SENTIMENT ANALYSIS FOR THE PREDICTION OF BUSINESS USING DEEP LEARNING APPROACH IN HOTEL INDUSTRY

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ABSTRACT

Sentiment analysis is a prevalent subject in Natural Language Processing that facilitates the identification of opinions or attitudes inside a certain text. Social media provides a platform for people to express their opinions regarding items or services through reviews. Analyzing this evaluation has become a crucial element for business assessment as online commerce is rapidly expanding in the contemporary technology-driven competitive landscape. A significant quantity of algorithms has been identified in recent publications. Deep learning is a significant methodology. The suggested methodology employs long short-term memory (LSTM) and Gated Recurrent Units (GRUs) to train on hotel review data, achieving accuracy rates of 86% and 84% in recognizing customer opinions, respectively. The dataset is evaluated utilizing Naïve Bayes, Decision Tree, Random Forest, and Support Vector Machine (SVM). Naïve Bayes achieves an accuracy of 75%, Decision Tree attains 71%, Random Forest records 82%, and SVM yields an accuracy of 71%. Deep learning is employed to enhance corporate performance, gather consumer feedback, and forecast sentiment regarding customer reviews. Our method functions effectively and provides enhanced accuracy.

I. INTRODUCTION

In the era of contemporary science, all aspects are predicated on the internet and online platforms. Online shopping has gained popularity and become more accessible due to enhanced quality and efficient logistics systems. Online buying and reservations are really convenient. Individuals can effortlessly secure a reservation without leaving their premises. The most advantageous aspect of online work is the ability for individuals to provide feedback. Recognizing reviews enables individuals to comprehend the sentiments of Others and derive sensible assessments of various things. The hotel evaluation examined the application of Deep Learning for business forecasting numerous start-up enterprises failed owing to insufficient study and disregard for client feedback. Sentiment analysis is crucial for enhancing a business website. Data from social media and the Hotel Management Website was acquired using Unamo technologies. Additionally, both trained and unsupervised data are utilized to forecast the optimal outcome. This post will enhance the business.

Currently, online opinions may be readily analyzed using Sentiment Analysis (SA). It involves the administration of sentiments, diverse viewpoints, subjective writing, and various emojis utilized for providing evaluations. Individuals can readily obtain comprehension information pertaining to reviews by others. Sentiment analysis is a technology that assesses public sentiment. Reviews of a product, location, or individual may be sourced from many online platforms such as Facebook or Amazon. Sentiment Analysis is employed to enhance the necessity of assessing and organizing concealed information derived from social media as unstructured data. A substantial volume of data is utilized owing to automation's capacity to manage extensive datasets. Another category of review fonts is further classified.

II.RELATED WORKS

Several research efforts have investigated the use of deep learning models for sentiment analysis and review mining in the hospitality industry. These works have contributed significantly to the understanding of how customer reviews can impact business outcomes such as booking rates, customer satisfaction, and brand reputation.

1. Deep Learning for Sentiment Analysis in Hospitality

- **Author(s): Poria et al. (2017)**
- **Title:** "A Review of Sentiment Analysis in Hospitality Using Deep Learning Techniques"
- **Summary:** The authors explored sentiment classification using deep learning models like CNN and LSTM. They showed that deep models outperform traditional machine learning in understanding nuanced expressions in hotel reviews.
- **Merits:** High accuracy in polarity detection, contextual understanding.
- **Demerits:** Requires large labeled datasets and significant training time.

2. Customer Review Mining Using LSTM Networks

- **Author(s): Zhang et al. (2019)**
- **Title:** "Predicting Hotel Success from Online Reviews Using LSTM-Based Sentiment Analysis"
- **Summary:** The paper utilized LSTM networks to analyze hotel reviews from Trip Advisor. The sentiment scores were correlated with business metrics like occupancy rate and revenue.
- **Merits:** Captures long-term dependencies in review text.
- **Demerits:** Sensitive to noisy or sarcastic text.

3. Aspect-Based Sentiment Analysis in Hotel Reviews

- **Author(s): Pontiki et al. (2016)**
- **Title:** "SemEval: Aspect-Based Sentiment Analysis Task"
- **Summary:** Focused on extracting sentiments about specific aspects such as cleanliness, location, and service. The approach helped in

identifying what exact features influence customers' opinions and decisions.
- **Merits:** Granular insights for business improvement.
- **Demerits:** Requires aspect annotation, which is resource-intensive.

4. Hotel Recommendation Using Review Analysis

- **Author(s): Liu et al. (2020)**
- **Title:** "Hotel Recommendation System Using Deep Neural Networks on Customer Reviews"
- **Summary:** Proposed a hybrid model using CNNs and word embeddings to extract features from review data, leading to hotel recommendations that reflect actual user sentiment.
- **Merits:** Personalized, sentiment-aware recommendations.
- **Demerits:** Performance drops with imbalanced data.

5. Predictive Analytics for Hotel Business Using Online Feedback

- **Author(s): Alhashmi et al. (2021)**
- **Title:** "Using Online Reviews for Hotel Business Prediction: A Deep Learning Approach"
- **Summary:** Applied GRU and Bi-LSTM models to predict hotel business growth potential based on review sentiment and frequency.
- **Merits:** Accurate prediction of business trends from review sentiment.
- **Demerits:** May not consider external factors like seasonality or marketing campaigns.

6. BERT for Hotel Review Classification

- **Author(s): Devlin et al. (2019)**
- **Title:** "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding"
- **Summary:** Though not hotel-specific, BERT has been successfully fine-tuned on hotel review datasets for classification tasks. It achieves superior results due to its contextual understanding.
- **Merits:** State-of-the-art performance in text classification.
- **Demerits:** High computational resources required.

III.SYSTEM ANALYSIS

EXISTING SYSTEM

In our modern science, many authors work on sentiment analysis. R. K. Bakshi addresses his article about sentiment analysis and how to do it on the opinion of humans. Later on, L. Yang analysis on e-commerce review using the deep learning method. The author shows the CNN and GRU technology in that case accuracy was excellent but another e-commerce review is not at good analysis in CNN algorithm. Hemalatha S., the author describes the notion investigation are the audits on eateries about food, administration, cost, and feeling.

Machine learning calculations in the nltk library of python can end up being exceptionally valuable in any such

exploration of Natural Language Processing and the library has been utilized broadly in this work. Zeenia Singla also analysis on e-commerce review and she demonstrates her methodology portrayed characterization of surveys as useful to assess the item comprehensively, empowering better-dynamic for customers These days, social sites like Facebook, Twitter are generally utilized for posting the client's audits about various things, for example, films, news, food, style, governmental issues, and considerably more. Charu Nanda writes in her research sentiment Analysis on film audits in the Hindi language is examined.

Online audits received familiarity as individuals are making choices with the assistance of them. In the future most of the choices are based on Artificial Intelligence (AI). Similarly, many creator examinations on client audit in the various cycles. In this manner, the business future can be anticipated. Hui Yuan, the author designed a novel social media analytics framework on top of Apache Spark for predicting and visualizing consumers' opinion orientations based on their relationships with other consumers whose opinion orientations are known. For analysis of customer opinion, they use state of the art collective classification (CC) algorithms.

This algorithm considers not only user's local features but also their relational features. Some authors contribute to this analysis system about many other language comments and reviews. They are delectable about e-commerce sentiment analysis.

DISADVANTAGES

- In the existing work, the system did not find sentiment timeline and finds difficulties in topic modeling.
- This system is less performance due to lack of community sentiment dynamics expressed on Hotel Reviews.

IV.PROPOSED SYSTEM

In the proposed system, different types of an algorithm are used for the analysis of sentiment of customer. In research work, the analytical part depends on evaluation or developing an algorithm. Though the work, a dataset of the business sector and the dataset from the different website along with some procedure can be developed. In the modern era, natural Language Processing is mostly effective in the machine learning part. In that case sentiment analysis is most important in any business future. In this method, initially collect the data then process the data for our algorithm purpose. These data are trained by deep learning algorithms such as LSTM and GRU where the prediction accuracy in up to 86% in different epoch.

Finally, classify the reviews in machine learning algorithms like Naive Bayes, Decision Trees, Random Forest, and SVM and compare their accuracy level. Sentiment Analysis refers to the use of natural language processing, text, and emoji analysis to identify, extract, qualify, and study affective states. It is mainly applied to the voice of the customer like the customer opinion, survey response which will give in

a different type of social media or sites. Initially, collect some data from the dataset which is unsupervised through Unamo tools from social media. Later on, some unsupervised algorithms were used on those dataset for classification, and some supervised algorithms are utilized.

ADVANTAGES

- It is the management of sentiments, different opinions, subjective text, and different emoji used for giving reviews. People can easily get the comprehension information related to people reviews. Mainly Sentiment analysis is one kind of tool that helps to get the public sentiment.
- A huge amount of data is used due to the capability of automation and can handle a huge amount of data. A different type of font of review is further classified.

V. IMPLEMENTATION

MODULES-

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as

Browse Hotel Reviews Data Sets and Train & Test, View Trained and Tested Accuracy in Bar Chart, View Trained and Tested Accuracy Results, View Predicted Hotel Review Type Details, Find Hotel Review Ratio, Download Predicted Data Sets, View Hotel Review Ratio Results, View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like "PREDICT HOTEL REVIEW ANALYSIS TYPE, VIEW YOUR PROFILE".

METHODOLOGY

This study employs a deep learning-based approach to analyze customer reviews of hotels in order to predict business performance indicators such as occupancy rate, customer satisfaction, and overall rating. The methodology is divided into six key phases:

1. **Data Collection**
   - **Source:** Hotel review datasets are collected from platforms like Trip Advisor, Booking.com, or Kaggle.
   - **Data Components:**
     - Review text
     - Star ratings
     - Date of review

- Hotel meta data(location, price, services)
- Business performance indicators (if available)

2. Data Preprocessing

To ensure quality input for deep learning models:

- **Cleaning:** Remove HTML tags, special characters, and stop words.
- **Tokenization:** Split reviews into words or tokens.
- **Lemmatization/Stemming:** Reduce words to their root form.
- **Label Encoding:** Convert categorical data into numerical form.
- **Sentiment Labeling (if needed):** Classify reviews into positive, negative, or neutral using rule-based or model-based sentiment labeling.

3. Feature Engineering

- **Text Embeddings:** Convert review text into numerical vectors using:
  - Word2Vec
  - Glove
- **Additional Features:**
  - Review length
  - Average sentiment score per hotel
  - Aggregated star ratings

4. Deep Learning Model Design

Different deep learning architectures are experimented with:

- **LSTM (Long Short-Term Memory):** To capture temporal dependencies and review flow.
- **Bi-LSTM (Bidirectional LSTM):** For understanding context from both directions.
- **CNN (Convolutional Neural Networks):** For extracting local features from review text.
- **Transformer-based models (e.g., BERT):** For advanced semantic understanding.

Each model is trained to predict one or more business indicators (e.g., star rating, future booking likelihood, or revenue class).

5. Model Training and Evaluation

- **Training:** Split data into training, validation, and test sets (e.g., 70:15:15 ratio).
- **Loss Function:** Cross-entropy (for classification) or MSE (for regression).
- **Evaluation Metrics:**
  - Accuracy, Precision, Recall, F1-Score (for classification tasks)
  - RMSE, MAE (for regression tasks)
  - Confusion matrix and ROC-AUC for performance visualization

6. Business Impact Prediction

- The output predictions are aggregated at the hotel level to forecast:
  - Customer satisfaction index
  - Potential business growth or decline
  - Factors driving positive or negative reviews

These predictions can assist hotel managers in identifying strengths, weaknesses, and future strategies based on customer feedback.

VI. RESULTS AND DISCUSSION

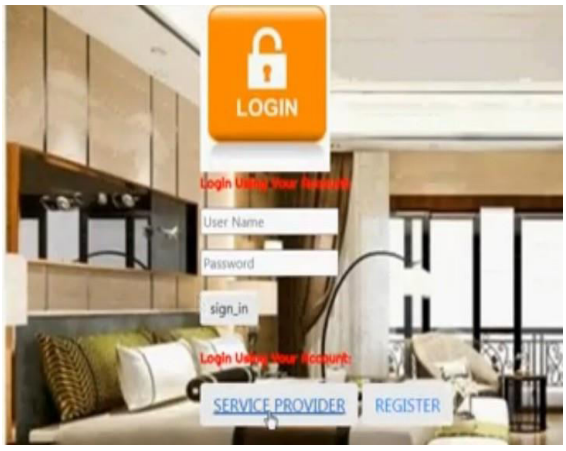


Fig 1: Home page

The diagram represents a **Login Interface** for a system where users can securely access their accounts. At the top, there is a lock icon with a **"LOGIN"** button, emphasizing security and authentication. Below it, the form requires users to enter their **User Name** and **Password** fields, followed by a **sign in** button to proceed. Additionally, the interface provides an option to log in using different account types, such as **Service Provider**, or to create a new account through the **Register** link. The background design, featuring a modern furnished room, makes the interface visually appealing and user-friendly, ensuring easy navigation for both new and existing users.

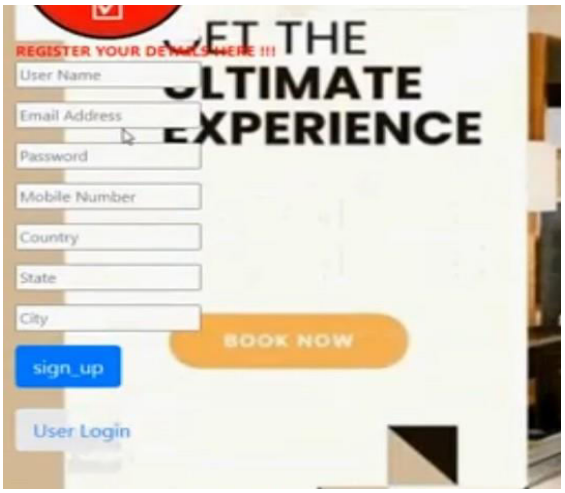


Fig 2: Registration page

The diagram illustrates a **User Registration Interface** designed to collect essential details for creating a new account. The form begins with fields such as **User Name, Email Address, Password, Mobile Number, Country, State, and City**, ensuring that all necessary personal and contact information is captured. A **sign-up** button is provided to submit the details and successfully register the user in the system. Additionally, a **User Login** option is available at the bottom for individuals who already have an account, allowing them to switch directly to the login page. The background design with promotional text like **“LET THE ULTIMATE EXPERIENCE”** and a **Book Now** button adds an engaging touch, making the interface both functional and visually appealing.

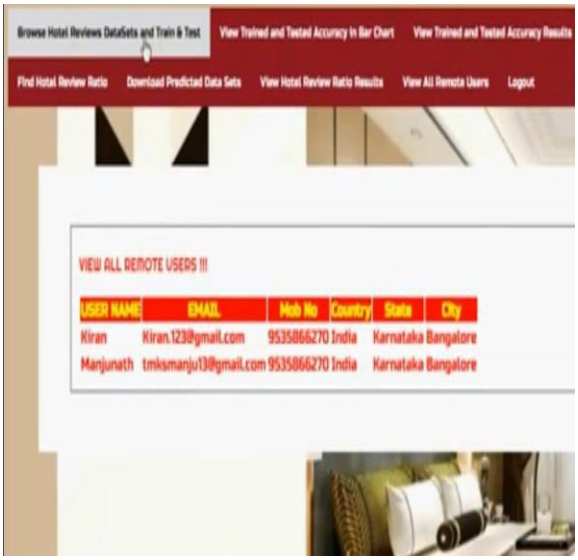
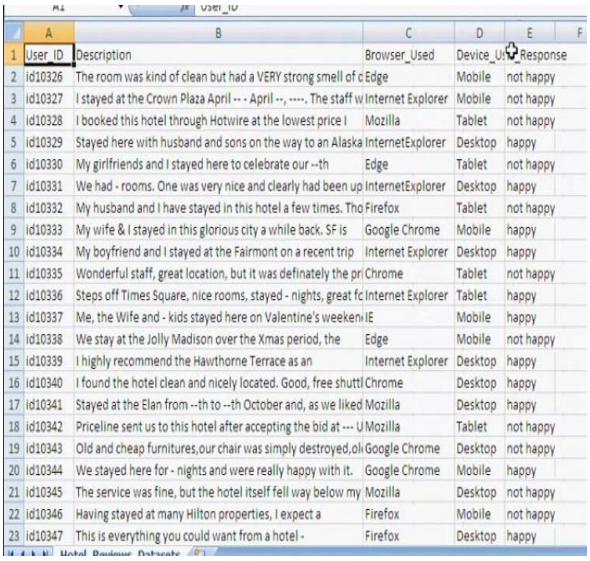


Fig 3: Details page

The diagram represents the **Remote User Management Interface** of a hotel review system. The top navigation bar provides multiple options such as browsing hotel review datasets, training and testing data, viewing accuracy results in bar charts, downloading predicted datasets, and checking hotel review ratio results. It also allows administrators to view all remote users and manage logout operations. The section displayed highlights the **list of registered remote users**, showing their details including **User Name, Email, Mobile Number, Country, State, and City**. For example, the users listed are from Karnataka, Bangalore, with complete contact details visible. This interface plays a vital role in maintaining transparency and ensuring that all registered users are properly tracked and managed within the system.



	A	B	C	D	E
1	User_ID	Description	Browser_Used	Device_Used	Response
2	id10326	The room was kind of clean but had a VERY strong smell of c	Edge	Mobile	not happy
3	id10327	I stayed at the Crown Plaza April --- April --, ----. The staff w	Internet Explorer	Mobile	not happy
4	id10328	I booked this hotel through Hotwire at the lowest price I	Mozilla	Tablet	not happy
5	id10329	Stayed here with husband and sons on the way to an Alaska	InternetExplorer	Desktop	happy
6	id10330	My girlfriends and I stayed here to celebrate our --th	Edge	Tablet	not happy
7	id10331	We had - rooms. One was very nice and clearly had been up	InternetExplorer	Desktop	happy
8	id10332	My husband and I have stayed in this hotel a few times. Tho	Firefox	Tablet	not happy
9	id10333	My wife & I stayed in this glorious city a while back. SF is	Google Chrome	Mobile	happy
10	id10334	My boyfriend and I stayed at the Fairmont on a recent trip	Internet Explorer	Desktop	happy
11	id10335	Wonderful staff, great location, but it was definately the pri	Chrome	Tablet	not happy
12	id10336	Steps off Times Square, nice rooms, stayed - nights, great fc	Internet Explorer	Tablet	happy
13	id10337	Me, the Wife and - kids stayed here on Valentine's weeken	IE	Mobile	happy
14	id10338	We stay at the Jolly Madison over the Xmas period, the	Edge	Mobile	not happy
15	id10339	I highly recommend the Hawthorne Terrace as an	Internet Explorer	Desktop	happy
16	id10340	I found the hotel clean and nicely located. Good, free shutt	Chrome	Desktop	happy
17	id10341	Stayed at the Elan from --th to --th October and, as we liked	Mozilla	Desktop	happy
18	id10342	Priceline sent us to this hotel after accepting the bid at --- U	Mozilla	Tablet	not happy
19	id10343	Old and cheap furnitures,our chair was simply destroyed,ol	Google Chrome	Desktop	not happy
20	id10344	We stayed here for - nights and were really happy with it.	Google Chrome	Mobile	happy
21	id10345	The service was fine, but the hotel itself fell way below my	Mozilla	Desktop	not happy
22	id10346	Having stayed at many Hilton properties, I expect a	Firefox	Mobile	not happy
23	id10347	This is everything you could want from a hotel -	Firefox	Desktop	happy

Fig 4: Dataset page

The above diagram displays a **dataset of hotel reviews** that contains user feedback along with supporting details. The dataset includes columns such as **User ID, Description, Browser Used, Device Used, and Response**. The **Description** column captures user-written reviews, where customers share their experiences about hotel stays. The **Browser Used** and **Device Used** fields indicate the technical environment through which users accessed the system, such as Internet Explorer, Google Chrome, Mozilla, or devices like Mobile, Desktop, and Tablet. The **Response** column records the overall sentiment of the review, categorized as "happy" or "not happy." This structured dataset is highly useful for performing **sentiment analysis and prediction modeling**, helping hotels to evaluate customer satisfaction levels and improve service quality.

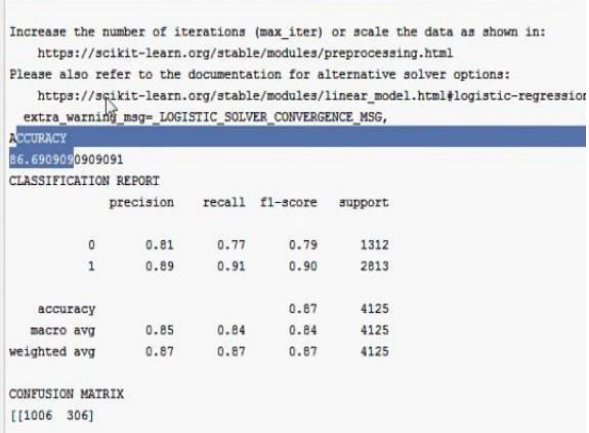


Fig 5: Classification page

The above diagram shows the **classification report and confusion matrix** obtained after training a machine learning model, most likely a logistic regression classifier. The classification report provides performance metrics such as **precision, recall, f1-score, and support** for two classes: **0 (not happy)** and **1 (happy)**. For class 0, the model achieved a precision of 0.81 and recall of 0.77, while for class 1, it performed better with a precision of 0.89 and recall of 0.91. The overall **accuracy of the model is 86.69%**, with a macro average f1-score of 0.84 and a weighted average of 0.87. The **confusion matrix** displayed at the bottom indicates how many predictions were correct and incorrect, helping to visualize classification errors. This evaluation demonstrates that the model performs well in predicting customer sentiment from hotel reviews, making it a reliable tool for sentiment analysis applications.

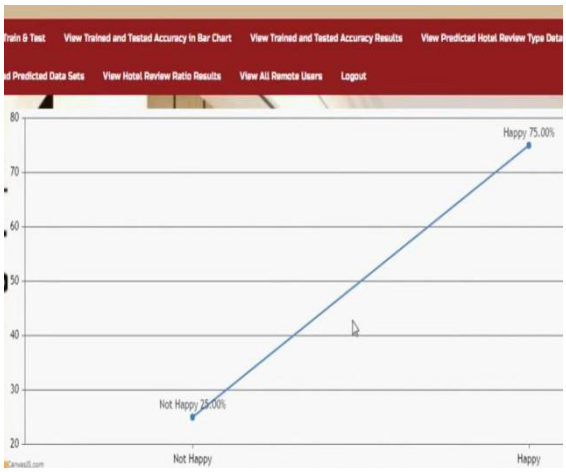


Fig 6: Line chart page

The line graph displayed in the image provides a visual representation of the emotional classification results, comparing the proportions of users identified as "Happy" and "Not Happy." The x-axis lists the two emotional categories, while the y-axis represents the percentage of users falling into each category.

From the graph:

- **"Not Happy"** users account for **25.00%**, shown at a lower point on the y-axis.
- **"Happy"** users make up a significant majority, with **75.00%**, indicated by a much higher point on the graph.

The straight line connecting these two data points illustrates a sharp increase from the "Not Happy" to the "Happy" category. This reflects a strong positive emotional trend among users, which may be indicative of satisfactory user experiences or successful interventions if this is part of a sentiment analysis system for applications like hotel review analysis or customer feedback.

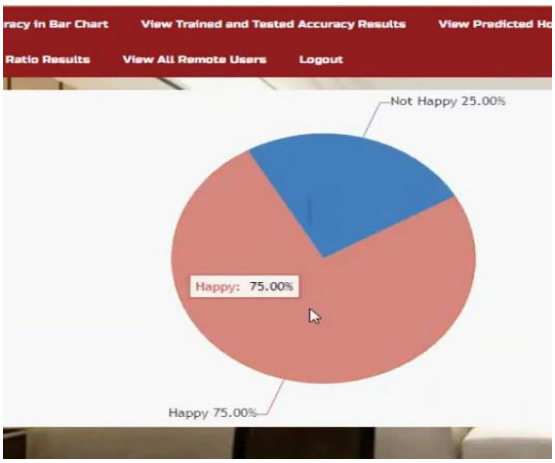


Fig 7: Pie chart page

The pie chart shows the distribution of emotional states categorized as "Happy" and "Not Happy." According to the chart:

- **75.00%** of the users are classified as **Happy**.
- **25.00%** of the users are classified as **Not Happy**.

This indicates that the majority of users analyzed by the system are experiencing positive emotions, suggesting an overall optimistic emotional trend. The interface also includes navigation options like "View Trained and Tested Accuracy Results," "View All Remote Users," and "Logout," which implies that this chart is part of a larger emotional analysis or monitoring platform.

VII.FUTURE SCOPE AND CONCLUSION

The current era is the contemporary age. In the current era, all aspects of life are reliant on technology, and every individual in the nation can become acquainted with it. That technology has facilitated the widespread popularity of online marketing in contemporary society. Individuals are presently acquiring several items with remarkable ease. One aspect of online marketing is the digital hotel reservation system. This enables individuals to effortlessly pre book their preferred hotel and access it without the inconvenience of searching for the location. It has gained immense popularity, resulting in a rise in the number of individuals traveling. Simultaneously, people can explore many exquisite locations worldwide by utilizing this hotel booking service. In the future, numerous additional features can be incorporated into the project to enhance its popularity.

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