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CONTENTS

CSR Initiatives and Financial Performance: A Study of top Indian Banks

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ABSTRACT
Purpose– The purpose of this research is to study the CSR initiatives and expenditure incurred by the top Indian banks (based on market capitalization). Further, this research study examines whether these initiatives translate into improved financial performance (in terms of Tobin's Q and ROA) in the Indian Banking sector.
Design/methodology/approach– Top eight Indian banks (based on market capitalization) listed on the National Stock Exchange (NSE) as on 31st March, 2023 were selected for the study. The CSR initiatives, expenditure, and the performance of these banks have been evaluated.
Findings– The study evaluates the CSR initiatives of various Indian banks to discover that most initiatives are concentrated in the areas of education, healthcare, environment, and rural development. Further, on the basis of ROA and Tobin's Q it is concluded that private sector banks outperform public sector banks because they contribute a greater portion of their profits towards CSR initiatives.
Research limitations– The study uses data only of the Indian Banking sector, which can restrict the generalization of the results of the study.
Originality/value– The study provides deep insights into the intricacies of CSR. This study contributes in terms of adding a novelty to the past studies by analyzing the association between CSR expenditure and financial performance, while simultaneously providing a comparison between the public sector and private sector banks.
Keywords: CSR expenditure, CSR initiatives, Corporate social responsibility, financial performance, banking industry.

1. INTRODUCTION:

CSR has been defined by the Business dictionary as "A company's sense of responsibility towards the community and environment (both ecological and social) in which it operates." In order to flourish in the long run, a company cannot merely focus on its profitability, but must also take into consideration its customers, shareholders, employees, the environment, and the society at large (Ramchandani & Arora, 2017). Past research studies have highlighted the contribution of CSR towards the company reputation, stakeholder relationship management, risk mitigation, profitability, and competitiveness.
Global problems associated with climate change, economic change, human rights violation, and poverty have driven corporations to pay greater attention towards societal and environmental issues (Yadava & Sinha, 2016). With such issues gaining importance in most of the countries of the world, India became the first country to make CSR mandatory. This was done via section 135 of the Companies Act, 2013, which makes CSR spending and disclosure compulsory for certain types of companies. While CSR efforts by corporations have been kept

largely voluntary in most countries, with only a few countries making it mandatory for corporations to disclose such activities (Sarkar & Sarkar, 2016).

The existing literature lacks conclusive evidence on the relation between CSR expenditure and the financial performance of the firm. Thus, the scope of the present study is to throw light on the CSR initiatives being adopted in the banking sector of India and to analyse the relationship between CSR expenditure and financial performance, while simultaneously drawing a comparison between public sector and private sector banks in India. This comparison holds a greater importance as the requirement of mandatory contribution towards CSR activities does not apply to public sector banks, thereby allowing an evaluation of the financial performance of firms which are required to mandatorily contribute a portion of their profits towards CSR activities with those firms which are not mandated to do so.

2. STUDY OBJECTIVES:

The present study has the following objectives:

- To study the initiatives taken in the field of CSR by the banking sector of India.
- To compare the CSR initiatives and expenditure of public sector and private sector banks.
- To compare the financial performance of public sector and private sector banks in India.

3. REVIEW OF LITERATURE:

The research work already done in the field of CSR has been summarised in the present section. According to Kotler & Lee (2005), "CSR is the commitment to improve community well-being through discretionary business practices and contribution of economic resources". CSR is thus, concerned with integrating the economic concerns of a company with the environmental and social concerns with the aim of building a better society. Past studies have suggested that Western firms are ahead of Asian firms in the area of CSR practices. However, the entry of MNCs into Asian markets has led to an increased stakeholder awareness and expectations, thereby creating a stronger case for CSR in Asian countries, including India.

Though the enhanced legal provisions related to CSR have been introduced as part of the Companies Act, 2013, the concept is not new to India. Sundar (2000) suggested that CSR evolution in India took place in four phases, beginning from the pre-independence era which was "philanthropic and charity based" to the fourth phase (1980s-present) which adopts an integrated approach, where CSR is viewed as an indispensable part of the company's plan of action and inevitable for firm's survival and growth.

CSR and Financial Performance*:*

Verma & Kumar (2014) conducted a study of thirty companies included in the BSE Sensex (between 2001-2012). The study found that these companies spent less than 1 percent of their profit on CSR activities. This highlighted the need to introduce a mandatory provision in the Companies Act, 2013 as an appropriate step in order to make corporates more socially responsible.

The insertion of this provision has not only led to an increase in the CSR spending, but also resulted in a more progressive CSR approach, where companies aim to implement a broader vision of sustainable development at the corporate level. Further, meeting the mandatory CSR requirements and adopting innovative CSR practices is not only beneficial for the society, but also contributes towards the financial performance of the firm. Positive impact of CSR on financial performance of the companies has been highlighted by various research studies (McGuire et al., 1988; Pava & Krausz, 1996; Orlitzky et al., 2003; Van Beurden & Gössling,

2008). Some recent studies, elaborating on this relationship have been summarised as follows:

Rai & Bansal (2015) conducted a multi-industry study of Indian listed companies for 2012-13. The results suggest a two-way relationship between CSR expenditure and profitability, where an increase in profitability allows companies to spend more on CSR activities, due to availability of additional resources and the adoption of CSR practices enhances the firm reputation, thereby contributing towards profitability in the long-run.

Ramchandani & Arora (2017) studied the banking sector in India and NBFCs in terms of CSR expenditure and its effect on financial performance.

The results established a positive relationship, while also highlighting that private sector banks and NBFCs spent a larger portion on CSR activities and hence portray superior financial performance.

Cho et al. (2019) studied the relationship between CSR, profitability using regression analysis, and firm value (using Tobin's Q). The results highlighted that the CSR activities demonstrate a partially positive impact on the financial performance in the firms listed on the Korena Exchange. Thus, it is inferred that firms must engage in effective CSR activities so as to achieve better financial performance.

Oware & Mallikarjunappa (2020) used regression analysis on 80 firms listed on the Indian stock exchanges between 2010 to 2019, to study the relationship between CSR expenditure and financial performance. The findings indicate that there is a positive correlation between CSR spending and financial performance. Additionally, it points out that the requirement for mandatory CSR reporting plays a moderating role in this relationship.

George et al. (2023) employed panel regression models to studied the relationship between CSR expenditure and financial performance in the Indian banks between 2016 to 2022. The results highlighted that CSR expenditure has a significantly positive impact on profitability, while there is no significant relationship between CSR expenditure and market returns in the Indian Banking sector.

The present study goes a step further to make a comparison between the CSR initiatives and performance of private and public sector banks.

4. RESEARCH METHODOLOGY:

Narwal (2007) highlights the role of banks towards societal development, identifying the concept of "community service banking".

The banking sector is taking increasing interest in influencing the CSR performance by behaving in a responsible way towards the society and has been making greater contributions in diverse areas, along with improved CSR reporting (Sharma & Kiran, 2013).

Thus, the Indian Banking sector has been selected for the purpose of this study.

The top 100 companies (based on market capitalization as on 31st March 2023) listed on the NSE were considered for the study. Out of those, only 10 were banks, however Punjab National Bank and IDBI Bank Ltd. were removed because these banks had incurred huge losses in the previous years.

Therefore, eight banks were selected for this study, which have been specified in Table 1.

The major CSR initiatives of these banks for 2022-23 have been elaborated in the next section of the study.

Further, a comparison of the CSR expenditure and the financial performance of these banks has also been conducted for the financial years 2021-22 and 2022-23. For both these purposes, the study utilizes data from the Business Responsibility Reports and the Annual Reports of these eight banks.

The financial performance has been measured by taking two parameters:

- Return on assets (ROA)
  ROA is calculated by dividing the net income by average total assets of the company. A high ROA indicates that the company is efficiently using its assets to generate income.
- Tobin's Q ratio
  It is measured by dividing total market value of the firm by total asset value. It indicates whether the stock of the firm is overvalued or undervalued, in other words whether the value of firm's stock is equal to the replacement cost of its assets. 1 is the ideal value for Tobin's Q, while a value lower than 1 illustrates that the stocks are undervalued and a value greater than 1 depicts overvalued stocks.

TABLE 1: Banks selected for the study along with their Market Capitalization

BANK	TYPE	MARKET CAPITALIZATION AS ON 31st MARCH, 2023 (in crores)
HDFC Bank Ltd.	Private Sector	898087.50
ICICI Bank Ltd.	Private Sector	612482.50
State Bank of India	Public Sector	467426.55
Kotak Mahindra Bank Ltd.	Private Sector	344231.49
Axis Bank Ltd.	Private Sector	264121.00
Bank of Baroda	Public Sector	87318.45
IndusInd Bank Ltd.	Private Sector	82857.88
Canara Bank	Public Sector	51602.94

Source: NSE website

5. ANALYSIS, FINDINGS & DISCUSSIONS:

Corporate Social Responsibility Initiatives

The top banks under study have been actively involved in CSR activities. Their contribution to the society, encompassing a plethora of social initiatives like education, rural development, environment, sustainability, skill enhancement, healthcare, financial literacy, etc. have been outlined as under:

- **HDFC BANK:**

HDFC is on top of our list as the largest bank in terms of market capitalization. Central to its CSR initiatives is its programme called 'Parivartan' which is an umbrella programme covering various areas of CSR. The bank has a holistic rural development programme (HRDP), which works towards improving the condition of the people of Indian villages by starting programmes for improving productivity of farmland, providing solar power, rain shelters for protected farming and revitalizing the self-help groups (SHG) of the villages to increase income opportunities. In the area of health and hygiene, the bank organizes awareness campaigns, health camps and blood donation drives. For promotion of education, the bank has taken a plethora of skill enhancement initiatives and arranged for teachers' training programmes, striving to create a holistic learning environment, giving scholarships and career guidance. Further, financial literacy workshops are conducted to educate the public about various financial matters and thereby empower them to make smart financial decisions.

- **ICICI BANK:**

The ICICI Bank not far behind HDFC, contributes towards betterment of society through its philanthropic arm the "ICICI Foundation for Inclusive Growth". Its major focus areas are environment, healthcare, livelihood, and community development.
The environmental initiatives include awareness about the harmful effects of stubble burning and suggesting alternative ways to make better use of it, installing solar panels at schools for meeting their electricity needs, wildlife and forest conservation and water harvesting.
In the area of healthcare, it organizes blood donation camps, affordable dialysis support and cancer support through contributions to Tata Memorial Centre (TMC) for cancer treatment. For supporting the livelihood, the foundation undertakes to impart knowledge of climate smart scientific agriculture, providing skill training through ICICI Academy for skills and supporting the lac farmers of Jharkhand.
The community development programmes taken by the bank include development of rural infrastructure like bridges, roads, etc., disaster relief activities and promoting financial literacy by arranging various training sessions focussed on target groups.

- **STATE BANK OF INDIA (SBI):**

Matching up to its reputation of being the bank with the largest network of branches across the country and the largest public sector bank (based on market capitalisation), the State Bank of India has been actively engaged in CSR since over six decades. Its CSR expenditure for the financial year 2023 was INR 316.76 crores, with the majority being spent on healthcare, providing livelihood, and entrepreneurship.
Besides this, SBI contributes towards education, environment, rural development, PwD welfare, women empowerment, and sports among other things. SBI's notable CSR initiatives towards healthcare includes partnering with Indian Institute of Science, Bengaluru to establish a new hospital, supporting TB patients under Pradhan Mantri TB Mukt Bharat Abhiyaan, donating to Vision India Foundation for free eye treatment to patients, and donating electric ambulances.
Working towards women empowerment, the bank contributed to Bhartiya Sankalp Path Foundation for procuring and distributing laptops and sewing machines to women who completed training under Pradhan Mantri Kaushal Vikas Yojana. Further, it donates generously to support armed forces veterans, martyrs, and their dependents and towards Swachh Bharat Abhiyaan.

- **KOTAK MAHINDRA BANK:**

It occupies the fourth place among banks in India in terms of market capitalization for the year 2022-23. It extensively engages in CSR activities in the field of education and livelihood, healthcare, environment, and sports.

It contributes towards education and livelihood through its arm called the Kotak Mahindra Foundation.

The foundation is involved in several socially relevant projects like Umang, Unnati, project LEAD, project Digital learning Solution, collaboration with Khan Academy and many more. In the area of healthcare, it has donated ambulances and medical equipment to hospitals and has also partnered with various NGOs such as the Dhanwantri Medical Trust, Cancer Patients Aid Association, Make a Wish Foundation and many more, for the supply of healthcare services.

In its endeavour towards environmental protection, the bank has partnered with various

organizations like the Environmentalist Foundation of India, DHAN Foundation, Watershed Organization Trust, Centre for Environment Education and Research, etc. It also makes generous donations to the Inspire Institute of Sports and Pullela Gopichand Badminton Foundation, for promoting sports.

- **AXIS BANK:**

Axis Bank strives to achieve its objective of fulfilling its CSR goal through a myriad of concerted efforts and projects in the field of education, sustainable livelihood, financial literacy, inclusion, and environmental sustainability.
It works through its philanthropic vertical called the Axis Bank Foundation (ABF).
The foundation has also partnered with various NGOs to achieve maximum coverage and depth. ABF focuses on rural development through enhanced productivity and watershed management; and empowering women through self-help groups by educating and training them.
Further, it provides loans to farmers for purchasing livestock and educates them through programmes focused on livestock management, veterinary support, vaccination, etc.
The bank also imparts skill development training, with a special focus on differently abled persons to increase their employability and making them self-sufficient.

- **BANK OF BARODA:**

Bank of Baroda contributes to the welfare of society through its efforts in the areas of healthcare, sanitation, digital empowerment, education, skill enhancement, women empowerment, and economic development. Its majority contribution goes to RSETIs (Rural Self-employment Training Institutes) and FLCCs (Financial Literacy and Credit Counselling Centre) which are managed by the bank with cooperation from the government.
Out of the INR 13.5 crore spent on CSR in the year 2022-23, around 85% has been on education and training, followed by expenditure on economic development, healthcare, and women empowerment, in that order.

- **INDUSIND BANK:**

Environmental sustainability and working towards the uplift ment of weaker and marginalized sections of the society, are at the heart of the bank's CSR policy.
Its two-pronged strategy comprises of flagship programmes and strategic projects.
Holistic Rural Development Programme (HRDP) is the flagship programme of IndusInd Bank designed towards empowerment of the rural communities by raising their income levels though management of farm productivity.
Besides this it undertakes various strategic projects focused on environmental sustainability with stress on waste management, afforestation, renewable energy, water management, etc.
Further, the bank contributes towards education through remedial classes, teaching learning for differently abled, scholarships and awards, while also laying stress on sports for women and differently abled.

- **CANARA BANK:**

Canara bank has made its mark in the area of CSR by setting up a number of trusts namely, Canara Centenary Rural Development Trust, Canara Financial Advisory Trust, Canara Golden Jubilee Education Fund, and Canara Relief & Welfare Society.
The bank collaborates with various NGOs and other organizations to focus on areas such as

women empowerment, small & marginal farmers & craftsmen, differently abled people, minority community, scheduled caste and scheduled tribes, victims of natural calamities, etc. It has launched a project for promotion of digital payments in rural areas.
It has established various rural self-employment training Institutes, artisan training institutes and information technology institutes to promote self-employment among rural population.

6. EXPENDITURE ON CSR INITIATIVES:

After having discussed the various initiatives undertaken by the different banks, the focus shifts on the expenditure incurred by these banks on such CSR initiatives.

Table 2 provides the CSR expenditure for these eight banks, in absolute terms and as a percentage of their average net profits for the preceding three financial years.

The trend generally indicates an increase in the CSR expenditure from 2021-22 to 2022-23.

TABLE 2: Comparison of CSR Expenditure

BANK	CSR EXPENDITURE (as a % of average net profits of preceding 3 financial years)		% CHANGE IN AMOUNT SPENT ON CSR
	2021-22 (in crores)	2022-23 (in crores)	
HDFC Bank Ltd.	736.01 (2.01%)	820.89 (1.99%)	11.53%
ICICI Bank Ltd.	266.62 (2.04%)	462.66 (2.31%)	73.53%
State Bank of India	204.1 (1.71%)	316.76 (1.43%)	55.20%
Kotak Mahindra Bank Ltd.	65.94 (0.81%)	94.83 (1.01%)	43.81%
Axis Bank Ltd.	113.37 (1.64%)	172.31 (1.73%)	51.99%
Bank of Baroda	8.29 (1.38%)	13.5 (0.47%)	62.85%
IndusInd Bank Ltd.	108.69 (2.02%)	108.51 (2.00%)	-0.17%
Canara Bank	25.48 (*)	47.51 (*)	86.46%

Source: Annual reports of the companies and author's calculations.

(*) the CSR expenditure for Canara Bank has not been calculated as a percentage of net profits (of preceding 3 financial years) due to loss in FY 2020.

The banks are arranged in chronological sequence of their market capitalization as on 31st March, 2023. As already mentioned, the private sector banks are required to spend 2% of their average net profit for last three years on CSR activities, while there is no such mandatory requirement in case of public sector banks.

Amongst the private banks HDFC Bank, ICICI Bank and IndusInd Bank fulfil this requirement, while Axis Bank and Kotak Mahindra Bank do not. Despite spending less than the mandatory requirements, these two banks still seem to be on the right path as they have increased their CSR expenditure (both in absolute and percentage terms). Moreover, the deficit has been transferred to the unspent CSR account to be utilised in the subsequent years.

State Bank of India is the largest public sector bank (based on market capitalisation), spent a hefty sum of around 317 crores in 2022-23 towards its CSR initiatives, while the CSR expenditure of Bank of Baroda is the lowest in absolute terms. The CSR expenditure for Canara Bank has not been expressed as a percentage of average net profits for the preceding 3 financial years because of heavy losses incurred in FY2020. Though the bank shows an increase in CSR expenditure (in absolute terms), however if seen as a percentage of net profit (for previous

year), it shows a fall from 1% in 2021-22 to 0.83% in 2022-23. No public sector bank spends close to 2% on its CSR initiatives, however SBI emerges as a leader in this category with the highest CSR expenditure (both in absolute and percentage terms).

7. MEASUREMENT OF FINANCIAL PERFORMANCE:

For measuring the financial performance, two parameters: return on assets (ROA) and Tobin's Q ratio have been used. ROA is calculated by dividing the net income by average total assets of the company. Tobin's Q is measured by dividing total market value of the firm by total asset value.

TABLE 3: PERFORMANCE INDICATORS

BANK	2021-22	2022-23	2021-22	2022-23
	ROA (in %)	ROA (in %)	Tobin's Q	Tobin's Q
HDFC Bank Ltd.	2.03	2.07	0.39	0.36
ICICI Bank Ltd.	1.84	2.86	0.36	0.39
State Bank of India	0.67	0.96	0.09	0.08
Kotak Mahindra Bank Ltd.	2.1	2.5	0.81	0.70
Axis Bank Ltd.	0.8	1.21	0.18	0.22
Bank of Baroda	0.6	1.03	0.05	0.06
IndusInd Bank Ltd.	1.28	1.81	0.18	0.18
Canara Bank	0.48	0.81	0.03	0.04

Source: Annual reports of the companies and author's calculations.

Table 3 depicts the two performance indicators. On analyzing the return on assets ratio, it is found that the private sector demonstrates superior results, while the performance of public sector banks remains below par, with SBI being the only exception.

SBI emerged as a leader amongst the public sector banks in terms of its CSR expenditure, demonstrates good results in terms of ROA as well. Moreover, an improvement is seen in the ROA of all banks in the year 2022-23, when compared to 2021-22, with a significant improvement observed in Bank of Baroda and Canara Bank, followed by ICICI Bank and SBI which can be partly attributed to their increased CSR expenditure during this time frame.

The Tobin's Q ratio for all the banks indicates an undervaluation of stocks. The highest ratio is exhibited by Kotak Mahindra Bank for both the years, which is the closest to the ideal ratio of 1, while Canara Bank has the lowest Tobin's Q ratio.

The results highlight a superior performance of private sector banks in this area as well, however not much change has been observed in these ratios between the two years. While the value of Tobin's Q is below 0.1 for all public sector banks, the performance by SBI is still superior compared to the other two public sector banks.

Based on the comparison of these banks using the two parameters, it can be concluded that the private sector banks showcase superior financial performance. This can be majorly attributed to their high CSR expenditure and the robustness of their CSR initiatives. Despite the poor financial performance of public sector banks, a major improvement is observed (in terms of ROA) from 2021-22 to 2022-23, which is in line with their increased CSR expenditure (at least in absolute terms) during this time frame.

8. CONCLUSION:

The idea behind this paper is to study the relationship between the CSR expenditure and financial performance in the Indian Banking sector. The embedded belief is that since the corporate derives its resources from the society and thus, has a responsibility to give back to the society through its CSR activities.

The core CSR initiatives of the Indian Banking sector are focused on the environment, education, healthcare, and rural development (by helping the poor and marginalised communities). In terms of the financial performance, it can be concluded that banks focused on increasing their CSR expenditure and adopting robust CSR initiatives showcase a superior financial performance.

Moreover, the private banks spend a greater portion of their profits on CSR activities, which translates into superior financial performance as compared to the public sector banks. Despite of a comparatively poor performance, the public sector banks still seem to move in the right direction with increased CSR expenditure and improved financial performance (in terms of ROA) from 2021-22 to 2022-23 and with concerted efforts the results are bound to improve significantly in the years to come.

9. IMPLICATIONS OF THE STUDY:

The study reemphasizes the importance of CSR for the corporates and the society both alike. The analysis provides certain useful insights which can be utilized by these companies to improve their performance, by devising a more in depth socially relevant CSR policy. Some of the implications can be summed up as under:

- Spending on CSR activities does create a constructive image for the organization. It should be wholeheartedly taken up by the company. Even those which do not have any mandatory requirement for engaging in CSR should take it up earnestly for projecting a positive image which would eventually convert into financial gains.
- Public sector banks should further expand their focus on these social and environmental initiatives. Efforts must be continuous and earnest for them to percolate and translate into gains for the company.
- Directly engaging in CSR has a deeper and long-lasting impact than making donations to NGOs and other organizations. The corporates should create a separate vertical for undivided focus in this area. Partnering with various institutions can then be taken up simultaneously.
- Quantity though is important, but the quality is of even greater relevance as far as CSR expenditure is concerned (which can be observed in the case of Kotak Mahindra Bank). Therefore, even relatively smaller companies can make their presence felt through sustained efforts and can thereby make a sizable impact.

10. LIMITATIONS & SCOPE FOR FUTURE RESEARCH:

The study throws light on the close relationship between CSR expenditure, CSR activities and the financial performance in the Indian Banking sector. However, the study takes into consideration only eight Indian banks.

Thus, the results cannot be generalized for all companies across different countries. The study provides useful insights for future academicians and practitioners in the field of CSR and sustainability to further expand this research study and test the results across different industries and countries.

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ABSTRACT

In a world where busy lifestyles often leave little time for meal planning and preparation, there's a growing need for innovative solutions that help individuals make healthier choices and utilize the ingredients they have at home efficiently. Therefore, it is proposed to develop a recipe recommendation system through image recognition of food ingredients[1]. Till today's date this system is a mobile application which will recognize an image provided by any user and recommends recipes based on the recognized ingredients from the image. Using the art of PyTorch deep learning model, it offers a unique combination of food detection and recipe generation. Whether you're wondering what to do with that random vegetable you picked up at the market or you want to make the most of your pantry, this app has you covered with the power of cutting-edge PyTorch deep learning models, It also allows you to identify fruits or vegetables with a simple snap of your camera. Say goodbye to mystery produce items and hello to a deeper understanding of your ingredients. Based on the ingredients you've identified or searched for, It will you offers a curated selection of recipes. From vibrant salads to hearty stews, each recipe is handpicked to showcase the natural flavors and nutritional benefits of the ingredients involved.

Keywords: Ingredients recognition, artificial intelligence, machine learning, Pytorch, datasets, fruits and vegetable detection, recipe recommendation, i m a g e processing.

1. INTRODUCTION:

For most Indian women, the day in the office is well over but the day certainly does not end there. They also have to make some dinner for the family. The next inescapable question that beckons them is: "What to cook today?". The proposed system will automatically identify the vegetable with which half dish can cook and suggest various amazing dishes. This is achieved with the magic of computer vision [2]a, users can effortlessly capture or upload images of vegetables, allowing the app to identify them accurately. Say goodbye to the mystery of unknown vegetables in your pantry! Once it identifies the vegetable, it opens the door to a treasure trove of culinary delights. The extensive database houses a collection of recipes tailored to each vegetable, ensuring that you receive recipes that not only match your ingredient but also tantalize your taste buds. No need to browse through endless lists. It will simplify the recipe search

process with an intuitive search bar. Just type in the name of your favorite vegetable, and watch as a world of recipes unfolds before you, ready to inspire your next culinary masterpiece. The paper introduces the introduction to the topic and Related works in detail and working of the proposed system successively. It also contains the algorithm, which has been proposed for its implementation. The User Interface for the proposed system is discussed alongside few case scenarios. Conclusion and future scope is mentioned at the end of section of the paper.

2. RELATED WORK:

In this paper the technique used to detect the images of fruits and vegetables is Pytorch, Why Pytorch? Since PyTorch is popular for dynamic computation graphs and flexibility while developing a model. This feature makes it easier to debug and modify models on the fly, facilitating rapid experimentation and iteration. Developers find PyTorch's syntax more intuitive compared to other frameworks like TensorFlow, which can speed up the development process significantly [3]. The language used in Pytorch is Python that makes it easy to understand the coding environment. PyTorch gives you access to many pre-trained models that have already been trained on large datasets like ImageNet. These models include state-of-the-art architectures such as VGG, ResNet, and Inception, which can be easily fine-tuned for specific image classification tasks. This capability allows developers to leverage existing work and achieve high accuracy with minimal effort [4]. The datasets that is used for training contains a wide variety of fruits and vegetables classes, it has aroud 40 group of classes each. The Recipes are fetched from the real time database that has 10000+ recipes allowing a wide range of recipes recommendations to the user. It also allows the users to type their ingredients and get recipe according to it.[5]

3. LITERATURE SURVEY:

PyTorch, regarded as a framework with great flexibility and ease of use, particularly for research and development purposes. It allows for dynamic computation graphs, which are beneficial for building complex neural networks. The integration of machine learning and computer vision technologies for everyday tasks has seen substantial growth, driven by the increasing capabilities of frameworks like PyTorch. One such application is the automatic identification of fruits and vegetables and suggesting relevant recipes based on the identified items. This literature review explores existing research and methodologies for building such a system, focusing on image processing, object detection, and machine learning algorithms.

Image Processing and Object Detection Techniques:

Image processing is crucial in transforming images into a format suitable for machine learning algorithms. Techniques like color histogram comparison, texture classification, and gray level thresholding are commonly employed for object detection and identification.

1. **Histogram Comparison**: Histogram comparison involves converting images into HSV (Hue, Saturation, Value) color space to minimize illumination effects.

The color histograms of the input image are compared with those in the trained database to find a match[2] .

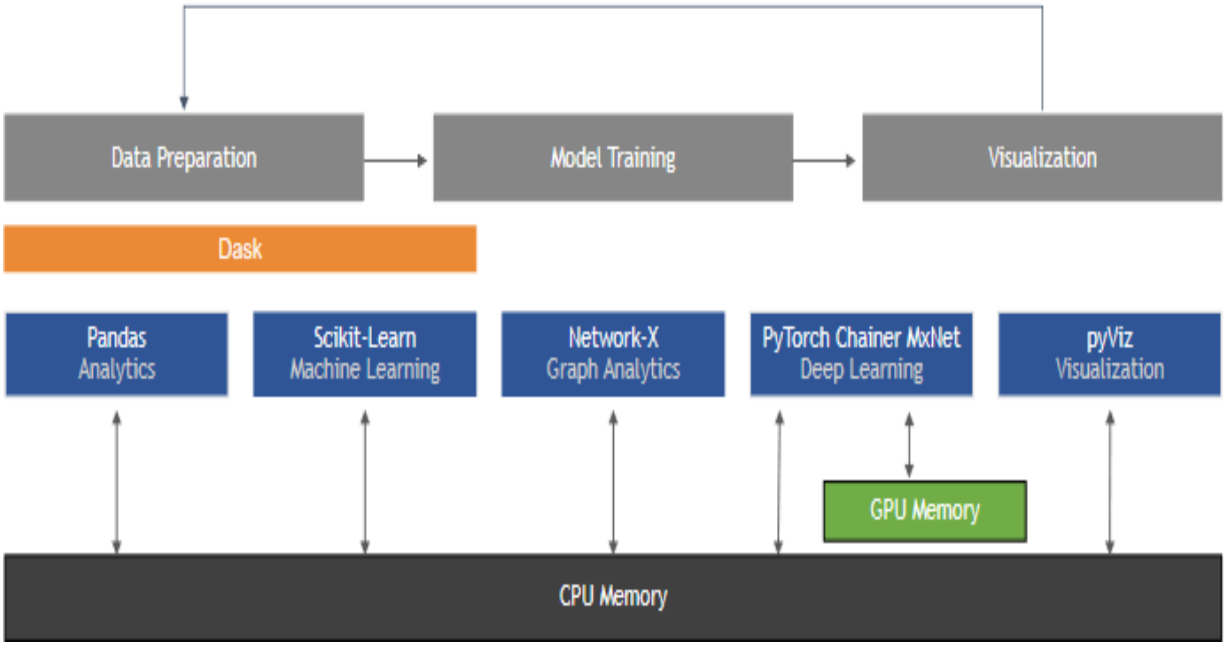
2. **Texture Classification**: Texture classification helps in distinguishing between objects that belong to the same parent class but differ in finer details. Small blobs are removed, and connected

   component size is computed using gray level thresholding.

   This technique helps in identifying child classes within the parent class, such as distinguishing between zucchini and beans based on their texture and shape[2].

Scientific Computation and Machine Learning using Python:

Like Pandas, the first version of NumPy (under its former name, "Numeric") came out more than 25 years ago, but also is still actively developed and maintained. In 2017, the Moore Foundation awarded the NumPy development team a $645,000 grant to support its continued evolution and ongoing care. As of this writing, Pandas, NumPy, and SciPy remain the most user-friendly and recommended choices for many data science and computing projects[6].



(The standard Python ecosystem for machine learning, data science, and scientific computing[6])

Case Studies and User Interface:

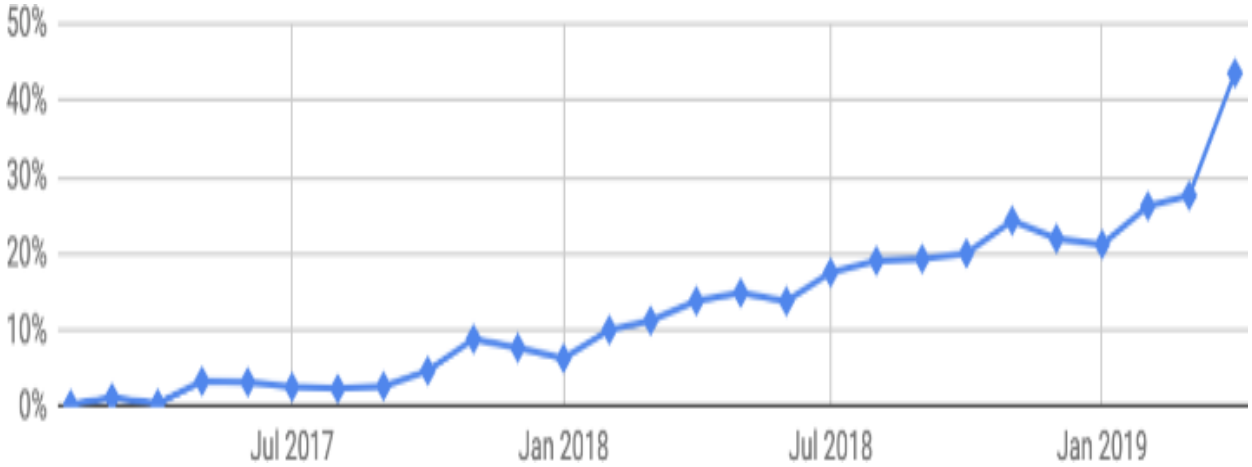
Practical implementations of these systems demonstrate their effectiveness and usability.

1. **User Interface**: A user-friendly interface typically involves screens for uploading images, displaying identified vegetables, and showing suggested recipes. The system's accuracy in identifying vegetables and providing relevant recipes can significantly enhance user experience[2].

2. **Accuracy and Performance**: Experimental results show high accuracy rates in vegetable identification, with some systems achieving up to 96.55% accuracy. This ensures reliable performance in real-world applications[2].

Adoption:

The validity of design decisions and its impact on ease-of-use is really hard to measure. As a rough proxy for the reception of PyTorch in the machine learning community, we tried to tally the mentions these and a few other machine learning tools (Caffe, Chainer, CNTK, Keras, MXNet, PyTorch, TensorFlow, and Theano) have received on arXiv e-Prints since PyTorch was released in January of 2017. In the graphbelow we report the monthly number of mentions of the word "PyTorch" as a percentage of all mentions among these deep learning frameworks.[4]



(Graph from [4])

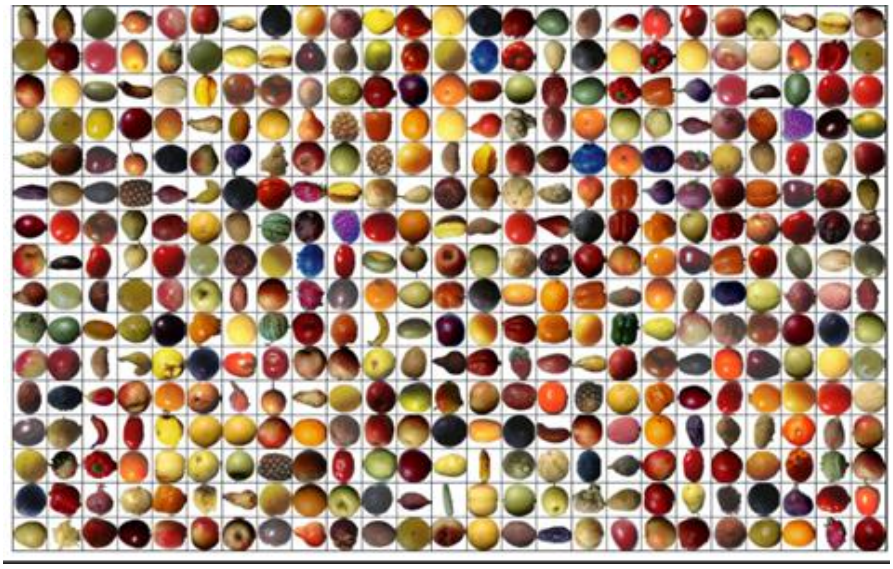
4. PROPOSED SYSTEM:

The key Function of the system is to detect the imagery of fruits and vegetable through live camera.
The author of 4 usefully notes that PyTorch has gained popularity in the deep learning research community by balancing an emphasis on ease-of-use with performance attention to detail.

In addition to continuing to support the latest trends and advances in deep learning, in the future we plan to continue to improve the speed and scalability of PyTorch.The vegetable and fruit recognition system can recognize, analyze and process the images by performing different steps they are as follows:

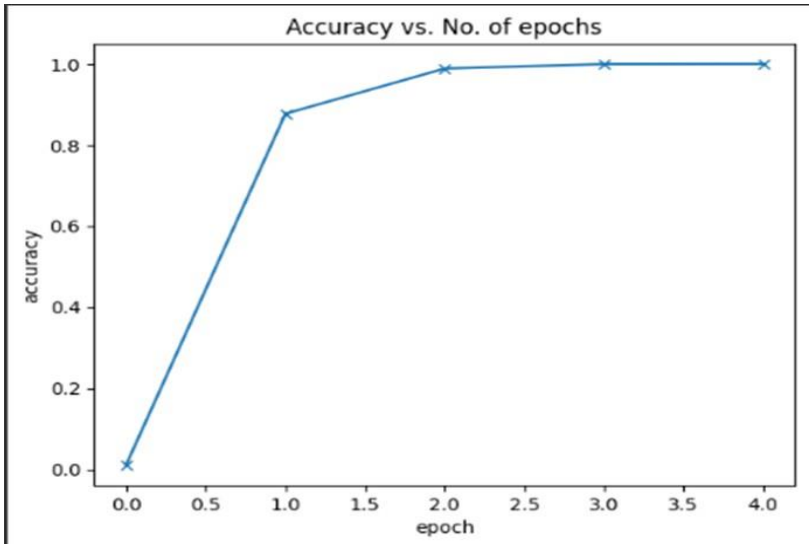
1. **Import Libraries:** Import necessary libraries such as PyTorch and any relevant modules.

2. **Load and Preprocess Data:** Use DataLoader to load the dataset and apply transformations (e.g., normalization).(Figure 1)



3. **Define the Model:** Create a neural network by sub classing torch.nn.Module and defining the architecture.
4. **Specify Loss Function and Optimizer:** Choose an appropriate loss function (e.g., CrossEntropyLoss) and an optimizer (e.g., Adam)[7].
5. **Training Loop:**

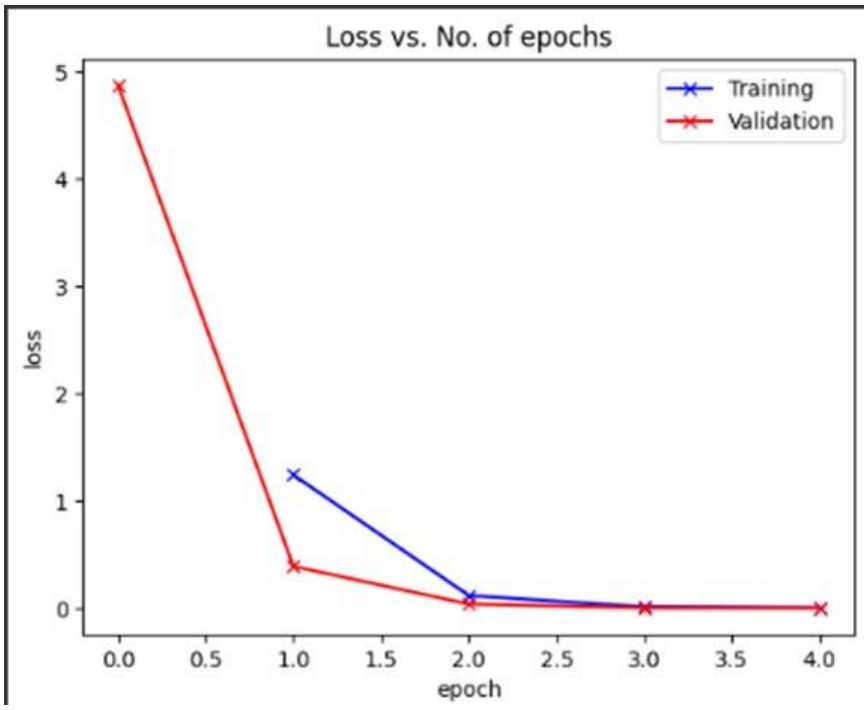
i. Iterate over the dataset:



(Figure 2)

ii. Perform forward passes.

iii. Calculate the loss.

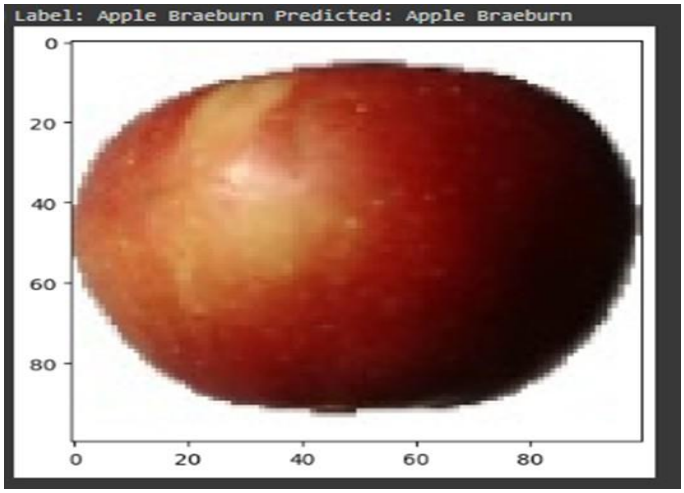


(Figure 3)

iv. Back propagate the gradients.

v. Update model parameters.

6. **Evaluate the Model:** Test the model on a validation or test dataset to assess performance.

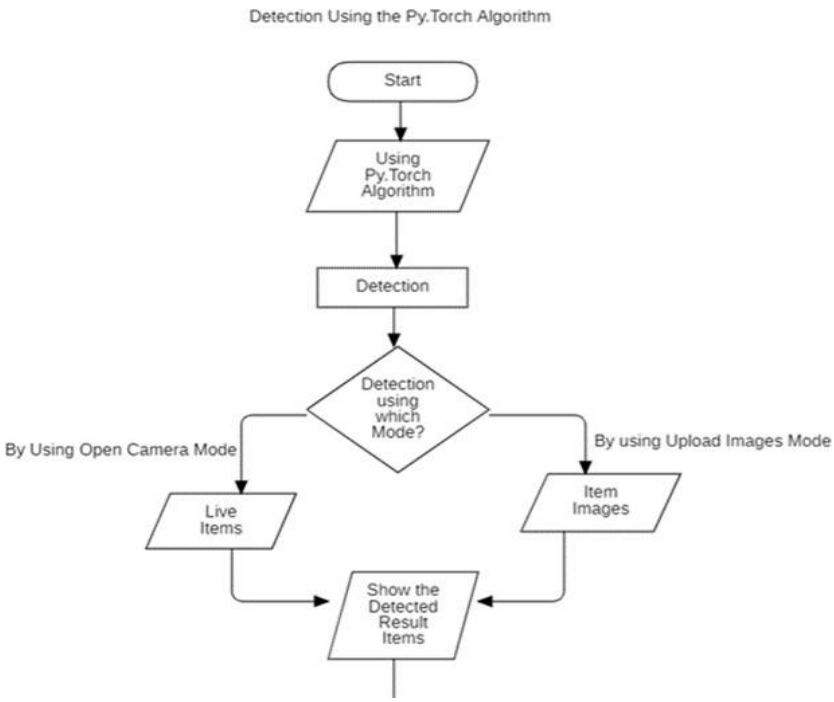


(Figure 4)

7. **Save the Model (Optional):** Save the trained model for future use.

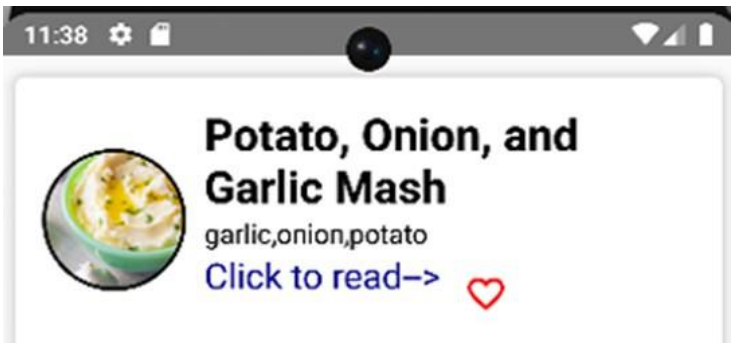
4.1 Flow chart of the application:

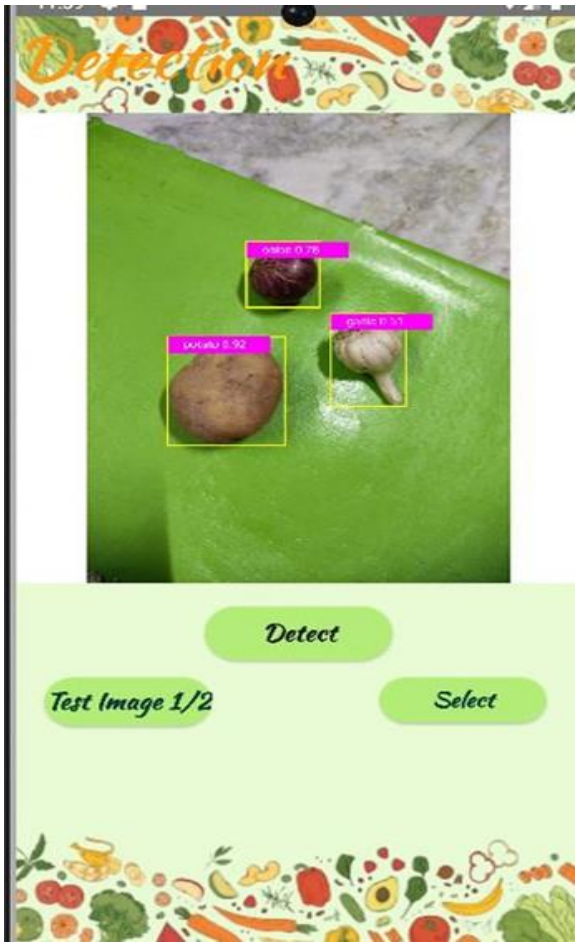
(Figure 5: Flow Chart)

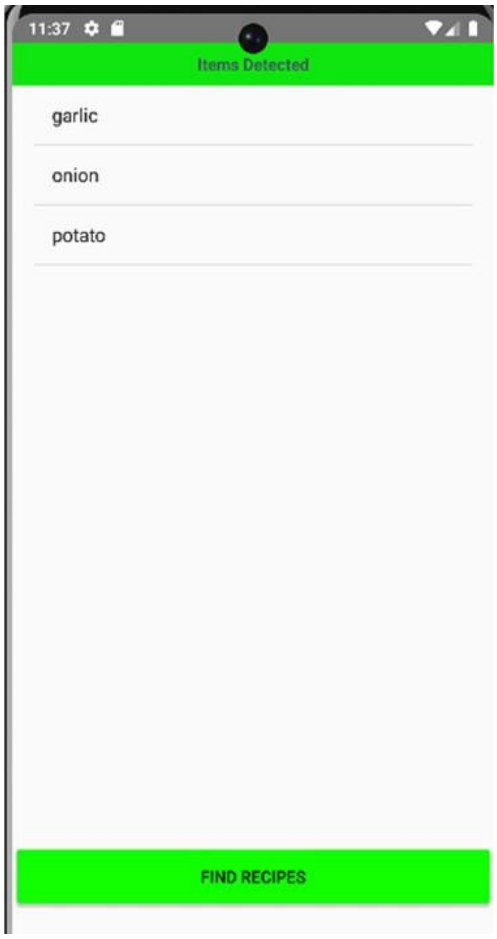



```
FirebaseDatabase.getInstance().getReference().child("Recipes")
.addValueEventListener(new ValueEventListener() {
@Override
public void onDataChange(@NonNull DataSnapshot dataSnapshot)
{ for (DataSnapshot snapshot : dataSnapshot.getChildren()) {
   MainModel recipe = snapshot.getValue(MainModel.class);
allRecipes.add(recipe);
}
}
```

4.3 User Interface:







4.4 Dataset:

Datasets are examples of specific databases who will be used to train the algorithms for Artificial Intelligence or for other types of Data Science projects.

Choosing the appropriate dataset is critically important for training a model that generates results closest to the truth.

Specifically, when looking through scientific studies on related topics, it was noted that the Food-101 dataset is a common one.

However, it contains a lot of entries (~10000+) and since it mostly contains images of prepared recipes, it does not really help with the project goal of using only very simple and recognizable ingredients.

Therefore, a search for alternative datasets was conducted, and the "Fruits and Vegetables Image Recognition Dataset," available on the Kaggle website, was found to be more relevant to the project's objectives [8].

However, it restricts the range of ingredients to fruits and vegetables only [3].

(Figure 6:- Dataset folders)

(Figure 7:- Folders of the dataset classes)

Training and validation: Provide labeled samples for model learning and evaluation. Diversity: Expose models to various scenarios, improving generalization.
Data augmentation: Artificially increase dataset size, enhancing robustness. Benchmarking: Standardize conditions for comparing model performance.

Research: Enable testing of new algorithms and driving innovation.
Datasets are essential for training effective image identification models, facilitating learning, evaluation, and advancements in computer vision.

5. EXISTING SYSTEM:

• **Plant Snap:** Plant Snap is a mobile app that helps users identify plants, including fruits and vegetables, using visual recognition technology. It provides information about the plant's species, habitat, and uses. While it doesn't provide recipes directly, it could serve as a helpful tool for identifying plants and finding recipes elsewhere.

• **Yummly:** Yummly is an application in your device for recipes based on information taken from the user preferences and what is in their pantries to create appropriate recipe suggestions. Though the recipes through Yummly don't particularly cater towards fruits and vegetables alone, recipes involving fruits and vegetables do appear.

• **All Recipes:** All Recipes is a popular recipe app that offers a vast collection of recipes, including those that feature fruits and vegetables. It also provides a search filter where you can specifically look for vegetarian recipes or recipes that include certain fruits or vegetables.

• **Smart Refrigerator:** Converting the old-fashioned refrigerator to smart and intelligent using Arduino UNO and Python. The module can detect the deficiency of any food item within it, which also makes the owner/user aware about this problem, uploads the data into the sql server, and gives information related to the fridge temperature and humidity. Google API can be used for object recognition based on natural language processing algorithms and strong neural networks to recognize the commands given to give responses. User Apps directly connected with server which shows real time contents of freeze also user suggested the recipes as per availability of vegetables.[9]

6. LIMITATION:

• Android Studio is able to work with limited datasets.
• Foreign fruits or vegetable may not be detected as the dataset is unavailable.
• Users can not add their own recipes.

7. FUTURE SCOPE:

• Increasing the size of datasets by adding more variety of fruits and vegetables.
• Increasing the number of recipe list by adding foreign cuisines as well [10].
• Users can add their own recipes to share it globally.
• Can be made to work on ISO platform if needed.

8. CONCLUSION:

This application is pretty handy and useful for cooking variety of recipe with minimum search effort from the internet. Internet recipe may appeal to one but not to the other, some people like experimenting and trying own recipes. It will help people save their time and energy finding recipes for daily routine as well as for special occasions. And because it is a mobile application, users have freedom to find recipes where they are, and save later.
Suitable for use from very diversely different kind of user who may seek to find novel recipe so that cook for their children, may be restaurant owner looking out to have a new thing to offer in their menu, anybody doing normal cooking.
This paper presented a Pytorch model to recognize food ingredients and a recipe recommendation algorithm based on detected ingredients to suggest cooking recipes [11]. We also introduced a custom dataset of 32 categories of food ingredients. We achieved a testing accuracy of 94%, which is quite impressive, and proved that the performance of this model in recognizing food ingredients from images is more advanced. Because of these high accuracy levels, we found Pytorch very appropriate for food ingredients recognition.

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Biodegradable Electronics: A Greener Future for Gadgets

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ABSTRACT

The environmental problems caused by conventional electronic waste can be resolved in a sustainable way with the help of biodegradable electronics. Eco-friendly substitutes are in greater demand as knowledge of the negative consequences of e-waste develops. Businesses that use biodegradable materials improve their brand image by meeting consumer expectations for items that are ecologically conscientious. Finding the ideal balance between gadget performance and biodegradability is still difficult, despite the bright future ahead of us. The goal of current materials science research is to bring in a new era of ecologically sustainable electronics that can meet performance standards.

Keywords: *Eco-friendly components, biodegradable, Gadgets.*

1. INTRODUCTION:

Biodegradable electronics with integration of materials science and electronics, pioneers the meticulous engineering of electronic components for natural degradation, addressing the environmental impact of traditional electronic waste.

This transformative technology, utilizing biocompatible materials like silk or cellulose, enables seamless integration with biological systems, unlocking applications from transient medical implants to sensors with predetermined lifespans before eco-friendly decomposition.

The key feature of biodegradable electronics is the strategic selection of materials with both electronic functionality and inherent biodegradability, driving the exploration of solutions to balance performance and environmental sustainability.
Ongoing research focuses on finding materials with desirable electronic properties compatible with natural degradation processes, advancing manufacturing methodologies to harmonies electronics' complexities with the imperative of biodegradability.

This trajectory holds promise for a future marked by reduced electronic waste, envisioning a sustainable era where electronic devices' lifecycle aligns seamlessly with ecological preservation, highlighting the profound impact of biodegradable electronics on our

technological landscape.

2. POWER SOURCE

For biodegradable electronic systems to perform potential electrical functions, such as wireless communication, stimulation, sensing, etc., a biodegradable power supply is a necessary component. Various strategies have been suggested, including battery systems, Si-based photovoltaics, piezoelectric energy harvesters, super capacitors, and fully degradable radio frequency (RF) power electronics.

One appealing technology for use in biomedical applications that can transmit data and supply power simultaneously is radio frequency communication. Using silk substrate, metal (Mg), dielectric layer (SiO2), and semiconductor (Si NM), a full wave rectifying circuit based on biodegradable materials has been achieved.

Battery systems, on the other hand, provide an additional power option due to their deployment's potential convenience and lack of dependence on external circuits. Because of their superior biocompatibility and high energy density, galvanic cells employing metallic electrodes, such as magnesium and zinc, are the main focus of current bio-battery system research. Completely biodegradable Mg-Mo battery systems and partially degradable batteries, such as Zn-Cu cells for extended in vivo monitoring, Mg-Fe batteries, and Mg-air batteries with gel electrolyte or silk fibroin, are among the systems that have been reported. Additionally, non-metallic electrode materials for bio-batteries have been proposed; examples include enzymatic fuel cells and edible sodium-ion batteries.

One advantage of a fully biodegradable battery is that it can completely degrade, making it a representative battery system that eliminates the possibility of materials being retained for in vivo use. The battery module is made up of four magnesium-morium cells covered in polyanhydride materials. It can operate at a discharge current density of 0.1 mA cm−2 for approximately six hours, with an output voltage of up to 1.6 V. As it shows useful applications, the power supplied is sufficient to turn on an LED and a wireless radio circuit.
Because all of the component materials are soluble in water, the battery can completely degrade in phosphate buffered saline, removing the need for unnecessary material retention. The focus of ongoing research is on ways to increase power density, prolong battery life, and reduce battery system size.

In addition to systems, primary flow batteries using organic Quinone redox species have also been investigated for environmentally benign applications. These batteries are produced through chemical reactions or chemical/mechanical disintegration.

3. LITERATURE REVIEW:

The development of biodegradable electronics specifically designed for medical applications, highlighting their potential to serve as temporary implants that can safely dissolve within the body.

The authors discuss various materials and design strategies that enhance biocompatibility and functionality, ultimately contributing to improved patient outcomes and reduced long-term waste.

This research underscores the growing importance of sustainable technologies in healthcare, aiming to minimize the environmental impact of medical devices [1].
Gao, Wang, and Zhou (2022) draw attention to the main difficulties in producing biodegradable electronics, such as the choice of materials and processing methods that frequently result in performance compromises. They stress that in order to improve the viability and scalability of these environmentally friendly gadgets, interdisciplinary collaboration and creative ideas are required [2].

The article authored by Huang et al. (2023) will discuss the creation of modern biodegradable batteries made from magnesium, arguing that these batteries will address environmental issues faced with traditional batteries. It addresses primarily the structure, the electrochemical properties, the biodegradability and the usage aspects of these batteries in elaborating the development as the green technology [3].
Li et al. (2022) focus on natural polymers and the prospects for their application in the field of biodegradable electronics and consider their positive impact on the environment and the properties of materials. The paper covers many types of natural polymers, processing methods and possible spheres of application, which paves the way towards the development of green electronics in a bid to curb environmental degradation [4].

In their work, Miller et al. (2023) offer a full lifecycle assessment of the biodegradable electronics, assessing their impacts from manufacture to disposal. The research reveals the benefits of biodegradable materials as opposed to conventional electronics while also addressing the issues associated with their production and end of use, which are beneficial for the development of green technology [5].

Park et al. (2021) look at biodegradable environmental sensors, the design, functionality and applications in monitoring environmental conditions. The paper covers the materials, sensor performance and the benefits of biodegradability in sensor tech for sustainable monitoring solutions [6].

Thompson et al. (2024) look at consumer awareness and attitudes to biodegradable electronics, the gaps in knowledge and attitudes to sustainable products. The study looks at the factors that influence behaviour and suggests ways to increase awareness and acceptance so we can get biodegradable tech into the market [7].

Teng et al. (2021) review biodegradable conductive polymers, the synthesis, properties and applications in devices. The paper looks at the benefits of these materials for sustainable electronics and the challenges of performance and scalability in real world use [8].

Xu et al. (2023) look into wearable biodegradable sensors and their application in healthcare.

The paper talks about material selection, sensor functionality and biodegradability and how these sensors can monitor physiological parameters sustainably without harming the environment [9].

Zhang et al. (2023) study the stability and durability of biodegradable electronics and their performance under different conditions. The paper lists out the key factors that affect the lifespan and reliability of these materials and what needs to be improved for practical application in sustainable electronics [10].

Li et al. (2023) look into the recent progress of biodegradable materials and their applications in transient electronics and how they can reduce electronic waste. The paper talks about material properties, fabrication methods and performance metrics and how these innovations can lead to sustainable and eco-friendly electronic devices [11].

Jiang et al. (2022) introduce a plant-protein enabled biodegradable triboelectric nanogenerator for sustainable agriculture. The paper discusses the development, efficiency and application of this technology to harvest mechanical energy from the environment and how it can promote eco-friendly farming and reduce non-renewable energy sources [12].

Li et al. (2023) take stock of the progress made in micro and nanores materials and processing techniques that embrace the concept of printing biodegradable electronics. This focuses on the properties and uses of these materials and emphasizes their capability of making eco-friendly electronic devices while overcoming performance and manufacturing growth issues [13].

Navarro-Segarra et al. (2022) describe a new biodegradable battery based on plant structures for precision farming power supply and seeking upsides on the plant systems. The paper emphasizes on eco-design principles and performance parameters of this “plant” type battery aiming to practice agriculture without polluting the environment [14].

According to Shi et al. (2022), the integration of both the AI and IoT domains is the future, which is inclusive of developments in areas such as WI wearables and brave photonics. This paper discusses the possible offerings of such technology in terms of user interface enhancement, data thermos networking, and intelligent environment cultivation aspects while outlining possible challenge areas in the use and mass adoption of the technology [15].

As Choi pointed out in the 2023 discussion, studies have implemented concepts to create biodegradable power generators that may be used for energy supplying medical implants that can be completely resorbed by the body. The potential advantages of such technology namely, the decreased need for surgical extractions, better health outcomes for patients, and other will be presented, while noting the relevance of sustainability in medical technology design [16].

In the article by Teixeira et al. (2023), the authors carry out a detailed analysis of the development of e-waste-free biosensors and electronics which are easily degradable and biocompatible along with their unique standing designs, materials, and their usage.

This paper deals with the societal impact of these technologies and outlines the requirements

for the further development of these means in different areas, claiming that it is also possible to work on the green side and solve global warming by creating greener electronics [17].

4. METHODOLOGY:

- Evaluation of the electrical performance of biodegradable electronic devices:

  This involves conducting comprehensive tests to assess the electrical properties of the biodegradable electronic components. Parameters such as conductivity, resistance, capacitance, and voltage-current characteristics are measured and analyzed.

  Techniques such as impedance spectroscopy, cyclic voltammetry, and electrical impedance measurements may be employed to evaluate the electrical performance.

- Assessment of durability and stability under different environmental conditions: Biodegradable electronics must withstand various environmental factors such as temperature fluctuations, humidity, and mechanical stress.

- Durability tests involve subjecting the devices to accelerated aging tests, mechanical stress tests, and exposure to harsh environmental conditions. Stability assessment includes monitoring the performance of the devices over time to ensure consistent functionality and degradation behavior under different environmental scenarios.

- Quantitative analysis of the environmental footprint of biodegradable electronics compared to traditional counterparts: This analysis involves quantifying the environmental impact of producing, using, and disposing of biodegradable electronics compared to conventional electronics. Life cycle assessment (LCA) methodologies are employed to evaluate factors such as energy consumption, greenhouse gas emissions, resource depletion, and waste generation throughout the entire lifecycle of the products. Data from LCA studies can provide insights into the environmental benefits of adopting biodegradable electronics in terms of reducing carbon footprint and resource utilization.

- Discussion on the potential benefits in terms of waste reduction and sustainability:

  This discussion explores the potential positive impacts of biodegradable electronics on waste reduction and sustainability. Biodegradable materials offer the advantage of decomposing into harmless byproducts, reducing the accumulation of electronic waste in

  landfills.

- Sustainable manufacturing processes and materials sourcing can further enhance the environmental credentials of biodegradable electronics. The adoption of biodegradable electronics aligns with the principles of a circular economy by promoting resource efficiency and minimizing environmental degradation.

- Making use of academic knowledge and studying real-life applications in various fields:

This involves leveraging existing academic research and theories to inform the design, fabrication, and evaluation of biodegradable electronic devices.

Studying real-life applications allows researchers to understand the practical challenges and requirements of integrating biodegradable electronics into different industries such as healthcare, consumer electronics, and environmental monitoring.

Collaborations with industry partners facilitate the translation of academic knowledge into scalable, commercially viable solutions that address real-world needs while promoting sustainability.

5. ADVANTAGES AND DISADVANTAGES:

- **Delicate and Adaptable**

  Biodegradable electronics are sometimes called "soft electronics" because they can meet human tissue and rarely or never cause irritation. Furthermore, the exceptionally high softness and flexibility of soft electronics enable devices to take on a variety of shapes.

- **Regulated Time Restriction**

  Electronics made of biodegradable materials may have time constraints. Research has shown that soft electronics used in biomedicine will disintegrate, reabsorb, or disappear at controlled rates during the device's expected lifespan. These unique characteristics make biodegradable electrical components widely used in biomedical devices.

- **Applications of Biodegradable Electronic Components in Medicine**

  Potential applications of biodegradable electronics to promote healing and aid in tissue regeneration could lead to novel medical discoveries. Researchers are now able to produce implantable devices made of soft polymers thanks to advancements in micro- and nanofabrication technologies.

6. CHALLENGES FACING BIODEGRADABLE ELECTRONICS:

Research teams are still working to make sure that advanced polymers and biodegradable components dissolve completely and do not leave minute traces of hazardous chemicals, even though biodegradable medical devices show great promise.
Scaling the creation of pliable, transient electronic circuits and components for mass manufacturing presents additional difficulties.

- **Electronics That Are Water-Soluble**

Additional studies have demonstrated the potential of water-soluble materials as integrated circuits and other parts for disposable cell phones, medical sensors, and environmental sensors. Water-soluble electronic devices, sometimes known as transient electronics, are programmed to function for a predetermined amount of time before disintegrating into waste materials like soil, water, or bio fluids.
The environmentally benign silicic acid is created when the thin silicon layers used in the ICs

dissolve.

- **Degradation Mechanism**

Biodegradable electronics are designed to break down and be absorbed by the environment, reducing electronic waste. The degradation mechanism involves materials that are environmentally friendly and capable of undergoing natural processes. Common components include biopolymers, organic semiconductors, and bioresorbable substrates.

The substrate, often made of biodegradable polymers like polylactic acid (PLA) or polyhydroxyalkanoates (PHA), serves as the structural foundation. These materials are susceptible to microbial activity and enzymatic degradation.

The degradation of biodegradable electronics involves a combination of microbial action, hydrolysis, enzymatic processes, and controlled aging. These mechanisms collectively enable these devices to seamlessly integrate into the environment, minimizing the ecological impact of electronic waste.

Researchers aim for controlled degradation, ensuring that the electronic components function for the required lifespan before initiating the breakdown process. This balance allows the device to perform its intended purpose before safely returning to nature.

7. RESULTS:

Electronics is used extensively in practically every industry, including telecommunication, entertainment, and healthcare, to mention a few. It has had a profound impact on human society. Although traditional electronics are known for their long-lasting stability, there is a new kind of device that is becoming more and more popular that has "transient" functions.

These devices are called "transient electronics" or "biodegradable electronics" for biomedical or environmentally friendly applications. They are composed of biodegradable materials and can dissolve, resorb, or physically vanish after operating in physiological or environmental conditions at controlled rates. Like biodegradable sutures or cardiovascular stents, biodegradable electronics as temporary implants can be safely absorbed by the body after serving their therapeutic and diagnostic purposes.

This eliminates the need for repeat surgeries to retrieve the device and lowers the risk of infection that goes along with it. It is anticipated that adding biodegradability to consumer electronics or environmental monitors will significantly reduce the amount of electronic waste (E-waste, more than 50 million tonnes annually), which causes landfills and environmental problems. It will also remove the costs and hazards related to recycling operations. Furthermore, data-secure hardware can be made from temporary devices with self-destruction capabilities that shield data from unwanted access.

Thus far, most transient devices that have been demonstrated have been linked to aqueous solution degradation with the aim of biomedical or environmental applications. Studies on biodegradable materials for transient electronics have been conducted by researchers.

These studies have covered topics such as device integration, fabrication methods, degradation modelling, and materials dissolution chemistry.

The focus of early efforts was on organic materials, such as synthetic or natural biodegradable polymers, and partially degradable devices were achieved primarily with contributions from substrate components.

According to recent research, depending on the kind of aqueous solution, monocrystalline silicon Nano membranes (Mono-Si NMs) can dissolve in physiological environments at rates of a few nanometers to over 100 nm per day.

Dissolvable Si NMs allow for fully biodegradable electronics with superior operation characteristics that can also be compatible with semiconductor foundry processes when combined with degradable inorganic dielectrics, metals, and polymer substrates.

To prevent material destruction by solvent, temperature, or water, novel fabrication techniques have been developed to adapt the sensitive nature of biodegradable materials to device integration. Thermal therapy devices, intracranial pressure sensors (ICP), electro corticography (ECoG) recording systems, radio frequency (RF) electronics, batteries, drug delivery systems, and other fully biodegradable devices in physiological solutions have all been demonstrated. Encapsulation materials play a crucial role in achieving both transience at a later stage and stable operations for a specific duration.

The degradation time and water permeability of the encapsulating materials, as well as the thickness of the active electronic components, primarily determine the functional lifetime of achieved transient devices. An additional factor to establish the transience threshold is an external trigger stimulus (moisture, temperature, light, mechanical force, etc.); examples of triggered degradation in non-aqueous environments are primarily linked to non-biological uses. Devices in these situations can either fully transient or partially degrade.

Since its initial proposal in 2012, transient electronics has rapidly advanced as an emerging technology, and more avenues for exploration need to be investigated to maximize its potential applications in the fields of green electronics and healthcare.

With an emphasis on environmentally friendly and biomedical uses, this review outlines recent developments in biodegradable electronics and materials. It has been observed that most biodegradable electronics intended for medical use can be easily modified for environmentally responsible use.

After reviewing a wide range of biodegradable materials, several innovative fabrication techniques will be introduced. Perspectives to further advance high-performance multifunctional transient electronics will be discussed, and representative biodegradable functional electronic systems and environmentally friendly devices will be described.

More ecologically friendly electronics are becoming increasingly necessary as environmental issues take center stage in global politics.

As a result, there is more interest in biodegradable or naturally derived materials for green electronics. First, a great deal of research is done on metal-green hybrid electronics. Because of their metallic components, these materials have high utility even though they are partially biodegradable. Carbon framed materials have since been studied, including laser-induced graphene, graphite, cylindrical carbon nanomaterials, and graphene.

As a result, different approaches to carbon-based materials have been adopted, including blending them with biodegradable materials. Additionally, several conductive polymers have been created, and scientists have investigated how they might be applied to green electronics. By cutting the polymer chains shorter, scientists have tried to create conductive polymer composites that are highly biodegradable.

Furthermore, biodegradable compounds have been used to study a variety of physical, chemical, and biological sensors that are vital to modern society. With these new developments

in green electronics, society will have a more promising future as they pave the way for their practical application.

Biomedical Uses for Biodegradable Electronic Components

The possibilities for biodegradable electronics that can stimulate healing and assist with regenerating tissue may usher in new medical breakthroughs.

The development of micro/nanofabrication technologies has allowed researchers to create implantable devices that consist of soft polymers.

8. CONCLUSION:

Biodegradable electronics stand at the forefront of a transformative paradigm that converges materials science and electronics to address the pressing environmental concerns associated with the proliferation of electronic waste.

This innovative field exemplifies a shift away from the traditional trajectory of electronic devices by introducing materials with inherent biocompatibility, such as silk and cellulose, fostering a symbiotic relationship between technological advancement and ecological preservation.

The manifold applications of biodegradable electronics, spanning from transient medical implants to environmentally responsive sensors, underscore its vast potential to revolutionize diverse sectors while mitigating the environmental impact of electronic waste.

But there are obstacles in the way of the widespread use of biodegradable electronics. Striking a delicate balance between electronic performance and biodegradability remains a focal point of ongoing research, necessitating continuous exploration of novel materials and advancements in manufacturing processes.

Addressing these challenges is crucial for ensuring the viability and scalability of biodegradable electronics in the market. Despite the current hurdles, the overarching goal is clear – to pave the way for a sustainable future where electronic devices seamlessly align their lifecycle with ecological preservation, contributing significantly to the reduction of electronic waste and minimizing the environmental footprint of our technological advancements as researchers navigate the intricate landscape of biodegradable electronics, the collaborative efforts of interdisciplinary teams become paramount.

The integration of expertise from materials science, electronics, and environmental science is essential for overcoming hurdles, fostering innovation, and driving the field towards maturity. Ultimately, the pursuit of biodegradable electronics represents not only a technological breakthrough but also a conscientious step towards a more sustainable coexistence between human innovation and the planet's ecological wellbeing.

9. FUTURE PERSPECTIVE:

- **Biodegradable Electronics Future**

Despite the challenges already highlighted, biodegradable electronics seem to have endless potential. Agricultural sensors can monitor growing conditions in real-time, relay information to farmers, and eventually decompose into the soil. At the end of their useful lives, consumer entertainment devices could decompose without adding harmful substances to e-waste.

Drones and robotic devices with biodegradable end of-life routines programmed in are examples of defense applications.

The possibilities for biodegradable electronics appear limitless, notwithstanding the difficulties previously mentioned. Agricultural sensors could detect growing conditions in real-time, send farmers information, and then break down into the soil.

When a consumer entertainment device reaches the end of its life, it can dissolve without adding harmful chemicals to e-waste. Drones or robots with biodegradable end-of-life protocols are a couple of examples of defense applications.

The future of biodegradable electronics is undoubtedly bright; these are just a few examples of how they might transform the industry.

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Exploring the Integration of Digital Technology in Kindergarten Education

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ABSTRACT
This study examines the impact of digital technology on kindergarten education, focusing on children's learning capabilities, mental and physical health, and smart learning. It explores the perspectives of educators and parents, evaluates digital tools' contributions to creativity and problem-solving abilities, and suggests best practices for implementation. Using a mixed-methods approach, data were collected via online surveys from more than 50 early childhood educators and parents of children aged 3-6 in Mumbai, conducted from July 11 to July 18, 2024. The findings provide insights into existing digital platforms for kindergartens, such as playgroup poems/rhymes YouTube channels and learning applications. The study concludes with recommendations for integrating digital technology to maximize educational benefits while minimizing adverse effects.
Keywords: Digital technology, kindergarten education, learning capacities, early childhood education, mental and physical health effects, problem-solving abilities, digital platforms, Mumbai kindergartens.

1. INTRODUCTION:

Digital technology has brought about a huge evolution in education, especially in kindergarten education, by improving individualized and interactive learning experiences. Young learners benefit greatly from the use of tools like interactive whiteboards, educational apps, and digital platforms since they encourage creativity and problem-solving abilities. By enabling customized instruction, these technologies raise the standard of education as a whole. Nonetheless, the possible harm that too much screen time may cause to kids' social and physical development emphasizes how crucial it is for parents and teachers to work together to promote responsible digital usage.

Preschool education policy in India are progressively incorporating digital technologies to improve the quality of early childhood education. In order to enhance learning outcomes and guarantee high-quality education, the National Education Policy (NEP) 2020 places a high priority on technology integration at all educational levels, including preschool. The Early Childhood Care and Education (ECCE) Policy encourages the creation of specially crafted digital content for young learners and places a strong emphasis on utilizing digital tools to enhance early education experiences.

Samagra Shiksha Abhiyan and other programs promote the use of ICT in the classroom, which makes it easier for teachers to use digital resources for instruction. The DIKSHA platform offers e-learning materials and content to help teachers incorporate digital tools into their teaching practices. Moreover, preschoolers can learn through engaging and dynamic resources and smartphone apps like "ABCmouse" and Indian YouTube channels like "ChuChu TV" and "Pinkfong India."

This research explores how digital technology supports intelligent instruction in kindergartens, its impact on children's health, and perspectives of parents and educators on its use. It evaluates digital tools' effectiveness in fostering creativity and problem-solving. Understanding these dynamics can guide stakeholders in promoting holistic development and improving early childhood education outcomes.

2. REVIEW OF LITERATURE:

2.1 Digital Technologies in Preschool Education: A Study with Cape Verdean Educators:

The study by Patrício and Moreno examines the lack of usage of digital technologies in Cape Verdean preschools, emphasizing the need for teacher training and technological acceptance. The study emphasizes how important digital literacy is for creating dynamic learning settings and giving kids the tools they need to thrive in a changing global environment. The research highlights the potential advantages of incorporating digital technologies at an early age in education to improve teaching practices and children's readiness for future social needs by filling up these gaps.

2.2 Early Childhood Teachers' Perceptions and Management of Parental Concerns about their Child's Digital Technology Use in Kindergarten:

In her research work, Vicki Schriever examines how Australian early childhood educators respond to and understand parents' worries around the use of digital technology in kindergartens. It highlights how home and school digital practices differ and stresses the need for teachers to inform and comfort parents about the responsible use of digital technology in early childhood education.

2.3 Covid-19 and Online Classes: Measuring Indian Parents' Attitude Towards Online Classes at Kindergarten and Junior School Level:

Eliza Sharma's study looks at how Indian parents feel about their kids taking online courses during COVID-19, noting obstacles related to technology, infrastructure, and personal health. The study provides ideas for bettering online education by highlighting the ways in which these impediments negatively affect parents' attitudes and the ways in which perceived effectiveness positively influences them.

2.4 Baaljyoti – Shiksha Ke Nanhe Kadam an Android Based E-Learning for Primary Kids in India:

"Baaljyoti – Shiksha ke Nanhe Kadam" by Mohit Yadav, Aditya Vardhan, and Manisha Gupta introduces an Android application aimed at primary kids in India, focusing on teaching reading, writing, and basic math through an engaging interface. The app enhances children's learning

and writing skills via interactive finger touch screens.

2.5 How Children Under 10-Years Access and Use Digital Devices at Home and What Parents Feel About It: Insights from India:
The study by Attavar and Rani investigates parental viewpoints as well as Indian children under 10's access to and use of digital devices. The results of the thematic analysis of the interviews show that parents have differing opinions, a wide range of digital activities, and high access through smartphones. Parental controls, dialogues, and occasionally dishonesty are used to monitor consumption.

3. METHODOLOGY:

3.1 Research Design:
This study uses a quantitative methodology to look into the use of digital technologies in preschool education in great detail.
The study intends to collect a wide range of data and statistical trends about digital technology usage in early childhood settings by concentrating on quantitative methodologies.

- Quantitative Component:

3.2.1 Survey Design & Data Collection:
To collect information from parents and instructors of preschool-aged children in Mumbai, a structured Google Form survey was created.
The survey consists of the following sections' worth of questions:

- Child's Information
- Digital Technology Usage
- Awareness of Digital Resources
- Challenges and Concerns
- Observations and Impacts
- Device Preferences and Benefits
- Overall Impact and Future Prospects.

These categories were selected to provide a comprehensive picture of how digital technologies are affecting preschool education, including their actual use in the classroom, results that have been seen, and the opinions of individuals who are closely involved in the teaching process.
In order to guarantee a broad audience and convenient access for respondents, the survey's data collection was done online.
Due to the survey's distribution via social media and email, a wide range of respondents were able to participate.
This distribution strategy guaranteed timely and effective data collection as well as a sizable sample size for analysis.

3.2.2 Data Analysis:
Basic statistical techniques will be used in the analysis of the quantitative data to compile and contrast the survey replies. A summary of the data will be provided using descriptive statistics, such as counts and averages that aid in illuminating broad trends and patterns. By comparing the answers from parents and teachers, for example, comparative analysis will be utilized to investigate correlations between various variables.
In order to find patterns and links in the use and effects of digital technologies in preschool education, the results will be analyzed and examined based on the designated categories. This will lay a strong foundation for comprehending the larger trends.

3.3 Data Integration:
The integration of survey results is a crucial component of this quantitative study, since it offers a thorough comprehension of the research issues.

To assess the data and determine the prevalence and effects of digital technology use in preschool education, statistical trends will be analyzed. The study seeks to offer precise and impartial insights on the trends and impacts of digital technology on the learning settings of young children by concentrating only on quantitative data.

3.4 Ethical Considerations:
Privacy and confidentiality for participants are crucial. Prior to collecting any data, participants will be made aware of the study's objectives and their agreement will be sought. Participants' confidentiality will be upheld, and all information will be anonymized to guarantee privacy.
No personal information will be revealed or used for any other purpose with the information gathered.

The goal of the research is to add to our understanding of how digital technologies can be utilized in early childhood education in a responsible and productive manner by offering insightful information on their use in preschool education.

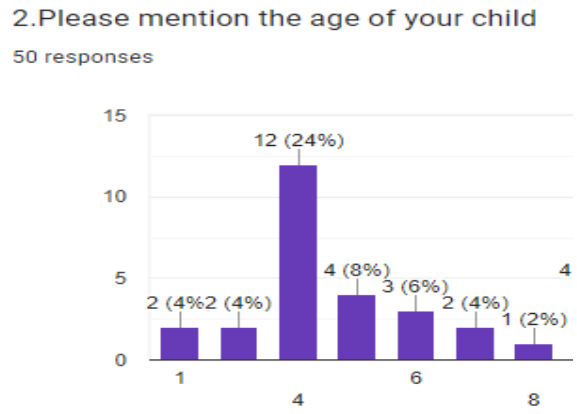
4. RESULTS & FINDINGS:

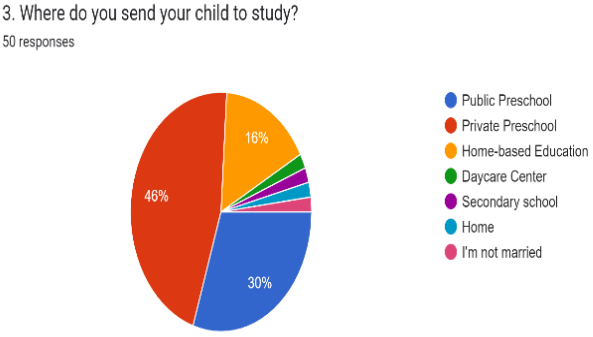
More than fifty parents and early childhood educators answered the questionnaire on the use of digital technologies in kindergarten teaching.

Data were collected online in Mumbai between July 11 and 18, 2024, and are organized as follows: information about children, usage of digital technology, awareness of digital resources, challenges and concerns, observations and impacts, device preferences and benefits, overall impact, and future prospects.

The thorough survey results emphasize important trends, advantages, and difficulties that educators and parents have mentioned, and they offer insightful information about how digital technologies are used and perceived in early childhood education.

4.1 Children's Information:



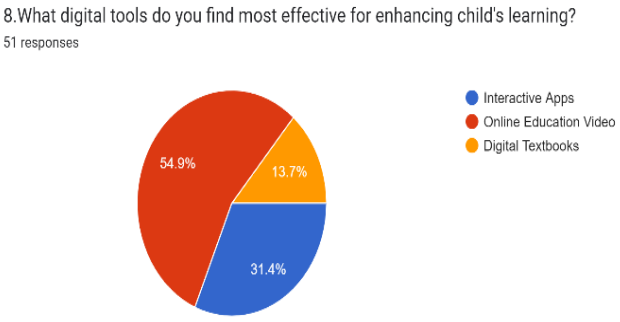


The survey's Child's Information category gathered age and educational setting demographics from the kids. Fourteen percent of the youngsters were four years old, eight percent were five years old, and six percent were six years old.

In terms of learning environments, 46% of parents and teachers said their kids go to private preschools, 30% go to public preschools, 16% are homeschooled since they do not meet the kindergarten age requirements, and the remaining kids fell into the "other" group.

This information offers a demographic summary that is crucial for comprehending the setting in which these kids use digital technology. Furthermore, it suggests that the majority of Mumbai parents view preschool education as essential to their kids' early growth and academic requirements.

4.2 Digital Tech Usage:

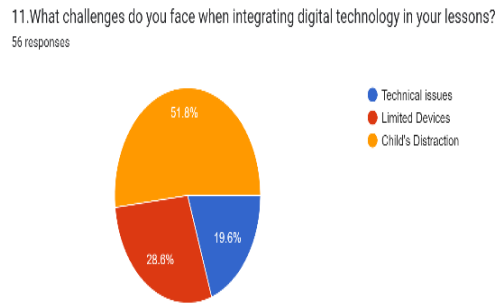


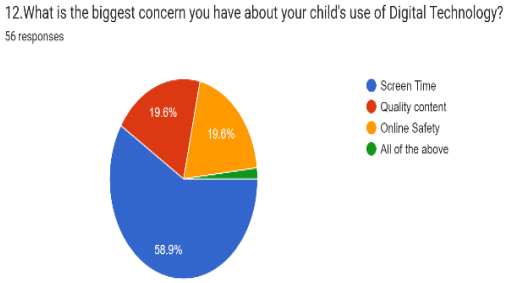
A number of significant insights were obtained in the area of digital technology usage. When

asked if their child's playgroup uses digital technology, 85% of respondents replied that they did, and 14% said that they did not. 31% of respondents were unaware of the usage of digital technology in nurseries, compared to 69% who were.
When asked which digital platform they preferred, 77% of respondents said YouTube above Android apps. 23% of respondents disagreed with the statement that technology aids in a child's development, while 77% agreed. Regarding useful digital tools for improving learning, the majority of respondents—54.9%—thought that interactive applications were the most useful, followed by online instructional videos (31.4%) and digital textbooks (remaining respondents). These answers show that parents and teachers in Mumbai have a strong preference for integrating digital technology into early childhood education.

4.3 Awareness of Digital Resources:
The poll measured the participants' knowledge with different YouTube channels and mobile apps under the Awareness of Digital Resources category.
Regarding YouTube channels, the remaining data included additional channels. Of the participants, 64.7% were aware of Coco melon, 41.2% were aware of ChuChu TV Nursery Rhymes, and 33.3% were aware of Little Baby Bum. When it came to smartphone apps, the ChuChu TV Nursery Rhyme Pro app was known by 60.8% of participants, while LooLoo Kids - Nursery Rhymes was known by 29.4%. Other apps took up the remaining space. These figures show that Mumbai's parents and teachers have a good awareness of widely used digital resources.

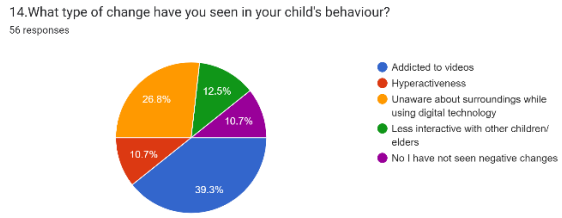
4.4 Challenges and Concerns:





Participants outlined a number of problems with incorporating digital technology into the classroom in the category titled Challenges and Concerns.
When asked what obstacles they encounter when using digital technology into their teaching, 51.8% of respondents named child distraction, 28.6% named device limitations, and the remainder respondents stated technical difficulties.
Screen time accounted for 58.9% of participants' concerns over their children's use of digital technology, followed by quality material and online safety (19.6% of respondents) and all other issues (regarding to which participants were concerned).
These figures highlight important issues and difficulties with incorporating digital technology into preschool instruction.

4.5 Observations and Impact:



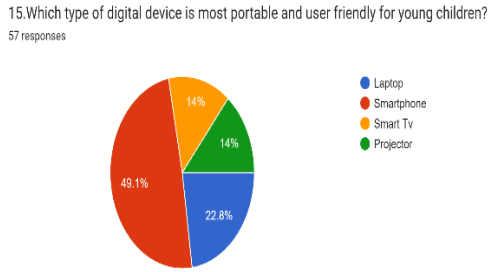
The survey investigated behavioral changes in children as a result of using digital technology under the Observations and Impacts area.

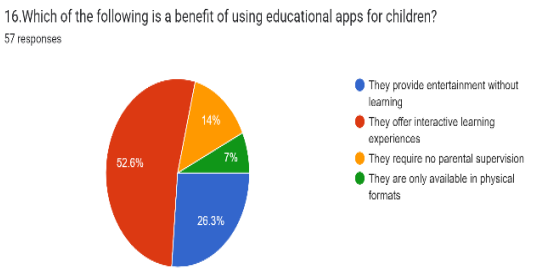
When asked if they had noticed any behavioral changes in their child as a result of digital technology, 92.9% of participants indicated yes, and the remaining people said no.

Regarding the particular changes seen, 39.3% of parents said that their kids were addicted to videos, 26.8% said that their kids were using digital devices and were not aware of their surroundings, and 12.5% said that their kids were interacting with other kids and adults less frequently.

Furthermore, 10.7% of respondents reported either no unfavorable behavioral effects or hyperactivity. These results underline the importance of balanced and thoughtful use by highlighting the major behavioral effects—both good and negative—associated with young children's use of digital technology.

4.6 Device Preference and Benefits:





Within the Device Preferences and Benefits area, the poll investigated the preferred digital devices for young children as well as the perceived advantages of educational applications.

In response to the question, "Which sort of digital device is most portable and user-friendly for young children?", 49.1% of respondents selected smartphones, laptops, and smart TVs and projectors each received 14.8% of the vote.

When asked about the advantages of educational apps, 52.6% of participants emphasized that they provide interactive learning opportunities, 26.3% thought they only offered entertainment without any educational value, 14% said they did not need parental supervision, and the remaining respondents said these apps are only available in physical formats. These findings highlight the widespread use of smartphones and the engaging possibilities of educational applications.

4.7 Personal Response and Future Aspects:

Participants in the category "Overall Impact and Future Prospects" offered their personal perspectives on how digital technology affects children's education and how it can influence their future.

Divergent views were expressed in response to the question, "Do you think digital technology has a positive or detrimental impact on a child's education (why/why not)?" "My child is having a positive influence because she can use educational videos to catch up on missing school classes," a parent wrote. "It has both positive and negative effects," said another parent. Positive because my kid picks up concepts through movies rapidly; bad because he is getting dependent on the technology."

A teacher emphasized the importance of supervision by saying, "Parental supervision is positive, but distraction is detrimental." The impact is dependent on how digital technology is utilized, as many respondents acknowledged, highlighting the significance of managing screen time and producing high-quality material.

As one parent put it, "Educational information can have a positive impact if your child is watching it with adequate supervision." But unsupervised use of entertainment videos can be harmful."

There were differing opinions in response to the question, "Do you believe this digital technology can affect the child's future for its betterment?".

While some were wary of possible negative impacts, others thought that digital technology may improve learning and future chances with the right leadership. These different viewpoints highlight the complex effects of digital technology in early childhood education and how, depending on usage and supervision, it may have a positive or detrimental impact on children's futures.

4.8 Policies and Related Activities by Government of India:

4.8.1 National Education Policy (NEP) 2020:

The survey responses align with the National Education Policy (NEP) 2020, which emphasizes the integration of digital technology in early childhood education.

The NEP 2020 advocates for leveraging technology to enhance learning, promote digital literacy, and ensure equitable access.

The participants' insights on high usage of digital tools, awareness of educational resources, and the benefits of interactive learning resonate with the policy's objectives. Additionally, the identified challenges and concerns, such as screen time and the need for supervision, underscore the NEP's emphasis on balanced and mindful technology use.

This alignment highlights the relevance of digital integration in achieving NEP 2020's goals for holistic and inclusive education.

4.8.2 Early Childhood Care and Education (ECCE) Policy:

The survey's findings, which highlight how digital technology can improve early learning opportunities, are consistent with the Early Childhood Care and Education (ECCE) Policy. With its emphasis on educational resources, supervised use, and problem-solving, ECCE aims to support holistic development and guarantee high-quality early childhood education. ECCE's

dedication to incorporating cutting-edge techniques for early childhood development is demonstrated by the widespread use of digital resources, awareness of quality educational content, and advantages of interactive learning technologies.
Concerns around screen time and the necessity of moderation in technology use further underscore the policy's focus on the thoughtful and appropriate integration of technology to promote children's overall development and well-being.

4.8.3 Samagra Shiksha Abhiyan:
The survey results, which emphasize the inclusive and comprehensive use of digital technology in early childhood education, are consistent with the Samagra Shiksha Abhiyan. Enhancing educational quality, equity, and access are program objectives that are well-aligned with the focus on digital technologies, knowledge of educational resources, and advantages of interactive learning approaches. The goal of providing balanced and thoughtful technology integration—which ensures full development and learning opportunities for all children—aligns with addressing issues like screen time and the need for supervision.

4.9 Analysis of Results:
Analysing the survey data on the use of digital technology in kindergarten education in Mumbai offers insightful information about attitudes and practices at the moment. The results highlight a preponderance of private preschool enrolments, indicating a predilection for regimented early learning settings that support digital integration. Young children are increasingly using smartphones and YouTube to consume educational content, which highlights the accessibility and allure of digital platforms.
Diverse levels of awareness about digital resources affect how people access and use educational information. Effective integration of digital resources can be complicated, as seen by the difficulties parents and educators have in limiting screen time and addressing behavioral implications. The varied effects of digital technology in early childhood settings are exemplified by concerns about addiction and distraction as well as beneficial educational involvement with children's behavior.
Smartphones are preferred because they are practical and appropriate for use in educational environments, which is in line with the adoption of digital tools. In general, differing viewpoints regarding the educational advantages of digital technology highlight the significance of responsible usage and knowledgeable oversight to fully realize its potential for enhancing early childhood education experiences. These observations provide valuable context for current attempts to manage the changing terrain of digital integration in kindergarten education across Mumbai, highlighting the importance of thoughtful implementation and encouraging policies.

5. CONCLUSION:

By combining quantitative data from surveys with qualitative insights from parent and educator interviews, the research used a mixed-methods approach to provide a deeper picture of digital technologies in early childhood education.
The results of the survey highlight accessibility and content consumption, with a high enrollment rate in private preschools and widespread usage of smartphones and YouTube by

young children. Different levels of awareness of digital resources have an impact on usage patterns and preferences. Concerns about the usage of digital technology are brought to light by issues like controlling screen time and behavioral effects. Positive involvement and worries about over-dependence are among the observations are made.

In conclusion, this study's result promotes the careful and methodical integration of digital technology into kindergarten instruction.

The distinct socio-economic profile of Mumbai and the youthful, tech-savvy populace make it imperative to harmonize educational methodologies with the rapidly changing technology environments, all the while giving equal access and holistic child development first priority. Digital education implementation has both opportunities and challenges due to the dynamic and diversified environment of the city.

Teachers and legislators can direct educational practices in the direction of promoting enriched learning experiences for children by addressing issues that have been identified and utilizing the knowledge gained from this study. Young students in the city will be well-prepared for the future thanks to this strategic integration, which will allow them to take advantage of the advantages of digital innovation while avoiding its drawbacks.

6. ACKNOWLEDGEMENTS:

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From Traditional to Digital: Evaluating the Role of Spirituality in Mental Health and Therapy

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ABSTRACT
The increasing number of mental health issues has obliged us to find new methods that are not only innovative but also so easy that they can be used by almost everybody. The given paper examines the progress and effect of the mental health and life- assisting chat-bot. The main idea of the chat-bot incorporates elements from the Bhagavad Gita, the ancient spiritual manual. Information was collected to measure the public's view of introducing spirituality into the traditional treatment, the results reveal that the majority back such a venture. A study (n=51) was conducted, and respondents were asked questions about their age, religion, opinion on spirituality and mental health, and choice for which method online therapy or traditional therapy. It was found that out of all the respondents, (80.4% aged 16-25) there was a large majority (88.2%) that mentioned the spiritual aspect of mental well- being. There were a lot (most responses were YES) of them have been into spiritual exercises when they faced the difficulties, they still believe that it still could be personalized intervention to use. Even as traditional therapy is the main option (70.6%), a significant number of respondents (29.4%) still feel comfortable with online help. Those research counterparts that focus on the role of technology in mental health improvements which tend to look to the public for a response, are the ones that discuss the chance for the Bhagavad-Gita chatbot as a supplementary tool. The proposed chatbot will make use of Natural Language Processing (NLP) in understanding a user query and generating an answer through reference to Bhagavad Gita.
Index Terms— Bhagavad Gita, Mental health, Chatbot, Spiritual therapy, Technology-assisted therapy

1. INTRODUCTION:

Mental health is a growing concern worldwide, affecting people from all backgrounds [1]. Even though
traditional therapy can help, it may not always meet the complete well-being needs of people, especially those looking for help outside of the medical system [2].
This paper shows a new way to help people with their mental health and other life problems

using a chatbot that uses the deep wisdom of the Bhagavad Gita, a holy Hindu book.
The Bhagavad Gita, a part of the Mahabharata epic, provides wisdom for all of life's challenges [3]. It teaches about Dharma (upright conduct), Karma (acting without attachment), and Moksha (freedom) – key principles that guide people towards a meaningful life [4].
By incorporating these teachings into technology, researchers can investigate whether the Bhagavad Gita can help people improve their mental health and make sense of their lives.
The following sections delve into the motivations behind this research, present a review of relevant literature, and outline. The methodology employed in developing and evaluating the Bhagavad Gita-based chatbot.

2. PROCEDURE FOR PAPER SUBMISSION:

This research aims to create a chatbot that uses wisdom from the Bhagavad Gita to help with mental health and life issues. The chatbot, which is currently being made, will give users teachings and advice from the Bhagavad Gita that are tailored to their specific questions and concerns. Users will also have the option to get in touch with real-life counselors through the chatbot if they need more help than the chatbot can provide.

3. SYSTEM ARCHITECTURE DESIGN:

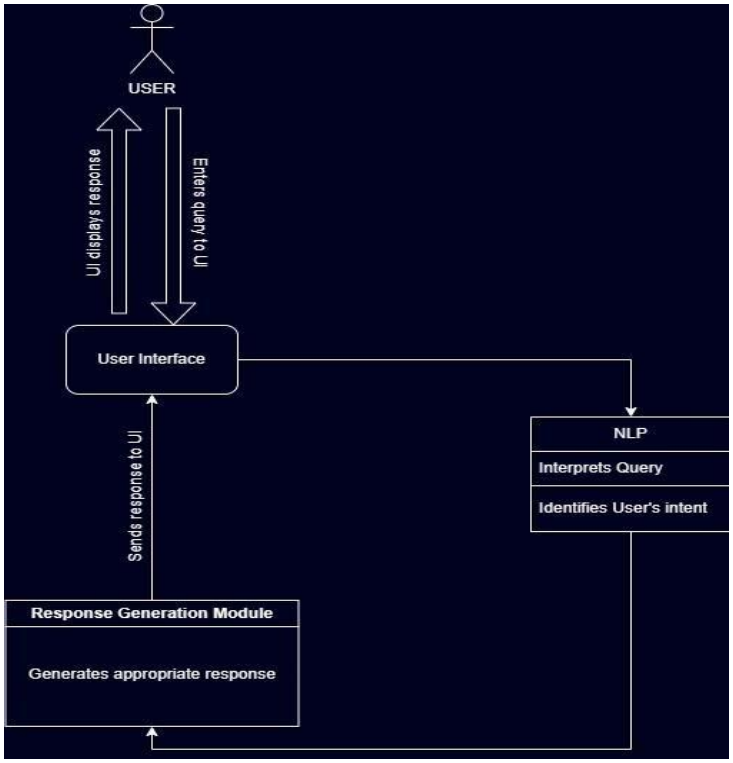
The chatbot architecture consists of the following components:

Natural Language Processing (NLP) module:
Processes user questions by splitting them into smaller units (tokenization), finding the base form of words (stemming and lemmatization), and extracting their purpose (intent) and vital information (entities).

Dialogue Management module:
Controls the flow of conversation by using the NLP module's interpretation of the user's intent to choose suitable responses from the available knowledge.

Knowledge Base:
This central repository serves as a comprehensive resource for the Bhagavad Gita, providing access to verses, interpretations, and commentary.
It additionally offers guidance on mental health and self-care, including a directory of licensed counselors.

Response Generation module:
This module gathers helpful information from our database and delivers it to you in an easy-to-understand way, allowing you to get the answers you need



System Architecture Content

Components:

Interface of the User (UI):

It is the platform in which people meet chatbot. It may be a text-based interface, a chatbot window or an app made for phone.

Natural Language Processing (NLP) – This module processes user inquiries by doing actions such as tokenization, stemming and lemmatization. It recognizes what the user wants (intent) and important words (key entities) in the user's query.

Response Generation:

The above module retrieves relevant information from knowledge base and presents it to user-friendly form thus generating responses for users. Depending on dialogue management decisions, it could also use predefined conversation flows.

Data Flow:

Query entry by User through User Interface

NLP module receives the query

NLP interprets query and identifies intent of the user

Response Generation module receives intents other than any related entities

Retrieved details are written into a response that is meaningful to the client by response generation module.

After that response is returned to UI via which it pops up to users' screen

Chatbot Functionalities

The chatbot offers the following functionalities:

Query understanding:
The chatbot take queries regarding mental health from user by using Natural Language Processing.

Bhagavad Gita references:
The chatbot provides verses interpretations from the Bhagavad Gita that address the user's issues and help to guide them.

Self-care recommendations:
Meditation, mindfulness exercises and positive affirmations are some of the self- care practices suggested by the bot, which finds root in the principles of Bhagavad Gita.

Referral feature:
The chatbot identifies cases where professional support is needed and assists them to book an appointment with the concerned doctor.

Ethical Considerations in Building a Mental Health Chatbot Based on Bhagavad Gita

The development and deployment of a mental health chatbot, especially one rooted in religious texts like the Bhagavad Gita, calls for careful attention to ethical principles. In this section, we will address key ethical concerns surrounding our Bhagavad Gita chatbot and the steps taken to resolve them

User Privacy and Security:

Data Collection and Storage:
During interactions, our chatbot will get user queries and responses. This data will be anonymized and stored securely on encrypted servers. Users will be notified about data collection process through privacy policy which is available at the chatbot interface.

Limited Data Collection: The bot collects only relevant data from users' inquiries or replies. We shall desist from collecting any personal identifying information (PII), unless explicitly shared by users themselves for referral purposes (e.g., contact details when booking appointments with counselors).

User Consent:
Before any data collection occurs, there should be a clear consent form that outlines the kind of data being collected, its purpose and how it will be used presented to users in concise manner. Users can withdraw their permission at any time with ease as described by the chatbot itself.
Transparency and Bias

Limitation Remarks:
This chatbot is an online self-help tool and not a substitute for professional therapy, the limitations of which will be properly outlined in its interface and in responses.

Reducing Bias in Bhagavad Gita Interpretations:
Some interpretations from the Bhagavad Gita itself could be termed as being biased. This way, the chatbot will make sure it presents different opinions of scholars on this matter as well as their comments so that they can be unbiased about any religious beliefs or practices.
NLP Algorithms should contain no Bias: It is quite possible that there may be biases inherent within Natural Language Processing (NLP) algorithms, employed by our Chatbot. These attempts to reduce bias in responses made by the Chatbot include debiasing strategies like diverse training sets.
User Safety and Well-being

Recognizing Cases That Require Professional Assistance:
The chatbot should recognize scenarios where users might need professional mental health assistance. For example, we could instruct the bot to look out for specific keywords that indicate crisis situations or severe mental health symptoms.

Nurturing and Compassionate Language:
The language the chatbot will be programmed to use in interactions must be supportive, empathic, and non- judgmental. It should not employ any words that can cause emotional harm or intensify certain emotions in the users

Respecting Users' Autonomy and Beliefs:

Non-Coercive Environment:
The chatbot will not exert pressure on its users to adopt specific interpretations of the Bhagavad Gita or religious beliefs. A user may decide how much or little religious content he/she wishes to access; hence, he/she has complete control over it. For those who do not wish to receive religious references or interpretations from the chatbot, options for opting out shall be provided.

User Choice and Control:
Users will have a say on what subjects they want the chatbot to address with them. There is no intention by this chatbot to encourage any religion's doctrines or practices.

With these ethical considerations, we intend our Bhagavad Gita chat-bot as a secure, dependable mental health tool which would add value in supporting people along their mental well-being paths. We acknowledge that continuous refinement is required and thus we shall continuously monitor and evaluate user experience of the chat bot platform making necessary adjustments where applicable to maintain highest ethical standards possible.

4. EXPERIMENT AND RESULT:

Survey categories	Result		
	Finding	***Percentage***	***Remark***
Age	16-25	80.4%	
	26-35	5.9%	
	36-45	3.9%	
	46-55	7.8%	
	56-65	2%	
Gender	Male	68.6%	
	Female	31.4%	
Spirituality & Mental Well- being	Yes	88.2%	
	No	2%	
	Maybe	9.8%	
Spiritual Practices	Yes		Majority
Therapy Preference	Face-to-face	70.6%	
	Other Options	29.4%	
Online Therapy Preferences	Convenience, Cost, Time, Comfort		

5. CONCLUSION:

Preliminary Observations:

The survey findings show that young people are especially interested in how spirituality and mental health connect.

Even though in-person therapy is still the most popular choice, a lot of people are open to trying online options.

Online therapy is seen as helpful, and chatbot are becoming more acceptable, which could help with our proposed intervention.

Survey categories	Result		
	Finding	***Percentage***	***Remark***
Therapists and Spiritual Competence	Yes		Most Cases
Online Therapy Effectiveness	Yes		Acknowledged by Most
Online Therapy Reservations	Privacy, Security, Effectiveness		
Chatbot Comfort	Yes	54.9%	

6. LIMITATIONS:

Sample Size: Further research is needed with wider, larger samples since this small sample size had only 51 participants.

Chatbot Development Stage: Its real-world effectiveness remains untested because the chatbot is not yet completed. To evaluate its impact on user well-being, rigorous user testing and clinical studies must be conducted.

The future work is as follows:

Refinement of Chatbot:
The chatbot needs to be continuously developed, with focus on improving its NLP capabilities, increasing its knowledge base, and enhancing it response generating mechanisms.

User Testing and Evaluation:
To examine the efficacy of the chatbots in promoting user wellbeing and minimizing mental health symptoms, there should be user testing from various demographic groups and clinical evaluations.
Longitudinal Studies: It will also be insightful to examine whether users can engage with this bot for a long time, and how it has affected their behavior over time.

Integration with Existing Systems:
Additionally, seamless integration of current mental health resources and booking platforms could improve user experience as well as ease access to further support

A chatbot based on Bhagavad Gita wisdom to address mental health problems and general life issues was introduced in this paper. The survey results presented provided a preliminary overview of the public's perception to this intervention. While still at its nascent stages, the proposed chatbot promises an innovative way of supporting mental health by combining spiritual teachings with technology-based remedies.

This research has several significant findings:

Interest in Spiritual Interventions:
As shown by the survey, a great number of individuals (88.2%) believed that spirituality could contribute towards their good mental health. This implies that there is room for such exploration within mental health interventions.

Openness to Technology-Assisted Therapy:
However, a big majority (70.6%) still insisted on face-to-face therapy as their option meaning that only a small minority (29.4%) were willing to try alternative options like online therapy.

Therefore, they are gradually embracing technology in service delivery within the field of mental healthcare.

Value of Therapist Training in Spiritual Competence:
The survey findings indicate that therapists should possess a certain degree of training in spiritual competencies (most level 3 responses). This would enable mental health professionals to better meet the needs of patients who are looking for help outside traditional therapeutic frameworks.

Comfort with Chatbot for Mental Health:
Most respondents (54.9%) expressed comfort with the idea of using a chatbot to address mental and emotional problems. This implies possible acceptance by users, as regards the proposed Bhagavad Gita-based chatbot intervention.

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Evaluating Housing Market Dynamics Through Linear Regression Models

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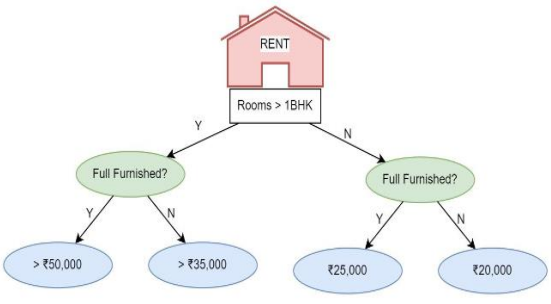
ABSTRACT
The property market is fiercely competitive, and the price of houses goes up and down due to various factors. Forecasting correctly the prices of houses is very much important for both customers and retailors. Traditional techniques rely on expertise and experience within a given field,but in line with progress made in machine learning better forecasts can be arrived at. This research work will focus on creating a web-based application that employs machine learning models like Linear Regression to estimate house values using such relevant variables as location, size, and number of bedrooms. The tool intends to offer useful information to estate agents, home buyers or owners through gathering data and preprocessing it, picking out effective algorithms as well ascombining those algorithms which will make them accessible viauser interfaces.
Keywords: Web based project, House Price Prediction

1. INTRODUCTION:

The real estate market is a complex and dynamic industry, with house prices exhibiting significant variation across different markets. The property market is fiercely competitive and the price of houses goes up and down due to various factors [1]. Forecasting correctly the prices of house it is very much important for both customers and realtors. Traditional techniques rely on expertise and experience within a given field, but in line with progress made in machine learning better forecasts can be arrived at. This research work will focus on creating a web-based application that employs machine learning models like Linear Regression to estimate house values using such relevant variables as location, size, and number of bedrooms [2]. The tool intends to offer useful information to estate agents, home buyers or owners through gathering data and preprocessing it, picking out effective algorithms as well as combining those algorithms which willmake them accessible via user interfaces [17].



Decision tree diagram diagram for predicting house prices

2. SCOPE:

The primary goal of this project is to develop a reliable house price prediction tool and create an accessible web-based application that leverages machine learning techniques to forecast house prices. This tool will serve as a comprehensivesolution for individuals and professionals in the real estate market, offering precise and data-driven price predictions based on user inputs [5]. The scope of this project extends across several critical stages, ensuring a holistic approach to delivering a functional and effective tool.

Data Collection and Preprocessing

The first stage involves the collection of a rich dataset encompassing various attributes that influence house prices.

This includes data on property location, size (in square feet or meters), number of bedrooms, bathrooms, age of the property, proximity to amenities (schools, hospitals, shopping centers), crime rates, historical price trends, and more [3]. Data preprocessing is crucial, involving data cleaning, missing values handling, data normalizing, and performing feature engineering to extract meaningful insights.

Once the data is prepared, the subsequent step involves evaluating a range of machine learning algorithms to identify the most suitable model for this specific task [4]. This involves experimenting with various models, including Linear Regression, Decision Trees, Random Forests, Gradient Boosting Machines, and advanced techniques like Neural Networks. Every model will cross-validation to test and validated using techniques to ensurerobustness and accuracy. To optimize the models further Hyper parameter tuning will be conducted.

Model Training and Evaluation

After selecting the appropriate algorithm, the model will be trained on the historical data. The training process involves feeding the model with input features and corresponding house prices to learn the underlying patterns and relationships [21].

Web Interface Development

The final stage is to integrate the trained model into a user- friendly web interface. This involves developing a responsiveand intuitive web application where users can input their data easily. The interface will include input fields for various property details, such as location (selectable via a map interface or dropdown menu), property size, number of bedrooms, and other relevant features. Additionally, the application will incorporate an API endpoint to process data submissions and provide real-time predictions.

Additional Features and Functionality

To enhance the usability and value of the tool, additional features will be incorporated. This includes data visualizationtools to provide users with insights into market trends, heatmaps showing price variations across different regions, and comparative analysis features that allow

users to compare predicted prices with actual market listings. Moreover, robust security measures will be implemented to safeguard user data and maintain privacy.

Deployment and Maintenance

Once the development is complete, the application will be deployed on a reliable hosting platform with high availability and scalability. Regular updates and maintenance will be scheduled to to update the tool with the latest market data and improvements in machine learning techniques. User feedback will be actively sought and incorporated to refine and enhance the tool continually.

3. PROBLEM DEFINITION:

In this study, our objective is to predict house prices using machine learning techniques like Linear Regression [8]. As real estate agents, our goal to estimate the selling price of a house based upon certain criteria such as size, number of rooms, bathrooms, location, availability, and other relevant factors.

These models analyze how these features collectively influence house prices. Linear Regression establishes a direct relationship between features and price. By training and evaluating these models using real estate data, we can provide reliable estimates of house prices, empowering real estate agents and homeowners to make more informed decisions in the housing prices.

Furthermore, by leveraging these machine learning techniques, deeper understanding of the factors can be gained that drive house prices and identify trends in the market. For instance, we can analyse how the number of bedrooms and bathrooms affects the price of a house, or how the location of a house impacts its value [22].

Additionally, we can use these models to identify areas where the housing market is likely to grow or decline, allowing real estate agents and investors to make more informed decisions.

Moreover, the use of machine learning techniques in predicting house prices can also help to reduce the risk of overpricing or underpricing a house [31].

Trends that may not be apparent to human analysts can be identified by analyzing large datasets of real estate information. These models can uncover hidden patterns. This can help to ensure that houses are priced accurately and fairly, which can lead to faster sales and more satisfied customers.

In addition, the application of machine learning techniques in real estate can also help to improve the overall efficiency of the housing market. By leveraging real estate data, we can train machine learning models to accurately predict housing prices, empowering real estate professionals and homeowners to make informed decisions.

Machine learning is poised to shake up the real estate game by transforming how we predict house prices. These powerful algorithms can analyze vast amounts of data, uncovering hidden patterns that even the sharpest human analyst might miss. By providing more accurate and reliable price estimates, these models empower real estate agents and homeowners to navigate the market with confidence. This translates to informed decisions, streamlined transactions, and

a more efficient housing market for everyone.

4. LITERATURE SURVEY:

Real estate, often seen as a symbol of wealth and status, is more than just a basic need. Investing in property is often considered profitable due to its generally stable, upward-trending value. Fluctuations in real estate values impact many stakeholders, including homeowners, bankers, and policymakers. Predicting property prices is therefore a crucial economic indicator, as it reflects market trends and economic health.

India's significant household count, ranking second globally with 246.7 million households according to the 2011 census, underscores the nation's vast housing demand. Despite this large number, past recessions have shown that real estate prices are unpredictable and closely tied to the economic stateof a region.
For example, the global financial crisis of 2008 underscored the vulnerability of property markets to economic downturns. As property values plummeted, investors and homeowners alike suffered significant financial losses [23]. This unpredictability underscores the importance of developing reliable methods for predicting house prices.

Currently, there is no standardized method to accuratelymeasure real estate values. Various factors, such as location,economic conditions, interest rates, and market demand, influence property prices.
Traditional methods of valuation, such as comparative market analysis and appraisals, often rely on historical data and subjective assessments, which canlead to inaccuracies. To bridge this gap, researchers have examined the potential of machine learning to accurately predict housing prices.

One study focuses on predicting house prices using machine learning and neural networks, aiming to minimize error and achieve high accuracy. This study emphasizes the potential of advanced algorithms to analyze extensive datasets and uncover intricate patterns that impact property prices [32, 33]. Machine learning models, such as linear regression has beenapplied to predict house prices with varying degrees of success. These models can incorporate numerous features, including geographical location, property size, number of bedrooms, and historical price trends, to generate accurate predictions.

Another important paper, based on hedonic models and pricedata from Belfast, examines how submarkets and residential valuations can be identified over larger areas, impacting the evaluation process and the quality of necessary variables.
Hedonic pricing models assess property value based on its characteristics, including size, location, and amenities [19]. By analyzing data from different submarkets, researchers can identify regional variations in property valuesand improve the accuracy of price predictions. This approachalso helps in understanding the impact of local factors, such as proximity to schools, parks, and transportation networks, on property prices.

Moreover, recent studies have explored the integration of geographic information systems

(GIS) with machine learning models to enhance the accuracy of house price predictions. GIS allows for the spatial analysis of property data, enabling researchers to visualize and analyze the geographical distribution of property prices [7]. By combining GIS with machine learning, researchers can identify spatial patterns and trends that influence property values, leading to more accurate predictions.

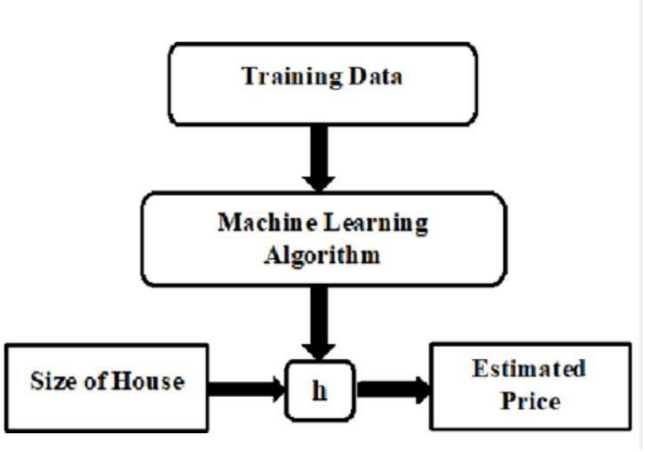
In addition to these technical advancements, researchers have also investigated the impact of socio-economic factors on property prices. For instance, studies have shown that social trends, such as urbanization, migration, and changes in household composition, can significantly influence property markets [15]. By incorporating socio-economic variables into machine learning models, researchers can better understand the drivers of property prices and improve the accuracy of their predictions.

These studies aim to understand current trends in house prices and homeownership, highlighting how feedback mechanisms or social trends can shape the perception of property as a crucial market investment [20]. The literature survey reveals a growing interest in using machine learning and data analytics to predict house prices, reflecting the need for more accurate and reliable valuation methods in the real estate market.

Furthermore, the literature emphasizes the importance of data quality and availability in developing accurate prediction models [24]. Access to comprehensive and up-to-date property data is essential for training machine learning models and ensuring their predictive accuracy. Researchers have called for the establishment of standardized data collection and reporting practices to improve the quality of real estate data and facilitate more accurate price predictions.

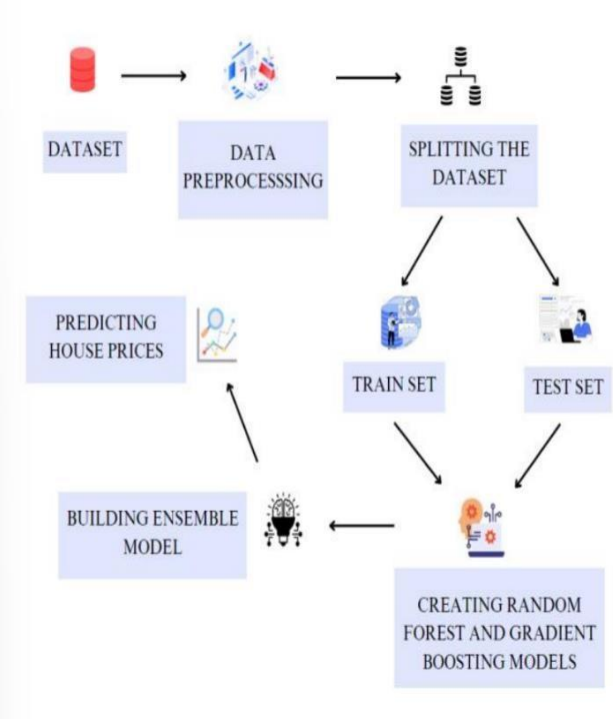
In conclusion, the literature survey underscores the potential of machine learning techniques to revolutionize house price prediction [14]. By leveraging advanced algorithms, large datasets, and spatial analysis tools, researchers can develop more accurate and reliable prediction models, empowering stakeholders to make informed decisions in the real estate market. The integration of socio-economic factors and the emphasis on data quality further enhance the robustness of these models, paving the way for more effective and data- driven approaches to property valuation.

5. OBJECTIVES:



The primary objective of this project is to develop a user-friendly web-based tool that leverages machine learning techniques to accurately predict housing prices. Specifically, the project aims to:

- ❖ Data Pre-processing and Preparation: Clean and pre-process the data to make it suitable for model training.
- ❖ Model Development: Developing and training machine learning models capable of predicting house prices based ondifferent features.
- ❖ Model Evaluation: Comparing performance of different models by analyzing them so as to select the most accurate, reliable one.



❖ Tool Development: To create a user-friendly tool, we integrate the best-performing model into a web application. This tool allows users to input house characteristics and receive instant price predictions.

❖ This project will develop a practical tool that assistsvarious players in real estate market through provision of dependable estimates thereby enhancing decision makingprocess.

6. METHODOLOGY:

Data Cleaning and Preparation:

We clean and prepare the data by fixing errors and filling in missing values to ensure data accuracy for robust model building [26]. A clean dataset helps our models learn effectively. We use various techniques such as data normalization, data transformation, and data imputation to ensure that our data is clean and consistent [30].

Creating Useful Features:

Feature engineering is about using what we know about the data to create new features orby refining existing ones. In our project, this means looking at details like the size of each house (total square feet) and introducing new metrics such as price per square foot [34]. These enhancements make our models smarter and more precise. We expand our feature set to include numerical features like the number of bedrooms and bathrooms, as well as categorical features like location and amenities. This comprehensive feature engineering approach aims to capture the underlying complexity of the housing market and improve model performance.

Reducing Complexity and Handling Outliers:

To simplify our analysis, we reduce the number of factors our models consider [12]. For instance, areas with fewer than 10houses are grouped together as "others". Outliers, which are unusual data points that can skew results, are also a concern.We use practical strategies, like focusing on bathroom features or applying business logic, to identify and handle these outliers. This ensures that our models providedependable predictions by focusing on the most relevant datapoints. We employ data visualization and statistical analysis to uncover hidden patterns and trends within the data. These insights enable us to identify and address outliers more effectively, improving the quality and reliability of our models.

Feature Selection:

We employ feature selection techniques, and retain a subset of the most relevant features from our comprehensive feature set. This process aims to improve model performance by reducing noise and enhancing generalization [29].

Dimensionality reduction techniques reduce the number of features, leading to simpler models, faster training times, and improved generalization performance by mitigating the curse of dimensionality. Data Transformation: - We transform the data to make it suitable for machine learning algorithms, often involving normalization or encoding categorical variables. This pre-processing step enhances the model's learning and prediction capabilities.

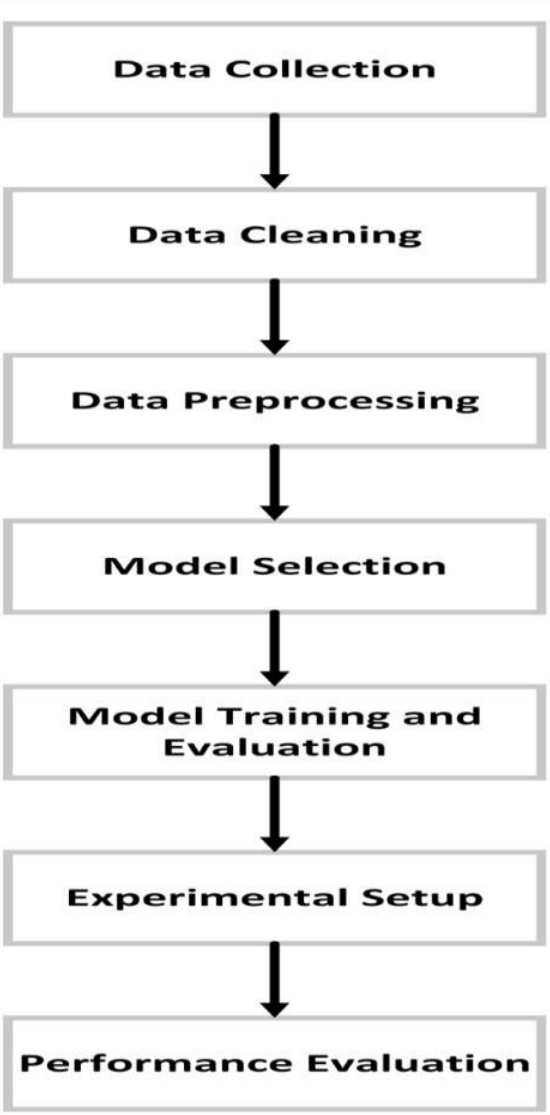
We use techniques such as logarithmic transformation, square root transformation, and normalization to transform our data. This helps us to stabilize the variance of our data and improvethe performance of our models.

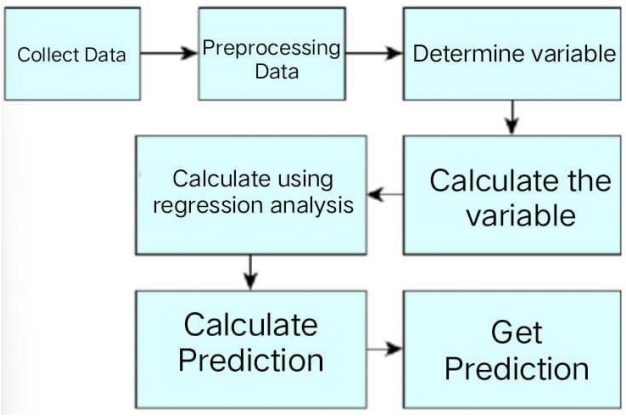
We address imbalanced data through techniques like oversampling, under sampling, and SMOTE. These methods help balance the dataset, leading to improved model performance and preventing bias towards the majority class.

Model Selection:

After data preparation, we select the most appropriate machine learning algorithm based on factors like data type, problem complexity, and desired performance metrics. To assess model performance and select the optimal model, we employ techniques such as cross-validation.

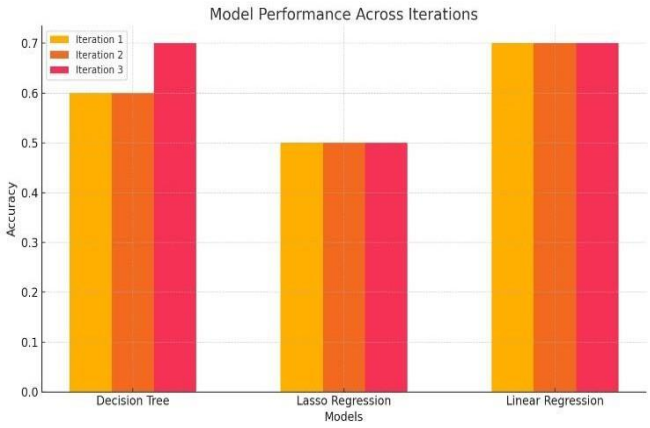

Housing price prediction
500
400
300
Price
220
200
100
0
1000
1250
2000
3000
House size

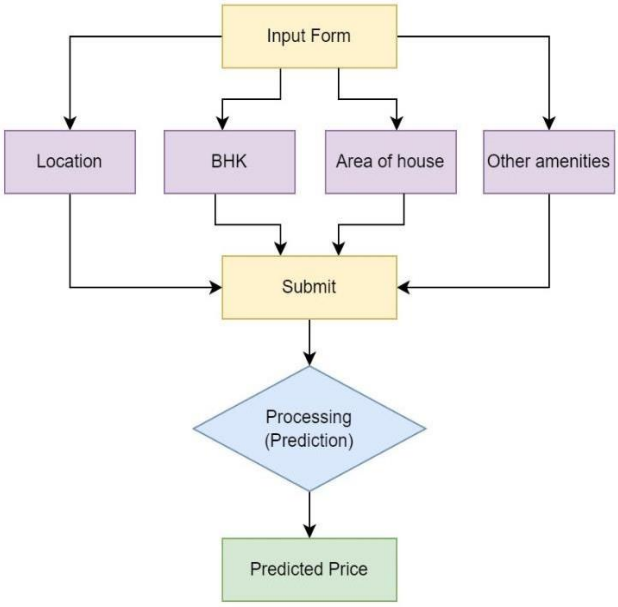

Data Collection
Data Cleaning
Data Preprocessing
Model Selection
Model Training and Evaluation
Experimental Setup
Performance Evaluation



By adhering to this methodology, we can guarantee that our machine learning models are trained on high-quality data, are robust and reliable, and can generate accurate predictions that can assist real estate agents and homeowners in making informed decisions [11].

7. PROJECT ARCHITECTURE:





Architecture of the model

8. EXPERIMENTAL SET UP:

Steps to Create Model:

1. Import Required Python Libraries
2. Load the Housing Price Dataset
3. Perform Exploratory Data Analysis to Understand the Data
4. Clean the Data to Handle Missing Values and Inconsistent Data
5. Create New Features from Existing Data to Improve Model Performance
6. Reduce the Number of Features to Avoid Overfitting
7. Remove Outliers Based on Domain Knowledge
8. Remove Outliers Using Statistical Techniques (e.g., Z-score)
9. Visualize the Data to Gain Insights and Identify Patterns
10. Train a Machine Learning Model (e.g., Linear Regression, Random Forest)
11. Evaluate the Model on a Test Set of Properties
12. Save the Trained Model for Future Use
13. Deploy the Model as a Web Application for User Interaction.

9. RESULT:

This is a example predict price of a house with 5000 square footage, 4 bedrooms, and 3 bathrooms

```
example_house = np.array([[5000, 4, 3]])
predicted_price = model.predict(example_house)
print(f'Predicted Price: ${predicted_price[0]:.2f}')
```

```
GrLivArea       0
BedroomAbvGr    0
FullBath        0
dtype: int64
0
Mean Squared Error: 2806426667.247853
R^2 Score: 0.6341189942328371
Coefficients: [   104.02630701 -26655.16535734  30014.32410896]
Intercept: 52261.74862694458
Predicted Price: $555815.59
```

This is a example predict price of a house with 2000 square footage, 3 bedrooms, and 2 bathrooms

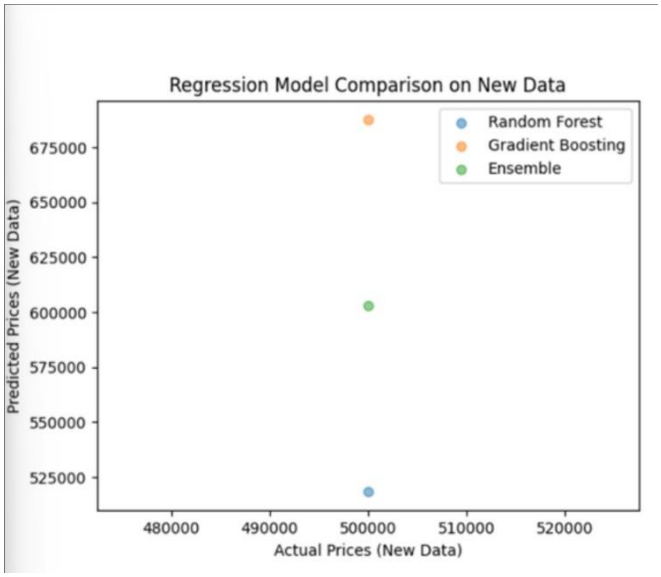
```
# Example: Predict the price of a house with 2000 square footage, 3 bedrooms, and 2 bathrooms
example_house = np.array([[2000, 3, 2]])
predicted_price = model.predict(example_house)
print(f'Predicted Price: ${predicted_price[0]:.2f}')
```

```
GrLivArea       0
BedroomAbvGr    0
FullBath        0
dtype: int64
0
Mean Squared Error: 2806426667.247853
R^2 Score: 0.6341189942328371
Coefficients: [   104.02630701 -26655.16535734  30014.32410896]
Intercept: 52261.74862694458
Predicted Price: $240377.51
```

This is a example predict price of a house with 15000 square footage, 5 bedrooms, and 5 bathrooms.

```
# Example: Predict the price of a house with 15000 square footage, 5 bedrooms, and 5 bathrooms
example_house = np.array([[15000, 5, 5]])
predicted_price = model.predict(example_house)
print(f'Predicted Price: ${predicted_price[0]:.2f}')
```

```
GrLivArea       0
BedroomAbvGr    0
FullBath        0
dtype: int64
0
Mean Squared Error: 2806426667.247853
R^2 Score: 0.6341189942328371
Coefficients: [   104.02630701 -26655.16535734  30014.32410896]
Intercept: 52261.74862694458
Predicted Price: $1629452.15
```



10. CONCLUSION:

This research utilized machine learning [10] techniques to forecast housing prices using historical data. Our project showcased how machine learning models can substantially improve the accuracy and dependability of price forecasts, offering crucial insights to stakeholders in the real estate market. By utilizing various algorithms and comparing their performance, we identified that Linear Regression offered the best predictive capabilities [27].

The model's ability to analyze patterns and trends within the dataset enabled it to make precise estimations of future housing prices, proving the efficacy of machine learning in this domain. Our findings underscore the potential of machine learning as a transformative tool in real estate valuation. It not only streamlines the prediction process but also offers a scalable solution that can adapt to changing market conditions. Future work can expand on this foundation by integrating more diverse datasets, incorporating additional features, and exploring advanced algorithms to further enhance prediction accuracy.

Future work can expand on this foundation by integrating more diverse datasets, incorporating additional features, and exploring advanced algorithms to further enhance prediction accuracy

[13]. By including variables such as environmental factors, neighborhood development plans, and social amenities, the predictive models can become even more comprehensive. Additionally, the exploration of ensemble methods and deep learning techniques could provide deeper insights and further improve the precision of housing price forecasts [28]. The continuous evolution of machine learning models promises to revolutionize real estate valuation, making it more reliable, efficient, and adaptable to future challenges.

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