REACH: Remote Elderly Assistance and Care Hub

KUSHAL S GOWDA[1], NEHA B K[2], SANJANA V[3], VISHAL S B[4], YAMINI SAHUKAR P[5]
[1, 2, 3, 4] *Student, Department of Artificial Intelligence and Machine Learning, Bangalore Institute of Technology, Bangalore, India*
[5] *Assistant Professor, Department of Artificial Intelligence and Machine Learning, Bangalore Institute of Technology, Bangalore, India*

Abstract— The global demographic shift towards an aging population, the demand for advanced and accessible solutions for elderly care intensifies. This initiative addresses the challenge by leveraging NLP capabilities, facilitating seamless and natural communication between elderly users and the application. Speech recognition enables seniors to effortlessly articulate their needs, while sentiment analysis ensures a nuanced understanding of their emotional states. The personalized assistance feature encompasses crucial aspects of daily living, including medication reminders, health monitoring, and emergency responses, enhancing overall well-being. The user-friendly interface of the Android application prioritizes simplicity and accessibility, catering specifically to the unique requirements of the elderly demographic. The harmonized widespread use of Android devices with the sophistication of NLP is aimed to establish a comprehensive, compassionate, and user-centric solution, contributing significantly to the enhancement of elderly care services in an era marked by a growing aging population.

Index Terms- Natural Language Processing (NLP), Mental health chatbot, Medication Management, Home Based Care Services.

I. INTRODUCTION

"REACH" revolves around the development of a user-centric Android application tailored to address the multifaceted challenges associated with ensuring the wellbeing of the elderly. The application is designed to seamlessly integrate real-time health tracking, secure communication features, and emergency notifications. At its core, the primary objective is to empower both the elderly individuals and their caregivers with a comprehensive tool that enhances health monitoring, fosters secure communication, and expedites emergency response. In terms of health tracking, the application will leverage real-time data collection mechanisms to monitor vital health metrics such as heart rate, blood pressure, and physical activity. This information will be presented in an accessible and user-friendly interface, allowing both seniors and their caregivers to track health trends over time. The goal is to provide actionable insights that facilitate proactive health management. The secure communication aspect of the application aims to bridge the gap between elderly individuals and their support networks. Features like video calls, messaging, and voice communication will be incorporated, prioritizing user-friendly interfaces for seniors. Privacy and security will be paramount, ensuring that sensitive health information and personal communication remain protected. In emergency situations, the application will employ a robust notification system to alert designated contacts or emergency services promptly. This feature can be triggered by predefined health thresholds or manually activated by the user. The goal is to expedite response times during critical moments, providing a safety net for elderly individuals living independently.

II. EXISTING SYSTEM

Artificial Intelligence (AI) tools and applications have significantly impacted elderly healthcare. These technologies aim to enhance the quality of life for elderly people by understanding the impact of information and communication technologies. Machine Learning (ML), Natural Language Processing (NLP), and Deep Learning models are considered important technologies used for AI-based elderly healthcare solutions. These technologies are used in various applications such as diagnosis and treatment applications, administrative applications, and more. Moreover, AI-based healthcare monitoring can help generate actionable information which could be used to enhance clinical workflow while reducing the risk levels for adverse events regarding elderly and at the same time improve timely access to appropriate care [17].

These systems are available for online video conferencing and danger detection. People use these kinds of systems but without any innovativeness, this system includes monitoring the elders and their abnormal behaviours detection. However, caring for someone from afar poses its own set of issues, modern technology, such as caregiver alert systems and geriatric monitoring gadgets, may provide you with peace of mind and a helping hand [14].

III. EXISTING DRAWBACKS

Moreover, data security and privacy are issues for the educational platforms that are now in use. As data collecting and analytics have grown in popularity, worries about user Insufficient coding expertise in manual ICD coding systems presents several significant drawbacks for healthcare organizations. Due to staffing constraints and resource limitations, maintaining an adequate number of skilled coding professionals becomes challenging. This shortage often results in a mismatch between assigned ICD codes and actual medical conditions, leading to discrepancies in healthcare planning and medical expense disbursement. Moreover, the lack of coding expertise exacerbates the challenges associated with manual ICD coding, impeding the timely and accurate processing of medical records. Streamlining coding workflows and optimizing coding accuracy also become problematic. This Existing systems in elderly care often comprise fragmented solutions, each addressing specific facets such as health monitoring, communication, and emergency notifications. Health monitoring applications typically employ algorithms for real-time data collection and analysis, utilizing sensors to track vital signs like heart rate and activity levels. However, these systems often operate in isolation, lacking seamless integration with other essential components, resulting in an incomplete overview of an individual's well-being. Communication applications designed for the elderly generally utilize standard messaging and video call algorithms. Emergency notification systems, on the other hand, typically rely on predefined triggers or manual activation. Additionally, concerns regarding privacy and security may arise due to the potential sharing of sensitive data between disparate systems their ability to access virtual consultations and other digital healthcare services. Moreover, telehealth solutions, while beneficial in many ways, have limitations in conducting physical examinations remotely, which can lead to incomplete assessments of an individual's health. Additionally, false alarms generated by health monitoring devices can create unnecessary stress and anxiety for both the elderly individuals and their caregivers. These false positives undermine the trust in the system's reliability and effectiveness, highlighting the need for improved accuracy and reliability in monitoring technologies. To address these issues comprehensively, there is a pressing need for integrated solutions that prioritize user-friendliness, accuracy, and privacy while bridging the gap between different facets of elderly care.

IV. PROBLEM STATEMENT

To develop a user-centric android application integrating real-time health tracking, secure communication, and emergency notifications to address the challenges faced in ensuring the well-being of the elderly.

V. PROPOSED METHODOLOGY

The proposed Android application is an innovative solution designed to address the pressing challenges associated with elderly care amid a global demographic shift towards an aging population. With a steadfast commitment to user-centric design, the system prioritizes the creation of a user-friendly interface tailored specifically to meet the unique needs and preferences of elderly individuals. Central to its design philosophy is the unwavering emphasis on data privacy and security, underpinned by robust encryption protocols and stringent security measures, ensuring the utmost confidentiality and instilling unwavering trust among users.

In its comprehensive suite of features, the application integrates essential healthcare management tools aimed at facilitating seamless navigation of healthcare needs for seniors, ranging from intuitive medication reminders to streamlined access to telehealth services, thereby empowering elderly individuals to take proactive control of their health and well-being. Safety remains paramount, with the inclusion of features such as panic buttons and GPS tracking, serving as a lifeline

in emergency situations and providing reassurance to both seniors and caregivers alike. Communication, a vital aspect of elderly care, is elevated to new heights through the incorporation of adaptive interfaces and advanced natural language processing (NLP) algorithms, enabling intuitive and personalized interaction tailored to the unique communication styles and preferences of elderly users.

Moreover, through continuous analysis of communication patterns and user feedback, the system iteratively refines its usability, ensuring an optimized user experience that evolves in tandem with the evolving needs of its elderly audience. Crucially, end-to-end encryption is employed to safeguard privacy and confidentiality during communication, addressing potential concerns and fostering a sense of security and confidence among users. In essence, the proposed Android application emerges as a beacon of innovation in the field of elderly care, poised to revolutionize the landscape by seamlessly integrating technological advancements with empathetic design principles, thereby enhancing the quality of life for seniors and alleviating the burdens faced by caregivers in an increasingly aging society.

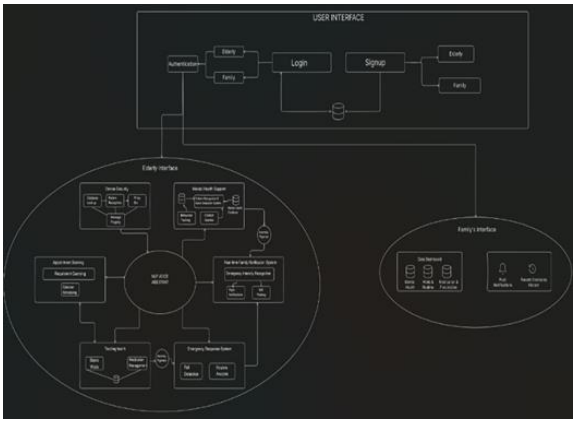

Figure 1. Generic architecture

The envisioned Android application represents a pioneering solution crafted to navigate the intricate challenges arising from the demographic shift towards an increasingly aged population across the globe. Embracing a philosophy deeply rooted in user-centric design, the system sets out to redefine the landscape of elderly care by placing paramount importance on tailoring its interface to cater specifically to the diverse needs and preferences of elderly individuals. With a steadfast commitment to fostering trust and confidence among its users, the application adopts a proactive approach towards safeguarding data privacy and security. Through the implementation of state-of-the-art encryption protocols and robust security measures, the system ensures the confidentiality of sensitive information, thereby instilling a sense of assurance in its user base.

Within its expansive repertoire of features, the application seamlessly integrates an array of indispensable healthcare management tools, each meticulously designed to facilitate the seamless navigation of healthcare needs for seniors. From intuitive medication reminders tailored to individual prescriptions and dosages, to streamlined access to telehealth services, the system empowers elderly individuals to take proactive control of their health and well-being, promoting a sense of autonomy and independence in their daily lives. Safety, a paramount concern in the realm of elderly care, is addressed through the incorporation of innovative features such as panic buttons and GPS tracking functionalities. Serving as a lifeline in times of emergency, these features offer reassurance to both elderly users and their caregivers, providing invaluable peace of mind and security.

The system architecture for your Comprehensive Elderly Care and Monitoring Application is designed to ensure robustness, scalability, and reliability while catering to the diverse needs of elderly users and their families. At its core, the architecture follows a client-server model, where the client side consists of interfaces tailored for both elderly users and family members, providing intuitive access to the application's features and functionalities. These interfaces serve as the primary interaction points, allowing users to schedule medical appointments, track health metrics, receive real-time updates, and utilize voice-assisted commands seamlessly. On the server side, a centralized application logic layer manages the processing of user requests, orchestrates data flow between the interfaces and the backend database, and interfaces with external services such as emergency response systems.

The backend infrastructure encompasses a robust database management system responsible for storing

and managing user profiles, appointment schedules, health data, and other pertinent information securely. This database facilitates efficient data retrieval and storage, ensuring that both elderly users and family members have access to up-to-date information and timely notifications. Additionally, the system architecture integrates with external services, such as voice recognition systems for the voice-assisted interface and notification systems for real-time updates and emergency alerts. Overall, this architecture ensures a seamless user experience, fosters community engagement, and promotes the well-being of elderly individuals by providing comprehensive care and monitoring capabilities tailored to their unique needs.

A. FALL DETECTION

Most of the existing studies use three-axis accelerometer sensors provided by smartphones to obtain data. However, because smartphones have the disadvantages of unfixed position, uncertain carrying time, and inability to ensure that the elderly always carry them, the sensors on mobile phones are not suitable for the elderly. In this paper, we use wrist-type three axis accelerometer (i.e. wristband), which has the characteristics of small size, light weight, convenient carrying. It is more feasible than mobile phones. The data collected are the acceleration values of X, Y, and Z axes. The dataset used in this paper is the public dataset HMP [18] which consists of 979 trials covering the 12 actions listed in Table 1 and the activity data of 16 volunteers (11 men and 5 women, aged between 19 and 81 years old). Since there is no specific annotation for the elderly data, all data are used.

Each experimental file records three-axis acceleration values once to perform an activity. There are a total of 729,476 records. The fall detection system encompasses a comprehensive array of features, each meticulously crafted to facilitate early detection and prompt intervention in the event of a fall. Central to its functionality is a sophisticated sensor network, capable of detecting sudden changes in movement patterns indicative of a fall. These sensors may be integrated into wearable devices or strategically placed within the user's environment, ensuring continuous monitoring and real-time detection of fall events. Upon detecting a fall, the system automatically triggers an alert, notifying designated caregivers or emergency responders of the incident and providing them with pertinent information, such as the user's location and vital signs, to facilitate swift and effective intervention.

In the process of statistical feature extraction, according to the data characteristics generated by the three-axis accelerometer, we apply the feature extraction method to process the data. For each dimension time series of data in sliding window, statistical-based features are extracted. Communication serves as a critical component of the fall detection system, with adaptive interfaces and advanced communication technologies employed to streamline interaction between users and caregivers.
These features can be used to describe the characteristics of the activities studied in this paper. The features generated from the multi-dimensional data are combined as new data segment representation so as to classify the activity of the elderly. The cross-validation method of training set and test set is used to ensure the correctness of the algorithm. The k-fold cross-validation is used to analyze the data, which is mainly applied in the case of insufficient sample data. The dataset is randomly divided into k parts, one of which is taken as test set, and the remaining k1 data is taken as training set.. We conducted experiments on these four datasets. The performance of the proposed algorithm is analyzed from two perspectives: the influence of feature number on the algorithm and the degree of improvement of algorithm performance by activity similarity method. Then our algorithm was compared with the algorithm proposed in reference on the same dataset to analyze the performance of our algorithm and compared with other machine learning algorithms to verify the superiority of the random forest algorithm.

B. EMERGENCY RESPONSE SYSTEM

The proposed emergency response system is a cutting-edge solution meticulously designed to cater to the unique needs and challenges of elderly individuals, particularly in emergency situations. At its core, the system prioritizes rapid and effective response mechanisms, ensuring the safety and well-being of seniors in times of crisis. Anchored by a user-friendly interface specifically crafted to accommodate the diverse needs and abilities of elderly users, the system

aims to streamline the process of seeking assistance during emergencies, thereby minimizing response times and maximizing outcomes. Central to its design philosophy is a steadfast commitment to data privacy and security, with stringent measures in place to safeguard sensitive information and instill trust among users.

The emergency response system encompasses a comprehensive suite of features, each meticulously crafted to facilitate swift and efficient assistance in times of need. Key among these features is a panic button functionality, providing elderly users with a direct and immediate means of summoning assistance in emergency situations. This feature is complemented by GPS tracking capabilities, enabling emergency responders to pinpoint the precise location of the user, thereby expediting the dispatch of assistance and enhancing overall response efficiency. Additionally, the system may incorporate biometric authentication measures to ensure the authenticity of distress calls and prevent false alarms, further optimizing emergency response processes.

Communication lies at the heart of the emergency response system, with the integration of adaptive interfaces and advanced communication technologies serving to enhance the user experience and facilitate seamless interaction during emergencies. Natural language processing (NLP) algorithms enable intuitive communication between users and emergency responders, ensuring clear and concise exchange of information even in high-stress situations. Furthermore, the system may employ real-time audio and video streaming capabilities, allowing emergency responders to assess the situation remotely and provide guidance or reassurance to the user until help arrives.

Crucially, the emergency response system operates within a framework of continuous improvement and refinement, with user feedback and data analysis driving iterative enhancements to usability and functionality. End-to-end encryption safeguards all communication channels, ensuring the privacy and confidentiality of sensitive information exchanged during emergency situations. In essence, the proposed emergency response system stands as a testament to the transformative potential of technology in enhancing the safety and well-being of elderly individuals, providing them with peace of mind and reassurance in the face of unforeseen emergencies. By seamlessly integrating advanced communication technologies with empathetic design principles, the system promises to revolutionize emergency response processes, ultimately saving lives and safeguarding the dignity and independence of elderly individuals worldwide. Similarity is adopted, by the test of the correlation between location, time and activity, and the correction activity through activity similarity, the recognition accuracy can generally be improved, especially the activity of getting up which is easy to be recognized as other activities.

C. MENTAL HEALTH CHATBOT

The chatbot module for mental health is a central component of the proposed system, leveraging artificial intelligence and natural language processing (NLP) techniques to provide interactive and personalized assistance to users. Designed to simulate human-like conversations, the chatbot serves as a virtual assistant for healthcare practitioners, patients, and other stakeholders, offering support, guidance, and information on various topics related to healthcare management and administration.

Powered by advanced NLP algorithms, the chatbot module can understand and interpret natural language queries from users, allowing for seamless communication and interaction. Through techniques such as tokenization, entity recognition, and sentiment analysis, the chatbot accurately identifies user intents and extracts relevant information from their queries, enabling it to generate appropriate responses and take relevant actions based on user input.

Dialogue management is a key functionality of the chatbot module, controlling the flow of conversation and guiding users through interactive dialogues to address their needs and queries. Contextual understanding and memory mechanisms enable the chatbot to maintain coherent and engaging interactions with users, remembering previous interactions and adapting responses based on the context of the conversation.

The chatbot module is integrated with the predictive module to provide real-time recommendations and suggestions to users during conversations. By

analyzing patient data and predictive models' outputs, the chatbot can offer personalized recommendations for appropriate ICD codes, treatment options, and billing procedures, empowering healthcare practitioners to make informed decisions and streamline their workflows.

Chatbots can be deployed across various platforms such as websites, messaging apps, and voice assistants, offering a wide range of functionalities including customer support, information retrieval, task automation, and entertainment. They are characterized by their ability to engage users in real-time conversations, offering personalized assistance and enhancing user experience. Overall, chatbot applications represent a versatile and efficient means of communication and interaction between users and systems in a wide array of domains.

User authentication and data security mechanisms are implemented within the chatbot module to ensure the privacy and confidentiality of user information. Secure authentication protocols verify users' identities and permissions before granting access to sensitive data, while encryption and access controls protect data in transit and at rest. By prioritizing user privacy and data security, the chatbot module instills trust and confidence in users, encouraging widespread adoption and usage of the system.

VI. ALGORITHM

A. SUSPICIOUS SMS ACTIVITY

1. Input:
- SMS content
- Sender phone number
- Timestamp
- Proxy server information

2. Check Whitelist:
- If sender phone number is in whitelist database, mark SMS as legitimate and exit.

3. Check Blacklist:
- If sender phone number is in blacklist database, mark SMS as suspicious and take appropriate action (e.g., block, flag) and exit.

4. Template Analysis:
- Compare SMS content with 5 templates specified by TRAI.
- If SMS matches a template, mark as legitimate and exit.
- If SMS does not match any template, proceed to next step.

5. Proxy Lookup:
- Initiate proxy lookup for links provided in SMS.
- Use proxy servers from server pool to access links.
- Track number of redirects and collect data from accessed links.
- Analyze collected data to determine link legitimacy.
- If link is suspicious, mark SMS as suspicious and take appropriate action.
- If link is legitimate, mark SMS as legitimate.

6. Output:
- Mark SMS as legitimate or suspicious.
- Take appropriate action based on classification (e.g., allow, block, flag).
- Log decision and relevant information for further analysis and audit purposes.

B. FALL DETECTION

1. Input:
- Accelerometer readings (x, y, z axes)
- Gyroscope readings (optional for additional accuracy)
- Tilt threshold value
- Fall detection threshold values.
- Buffer period duration (e.g., 30 seconds)

2. Initialize State:
- Set last_fall_time to a very early timestamp or null if no fall has been detected.
- Set is_in_buffer to false.

3. Check Tilt:
- Calculate the tilt angle using accelerometer readings.
- If the tilt angle exceeds a predefined threshold, mark the event as a potential fall.

4. Analyze Accelerometer Data:
- Compute the magnitude of acceleration using the accelerometer readings.

- If the magnitude exceeds a predefined threshold, mark the event as a potential fall.

5. Refine Fall Detection:
- Utilize gyroscope readings to refine fall detection.
- Analyze gyroscope data for sudden changes indicating rapid movement or impact.

6. Evaluate Fall Conditions:
- Combine information from tilt and accelerometer data to assess the likelihood of a fall.
- If there is no fall detected in last 10 minutes.
- If both tilt and accelerometer criteria indicate a fall, proceed to the next step.

7. Check Buffer State:
- Check the current time against last_fall_time and the buffer period.
- If the current time is less than last_fall_time plus the buffer period, set is_in_buffer to true.
- If is_in_buffer is true, suppress the fall detection alert and exit the algorithm.
- If is_in_buffer is false, proceed to the next step.

8. Confirm and Log Fall:
- Confirm the fall event.
- Update last_fall_time to the current time.
- Log the fall event details.

9. Output:
- Output a fall detection signal or alert.
- Provide relevant information such as timestamp and severity level.
- Initiate emergency response protocols if necessary.

VII. FUTURE ENHANCEMENTS

In this paper, we covered various aspects of an elderly care system, from conceptualization to implementation, employing tools like sequence diagrams, use case diagrams, and class diagrams. While these diagrams effectively illustrate system functionalities, they have limitations. Sequence diagrams excel in illustrating interactions between components over time, but they may oversimplify complex processes or overlook asynchronous interactions. Similarly, use case diagrams provide a high-level overview of system functionalities and actors but may lack granularity in detailing individual interactions. Class diagrams offer insights into system structure and relationships but may become cumbersome in complex systems, making them challenging to maintain and comprehend. Additionally, the provided explanations emphasized clarity and comprehensiveness, but brevity may sacrifice depth. Overall, while these visual representations serve as valuable tools for conceptualization and communication, they necessitate careful consideration and may require supplementary documentation and discussions to address their inherent limitations and ensure a robust and scalable elderly care system.

While the conversation successfully navigated various requests for diagrams, code snippets, and explanations, it was constrained by the format's inherent limitations, such as the inability to provide real-time visualizations or interactive demonstrations. Additionally, the complexity of generating detailed diagrams and code snippets within the constraints of a text-based interface posed challenges in conveying nuanced information effectively.

The future enhancements considering the breadth of discussions encompassing various facets of elderly care, future enhancements for the proposed Elderly Care Application could focus on several key areas. Firstly, integration with advanced monitoring technologies such as wearable devices and IoT sensors could enable real-time tracking of vital signs, activity levels, and environmental factors, enhancing the system's ability to detect and respond to health emergencies proactively. Additionally, incorporating machine learning algorithms for predictive analytics could enable the application to anticipate potential health issues or deteriorations in elderly individuals, facilitating early intervention and preventive care measures.

Furthermore, enhancing the user interface with intuitive features, multilingual support, and accessibility options would cater to diverse user demographics and improve user experience. Integration with telemedicine platforms could enable remote consultations with healthcare professionals, expanding access to medical expertise and facilitating timely interventions. Moreover, fostering interoperability with existing healthcare systems and

electronic health records would streamline data exchange and collaboration between caregivers, healthcare providers, and emergency responders, ensuring seamless continuity of care across different healthcare settings. These enhancements align with the overarching goal of leveraging technology to enhance the quality of elderly care, promote independent living, and ensure the safety and well-being of elderly individuals in our communities.

CONCLUSION

In this study, in the evolving landscape of elderly care, the Enhanced Aging project stands as a groundbreaking endeavor poised to revolutionize the way we approach aging and well-being. With a core focus on adaptability, the platform introduces a paradigm shift in personalized support for the elderly, tailoring its features to meet the unique and evolving needs of aging individuals. The integration of adaptive health monitoring not only provides real-time insights into vital signs but also empowers both individuals and caregivers with proactive tools for holistic health management. Security is a linchpin of the project, reflecting a steadfast commitment to ensuring the confidentiality and privacy of sensitive information, fostering a culture of trust among families and caregivers.

Beyond geographical confines, the project's global accessibility transcends borders, extending advanced elderly care solutions to families worldwide and promoting inclusivity. Moreover, the Enhanced Aging initiative serves as a dynamic hub for innovation, providing a secure foundation for entrepreneurs and developers to pioneer cutting-edge solutions that redefine the landscape of elderly care. As we confront the multifaceted challenges posed by an aging population, this project emerges as a beacon of progress, envisioning a future where elderly individuals experience graceful aging, surrounded by innovative, personalized care solutions that enhance their overall well-being and quality of life.

REFERENCES

[1] CBASH: A Care Bot-Assisted Smart Home System Architecture to Support Aging-in- Place: proposes a smart home system architecture integrating a mobile robot. Zeqiang Zhu, Yan Fu,Weiming Shen, Alex Mihaildis, Shun Liu, Wenshaung Zhou, Zhaohui Huang (2023)

[2] Artificial Intelligence (AI) Based Interactive Smart Robot for Elderly People Health Monitoring System: presents the development of an AI-based interactive smart robot, V. B, V. K. D. M and U. M (2023)

[3] An NLP-Empowered Virtual Course Assistant for Online Teaching and Learning: The assistant is designed to answer general course enquiries. S. Liu, S. Man and L. Song (2020).

[4] Intelligent Personal Assistant - Implementing Voice Commands enabling Speech Recognition: propose speech recognition systems and dealing with creating a virtual personal assistant. K. N., R. V., S. S. S. and D.R. (2023)

[5] Activity Recognition Method for Home- Based Elderly Care Service Based on Random Forest and Activity Similarity: propose a hierarchical pervasive wireless infrastructure for in home care of elderly people. Hanchuan XuRavi. (2020).

[6] Ubiquitous wireless infrastructure for elderly care: propose a hierarchical pervasive wireless infrastructure for in home care of elderly people. Muid Muft, Dimitris Agouridis, Sami ud Din and Adeel Mukhtar. (2019).

[7] Giancarlo Iannizzotto,Lucia Lo Bello,Andrea Nucita,Giorgio Mario Grasso: A Vision and Speech Enabled, Customizable, Virtual Assistant for Smart Environments (2023)

[8] A Mobile Health Monitoring System for the Elderly, Z. Lv, F. Xia, G. Wu, L. Yao and Z. Chen (2023)

[9] Fraud Detection and Prevention Using Machine Learning Algorithms, G. J. Priya and S. Saradha (2023)

[10] Mental Health Monitoring System using Artificial Intelligence, V. Mody and V. Mody (2018)

[11] Artificial Intelligence for the Elderly: From Assisted Living to Health-Care Monitoring, K. Qian, Z. Zhang, Y. Yamamoto and B. W. Schuller (2018)

[12] Towards the Development of a User-Centred Health Management, Fathima Naja

Musthafa,Mumtaz Begum Mustafa, Farzana Parveen Tajudeen (2020)

[13] AI and robotics to help older adults:Revisiting projects in search of lessons learned, Gabriella Cortellessa, Riccardo De Benedictis, Francesca Fracasso, Andrea Orlandini, Alessandro Umbrico, and Amedeo Cesta (2020)

[14] Development of Smart Elderly Care Mobile Application for Health Management System, Zuraini Dahari, Choong Chee Jun; Poh Jin Ze, Nurul Najwa Binti Mohd Zakir, Mohd Noor Faidhi Bin Mohd Fauzi, Muhammad Hafiz Syazwan Bin Mohamad Azam, Nurhaniza Hamiri (2022)

[15] Mobile Health Applications for Caring of Older People, Victoria Laput Anthony Berauk, BPharm(Hons),Muthu Kumar Murugiah, BPharm(Hons), MBA, DBA2, Yee Chang Soh, BPharm(Hons), MClinPharm,Yap Chuan Sheng, BPharm(Hons) (2021)

[16] Research on Intelligent elderly care system based on Neural Network, Yue Geng, Chenlu Jia, Shuo Sun (2022)

[17] Natural Language Processing (NLP) Based Innovations for Smart Healthcare Applications in Healthcare 4.0, Nemika Tyagi & Bharat Bhushan (2023)

[18] Mental healthcare chatbot based on natural language processing and deep learning approaches: Ted the therapist, Sumit Pandey, Srishti Sharma & Samar Wazir (2022)

[19] Natural language processing: state of the art, current trends and challenges, Diksha Khurana, Aditya Koli, Kiran Khatter, Sukhdev Singh (2022)

[20] Artificial Intelligence Tools and Applications for Elderly Healthcare, Sarfraz Iqbal, Department of Informatics, Linnaeus University, Sweden (2023)