Grenze International Journal of Engineering and Technology, June Issue

Assisting Dementia Patients through IoT Device

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***Abstract*— A GPS tracking system has developed to ameliorate safety and well-being for dementia patients. The system uses IoT devices to monitor the patient's real-time location, providing caregivers with precise information about their whereabouts. The device connects to a mobile application and a central monitoring platform, allowing caregivers to track the patient's movements and receive real-time alerts if they leave a safe zone or enter an unsafe area. The system also offers two-way communication, allowing caregivers to establish voice contact with the patient if needed. A panic button allows the patient to press in case of distress, automatically alerting caregivers or emergency services. The system also contributes to a better quality of life for dementia patients, allowing them to maintain independence and freedom while ensuring their safety. The data collected can be used to develop more effective care strategies and treatment plans. Privacy and security are paramount, with access to the patient's location information only granted with consent.**

***Index Terms*— Dementia, GPS tracking system, Patient safety, Caregivers, well-being, IoT devices.**

I. INTRODUCTION

Dementia is a debilitating condition that affects millions of people worldwide, causing memory loss, confusion, and disorientation. Caring for individuals with dementia, particularly when they wander away from their homes or care facilities, presents a significant challenge for caregivers and healthcare providers. To address this issue, a GPS tracking system specifically designed for dementia patients has been developed, offering a range of benefits in enhancing patient safety and quality of life. This GPS tracking system is a cutting-edge solution aimed at improving the well-being and safety of dementia patients. It utilizes IoT devices to monitor the real-time location of patients and provide caregivers with precise information about their whereabouts. The system consists of a small, discreet tracking device carried by the patient, which connects to a user-friendly mobile application and a central monitoring platform accessible to caregivers and healthcare professionals.

One of the key advantages of this system is its ability to provide immediate and accurate location information. Caregivers and family members can easily track the patient's movements and receive real-time alerts if the patient leaves a predefined safe zone or enters an unsafe area. This feature helps prevent potentially dangerous situations and ensures a rapid response in case of emergencies, such as the patient becoming lost or disoriented.

Moreover, the GPS tracking system offers a two-way communication feature, allowing caregivers to establish voice contact with the patient if needed. This can be reassuring for both the patient and the caregiver and can help guide the patient back to safety. Additionally, the system includes a panic button that the patient can press in case of distress, automatically alerting caregivers or emergency services.

Grenze ID: 01.GIJET.10.2.137

The system also contributes to a better quality of life for dementia patients. It enables them to maintain a level of independence and freedom while ensuring their safety. Many dementia patients experience anxiety and depression when they feel confined or lose their sense of autonomy. With the GPS tracking system, they can continue to enjoy outdoor activities and daily walks, knowing that their caregivers can locate them quickly and easily if necessary.
Furthermore, the collected data can be valuable for healthcare providers and researchers in understanding the behavioral patterns of dementia patients. By analyzing the tracking data, healthcare professionals can gain insights into the patient's daily routines, preferences, and potential triggers for wandering. This information can lead to more effective care strategies and improved treatment plans, ultimately enhancing the patient's quality of life.
Privacy and security are paramount in the design of this system. Caregivers and healthcare providers have access to the patient's location information only with the patient's or their legal guardian's consent. Strict privacy controls and data encryption measures are in place to protect the patient's information and ensure compliance with privacy regulations.
In conclusion, the GPS tracking system for dementia patients represents a breakthrough in the care of individuals living with this condition. It offers a range of benefits, including enhanced safety, improved quality of life, and valuable data for healthcare professionals. By providing real-time location information and two-way communication, this system empowers caregivers and patients, reducing stress and improving the overall well-being of dementia patients while addressing the unique challenges associated with wandering and disorientation. This technology is a promising step forward in dementia care and has the potential to positively impact the lives of both patients and their caregivers.

II. Literature Survey

The suggested system integrates GPS and GSM systems with a microcontroller for real-time tracking in order to address the problem of dementia patients going missing. A carer can track the patient's whereabouts on Google Maps by using the Android app that receives the patient's global coordinates from this system. The objective is to improve the safety of those with dementia when they are not in their homes by offering a dependable and affordable tracking system that will improve their quality of life. [12].
Dementia cases are rising because of an ageing population worldwide. The aberrant behaviors of dementia patients are a burden on individuals, families, and society as a whole because there is no long-term cure for them. An elderly tracking and rescue system based on shoes is suggested as a solution to this problem. The system consists of GPS-enabled shoes sending real-time data to a gateway device, which uses MQTT technology to deliver data to a cloud platform. By tracking the patient's location, body temperature, and voltage, families and carers can lessen the likelihood that elderly people will go missing and relieve their families' concern. [9].
The low battery life of the continuous GPS tracking devices used by dementia patients today means that they must be charged every day, which limits their mobility. The research suggests a novel remedy: a compact bracelet that combines GPS duty cycling and LoRa communication technology. The prototype shows remarkable energy economy through real-world testing, enabling up to 40 hours of continuous GPS monitoring at a location update rate of every 60 seconds. With a communication range of up to 3 km, the wristband successfully monitors patient locations and overcomes the shortcomings of current technologies. [13].
Dementia affects about 50 million individuals globally; symptoms include linguistic problems, cognitive impairments, and memory loss. There are 1.2 million specialized carers globally, yet there aren't many qualified dementia carers in India. The purpose of this study is to design the Memhans, a “bioengineering-based assistive device” for individuals with ‘mild to moderate’ dementia. The RFID module, GPS chip, Bluetooth, and smart watch app for alerts, relaxation, and item and person identification are all included in the prototype. This reasonably priced apparatus is intended for patients from underdeveloped nations. [6].
The user-centered development method for a GPS-based dementia monitoring system is presented in this work. Pre-study, prototyping, and long-term appropriation are all covered in three practical settings by the research. The paper looks at both pragmatic and ideological concerns behind the low use of GPS tracking in dementia care. The study emphasizes how important it is for ICT to deal with intricate organizational, ideological, and practical problems in a moral universe. [14].
The study investigates the variables affecting unpaid dementia carers' use of home-based surveillance systems. Concerns about dementia among carers, participation in online support groups, perceptions of social norms, perceived utility of monitoring devices, and extent of ICT use are the five predictors. The results have ramifications for dementia healthcare both theoretically and practically. [1].
The techniques, methodologies, scales, and evaluation instruments used to gauge the acceptability, uptake, and usefulness of information and communication technologies (ICTs) by individuals with dementia and their

caretakers are reviewed in this review. A comprehensive analysis of the literature found 74 papers out of 2182. The most widely used measures were the Post-Study "System Usability Questionnaire (4%)", the "ISONORM 9241/10 Questionnaire (4%)", and the "System Usability Scale (11%)". According to the review, there isn't a defined, consistent method for evaluating how useful ICTs are for dementia sufferers. [2].

Patients with dementia caused by Alzheimer's disease have trouble keeping track of their whereabouts. Attaching Global Position System (GPS) trackers to dentures—which are tracked via a mobile application—is a novel approach. This safe technique enhances patients' quality of life by assisting carers in tracking their movements. For Alzheimer's patients, denture tracking devices provide a safe and easy solution. [3].

In qualitative study, the reported difficulties that persons with dementia have comprehending and interacting with cartographic maps have received little attention. The possibility of mapping to comprehend how individuals with dementia travel and experience place is still unrealized, despite the fact that some may have difficulty with way finding and spatial orientation. Scholars are increasingly recognizing the significance of location and communities in comprehending the daily lives of those suffering with dementia. This paper explains the scaffolding that allowed individuals with dementia to take part in a crowd sourced map and scaffold sketch mapping interviews as a means of capturing their lived experiences. This strategy provides two avenues for place-based dementia research: including dementia patients in the creative potential of the map and encouraging significant community change. [4].

This study investigates how GPS tracking is used in geofencing technology, which creates virtual borders around a particular region of interest using satellite location and telematics. Geofences enable users to designate a precise radius area on a map by utilizing technologies such as Wi-Fi, cellular mobile, RFID, and GPS. Geofences are installed around a predetermined radius. This system helps with the surveillance of specified regions by automatically detecting when tracked mobile things enter or depart those zones. The real-time updates guarantee asset security and safety by offering an inspection mechanism to prevent unauthorized activities. [5].

46.8 million people worldwide are afflicted with dementia, a common brain disease. More sophisticated tracking of the movements of dementia patients is essential to lower the danger of injury. The public domain now hosts wearable's, GPS sensors, and Internet of Things devices, allowing patients and carers to communicate in real time. This study examines the suitability of seven widely used wearable's for tracking dementia by examining their price, features, and technology. An IoT-based "Force Sensor Resistance enabled System-FSRIoT" case study was put forth to verify the usefulness of IoT in wearable form factors for smarter tracking of dementia patients. The findings point to potential areas for effective supportive medical and physiotherapy care for dementia patients and their families, which could lower mortality rates and enhance social interactions. [8].

The study developed and tested algorithms for measuring mobility and activity using off-the-shelf devices. The solution extracted travel trajectories and home location from GPS data, calculated spatial, temporal, and count-based metrics. It was evaluated among five healthy subjects, revealing successful measurements but raised concerns about device validity for step count measurement [7].

A study with eighteen dementia patients and their carers discovered that there is a lack of established user experience when it comes to finding systems. According to the survey, most carers were willing to buy the prototype, and usability ratings drastically decreased after four weeks. Between the two periods, there was no discernible shift in carer load, technological willingness, or perceived self-efficacy. The findings highlight the necessity of including end users in the phase of research and development when identifying methods to enhance the quality of the user experience in home dementia care. Larger sample sizes in randomized controlled trials, along with creative hardware and software solutions, should be the focus of future research. [10].

The acceptability of GPS in assisting dementia patients who wander in their communities was examined in this study. Questionnaires, focus groups, and use logs were all part of a mixed-methods approach. 45 client-caregiver pairs in the study showed a high level of acceptance for GPS, and they were inclined to keep using the device. When clients got lost, participants said GPS gave them piece of mind and reduced their anxiety. [11].

III. METHODOLOGY

The below diagram illustrates the fundamental structure of the project to be conducted. The project plan involves the use of IoT devices. GPS devices will enable geofencing and provide real-time patient location data. A GSM module is to be incorporated for real-time messaging to caregivers. A buzzer driver will be used to connect the buzzer and battery for continuous power supply with NODEMCU ESP8266. The NODEMCU module will serve as the central core for the project, connecting each component to ensure their coordinated operation.

NodeMCU ESP8266: Popular open-source development board NodeMCU ESP8266 incorporates the ESP8266 Wi-Fi module. For Internet of Things (IoT) projects, the low-cost, low-power ESP8266 system-on-a-chip (SoC)

microcontroller with integrated Wi-Fi is perfect. Based on the ESP8266, NodeMCU is a development platform made to make the process of creating and prototyping Internet of Things applications easier.

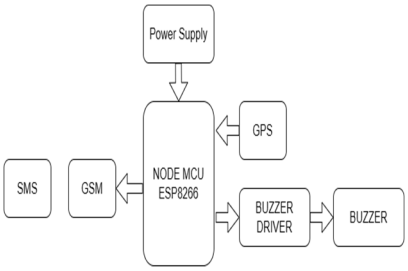

Figure 1. Block schematic of the suggested system

GSM Module: "A GSM (Global System for Mobile Communications) module" is a device that provides a mean of communication between electronic devices over the GSM network. GSM is a standard developed to ensure compatibility and global interoperability for mobile communications. GSM modules are commonly used in various applications such as IoT (Internet of Things), M2M (Machine to Machine) communication, security systems, and other remote monitoring and control systems.
GPS Module: A Global Positioning System (GPS) module is a gadget that uses signals from a constellation of satellites to pinpoint its exact location on the surface of the planet. A GPS receiver can receive time and geolocation data from the Global Positioning System (GPS) satellite navigation system from any position on or near Earth.

IV. RESULTS

With the use of a GPS and GSM module, the patient's whereabouts can be monitored. The circuit depicted in the figure will be similar to the real one. A microcontroller has been used to set a counter that would continually decrease. The GPS module will identify the patient's global location, including their name, latitude, and longitude coordinates, once the counter value reaches zero. Once the coordinates are acquired, a GSM module with a SIM card is used to send them to the caregiver's mobile device, as depicted in Figure.
The suggested solution will still deliver the intended outcomes and notify the carer of the patient's whereabouts even if they go to a location without telling them. The patient can still be monitored even if the carer is preoccupied and unable to view the messages on the patient's gadget.
The caretaker's interface receives a notification labelled "Location Detected" when our system automatically determines the patient's position. The carer will be taken to Google Maps when they click on the notification, allowing them to see the patient's precise location.The suggested approach will let the carer know where the patient is if they leave a place without telling them.Even if the patient's gadget isn't displaying incoming messages, the carer can still keep an eye on them. Numerous monitoring devices are available on the market that are intended to locate those afflicted with dementia and Alzheimer's disease. But these people's primary problem is that they have no recollection at all.. As a result, we are unable to guarantee that they will always carry that gadget. This is the main reason why we have developed this tracking system so that we can get the real-time information regarding whereabouts of the patient with this sort of disorder.

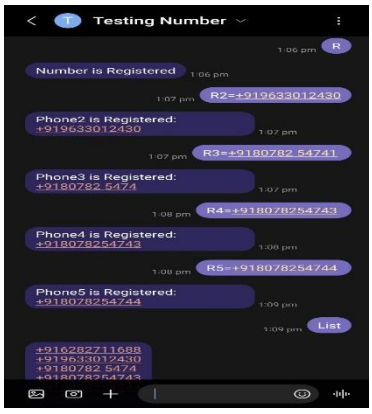

Figure 1: Show the register of various phone numbers. Figure 2: Shows the Geolocational parameters.

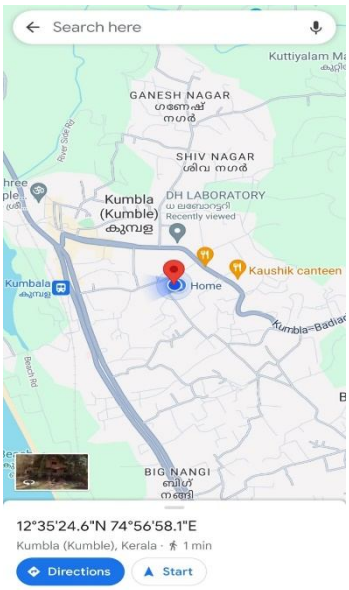

Figure 3: Shows the location on Google map

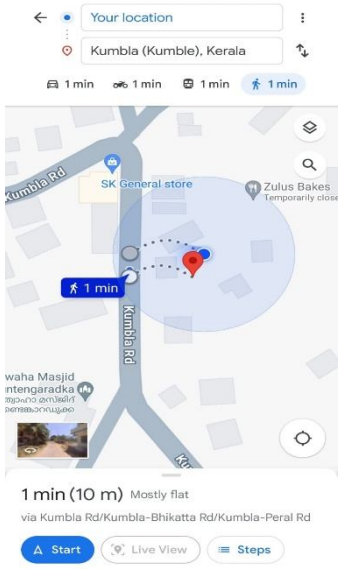

Figure 4: Show the range for the patient.

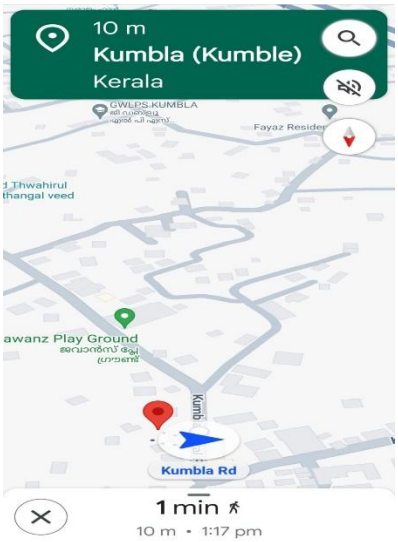

Figure 5: Showing the route to the patient

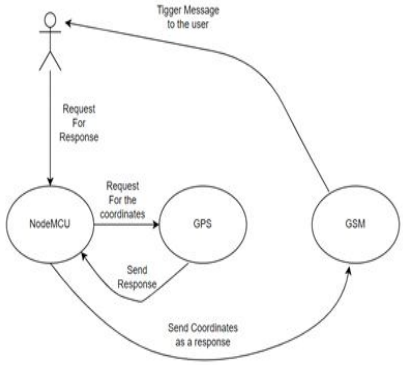

Figure 6: Flow of result.

Figure 6 show the actual flow of result. When actor/user initiate the process, this process will raise a request to the nodeMCU. The moment nodeMCU will receive the request from the actor, it will establish a communication with the GPS. GPS will send the actual coordinates to the nodeMCU. Upon getting the response from the GPS, it will send that data to the GSM, GSM will send this data to the user. This will be in a close to real time. Similarly, when it comes to geo-fencing, the boundaries will be hardcoded into the nodeMCU, So whenever the GPS will go beyond that coordinates, nodeMCU will trigger message to the GSM, GSM will send the alert message to the user.

V. Conclusion

The GPS tracking system for dementia patients is a groundbreaking solution that enhances the safety and well-being of dementia patients and their caregivers. This innovative technology monitors their movements in real-time, providing caregivers with peace of mind and enhancing the quality of care. It also facilitates prompt response in emergencies, reducing the risk of harm to dementia patients. The system's user-friendly interfaces and accessibility features are crucial for successful adoption. However, ethical and privacy concerns must be considered, and robust security measures and informed consent are essential. Despite these challenges, the GPS tracking system has the potential to significantly improve the lives of dementia patients and their caregivers.

REFERENCES

[1] Xu, Y. A., Wang, Y., Kim, S. S. Y., Kim, D. O. D., Sun, Y., & McLaughlin, M. L. (2023). Safe at home: Acceptance of surveillance technology among caregivers for persons with dementia. Health Informatics Journal, 29(1), 14604582231152188.

[2] Miguel Cruz, A., Daum, C., Comeau, A., Salamanca, J. D. G., McLennan, L., Neubauer, N., & Liu, L. (2023). Acceptance, adoption, and usability of information and communication technologies for people living with dementia and their care partners: a systematic review. Disability and Rehabilitation: Assistive Technology, 18(4), 443-457.

[3] Chander, N. G., & Reddy, D. V. (2023). Denture tracker for edentulous Alzheimer's patients. The Journal of Indian Prosthodontic Society, 23(1), 96-98.

[4] Brennan-Horley, C., Smith, L., Frost, D., & Phillipson, L. (2023). Getting People with Dementia onto the Map: Scaffolding Qualitative GIS. International Journal of Qualitative Methods, 22, 16094069231165706.

[5] Sinha, A., Singh, A., & Baghel, A. SMART GPS GEOFENCING SYSTEM.

[6] U. Sait et al., "Memhans: an Assistive Device for Dementia Patients," 2019 IEEE Global Humanitarian Technology Conference (GHTC), Seattle, WA, USA, 2019, pp. 1-5, doi: 10.1109/GHTC46095.2019.9033140.

[7] Thorpe, J. R., Forchhammer, B. H., & Maier, A. M. (2019). Development of a sensor-based behavioral monitoring solution to support dementia care. JMIR mHealth and uHealth, 7(6), e12013.

[8] Ray, P. P., Dash, D., & De, D. (2019). A systematic review and implementation of IoT-based pervasive sensor-enabled tracking system for dementia patients. Journal of medical systems, 43, 1-21.

[9] H. -K. Wu, T. -W. Hung, S. -H. Wang and J. -W. Wang, "Development of a shoe-based dementia patient tracking and rescue system," 2018 IEEE International Conference on Applied System Invention (ICASI), Chiba, Japan, 2018, pp. 885-887, doi: 10.1109/ICASI.2018.8394407.

[10] Megges, H., Freiesleben, S. D., Jankowski, N., Haas, B., & Peters, O. (2017). Technology for home dementia care: A prototype locating system put to the test. Alzheimer's & Dementia: Translational Research & Clinical Interventions, 3(3), 332-338.

[11] Liu, L., Miguel Cruz, A., Ruptash, T., Barnard, S., & Juzwishin, D. (2017). Acceptance of global positioning system (GPS) technology among dementia clients and family caregivers. Journal of Technology in Human Services, 35(2), 99-119.

[12] M. H. Kasliwal and H. Y. Patil, "Smart location tracking system for dementia patients," 2017 International Conference on Advances in Computing, Communication and Control (ICAC3), Mumbai, India, 2017, pp. 1-6, doi: 10.1109/ICAC3.2017.8318786.

[13] T. Hadwen, V. Smallbon, Q. Zhang and M. D'Souza, "Energy efficient LoRa GPS tracker for dementia patients," 2017 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Jeju, Korea (South), 2017, pp. 771-774, doi: 10.1109/EMBC.2017.8036938.

[14] Wan, L., Müller, C., Wulf, V., & Randall, D. W. (2014, April). Addressing the subtleties in dementia care: pre-study & evaluation of a GPS monitoring system. In Proceedings of the SIGCHI conference on human factors in computing systems (pp. 3987-3996).