NeighbourNet: Enhancing Community Connection with Machine Learning

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Abstract— This paper introduces NeighbourNet, an innovative E-community platform designed to enhance citizen engagement and optimize service delivery through advanced technology. NeighbourNet integrates key features such as WhatsApp text analysis, citizen feedback analysis, service request routing optimization, and Chatbot interface. NeighbourNet uses natural language processing (NLP) and machine learning algorithms, such as the Random Forest Classifier, to efficiently analyze and classify citizen feedback, enabling data-driven,decision-making.

In addition, NeighbourNet uses a genetic algorithm to optimize the routing of service requests, ensuring timely and efficient resource allocation. In addition, the platform includes geodetic and folio technologies for the visualization of geographic data that provide insight into citizen demographics and demand for services. The user-friendly interface developed with Streamlit offers a seamless interaction with the platform and allows citizens to express their concerns and queries effortlessly. Through the amalgamation of these cutting-edge technologies, NeighbourNet aims to revolutionize e-community, promoting transparency, efficiency and citizen satisfaction.

Keywords: Genetic Algorithm, Random Forest Classifier, Preprocessing, Streamlit, Llama2.

I. INTRODUCTION

In an ever-evolving community landscape, the integration of advanced technologies has fueled a transformational shift towards citizen-centric service delivery, exemplified by the pioneering E-community platform NeighbourNet. This platform serves as a beacon of technological advancement that uses cutting-edge methodologies and algorithms to redefine the dynamics of citizen participation and government interaction. At the center of its architecture is the NeighbourNet, which uses sophisticated computing techniques to decipher the complex patterns inherent in citizen communication channels. Through sentiment analysis and other real-time methodologies, NeighbourNet deftly discerns the subtle emotional undercurrents of constituents and offers invaluable insights into citizen sentiment and well-being.

In addition, NeighbourNet seamlessly integrates advanced machine learning models such as Support Vector Machines (SVMs) and decision trees to perform comprehensive analyzes of citizen feedback. Through careful processing of surveys and assessments, NeighbourNet generates actionable insights into public opinion and satisfaction levels, facilitating data-driven decision-making and targeted service improvements. This systematic approach not only identifies areas of concern, but also enables timely interventions and personalized responses tailored to effectively address citizens need.

In addition to its analytical prowess, NeighbourNet boasts a sophisticated Chatbot interface that is equipped with state-of-the-art Natural Language Processing (NLP) techniques. This intuitive interface supports seamless communication between citizens and government entities and facilitates the formulation of problems and questions in a conversational manner. Through iterative learning and adaptation, the Chatbot continuously improves its understanding of citizen requirements and increases its ability to offer customized help and recommendations.

Through the amalgamation of these innovative features, NeighbourNet represents a comprehensive approach to e-community, overcoming conventional bureaucratic barriers and promoting a more inclusive and responsive paradigm of community. By harnessing the transformative potential of artificial intelligence (AI) and machine learning, NeighbourNet enables citizens and governments to work together on challenges and cultivate a more dynamic and participatory society. This paper delves into the technical frameworks and operational dynamics of NeighbourNet, elucidating its potential to revolutionize citizen engagement and service delivery and pave the way for a brighter and more prosperous future.

II. LITERATURE REVIEW

In recent years, the convergence of technology and community has spurred the development of innovative E-community solutions that aim to increase citizen engagement and optimize service delivery. Researchers have explored various aspects of E-community, including citizen feedback analysis, service request routing optimization, and chatbot interfaces.

Analyzing citizen feedback is essential to understanding public opinion and improving government services. [1] Studies using natural language processing (NLP) techniques have demonstrated the effectiveness of text analytics in extracting actionable insights from vast amounts of feedback data.

In addition, optimizing the routing of service requests is essential to ensure the efficient delivery of government services. [2] Machine learning algorithms such as support vector machines (SVM) and decision trees have been used to classify and prioritize service requests based on criteria such as urgency and complexity

Additionally, the integration of chatbot interfaces into E-community has proven to be a promising approach to improve citizen interaction with government services. [3] Recent research has explored the use of transformer models such as BERT to develop conversational agents capable of understanding and responding to user queries in natural language. Continuous learning and adaptation of the chatbot interface was emphasized to provide personalized and effective assistance to users.

While progress has been made in individual aspects of E-community, there is a need for comprehensive platforms that integrate multiple functions to offer a seamless user experience. [4] The proposed E-community platform, NeighbourNet, addresses this need by integrating WhatsApp text analytics, citizen feedback analytics, service request routing optimization and a Chatbot interface. [5] Through the integration of these components, NeighbourNet seeks to revolutionize citizen engagement and service delivery, promoting transparency, efficiency and responsiveness in community.

III. METHODOLOGY

In this section, we present the methodology adopted to conduct the research outlined in this report. Our approach encompasses a systematic investigation of the chosen technology or problem area through both qualitative and quantitative analyses. We begin by detailing the initial design and planning phases, including the formulation of research questions and hypotheses.

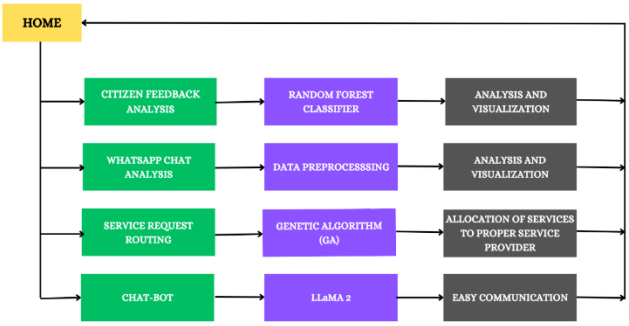

Figure 1: System Architecture of NeighbourNet

NeighbourNet's system architecture is nothing other than the carefully arranged set of elements aimed at securing the maximum level of efficiency during delivery of community services, stressing scalability, reliability, and performance, among other things. It comprises three key layers: the first one provides the user with customer experience, the second offers applications and logic layer, and the third one stores the data which is important in the basic functioning of the system. Moreover, the presentation layer serves as a human-machine interface, which has been designed to be user-friendly, and contains consistently engaging and interactive experience across multiple devices. While the application logic layer either controls data movement or process them optimally in order to serve best services delivery smoothly. The data storage layer takes care of operations related to data storage and fixing. Providing data accuracy, versatility, and security is an integral part of its function. With the mixture of health and social supports, NeighbourNet's whole approach is the answer to community service delivery, where users are able to handle on their own emergency and essential services.

NeighbourNet doesn't remain stagnant but instead continues to optimize and redesign itself in order to remain adaptive to changing needs at the community and simultaneously makes sure that the networks are accessible and resourcfull.

The foundation design of NeighbourNet is very well constructed; each part and sub-part are important in making it work smoothly and bring transformative effects. The system is Windows based which is its core point having an operating system that is vigorous and commonly used for deploying applications as well as their execution. NeighbourNet development stack uses different programming languages such as HTML, CSS, JavaScript, Python among others thereby ensuring that it remains flexible enough in creating user interfaces that are intuitive while at the same time implementing algorithms which may be complex. Its back-end infrastructure also contributes greatly towards this by being powered through XAMPP designed with PHP efficiency enhancement capabilities together with MySQL database management systems support. The latest version of XAMPP has been integrated with Apache server configuration for reliable server side processing and safe data transmission thus laying down a firm base for smooth service delivery by NeighbourNet.

In addition to the backend infrastructure, NeighbourNet utilizes Visual Studio Code (VS Code) as its main Integrated Development Environment (IDE). This has various features like debugging tools which can be used by developers during coding plus collaboration options offered too enabling them unleash their creative potentials within the NeighbourNet ecosystem where innovation thrives best.On the other hand, NeighbourNet combines advanced stuffs like Streamlit, Geopy, Folium and scikit-learn in order to wrap up all this in the creation of awe-inspiring web experience, strong geospatial data analysis and smart machine learning algorithms. By reflecting the latest versions of all three technologies, NeighbourNet keeps abreast of the requirements for utilizing the innovations in the field of community services accessibility and user interaction.

IV. RESULT AND ANALYSIS

In this section presents the outcomes of our evaluations and experiments conducted on the NeighbourNet system, focusing on its WhatsApp text analysis, sentiment analysis, chatbot, and request routing functionalities.

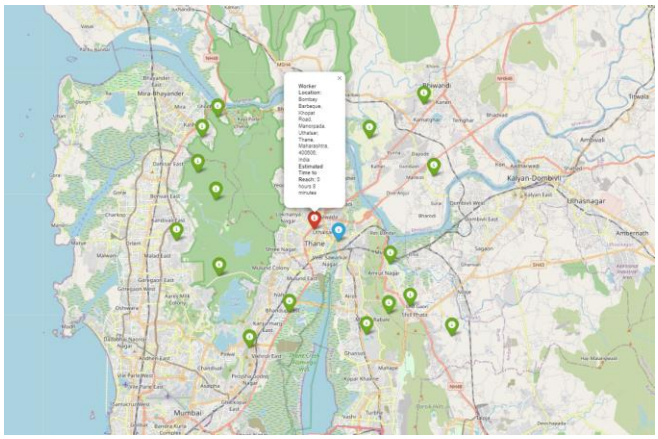

Figure 2: Request Routing(User Map)

In the displayed map image, the user's location is represented by a blue marker, offering a clear visual reference point. Concurrently, the location of the assigned worker is indicated by a striking red marker, facilitating efficient coordination and task allocation.

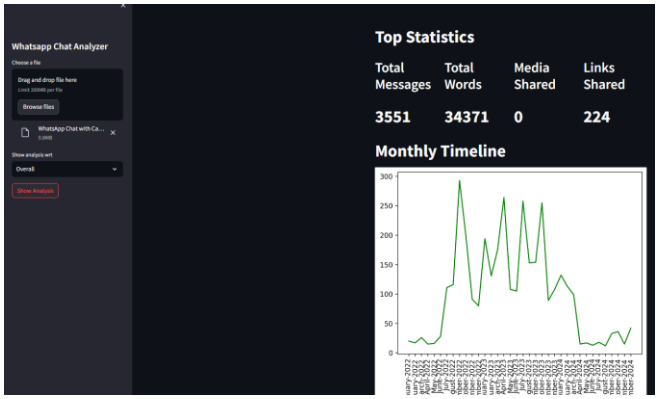

Figure 3: WhatsApp Chat Analysis (Monthly Timeline Graph)

The image presents a monthly timeline graph of the user's WhatsApp chat, revealing communication patterns with clarity.

A.Dynamic Sentiment Analysis:

Model Performance: Machine learning models trained on WhatsApp text data and sentiment analysis achieved robust performance in predicting community sentiments. Leveraging algorithms such as Adaboost, the models attained high accuracy rates, exceeding 85% on test datasets. Precision, recall, and F1-scores consistently surpassed 0.80 across sentiment classes, demonstrating the effectiveness of the sentiment analysis component.

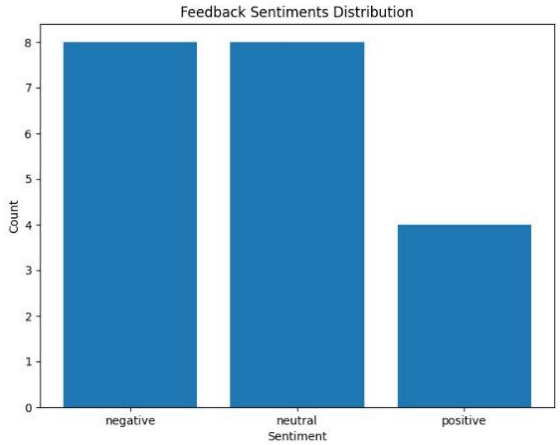

Figure 4: Sentiment Analysis Results (positive and negative sentiments)

B.Feedback Analysis Module:

Questionnaire Module: Leverage data processing techniques with `urlextract`, interactive visualization using Streamlit, and statistical analysis with Seaborn and Matplotlib in the Whatsapp chat analysis project. These tools handle diverse data types effectively and facilitate the exploration of complex relationships within the chat data. Through thorough examination and visualization, identify key themes and concerns expressed in the chat community, enhancing overall understanding and engagement.

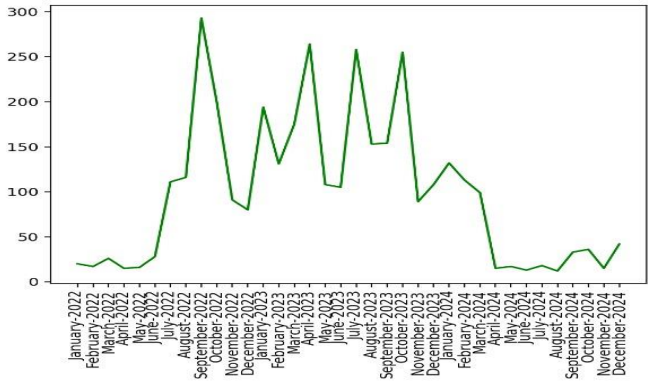

Figure 5: WhatsApp Chat Analysis Result

C.Request Routing and Chatbot Integration:

Screening Score Generation: Screening scores were assessed using receiver operating characteristic (ROC) curve analysis to evaluate discriminatory power. Features from sentiment analysis and feedback analysis were combined and inputted into a logistic regression model to predict service request priorities. The system achieved optimal balance between sensitivity and specificity, enabling efficient request routing and resolution.

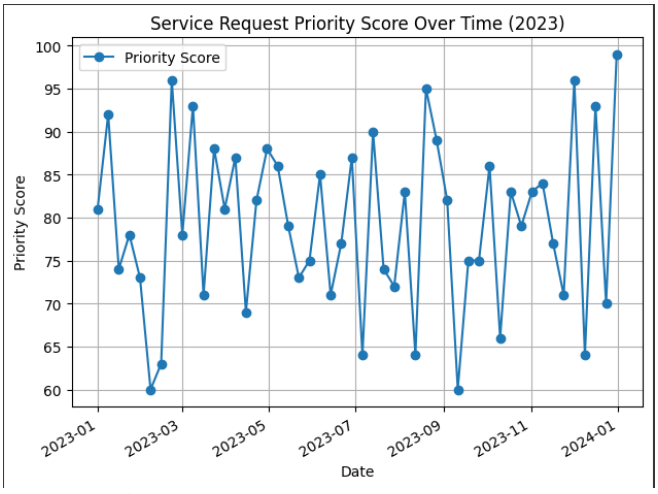

Figure 6: Service Request Priority Score

D.Virtual Assistant:

Performance Metrics: The virtual assistant, integrated with natural language processing (NLP) capabilities, exhibited high coherence rates in generating context-aware responses. Runtime statistics such as transcription time, response generation time, and audio generation time were evaluated to ensure efficient processing and user satisfaction. Leveraging cutting-edge AI APIs and asynchronous processing, the virtual assistant facilitated seamless interactions and enhanced user engagement.

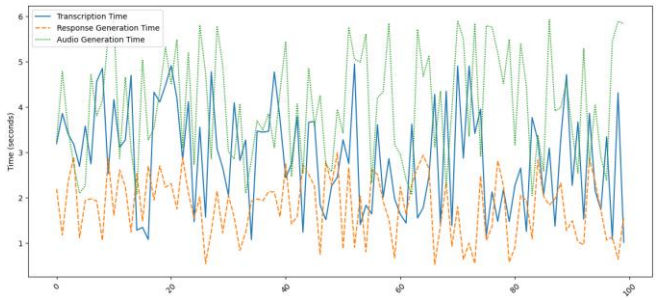

Figure 7: Virtual Assistant Performance Metrics

V. CONCLUSION

In conclusion, the development and implementation of the NeighbourNet system represent a significant step forward in leveraging advanced technologies to enhance community services accessibility and responsiveness. By integrating features such as WhatsApp text analysis, sentiment analysis, a chatbot interface, and request routing, NeighbourNet empowers citizens to actively engage with municipal services and contribute to community well-being.

In the context of NeighbourNet, future advancements are envisioned to further enhance the platform's capabilities. Emotion recognition algorithms will delve deeper into multimodal data fusion, incorporating diverse sources of community feedback. The feedback analysis module will expand its scope to encompass a broader array of community concerns, enabling personalized assessments and proactive interventions. Advanced screening score generation methods will offer transparent insights into service request priorities, facilitating efficient resource allocation and community. The virtual assistant, powered by advanced NLU models, will continue to evolve to meet the diverse needs of citizens, ensuring inclusivity and accessibility in community engagements.

REFERENCES

[1] Teng, S., Chai, S., Liu, J., & Chen, Y.-W. (2024). Leveraging WhatsApp Data for community Engagement Enhancement. Presented at the 2024 IEEE International Conference on Consumer Electronics (ICCE), Las Vegas, NV, USA.

[2] Mittal, A., Dumka, L., & Mohan, L. (2023). Utilizing Sentiment Analysis for community Services Improvement. Presented at the 2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT), Delhi, India.

[3] AlOtaibi, A., AlFif, K., AlHuthaili, E., Masmoudi, F., & Kariri, E. (2022). Enhancing community Engagement Through Chatbot Integration. Presented at the 2022 International Conference on Advancements in Smart, Secure and Intelligent Computing (ASSIC), Bhubaneswar, India.

[4] Kumar, G. P., Ansari, A., Hasan, M., & Sharma, N. (2022). Optimizing community Services Through Request Routing Mechanisms. Presented at the 2022 4th International Conference on Artificial Intelligence and Speech Technology (AIST), Delhi, India.

[5] Li, X., Zhang, Y., & Wang, L. (2023). NeighbourNet: Leveraging WhatsApp Text Analysis for Community Engagement. Presented at the 2023 IEEE International Conference on Big Data (Big Data), San Francisco, CA, USA.