communities, allowing them to govern specific aspects of their affairs. Autonomous councils and special provisions have been established to safeguard the interests of tribal communities in areas such as land ownership, cultural preservation, and representation in governance. However, the effectiveness of these measures is often debated, and challenges persist in achieving meaningful inclusion that addresses the multifaceted needs of the diverse communities.

The politics of inclusion also extends to addressing socio-economic disparities. Economic development initiatives, educational opportunities, and infrastructural projects are designed to uplift marginalized communities and bridge the gap between different sections of society. However, the implementation of these initiatives faces challenges such as uneven distribution, resource allocation, and the impact of large-scale development projects on indigenous communities and their traditional ways of life. Inclusive governance involves the participation of diverse communities in decision-making processes. The representation of ethnic groups in political bodies, administrative roles, and policy formulation is crucial for ensuring that their voices are heard and their interests are considered. However, achieving equitable representation poses challenges, and

the region has seen instances of political instability and resistance against what some perceive as dominant and exclusionary politics.

Cultural diversity is a hallmark of North East India, and the politics of inclusion recognizes the importance of preserving and promoting this diversity [18]. Efforts are made to celebrate indigenous languages, traditions, and festivals, fostering an environment where various cultural identities coexist harmoniously. Additionally, policies aim to protect the rights of indigenous communities over their ancestral lands and natural resources. While the politics of inclusion in North East India has made strides in addressing historical injustices and recognizing the unique identities of its diverse communities, it remains an ongoing and complex process. Striking a balance between autonomy and integration, economic development and cultural preservation, and ensuring equitable representation pose ongoing challenges. The effectiveness of inclusive policies is contingent on continuous dialogue, adaptive governance structures, and a commitment to addressing the evolving needs and aspirations of the region's diverse population.

4. TRIBAL COMMUNITIES IN NORTH EAST INDIA

The term is commonly associated in popular culture with individuals who live in remote areas away from the majority of people. An indigenous, homogenous unit, speaking a common language, claiming a common lineage dwelling in a certain geographical area, backward in technology, pre-literate, loyally preserving social and political norms based on kinship. That was the 1962 definition of a tribe given in the Shillong consolation of tribals. The word "Indigenous people" is substituted by "tribe" in International Circles by the United Nations Organisation (UNO). Indian tribals have long sought recognition as "Indigenous people," but the country's government has so far refused. Politicians and anthropologists in India are concerned that the word adivasi can lead to privilege claims and undermine efforts to promote racial and ethnic harmony.

With over 150 distinct tribal clans, northeastern India is home to a vast array of indigenous peoples. The northeastern tribe's people make up about 15% of India's overall tribal population, as reported in the 2001 census [19]. There is a significant tribal population in Assam (12.4% of the total population), Manipur (34.2%), and Tripura (31.1%), but this percentage is lower in India as a whole. Arunachal Pradesh, Meghalaya, Mizoram, and Nagaland also have disproportionately large tribal populations [20].

Table 1: Major Tribal Communities in North East India

State	Major Tribal Communities
Assam	Bodos, Karbis, Ahoms, Rabhas
Nagaland	Angamis, Ao, Sema, Zeliang
Mizoram	Mizo (Lusei, Hmar, Mara)
Meghalaya	Khasis, Garos
Arunachal Pradesh	Nyishi, Adi, Apatani, Galo
Manipur	Meiteis, Nagas, Kukis
Tripura	Tripuris, Jamatias, Reangs
Sikkim	Bhutias, Lepchas, Limbus, Tamangs, Sherpas

5. RELATED WORKS

Riamei et al. (2023) [21] examined India's ethnic diversity & the politics of inclusion. This study highlights the difficulty of embracing diversity while maintaining traditional traditions. The study explores inclusive policies' challenges and limitations for racially and ethnically diverse populations. This study examines the benefits and drawbacks of diversity as well as initiatives and legislation in North East India aimed at promoting it.

Deka et al. (2021) [22] examined traditional Ahom medicine in the Indian state of Assam. This study centres on the Ahom people and their extensive historical practice of utilising flora for medicinal purposes. The cultural significance and traditional Ahom medicine are also examined in the research. This research emphasises the significance of Ahom traditional medicine and its potential for promotion and preservation in order to improve the Ahom people's health and well-being.

Debbarma et al. (2020) [23] focused on the importance of overlooked veggies to the native inhabitants of Northeast India's Tripura region. According to this study, vegetables that are often overlooked are very healthy and help ensure the tribe's food security. The study also explores the customs and knowledge that have been passed down through the tribal society's generations with reference to the use of these plants. It is imperative for the health and well-being of the native population to increase the production and consumption of these unappreciated vegetables.

Singh et al. (2018) [24] focused primarily on the traditional processed meals of the indigenous peoples of the western hill states of India, including Manipur. This study demonstrates the nutritional value and significance of traditional processed foods in the diets of various ethnic cultures. The inquiry also addresses the traditional ways of food preparation and preservation used by the ethnic tribes. The study emphasises how important it is to preserve and promote ethnic tribes' traditional process foods for the sake of community health and wellness.

Dewri et al (2018) [25] examined the new issues brought forth by tribal ethnic nationalism in Assam. The political and historical context of Assamese tribal ethnic nationalism is examined in this paper along with its causes and circumstances. Furthermore, the study explores the challenges that indigenous groups face in defending their identity and rights. The research emphasises that inclusive policies and activities are crucial to resolving the problems that Assamese tribal people and other ethnic groups confront.

6. CHALLENGES TO INCLUSION POLITICS IN NORTH EAST INDIA

In North East India, despite efforts towards inclusive politics, several challenges persist, hindering the effective implementation of inclusion policies. The challenges to inclusion politics in North East India are multifaceted and deeply rooted in the region's complex socio-cultural and historical context. One significant challenge lies in the diverse ethnic tapestry of the North East, where numerous tribes and communities coexist. While efforts have been made to implement inclusive policies, balancing the aspirations of different ethnic groups within a federal structure poses a considerable challenge. Autonomy frameworks designed to empower local communities sometimes face resistance, as various tribes seek different degrees of self-governance, leading to intricate negotiations and occasional tensions.

Historical grievances and identity-based movements further complicate inclusion politics. Some ethnic groups have longstanding demands for autonomy or even separate states, driven by a desire to preserve their cultural heritage and address perceived marginalization. The Mizo movement, for example, and the demand for a Bodoland state in Assam exemplify the persistent challenges arising from historical grievances and aspirations for political autonomy. Economic disparities and developmental challenges also hinder inclusive politics. Despite efforts to promote economic development in the region, disparities persist, with certain areas facing infrastructural gaps and limited access to opportunities. Ensuring that development reaches all sections of society, including marginalized tribal communities, requires sustained efforts and strategic planning.

The presence of armed insurgent groups adds another layer of complexity. Insurgencies, rooted in historical, socio-economic, and identity-related issues, pose a significant obstacle to inclusive governance. The security situation in parts of the North East creates challenges for effective policy implementation and hampers the establishment of stable political structures. Moreover, the intricate demographic composition of the North East, coupled with porous international borders, raises concerns related to migration and citizenship. The issue of illegal immigration, particularly in Assam, has fueled tensions and shaped political narratives, impacting the delicate balance of inclusion politics. The dynamics of inclusion politics are also influenced by external factors. The region's geopolitical significance and proximity to neighboring countries contribute to a complex geopolitical landscape. External influences and cross-border dynamics can influence the internal affairs of the North East, posing challenges to the formulation and execution of inclusive policies.

7. BENEFITS AND DRAWBACKS OF DIVERSITY IN NORTH EAST INDIA

Benefits:

1. **Cultural Richness:** The diverse ethnic groups contribute to a vibrant tapestry of cultures, traditions, and languages, fostering a unique and rich cultural heritage.

2. **Traditional Knowledge:** Each community brings unique traditional knowledge, passed down through generations, contributing to a wealth of wisdom in various fields such as agriculture, herbal medicine, and craftsmanship.

3. **Ecological Harmony:** Indigenous practices, deeply rooted in the diverse cultures, often promote sustainable coexistence with the region's ecosystems, contributing to ecological conservation.

4. **Social Resilience:** The varied ethnicities provide a strong social fabric, and communities often exhibit resilience in the face of challenges, drawing strength from their cultural bonds and shared histories.

5. **Tourist Attractions:** The cultural diversity in the North East becomes a significant attraction for tourists, offering a plethora of festivals, traditional performances, and unique experiences.

Drawbacks:

1. **Ethnic Tensions:** Historical grievances and identity-based movements can lead to inter-tribal tensions, creating challenges for social cohesion and stability.

2. **Insurgent Challenges:** Presence of insurgent groups, rooted in historical, socio-economic, and identity-related issues, hampers stability and effective governance in certain regions.

3. **Economic Disparities:** Despite development efforts, some areas face persistent developmental gaps, leading to disparities in access to opportunities and resources.

4. **Migration Issues:** Concerns about illegal immigration and demographic changes contribute to social and political complexities, sometimes leading to tensions between communities.

5. **External Influences:** Geopolitical factors and the proximity to international borders introduce external dynamics, influencing internal affairs and occasionally impacting regional stability.

CONCLUSION

In conclusion, the intricate relationship between ethnic diversity and inclusion politics among North East India's tribal communities reflects a complex tapestry shaped by historical, cultural, and socio-economic factors. The region's ethnic richness contributes to a vibrant mosaic of traditions and knowledge, fostering a unique cultural heritage. However, the path to inclusive governance faces challenges arising from historical grievances, insurgencies, economic disparities, and external influences. Striking a delicate balance between preserving cultural identities and fostering a united socio-political framework is crucial for the region's sustainable development. The journey toward inclusive politics in North East India necessitates adaptive policies that consider the nuanced aspirations of diverse communities, ensuring equitable representation and addressing the multifaceted challenges embedded in the region's socio-political landscape.

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SMART SOLUTIONS: THE ROLE OF AI IN E-COMMERCE CUSTOMER GRIEVANCE HANDLING

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ABSTRACT

The adoption of Artificial Intelligence (AI) in e-commerce grievance redressal mechanisms has brought about a significant shift in customer service by improving efficiency, customization, and the accuracy of issue resolution. Cutting-edge AI technologies—such as Natural Language Processing (NLP), machine learning, and predictive analytics—are being increasingly utilized to streamline complaint management, deliver instant assistance, and identify recurring customer concerns. AI-driven solutions like chatbots, virtual agents, and sentiment analysis tools enable organizations to provide timely, data-backed, and customer-oriented responses. These advancements not only enhance user satisfaction but also lower operational expenditures and build consumer trust through secure and transparent complaint resolution systems. This study explores the impact of AI in addressing the challenges linked to resolving complaints in online retail, emphasizing its capacity to transform digital customer service.

Keywords: *Artificial Intelligence, complaint resolution, e-commerce, online retail, machine learning, customer satisfaction, predictive analytics, customer-focused systems.*

1. INTRODUCTION

The exponential growth of e-commerce has revolutionized the global retail industry, offering consumers unmatched convenience and a wide selection of products. However, this rapid expansion has also introduced significant challenges, particularly in effectively addressing customer grievances. Common problems such as delivery delays, damaged or incorrect items, and slow refund processes frequently lead to customer dissatisfaction, undermining trust in online platforms. Ensuring prompt and efficient resolution of these issues is vital for maintaining customer loyalty and sustaining business growth.

Conventional grievance redressal methods—such as call centers, email support, and manual service desks—often fail to meet modern customer expectations. These systems tend to be slow, resource-intensive, and lack the scalability required to handle increasing volumes of customer complaints, especially during high-traffic periods like festive seasons or major sales events. This results in not only customer frustration but also increased operational costs and inefficiencies for businesses.

Given the limitations of traditional grievance-handling mechanisms—especially their dependence on human agents and inability to process large datasets—there is a pressing need for innovative, scalable, and data-driven solutions. In this context, Artificial Intelligence (AI) has emerged as a transformative force capable of reshaping customer service in e-commerce.

AI technologies, powered by advancements in Natural Language Processing (NLP), machine learning, and predictive analytics, offer powerful tools for automating and enhancing grievance resolution processes. From handling routine queries through chatbots to providing real-time, personalized support, AI-driven systems improve both the speed and accuracy of customer service operations.

This paper examines the application of AI in online shopping grievance redressal systems, highlighting its potential benefits, practical uses, and associated challenges. It aims to present a comprehensive overview of how AI is redefining the customer support landscape in e-commerce by making it more efficient, responsive, and customer-focused.

Furthermore, AI enables companies to analyze vast volumes of customer feedback and behavioural data, offering valuable insights that facilitate proactive issue resolution. Techniques such as sentiment analysis help in assessing customer emotions, allowing for better prioritization of complaints and optimized allocation of support resources. These AI-driven capabilities not only enhance the overall grievance-handling process but also play a critical role in fostering improved customer satisfaction and long-term loyalty.

2. ROLE OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) has become a game-changer in modern customer service, especially in the area of grievance management on online platforms. By leveraging advanced algorithms and intelligent systems, AI enables businesses to streamline and enhance their complaint resolution processes. Through the automation of

routine tasks and the real-time analysis of vast volumes of customer data, AI not only accelerates the grievance redressal process but also increases its accuracy and efficiency.

Key AI technologies such as chatbots, natural language processing (NLP), and predictive analytics play a vital role in transforming the way companies handle customer issues. Chatbots, for instance, are capable of providing instant responses to customer queries, offering 24/7 support without the need for human intervention. NLP allows systems to understand, interpret, and respond to customer complaints expressed in natural language, thereby making communication more intuitive and user-friendly. Predictive analytics helps identify trends and recurring problems by analyzing historical data, allowing companies to address potential issues before they escalate into formal complaints.

Furthermore, AI systems continuously improve through machine learning, enabling them to adapt to new customer behaviour patterns over time. This adaptability empowers businesses to adopt a proactive approach to grievance management, where potential dissatisfaction is mitigated before it manifests. Such foresight not only enhances customer satisfaction but also contributes to operational excellence and brand loyalty.

In an increasingly competitive digital marketplace, the integration of AI into customer grievance redressal mechanisms offers a strategic advantage. It empowers organizations to deliver more personalized, efficient, and responsive customer service, ultimately strengthening customer trust and improving overall business performance.

3. LITERATURE REVIEW
Several studies highlight the role of AI in streamlining online shopping grievance management through automation, personalization, and predictive analysis. Key areas of impact include customer support, dispute resolution, fraud detection, and feedback analysis.

1. AI-Powered Chatbots in Customer Grievance Handling
AI chatbots play a pivotal role in improving grievance resolution processes by providing real-time support to customers.

Literature Insights:
- **Xu et al. (2020)** emphasize that AI chatbots powered by Natural Language Processing (NLP) can resolve up to 80% of common grievances without human intervention. Chatbots facilitate immediate response, reducing customer wait times.

- **Sharma and Bansal (2021)** underline the importance of personalization in chatbot interactions. AI-driven chatbots analyze user behavior to provide customized solutions, thus improving customer satisfaction.

2. Sentiment Analysis and Predictive Modeling

AI techniques, such as sentiment analysis, enable e-commerce platforms to identify customer emotions from reviews, complaints, and feedback.

Literature Insights:
- **Aggarwal et al. (2019)** note that AI-powered sentiment analysis tools can categorize grievances based on urgency and complexity, ensuring prioritized handling.

- **Wang et al. (2022)** discuss how predictive modeling can forecast potential grievances by analyzing past customer interactions, helping companies proactively address issues.

3. Fraud Detection and Resolution
AI has proven effective in identifying and mitigating fraudulent transactions and disputes.

Literature Insights:
- **Lee and Kim (2018)** show that machine learning algorithms detect anomalies in transaction patterns, preventing fraud-related grievances.

- **Kumar et al. (2020)** found that AI improves the accuracy of fraud detection systems, thereby reducing disputes stemming from fraudulent activities.

4. Integration of AI with Human Support
While AI provides significant automation, the integration of AI systems with human intervention is essential for complex grievance handling.

Literature Insights:

➢ **Davenport and Ronanki (2018)** argue that AI and human collaboration enhance problem-solving for grievances requiring nuanced understanding.

➢ **Thomas et al. (2022)** emphasize that hybrid system where AI assists customer support agents lead to higher resolution accuracy and faster response times.

5. Ethical Considerations in AI Grievance Handling

AI systems in grievance mechanisms must ensure transparency, fairness, and data privacy.

Literature Insights:

➢ **Smith and Johnson (2020)** highlight concerns regarding AI bias, which may lead to unfair grievance resolutions.

➢ **Rao and Patel (2022)** stress the importance of ethical AI practices, including explain ability and adherence to data protection regulations.

4. OBJECTIVES OF THE STUDY

The key objectives of this research are:

1. To explore AI's applications in online shopping grievance handling.

2. To evaluate the impact of AI on customer satisfaction and operational efficiency.

3. To identify the challenges and limitations of AI-based grievance systems.

4. To propose recommendations for the ethical and effective use of AI in grievance handling.

5. RESEARCH METHODOLOGY

5.1 Research Design: The study adopts a descriptive and exploratory research design to understand the applications and impacts of AI in grievance handling within e-commerce platforms.

5.2 Data Collection Methods:

- **Primary Data:** Collected through a structured questionnaire distributed to online shoppers and customer service professionals in e-commerce companies.

- **Secondary Data:** Sourced from academic journals, company reports, articles, and case studies related to AI applications in e-commerce.

5.3 Sample Size and Sampling Technique:

- **Sample Size:** 200 respondents

- **Sampling Technique:** Stratified random sampling to ensure diverse representation from customers of various e-commerce platforms like Amazon, Flipkart, Myntra, etc.

5.4 Statistical Techniques Used:

- Descriptive statistics (mean, percentage)

- Cross-tabulation

- Chi-square test

- Correlation analysis

5.5 Hypotheses of the Study:

H1: There is a significant relationship between the use of AI-based tools and customer satisfaction in grievance redressal.

H2: AI improves operational efficiency in grievance handling processes.

H3: There are identifiable limitations in the current AI grievance systems used in e-commerce.

6. ANALYSIS AND INTERPRETATION OF DATA

Objective 1: To Explore AI's Applications in Online Shopping Grievance Handling

Table 1: Awareness of AI Tools in E-Commerce Grievance Handling (N=200)

AI Tool	Aware (%)	Not Aware (%)
Chatbots	90%	10%
Virtual Agents	85%	15%
Natural Language Processing (NLP)	60%	40%
Predictive Analytics	55%	45%
Sentiment Analysis	50%	50%

Interpretation: High awareness of AI tools like chatbots and virtual agents among customers indicates widespread adoption at the user interface level. However, deeper tools like NLP and sentiment analysis show moderate awareness, highlighting scope for expansion.

Table 2: Usage of AI-Based Grievance Tools

Tool Used	Frequency	Sometimes	Rarely	Never
Chatbots	55%	25%	10%	10%
Virtual Agents	40%	30%	15%	15%
NLP-based Text Assistant	20%	25%	30%	25%

Interpretation: Chatbots are the most frequently used AI tool, while NLP assistants are still emerging, indicating a technology adoption curve.

Objective 2: To Evaluate the Impact of AI on Customer Satisfaction and Operational Efficiency

Table 3: Customer Satisfaction Level (N=200)

Level of Satisfaction	Respondents	Percentage
Highly Satisfied	40	20%
Satisfied	100	50%
Neutral	30	15%
Dissatisfied	20	10%
Highly Dissatisfied	10	5%

Interpretation: 70% of respondents reported being satisfied or highly satisfied with AI-based grievance resolution services, indicating effective implementation.

Table 4: Response Time for Grievance Resolution

Response Time	Before AI (%)	After AI (%)
Less than 1 hour	5%	35%
1-24 hours	25%	45%
1-3 days	45%	15%
More than 3 days	25%	5%

Interpretation: A marked shift toward quicker resolution times is observed post-AI adoption.

Table 5: Employee Opinion on AI Efficiency

Statement	Agree (%)	Neutral (%)	Disagree (%)
AI reduces workload	80%	10%	10%
AI enhances accuracy in Complaint Handling	75%	15%	10%
AI improves customer feedback management	70%	20%	10%

Interpretation: Employees largely acknowledge the efficiency improvements brought by AI tools.

Objective 3: To Identify the Challenges and Limitations of AI-based Grievance Systems

Table 6: Challenges Faced by Customers

Challenge	% of Respondents
Inability to Solve Complex Issues	45%
Robotic Responses	40%
Lack of Human Touch	50%
Language Barriers	30%
Privacy Concerns	35%

Interpretation: While AI is effective, limitations in handling emotional intelligence and complex queries are clear.

Objective 4: To Propose Recommendations for the Ethical and Effective use of AI in Grievance Handling

Table 7: Suggestions from Respondents

Suggestion	% of Respondents
Hybrid AI + Human Approach	60%
Improved Multilingual Support	40%
Better Training of AI Models	45%
Increased Transparency and Data Protection	35%

Interpretation: Respondents favour hybrid models and better personalization to address current AI limitations.

Statistical Analysis of Hypotheses

Hypothesis 1 (H1): AI Usage Improves Customer Satisfaction

Table 8: Chi-Square Test - AI Tool Usage vs. Satisfaction

Value	Result
Chi-Square	16.74
Degree of Freedom	4
p-value	0.002 (<0.05)

Interpretation: Significant relationship found. H1 is accepted. AI use positively impacts customer satisfaction.

Hypothesis 2 (H2): AI Improves Operational Efficiency

Table 9: Correlation between AI Use and Efficiency Scores (Likert Scale)

Variables	Correlation (r)
All Usage Frequency vs. Efficiency	0.72

Interpretation: Strong positive correlation found. H2 is accepted.

Hypothesis 3 (H3): AI Grievance Systems Face Limitations

Table 10: Perceived Limitations in AI Systems

Limitation Acknowledged	% Respondents
Yes	68%
No	32%

Interpretation: A majority accept AI's limitations. H3 is partially accepted.

7. FINDINGS AND SUGGESTIONS

7.1 Main Findings

1. Widespread Awareness of AI Tools:
- A large percentage of respondents are aware of common AI tools like chatbots (90%) and virtual agents (85%).

- Awareness of more advanced tools such as NLP (60%) and predictive analytics (55%) is comparatively lower, showing potential areas for further digital literacy and integration.

2. Frequent Use of AI in Grievance Handling:
- 55% of users reported frequent use of chatbots for resolving grievances.

- Usage of NLP-based assistants is still developing, indicating that more user-friendly and accessible interfaces are needed.

3. Positive Impact on Customer Satisfaction:
- 70% of respondents are either satisfied or highly satisfied with AI-based grievance systems.

- This shows that AI integration significantly improves customer experience by reducing wait times and offering quick solutions.

4. Reduction in Complaint Resolution Time:
- After implementing AI, the proportion of grievances resolved in less than 24 hours increased from 30% to 80%, marking a substantial improvement in operational efficiency.

5. Employees Recognize AI Benefits:
- 80% of employees agreed that AI reduces their workload.

- 75% believed that AI enhances the accuracy of complaint handling, and 70% acknowledged improvement in customer feedback management.

6. AI System Limitations Identified:

- 50% of users pointed out the lack of human touch, while 45% mentioned AI's inability to handle complex issues.

- 30–35% highlighted language barriers and privacy concerns.

7. Hypotheses Supported by Statistical Tests:

- Hypothesis 1 (AI improves customer satisfaction): Supported through chi-square analysis ($p < 0.05$).

- Hypothesis 2 (AI improves operational efficiency): Strong correlation ($r = 0.72$) found.

- Hypothesis 3 (AI grievance systems face limitations): Acknowledged by 68% of respondents.

7.2 Suggestions

1. Adopt a Hybrid AI-Human Approach:

- A mixed model combining AI with human support is recommended to handle complex queries and provide empathetic service, as 60% of respondents suggested.

2. Increase Investment in AI Training and Development:

- Improve the quality of AI models with updated datasets and better learning algorithms to reduce robotic or irrelevant responses.

3. Enhance Language and Regional Support:

- AI systems should be trained in multiple Indian languages and adapted to cultural nuances to widen accessibility and user satisfaction.

4. Improve Transparency and Data Security:

- Address privacy concerns by building secure, transparent AI systems that clearly communicate how customer data is handled.

5. Educate Consumers About AI Features:

- Increase digital awareness campaigns to help users understand how to interact effectively with AI-based grievance platforms.

8. CONCLUSION

The integration of Artificial Intelligence (AI) in e-commerce customer grievance handling has emerged as a transformative solution in today's digital landscape. This study clearly demonstrates that AI-driven tools—such as chatbots, natural language processing (NLP), and predictive analytics—have significantly enhanced the efficiency, speed, and accuracy of complaint resolution mechanisms. The research findings confirm that AI not only reduces operational workload and costs but also improves customer satisfaction by providing timely and personalized support.

The data analysis reveals that a majority of users are aware of and satisfied with AI-enabled grievance systems, particularly for handling routine queries. However, the study also highlights key limitations, including the lack of emotional understanding, language barriers, and concerns regarding data security. These challenges indicate that while AI is a powerful enabler, it cannot completely replace human intervention in complex and sensitive grievance scenarios.

The study concludes that a balanced, hybrid model—combining AI capabilities with human oversight—offers the most effective strategy for customer grievance management in e-commerce. Moreover, continuous innovation, ethical deployment, and customer education will be essential to maximize the benefits of AI while addressing its limitations. As technology evolves, businesses that strategically integrate AI into their service frameworks are likely to achieve higher customer loyalty, operational excellence, and a competitive edge in the digital marketplace.

However, challenges such as data privacy, algorithmic bias, and customer resistance must be carefully managed. The future of AI in grievance handling lies in more sophisticated technologies like emotional AI, hybrid human-AI systems, and the integration of blockchain for transparent grievance resolution.

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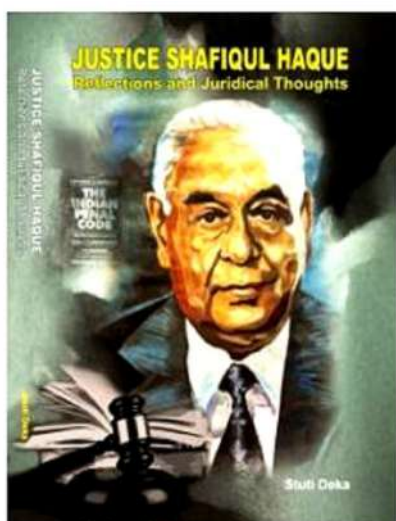
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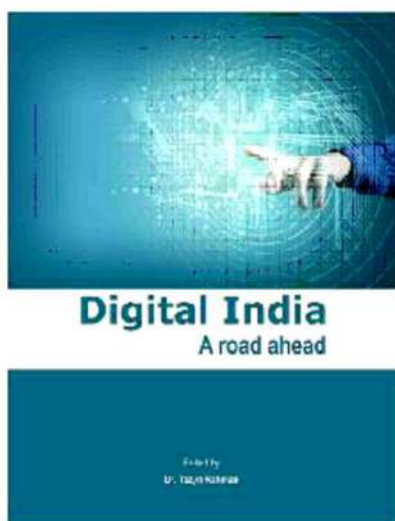
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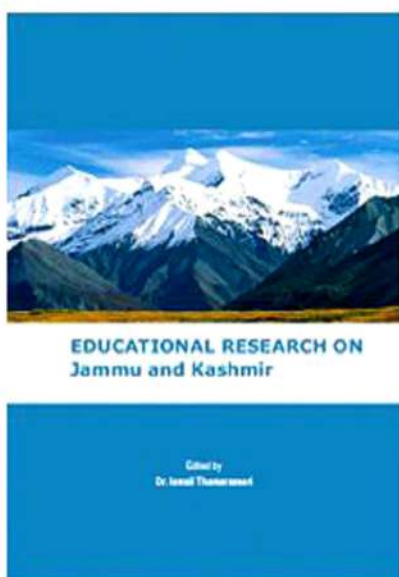
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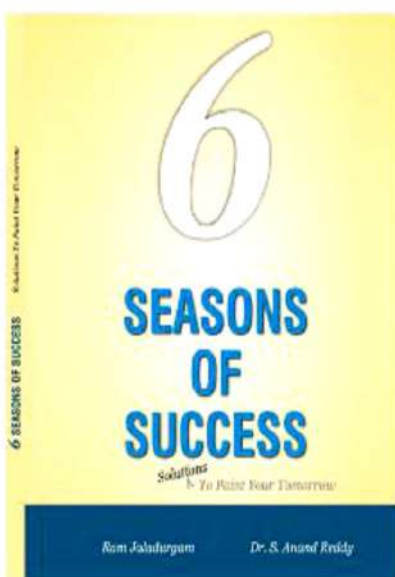
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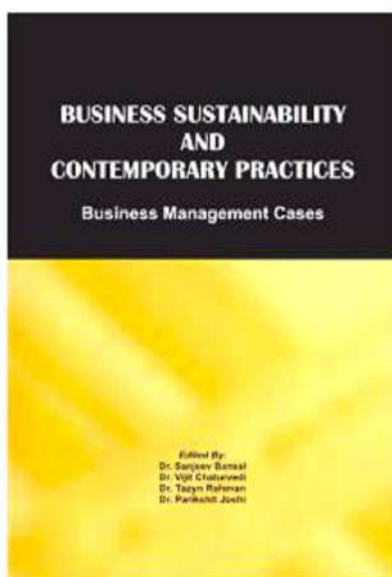
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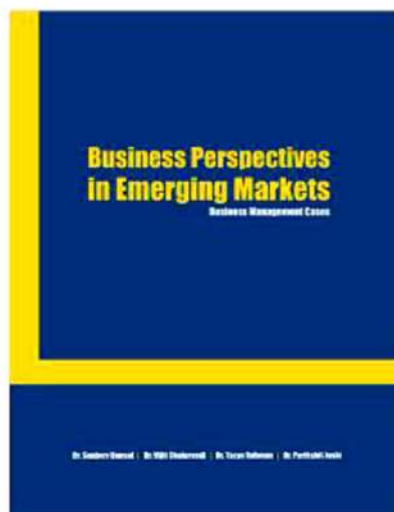
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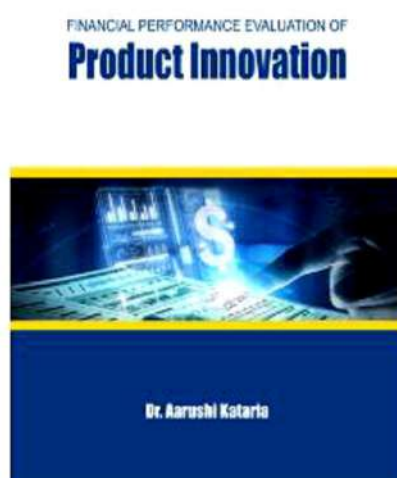
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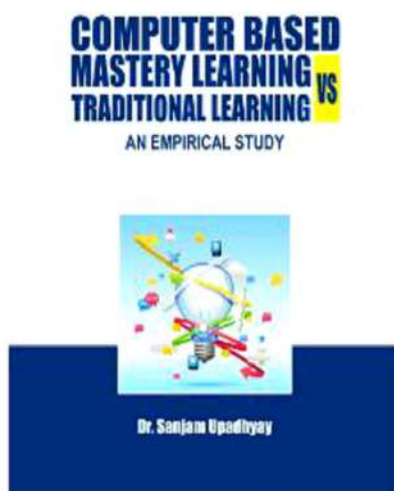
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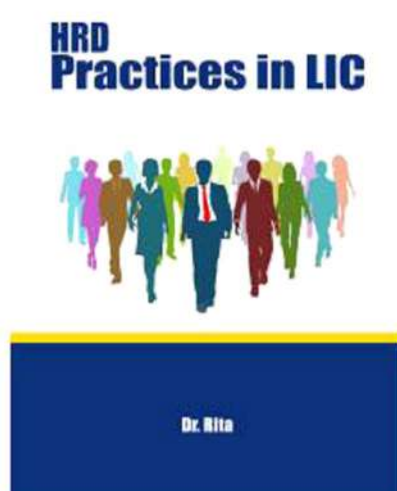
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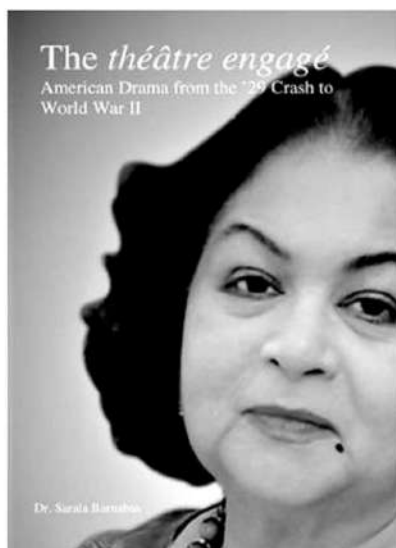
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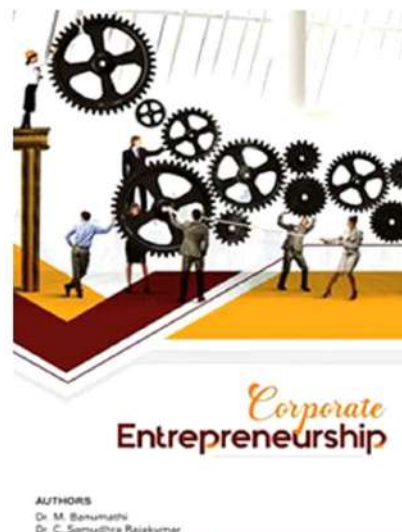
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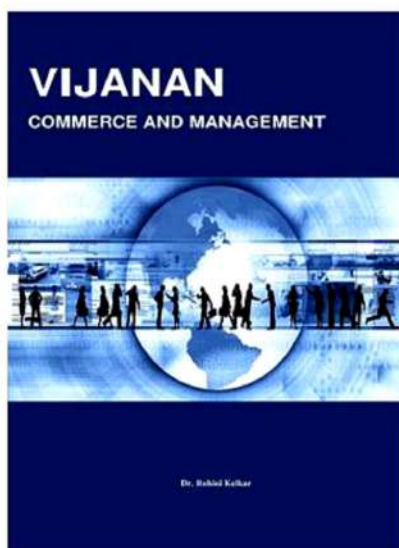
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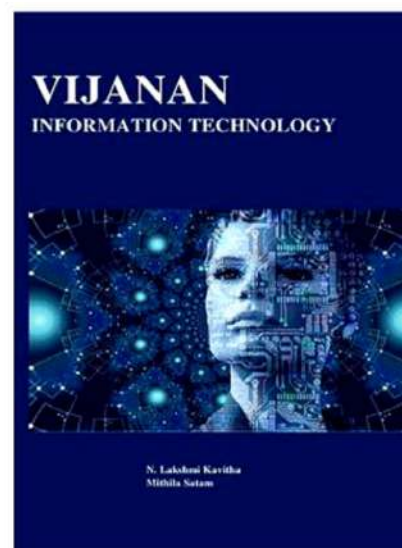
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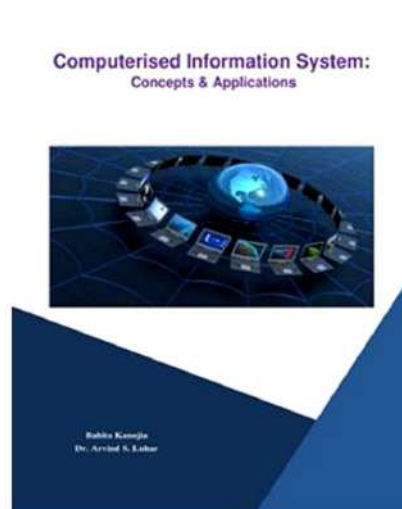
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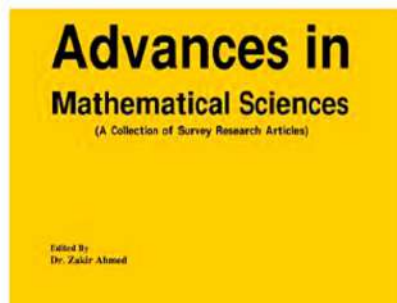
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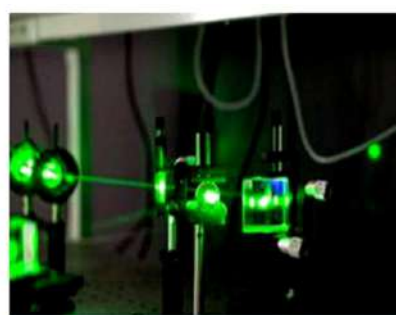
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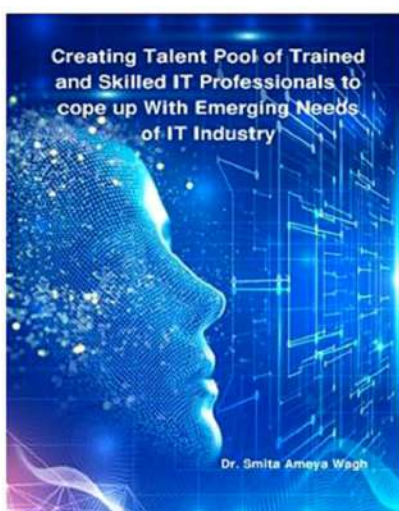
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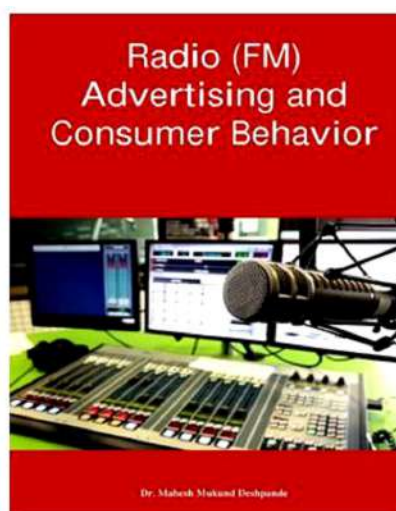
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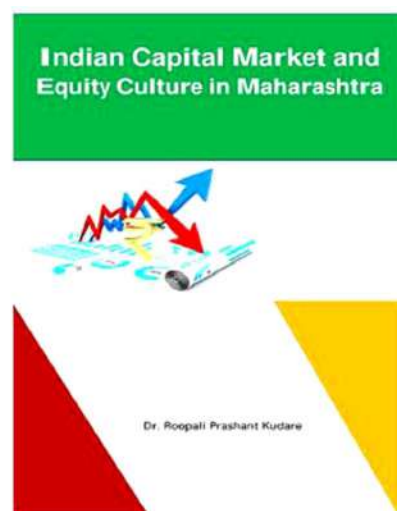
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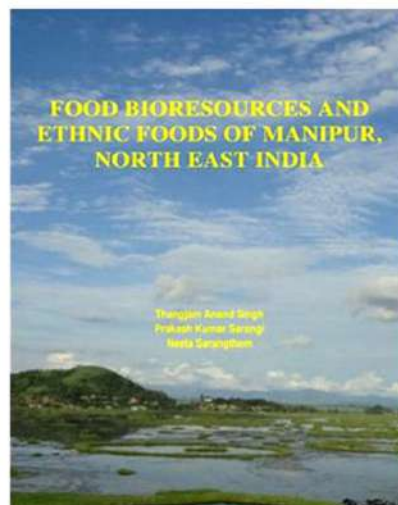
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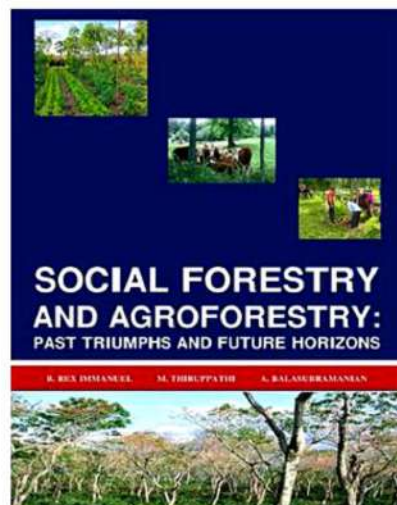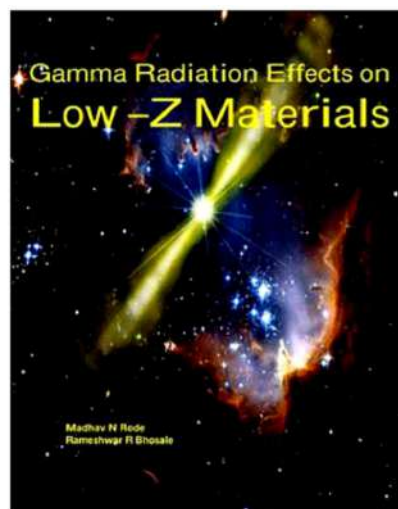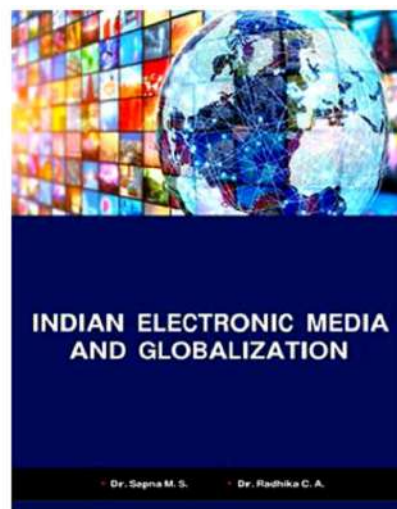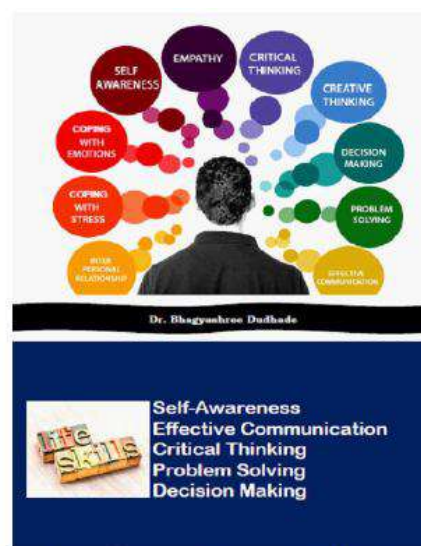
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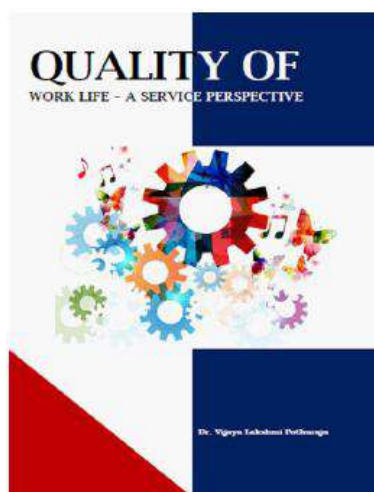
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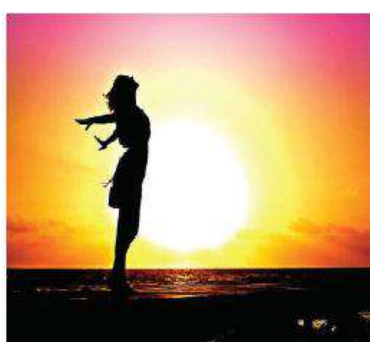
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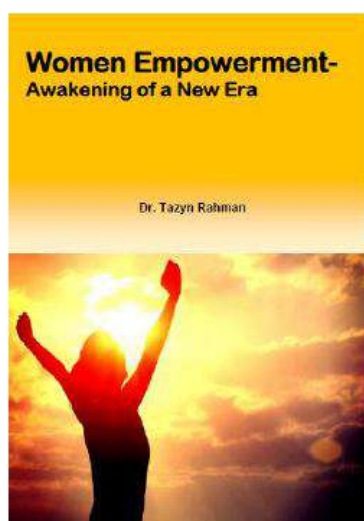
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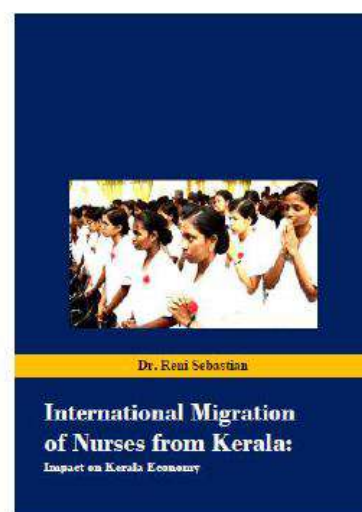
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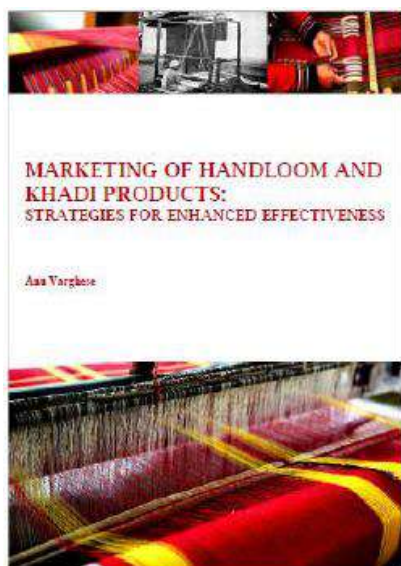
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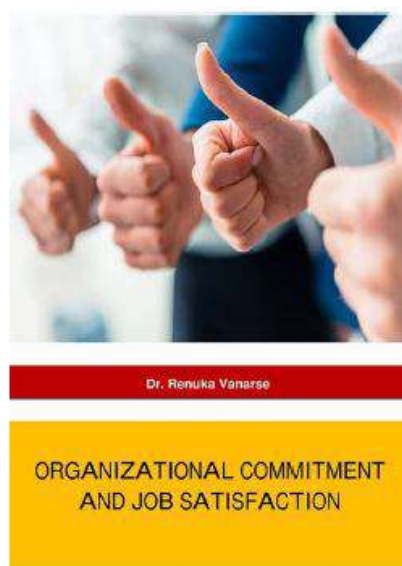**Dr. Vijay Prakash Gupta**
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