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Artificial Intelligence based intimation of houses for Tenants, Landlords and Other Folks

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Abstract - *Technology has immensely evolved in the last two decades. The major fields where technology has reached the next level were space technology, food delivery and restaurants, travel, finance, clothing, job boards, social media, etc. But one of the most important fields among the three necessities of Life (Food, Shelter, and Clothing) that was missed out is Shelter. One of the typical problems most of the people face is the problem of intimation of houses; be it that the houses they want to sell don't get a maximum reach without the intervention of the third person or they can't find the property of their dreams despite there are so many good properties longing to be known. Tenouse, which is an Artificial Intelligence based agile intimation of houses for tenants, landlords and other folks, significantly solves this problem of house reach, finding the right customers, eliminating third-person intervention, owner/tenant deposit/rent insecurity, etc., by its intelligent features which are used for classification, verification, search and match, gamification, smart prediction, visualization, which are powered by Machine Learning, Natural Language Processing and Data Analysis, and is a breakthrough point for the technology to marvelously evolve and excel in this field.*

***Key Words*: Artificial Intelligence based houses, House intimation, House Classification, No broker system, Personalized Houses, Smart House Finder**

1. INTRODUCTION

In the persistent process of technological evolutions, many uncertainties became certain, and reached heights. The genesis of this remarkable process started with an intention to significantly improve the three necessities of Life (Food, Shelter, Clothing), but in this process, the scrutiny signifies that the demand of the public's interest and the enhancement of technologies wrapped up together to evolve the technology in the fields of Food and Clothing. It seems like the technology in the field of Housing (Shelter) is the need of the hour and the breakthrough phase is not too far.

The type of people looking for houses can be clustered as Students, Employees, Self Employed, Tourists, and the type of people willing to offer the houses on rent can be clustered as General Landlords (who own Bungalows, Apartments, and Row-houses), Building Owners, Third Person or Agents.

Most often, landlords have a criteria for the house they offer, some would want a married couple, while some would have an age criteria. Similarly for a tenant, he might have his own preference of houses, surrounding place and landlords. For a landlord to find a tenant of his preference and for a tenant to find a house of his preference, they need a third person intervention which costs a lot, and the results do not always serve the requirements. To overcome this problem, an attempt has been made to build Tenouse - An Artificial Intelligence (AI) based system to improve the house reach so that the obscure material would get inclined in the scale of prominent material. The landlord will be able to find the tenants of his preference with a wide range of options without paying a penny. Similarly, the tenant will be able to find the house of his preference from a wide range of houses.

The preference will mostly vary from people in one cluster to people in another. For a student or any teen who's relocating to a different city or state might not know the place well in advance, and might be a victim of the fraudulent activities of the broker. He may also prefer a roommate, so that the rent money is well split between them. Some would want a roommate who is focused on their career while some might want for hanging out. Employees, in today's times, are ready to go an extra mile in search of opportunities, and would prefer a house near their work place with good facilities around the house like hospital, malls, banks, etc.

Married couples would prefer a furnished or an unfurnished house, and might also have a preference between a Bungalow, Apartment and Row house. Tourists sometimes face discrimination from real estate services based on racism, sexism, ethnicity, etc. when they travel to different countries. Sometimes they are charged more, or sometimes they are taken advantage of by their innocence. Building owners have a lot of houses to rent, and they find it difficult to find customers. Tenouse, intelligently solves all the problems by its smart AI based algorithms, and makes sure that the deal is fair and each person related with the house is equally benefited.

2. RELATED WORK

Since one of the necessities of Life is Shelter (House), previously there has been some research and analysis done in this field. However it's not much, but some of the ones which hold even today provide a good starting point, and clearly indicate that there is a huge need for further development.

Salant [1] has already analyzed the differences between utilizing the services of a broker and doing things by yourself. People do realize that the broker is overpricing them, but cannot always do the work by themselves that a broker can do. Hans [2] and Salant [1] have done a wonderful job of explaining how not to fall for the delusion of the broker and how the pricing can be done. But, in the real world, House is everyone's necessity and when it comes to necessity, people are ready to even go beyond the extra charges to sell or find a house, which has increased the demand of a broker. And now is the time to excel in this field, and find an optimal solution to this problem. NoBroker [3] has explained 5 simple steps to rent a home, and those steps seem quite effective. Finding the right tenant definitely needs an interaction between the owner and the tenant. Victor [4] intimates the users of their legal rights while renting a house in terms of pricing so that a tenant can avoid any arbitrary charges levied by the society. Aliandu [5] has used the Naive Bayes method to apply Sentiment Analysis and get the best places of accommodation, shopping and culinary location. The past literature [1, 2, 3, 4, 5] seems to provide a good start for the development in the Housing field, but needs a super smart AI to incline this field to the other prominent fields which are currently in a higher league.

3. THE PROPOSED METHODOLOGY

AI is the heart of most of the successful technological fields today. And if we need to boost an already existing important field which hasn't developed much, then AI is the most crucial component. Tenouse is a system which is fully driven by AI. It has two Machine Learning classification models based on Convolutional Neural Networks (CNN). One model is used to classify the house structure, whether it is a Bungalow, Building or a Row House. The other classification model classifies whether the house is a furnished or an unfurnished house. This will elude the user from entering data into extra fields, and it will also stop the user from entering wrong information about the house. One of the most important factors which is important is the house price in that locality, and hence another Machine Learning regression model, Support Vector Machine (SVM) Regression has been used to do the Data Analysis and predict the house price in a particular location at a particular time of the year. One of the most important features of any smart product is the recommendation system, and hence, The Apriori (Associative Rule Learning) model has been used to analyze the user activity on the application and show relevant recommendations to the user. The app also offers premium features, and hence Sentiment Analysis which is one of the core aspects of the Natural Language Processing has been used to predict the best houses to the user or to feature the houses of premium users. On the dashboard, the data is visualized in curves, bar graphs and pie charts for Analysis and Marketing purposes. While Marketing, it is necessary to do an Analysis on the historical data, and hence, Naive Bayes Classification model has been implemented to predict if a student or an employee or a tourist at a specific location at a specific time of the year will be interested in buying a premium, so that appropriate users can be targeted for marketing and the budget will be maintained. Also, there needs to be an analysis done on the historical data to understand the best season of the year and the best place where maximum profit has been earned previously, so accordingly marketing strategies can be used to increase the profit during different seasons of the year at different locations. This has been implemented using the Random Forest Regression model. And finally, to lower the marketing budget, the Reinforcement Learning (Thomson's Sampling) model has been implemented to choose the right advertisement on third party applications among many advertisements, so that the budget will be completely minimized. This is a full-fledged AI based system and can do wonders if brought into production.

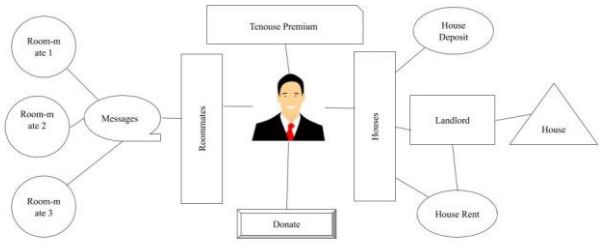

Fig -1: Architecture of the Tenouse Application

3.1 The Landlord Side

The Landlord can simply sign up on the application and after verifying his email, he can sign in into the application. On the Home Screen shown in "Fig-2", all the features of the application will be there. To post the house details, the Landlord can simply go to the create post page as in "Fig-3", and post the cover pic, house interior pic, and other required fields. Once the Landlord hits on Submit button, the CNN model will classify whether the house is a Bungalow, Building or a Row House, and will also classify whether the house is a furnished or an unfurnished house as shown in "Fig-4". After that the house details will get posted and will show in the Find property page and will be visible to all the people looking for a house. Once the tenant shows interest in the house, that is when they can message and share further details to communicate. After the discussion, when the house and the tenant is finalized, the agreement procedures will be done by the Tenouse team. The Tenouse team will be collecting the deposit amount from the Tenant and will be keeping it safe. This will remove the deposit amount insecurity issue. Also Tenouse will be making sure that the tenant is paying the rent on time. The payment can also be done through the Tenouse application, and all the transaction details will be stored for security reasons. This will create a more secured environment between the Landlords and the Tenants.

3.2 The Tenant Side

The Tenant can simply sign up and after verification of email, he can sign in into the application. To find a house, he can navigate to the Rent Property page as shown in "Fig-5", and view all the properties available and show interest in the house of his preference. He will also be able to see how far the hospital, bank, mall and airport from the house is. Also, he can follow any landlord or building owners, so that when they post any property, he will be notified. There is also a page where he can see all the posts of the users he is following. One of the most important common features that everyone can use is the house price prediction system. It is built on the Support Vector Machine Regression model, and has been well trained on the historical data. The Tenants might need a roommate to split the rent, or maybe to study together or hang out together, and He can find a roommate of his preference from this application.

One of the major problems to avoid is the unnecessary flooding of applications for houses or roommates. For example, if someone posts a house seeking for a Tenant, a lot of tenants will connect with the owners regarding the property and there might be chances that the tenant doesn't really need that house, because it does not match his preference. So to avoid this, we have introduced a new concept called the house match score. Based on the house data and the user seeking house preferences, a score will be calculated which will tell the users how relevant the house is to them. A circular progress bar with a score percentage in the UI of the house detailed page will inform the users about the match percentage which will save the users time from the reading the description as well as unnecessarily applying. Refer to "Fig-7".

This house match score can be calculated in the following steps: First, based on all the inputs and description taken from the user while posting the house, build a statement. For example, If city = Pune, house = Bungalow, house interior = Furnished, price = 15000 Rs, we can build the statement as "We are looking for a tenant from Pune location for our Furnished Bungalow priced at Rs 15000". Second, similarly build a statement for tenant based on his inputs, for ex, "I am looking for a furnished apartment at Mumbai for 12000 Rs". Once we have both the statements i.e. X and Y, we can now find the cosine similarity percentage. We will then convert the X and Y statements into vectors and calculate the cosine similarity, since the cosine similarity measures the similarity between two vectors of an inner product space. This similar process can be carried out to find the Behavior Analysis Score to find the perfect roommate.

3.3 The Premium Users

Tenouse will be offering three premium plans as shown in "Fig-8". The bronze plan, which will be the monthly plan, the silver plan, which will be a six months plan, and the gold plan, which will be the yearly plan. Any building owner who has so many apartments to rent will definitely need this plan to promote his houses. Some general landlords who are in a hurry for renting the house, might use it too. The Tenants who are looking for the best houses or to promote

themselves in the roommate section can use the Premium. The promotions and the best house recommendations in the premium feature is based on Sentiment Analysis.

3.4 Marketing Strategies

Tenouse has an admin dashboard where all the Data Analysis will be done. The Data Visualization as shown in "Fig-10" visualizes all the Tenouse Data, so that the Tenouse marketing team can understand where they need to focus and invest at. The Tenouse Premium buyers prediction as shown in "Fig-11" which is built on Naive Bayes Classification model helps to predict which type of user from which place at which time of the year is more likely to buy a Tenouse Premium. The Tenouse Profit prediction shown in "Fig-12" is based on analysis done on the historical data to understand the best season of the year and the best place where maximum profit has been earned, so accordingly marketing strategies can be used to increase the profit during different seasons of the year at different locations. This has been implemented using the Random Forest Regression.

The "Fig-13" represents the Advertisement Analysis, which is implemented using the Thompson's Sampling Algorithm of the Reinforcement Learning. The advertisement for which the reward calculated is high is selected as the optimal ad to display over cross platforms. But the ad performance might still vary from one location to another and hence calculating the rewards based on additional parameters like location, browser, time, etc would be much more beneficial and would save cost to great extent.

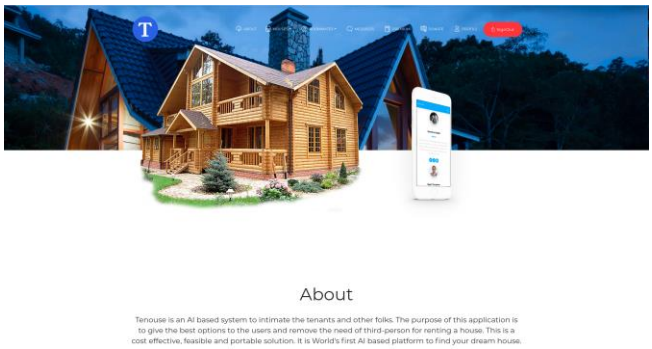

Fig -2: Homepage of the Tenouse Application

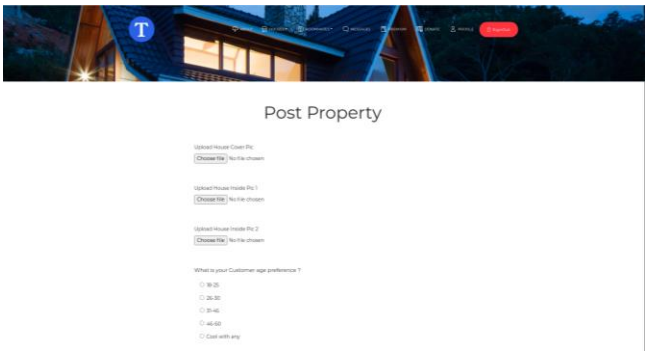

Fig -3: Post Property Page of the Tenouse Application

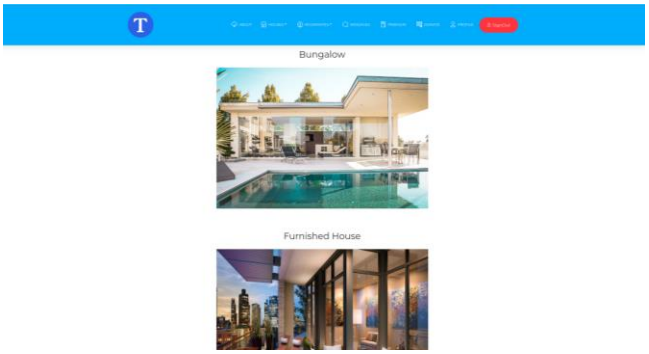

Fig -4: House Classification Page

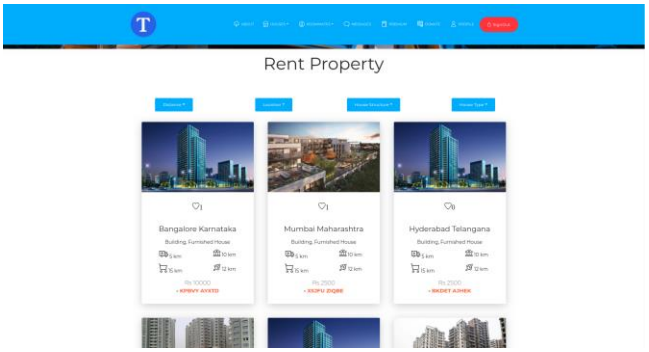

Fig -5: Rent Property Page of the Tenouse Application

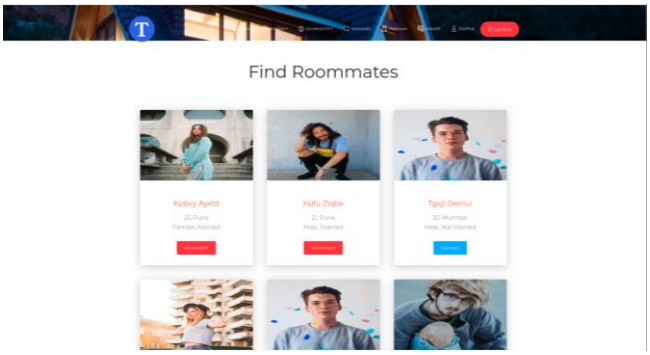

Fig -6: Find Roommates Page of the Tenouse Application

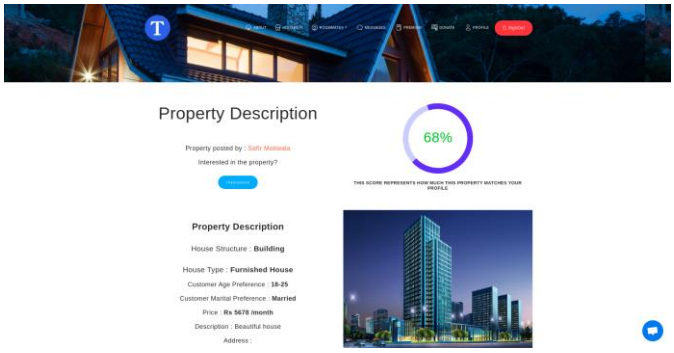

Fig -7: House Match Score Feature

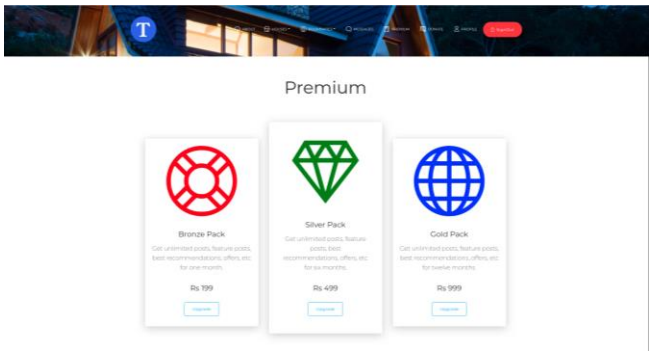

Fig -8: Premium Page of the Tenouse Application

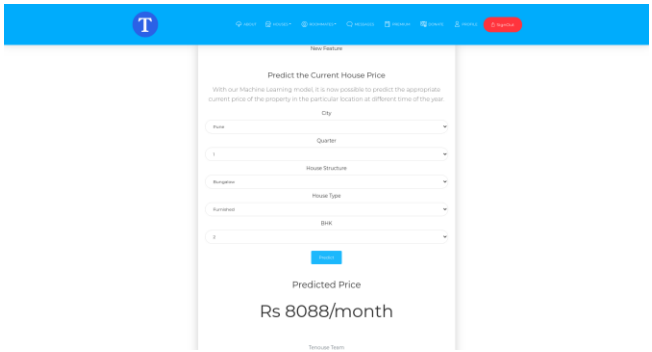

Fig -9: House Price Prediction Page of the Tenouse Application

Fig -10: Data Visualization Page of the Admin Dashboard

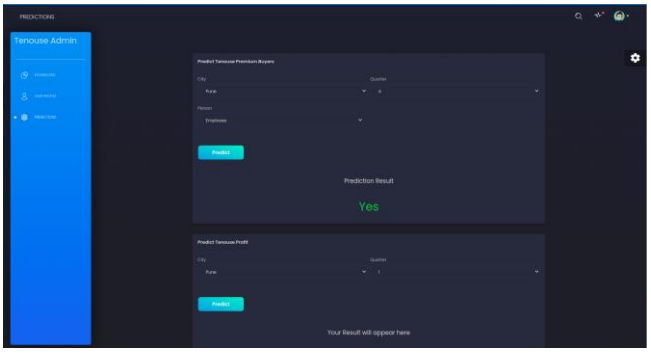

Fig -11: Premium Buyers Prediction Section of the Admin Dashboard

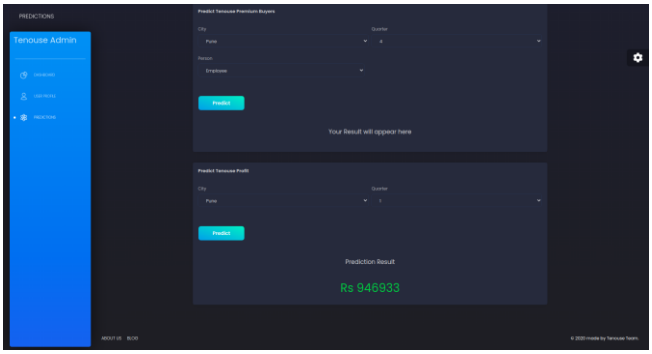

Fig -12: Profit Prediction Section of the Admin Dashboard

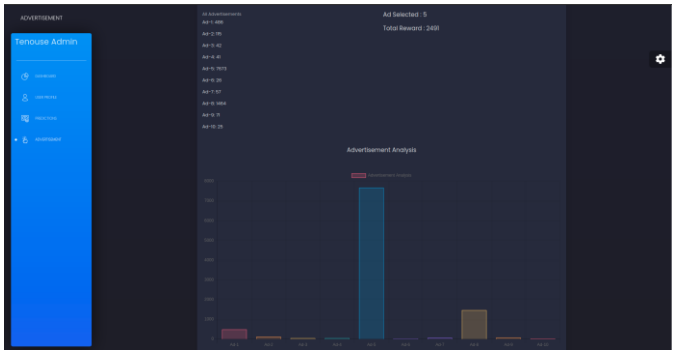

Fig -13: Advertisement Analysis Section

3.5 Personalized Approach

Today, most of the people are active on Social media, and communication platforms like WhatsApp, Telegram, Signal, Facebook Messenger, etc. are always working. An AI based personalized bot connects with the users on these platforms, and helps them perform operations by a single message that they would do instead by logging in on the website or the mobile app. The chatbots can be made by using the specific APIs for specific social media, but the core remains the same. The core personalized chatbot for Tenouse is built with RASA. Rasa is an open source machine learning framework for automated text and voice-based conversations, understanding messages, holding conversations, and connecting to messaging channels and APIs.

The "Fig-14" is an introduction to Chatbot, it verifies the email and logs the user in the platform. Once the user is logged in, he can send "menu" and he will be able to view all the options of the Chatbot as in "Fig-15". The "Fig-16" shows how to post the property on the platform, and when the user uploaded the picture of the house, the AI model immediately classified whether the house is a Bungalow, Building or a Row House. The bot is well trained to understand the sentences the user types and well responds to the user after performing the corresponding action.

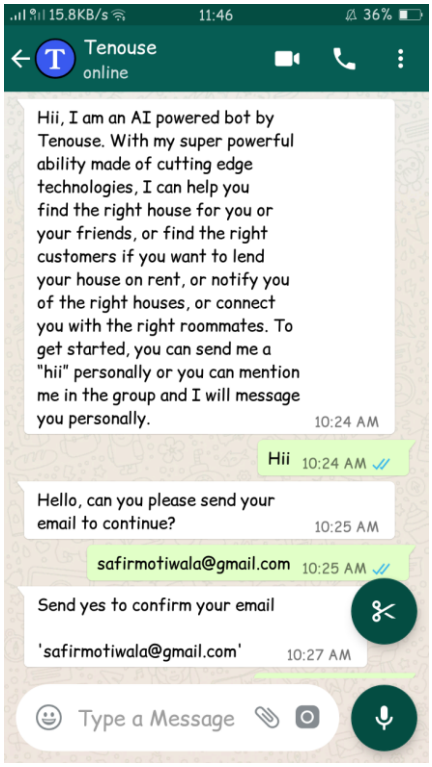

Fig -14: Intro to ChatBot

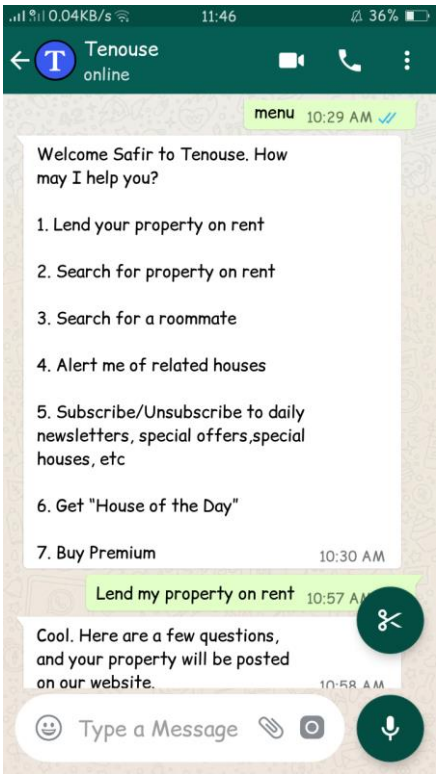

Fig -15: ChatBot menu

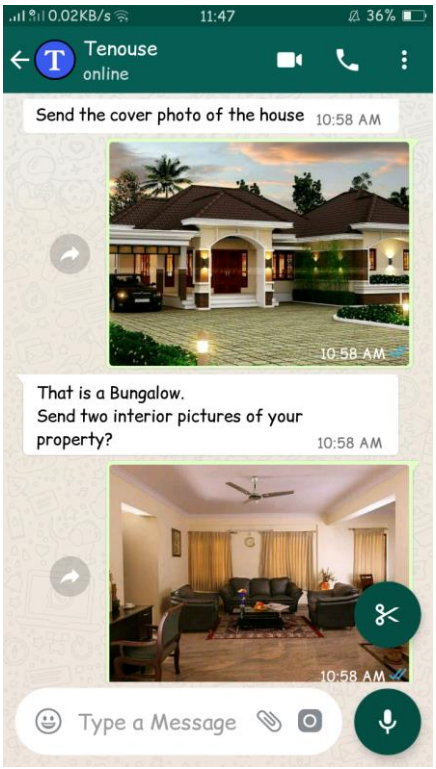

Fig -16: ChatBot menu

3.6 The Mobile App

It is true that a lot of users are interested in using mobile app to check quick updates or to run a task real quick. And so a personalized mobile app that provides all the features required to rent a property or buy a property, to search for a roommate or to predict the house price, etc. Mobile apps leverage the user traffic of the application and makes the process very handy. "Fig-17" represents the mobile app consisting of all the required features.

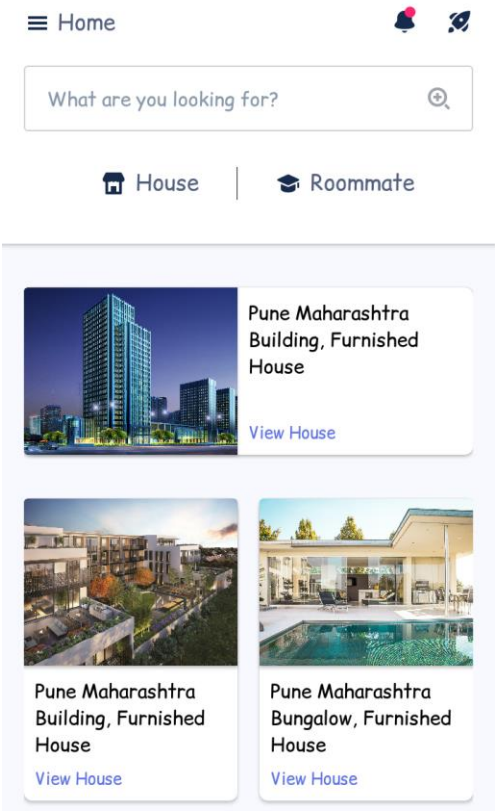

Fig -17: Mobile App

3.7 Innovation Problems

Whenever any innovation has taken place in the history of humanity, a lot of people have always lost their jobs. The innovation does make some lives better, but at the same time ruins some lives. The third person or the agents earns a living by becoming the middle man between the landlord and the tenant, and this innovation will take over their jobs. But, Tenouse won't let their lives ruin. Most of the Real Estate businesses or independent agents have a good network and outreach. So Tenouse will not just make the landlords and tenants lives better, but will also be providing job opportunities to the agents. Since, Tenouse will need a good marketing reach and also Tenouse will be looking after verification of its users, Tenouse will need a bulk of people for these roles. An innovation is a good innovation if it makes the maximum of lives better, but it is the best innovation if it makes everyone's lives better.

3.8 Human Welfare

Since this is a house based application, there will be a donation campaign on the application and shown in "Fig-18", where anyone can donate any amount, and the Tenouse team will use that amount to pay for the living of homeless people. This would help people fight poverty together and would encourage other organizations as well to do the social work.

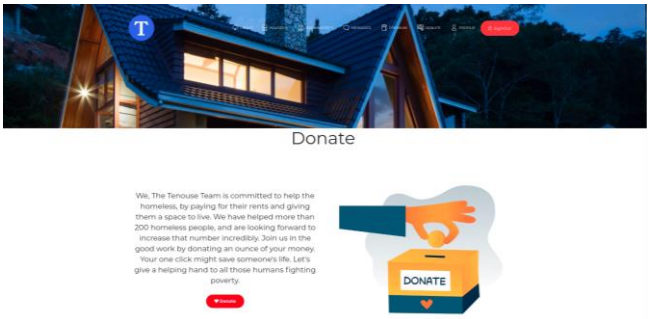

Fig -18: Donation Page of the Tenouse Application

4. RESULTS

This AI based house system makes life simpler and saves a lot of money, efforts and hard work. The Broker's besetting prices bumps into a precarious position. Bellicose communication is totally avoided. The obscure material is inclined in the scale of prominent material. It provides redundant free management, and digital process control and optimization. The personalized AI based application not just grabs the attention but also sustains it. The Machine Learning, NLP, Data Analysis models together make it the smartest application to ever exist in this field.

5. CONCLUSION

In this work we present a smart way to create a system to solve the problem of house reach, finding the right customers, eliminating third-person intervention, owner/tenant deposit/rent insecurity, etc., by building intelligent features which are used for classification, verification, search and match, gamification, smart prediction, visualization, which are powered by Machine Learning, Natural Language Processing and Data Analysis, and is a breakthrough point for the technology to marvelously evolve and excel in this field.

The development of the project and implementation of the idea was completed successfully, and a personalized smart application has been built.

6. FUTURE WORK

More Data Analysis can be added to improve the matching features in the application. Tenant's interest in the houses can be predicted. The buy and sell property feature can be added, which would cover all the core features a house application must have. Also the intelligence of the chatbot can be improved.

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