SMART ASSISTANT SYSTEM FOR ALZHEIMER'S PERSON

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ABSTRACT

Alzheimer's disease (AD) presents significant challenges for both patients and caregivers. This paper proposes a smart assistant system designed to improve patient safety, independence, and quality of life. The system leverages machine learning algorithms and a user-friendly mobile application. Machine learning techniques such as LSTM (Long Short-Term Memory), SVM (Support Vector Machine), Logistic Regression, Random Forest, and others are employed for various functionalities. Real-time location tracking and geofencing utilize sensor data to ensure patient safety and prevent wandering. Personalized reminders and schedule management support medication adherence and daily routines. Anomaly detection based on activity patterns can identify potential dangers or health risks. The application is developed using Flutter, a cross-platform framework, for a user-friendly interface accessible to both patients and caregivers. Firebase serves as the backend, providing secure data storage (including medical records, anonymized if applicable) and real-time functionalities for functionalities like alerts and notifications. This project outlines the system design, explores the potential benefits for patients and caregivers, and discusses the ethical considerations involved in developing such a technology. The project aims to contribute to advancements in AD care by offering a technological solution that empowers patients and eases caregiver burdens.

Keywords:- *LSTM, Real-time location tracking, Personalized reminders and schedule management support.*

1. INTRODUCTION

Alzheimer's disease is a neurodegenerative disease that often affects the brain, causing cognitive impairment and memory loss. It is most often caused by dementia, a term used to describe a group of symptoms associated with memory loss or other cognitive impairments that are severe enough to reduce a person's ability to perform daily tasks. Dementia Features of Alzheimer's disease include the buildup of abnormal proteins called beta-amyloid plaques and tau tangles in the brain. These deposits interfere with intercellular communication, eventually leading to cell death. Symptoms of Alzheimer's disease often begin with memory loss and difficulty performing daily tasks. As the disease progresses, people may experience more memory loss, confusion, behavioural changes, and problems with speech and problem solving. In the next stage, the person will become dependent on others. The cause of Alzheimer's disease is not fully understood, but a combination of genetics, environment and lifestyle are believed to play an important role. developed. Age is also an important risk factor; The risk of Alzheimer's disease increases with age. There is currently no cure for Alzheimer's disease, but various treatments and interventions can help control symptoms and improve the quality of life of affected individuals. Ongoing research aims to better understand the mechanisms underlying the disease and develop better treatments.

2. LITERATURE SURVEY

R. Reena et al (2023) proposes a smart belt embedded with Arduino UNO and GPS to address challenges faced by Alzheimer's patients, focusing on difficulties in daily activities and navigation. The smart belt, equipped with sensors, continuously monitors the patient's location and health, detecting increased heart rate and sending alerts to caretakers. It also features a speaker module for communication, aiding patients with mild to moderate Alzheimer's in daily life and providing a comprehensive support system.[1]

Rajesh Arunachala et al (2023) discovered Alzheimer's prediction model employing IoT and deep structured architectures for early detection Alzheimer. The research utilizes an enhanced deep residual network–long short-term memory (DRN-LSTM) for initial patient detection, incorporating a parameter-improved horse herd optimization algorithm (PI-HHO) for optimal feature selection and enhanced deep convolutional network (DCN) and deep residual network (DRN)-based detection. The system monitors audio, data, and video data from sensors to predict abnormalities using enhanced DNN + LSTM with PI-HHO. Abnormal patients are then alerted to nearby hospitals for appropriate treatment. The proposed model achieves a high accuracy and precision rate respectively, demonstrating superior performance compared to other algorithms in Alzheimer's patient monitoring.[2]

R. Chokri et al (2022) introduces a comprehensive wearable prototype for Alzheimer's patients, incorporating features such as image classification (family/non-family member using CNN), location tracking, secure image transmission via steganography, communication through voice messages, and integration with Google Assistant. The prototype aims to provide psychological support, enhance safety, and assist individuals with mild to moderate Alzheimer's. Results indicate its effectiveness in accurately detecting family members in images compared to benchmark techniques.[3]

B. Swasthik et al (2020) focused on leveraging advanced electronic technology to assist individuals with Alzheimer's disease in their daily tasks. The proposed solution is a wearable personal assistant that includes features such as an event reminder, location detector, fall sensor, and emergency Panic or SOS button. The wearable module, equipped with a display and built-in power supply, is designed to address memory, navigation, and health monitoring needs. Caretakers input pill-taking schedules, stored in a database, while the main project objectives include path tracing, navigation, emergency contacts, and health monitoring for Alzheimer's patients.[4]

X. Hong et al (2019) studied that the significance of early diagnosis in Alzheimer's Disease (AD) and highlights a gap in current research focusing on predicting disease progression. Author proposed solution by implementing Long Short-Term Memory (LSTM), a type of recurrent neural network, to leverage temporal data for predicting the development of AD stages. The LSTM model, incorporating fully connected and activation layers, demonstrates superior performance compared to existing models in experiments, showcasing its potential for accurate prediction and early intervention in Alzheimer's Disease.[5]

3. METHODOLOGY PROPOSED

The Smart Assistant System for individuals with Alzheimer's, incorporating Flutter for app development and LSTM machine learning algorithms, addresses several critical needs in the current market scenarios:

1. Rising Aging Population: With an increasing aging population globally, there is a growing demand for technologies that cater to the unique needs of individuals facing age-related cognitive challenges. The project can help fill this gap by providing valuable assistance and support.
2. Caregiver Burden: Alzheimer's often places a significant burden on caregivers. A smart assistant system can offer much-needed relief by providing tools for remote monitoring, communication, and timely alerts, allowing caregivers to provide better care and support.
3. Technology in Healthcare: The integration of technology in healthcare is a growing trend. A smart assistant system for Alzheimer's aligns with this trend, offering innovative solutions to enhance patient care, improve communication, and provide valuable health insights.
4. Personalized Healthcare Solutions: The project's use of LSTM for machine learning enables personalized solutions by adapting to the individual's behavior and cognitive changes over time. Personalization is increasingly valued in healthcare to improve the effectiveness of interventions.

5. Cross-Platform Accessibility: Leveraging Flutter for app development allows the system to be accessible across multiple platforms, making it versatile and widely available to users regardless of their device preferences (iOS or Android).
6. Remote Monitoring and Telehealth: In light of global events such as the COVID-19 pandemic, there's a growing emphasis on remote monitoring and telehealth solutions. The smart assistant system can contribute to these efforts by enabling remote health tracking and communication between individuals with Alzheimer's and healthcare providers.
7. Data-Driven Healthcare: The project's use of LSTM algorithms enables data-driven insights. Analysing trends and anomalies in health data can lead to more informed decision-making by caregivers and healthcare professionals, contributing to better healthcare outcomes.
8. Mental Health and Well-being: Addressing the mental health and well-being of individuals with Alzheimer's is crucial. The cognitive stimulation activities, communication support, and memory assistance features in the project can contribute significantly to improving the overall quality of life for these individuals.
9. Increasing Awareness of Alzheimer's: As awareness of Alzheimer's disease continues to grow, there is a heightened focus on developing solutions that address the unique challenges faced by individuals with cognitive impairments. The project aligns with this trend by providing targeted support.
10. Ethical Tech Solutions: Ethical considerations in technology are gaining prominence. Developing a smart assistant system with robust privacy features and user control aligns with the increasing demand for ethical and responsible technology solutions.
In summary, the Smart Assistant System for Alzheimer's, utilizing Flutter and Machine Learning Algorithms, aligns with current market needs by addressing the challenges faced by individuals with Alzheimer's and their caregivers, leveraging technology to improve care, and contributing to the broader trends in healthcare and aging populations.

3.1. Selection of Components:-

- Language used: Python.
- Frontend framework used for application development:- Flutter.
- Database Handling Services: firebase.
- Machine Learning Algorithms used:- LSTM/ Linear SVC/ Random Forest/ Logistic Regression/ Decision Tree/ rbf SVM classifier.

A. Python:-

Python is commonly chosen as the programming language for implementing machine learning algorithms in projects like the Smart Assistance System for individuals with Alzheimer's, especially when using platforms like Google Colab. Several factors contribute to the popularity of Python in the context of machine learning:

Advantages of using Python:-

- **Extensive Libraries and Frameworks:** Python has a rich ecosystem of libraries and frameworks spec ifically designed for machine learning, such as TensorFlow, PyTorch, and Scikit-learn. These libraries provide pre-built functions and modules that simplify the implementation of complex machine learning algorithms, including LSTM and SVM.
- **Google Colab Integration:** Google Colab is a cloud-based platform that provides free access to GPUs and TPUs, making it an attractive environment for running machine learning experiments. Colab supports Python natively, and its integration with popular Python libraries makes it a convenient choice for prototyping and implementing machine learning algorithms.

B. Flutter:-

Flutter is a powerful open-source framework for creating custom scripts for mobile, web, and desktop from a single source code. It has a rich set of pre-designed components, hot reload feature for faster development and efficient operation.

Advantages of using Flutter:

- **Cross-platform development:** Flutter can create applications that can run on iOS and Android platforms, thus reducing development time and costs.
- **Beautiful and consistent user interface:** Flutter provides a customizable and intuitive user interface, ensuring a consistent user experience and visual quality across devices.
- **Accessibility:** Flutter supports accessibility features, making it suitable for creating immersive user interfaces.

C. Firebase:-

Firebase is Google's mobile and web development platform. The backend functionality includes many services for live databases, authentication, and cloud storage.

Advantages of using Firebase:-

- **Real-time repository:** Firebase's real-time repository allows seamless synchronization of data transfer between devices, which is important for a collaborative environment.
- **Authentication:** Firebase Authentication ensures data privacy and security by providing secure and direct user authentication.
- **Cloud Functions:** Firebase Cloud Functions supports serverless backend logic to support scalability and responsiveness.

D. Machine Learning Algorithms: -

1. **LSTM (Long Short-Term Memory):**
- LSTM is well-suited for sequential data processing tasks, making it ideal for speech recognition and natural language processing in the smart assistant system.
- It can effectively model long-term dependencies in user interactions and preferences, enabling personalized assistance and memory augmentation.

2. **SVM (Support Vector Machine) Classifier:**
- SVM is a powerful algorithm for classification tasks, which can be used for sentiment analysis and classifying user inputs into categories such as positive, negative, or neutral.
- It offers high accuracy and robustness, making it suitable for handling diverse types of data and input features.

3. **Logistic Regression:**
- Logistic regression is a simple yet effective algorithm for binary classification tasks, such as predicting the likelihood of a user completing a specific action (e.g., medication adherence).
- It provides interpretable results and can serve as a baseline model for comparison with more complex algorithms.

4. **Linear SVC (Support Vector Classifier):**
- Linear SVC is suitable for multi-class classification tasks, such as categorizing user queries or requests into different types of assistance needed.
- It offers good scalability and can handle large datasets efficiently, making it suitable for real-time inference in the smart assistant system.

5. **Decision Tree:**
- Decision trees are interpretable models that can capture complex decision boundaries and interactions between features.
- They can be used for tasks such as personalized recommendation and adaptive assistance based on user preferences and contextual factors.

6. **Random Forest:**
- Random forests are ensemble learning methods that combine multiple decision trees to improve prediction accuracy and robustness.
- They are well-suited for tasks such as user profiling and behaviour analysis, where capturing subtle patterns and interactions is important.

4. RESULT AND DISCUSSION

The image of the activities performed by user is shown below:-

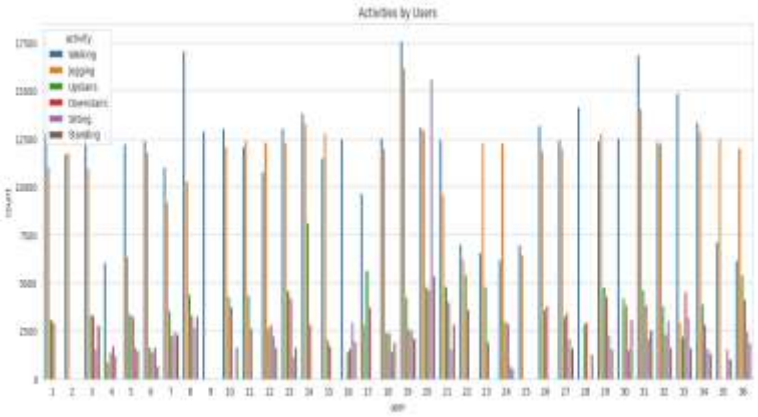

Figure 1 Activities by users

Activity	No of Samples	Percentage
Number of data points in class Walking	424397	38.64%
Number of data points in class Jogging	342176	31.16%
Number of data points in class Upstairs	122869	11.19%
Number of data points in class Downstairs	100427	9.14%
Number of data points in class Sitting	59939	5.46%
Number of data points in class Standing	48395	4.41%
Total	1098203	100%

Table 1. Number of Samples collected

After training and testing all the data set collected from gyroscope we have obtained the following result.

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** Machine Learning Model Comparision **
+---------------------------------+
|       Model Comparision         |
+---------------------+-----------+
|      Model Name     | Accuracy  |
+---------------------+-----------+
| Logistic Regression |  95.89%   |
|     Linear SVC      |  96.04%   |
|  rbf SVM classifier |  96.27%   |
|     DecisionTree    |  87.65%   |
|    Random Forest    |  92.06%   |
|         LSTM        |  96.15%   |
+---------------------+-----------+
```

Figure 2Accuracy Graph

From the above image we can clearly see that Linear SVC have performed well with accuracy score of 96.04%. While, LSTM have slightly higher score as compared to Linear SVC and comparatively scored a accuracy of 96.15%.

The home page and login page of mobile application is shown below:-

The Key Features of mobile application are as below:-

1. Separate login access for patient and family member or caretaker.

2. Emergency Contact of family member.

3. The app contains details of Patient medical Records and patient's family members details.

4. Live Location Tracking.

5. Scheduling task and sending alert messages to patient.

Figure 3 Home Page

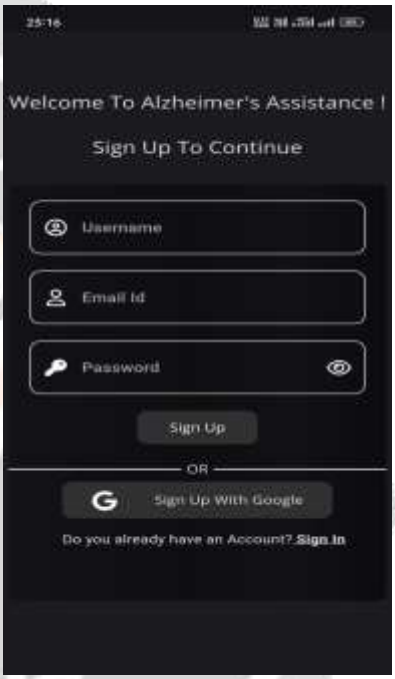

Figure 4 Login Page

5. CONCLUSION

A smart assistant system for Alzheimer's patients, leveraging machine learning and a user-friendly mobile app, has the potential to significantly improve patient safety, independence, and quality of life. This project proposes a framework that utilizes various machine learning algorithms (LSTM, SVM, Logistic Regression, Random Forest) alongside Flutter for app development and Firebase for data management. By combining location tracking, personalized reminders, anomaly detection, and activity monitoring. By addressing these considerations and focusing on user-centered design, this smart assistant system can become a valuable tool for supporting individuals with Alzheimer's disease and their caregivers. This project has the potential to not only improve the lives of patients but also contribute to advancements in Alzheimer's care and research.

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