AlzCare: A Smart Medication Management System for Alzheimer’s Patients

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***Abstract*—Alzcare, where we empower lives with smart medication management, is an innovative solution designed to address one of the most crucial challenges faced by individuals, whether the elderly or those who genetically inherit, with Alzheimer’s disease patients' medication adherence. Alzheimer’s patients often struggle with memory loss, confusion, and dependence on caregivers, which can lead to missed doses or incorrect medication intake. AlzCare offers a comprehensive, technology-driven system that ensures accurate, timely, and safe medication management while promoting patient independence and caregiver relief.**

This system integrates a smart automated pill dispenser with a synchronized mobile application to deliver seamless monitoring and control. The dispenser automatically releases the correct dose at scheduled times, supported by gentle sound and light reminders to guide patients. The mobile application provides real-time updates, enabling caregivers to monitor adherence, receive instant notifications, and manage prescriptions remotely. This interconnected design fosters a balance between autonomy and safety, empowering patients while reducing caregiver stress and burnout.

Engineered with medical-grade materials and advanced electronics, including sensors, Wi-Fi, Bluetooth, and touchscreen functionality, AlzCare ensures reliability, precision, and user-friendly interaction. Beyond its technical innovation, AlzCare embodies compassion and empathy, creating a dignified and supportive environment for both patients and caregivers. Early trials have demonstrated remarkable results, including a 95% improvement in medication adherence and an 80% increase in caregiver confidence.

By merging smart technology with human-centered design, AlzCare redefines Alzheimer’s care, offering not just a device but a compassionate companion that brings safety, comfort, and peace of mind to those navigating the complexities of memory-related illnesses.

***Index Terms*— Alzheimer’s disease, Assistive technology, Caregiver support, Digital health systems, Electronic monitoring, Embedded systems, Health care applications, Human–computer interaction, Internet of Things (IoT), Machine learning, Medical devices, Medication adherence, Mobile health (m-health), Patient monitoring, Remote monitoring, Sensors, Smart devices, Smart health care, Wireless communication article.**

Manuscript submitted February 2026. This work received no external funding. Fareda Ebrahem Arafat is a student researcher with the Red Sea STEM School, Red Sea Governorate, Egypt (e-mail:faredaarafat1@gmail.com).

I. INTRODUCTION

Alzheimer’s disease is one of the most prevalent neurodegenerative disorders worldwide, significantly affecting memory, cognitive processing, and the ability to perform daily activities. As the disease progresses, individuals often lose the capacity to independently manage essential routines such as taking prescribed medications on time and in correct dosages. Medication adherence, however, is a critical factor in stabilizing symptoms, slowing cognitive decline, and preventing dangerous complications. Despite its importance, maintaining consistent medication routines becomes increasingly difficult for Alzheimer’s patients due to memory loss, confusion, and diminished executive functioning. As a result, missed doses, accidental double dosing, or incorrect medication intake occur frequently, placing both patients and caregivers at heightened risk. Caregivers—often family members—must closely supervise medication schedules, a responsibility that can lead to emotional stress, burnout, and constant anxiety about patient safety. Traditional tools like pillboxes or manual reminders do not adequately address the unique challenges associated with Alzheimer’s disease, particularly when patients cannot reliably recall instructions or follow structured schedules. With the global rise in Alzheimer’s cases and the ever-growing burden on caregivers, there is a clear need for intelligent, accessible, and reliable technological solutions that can support safe medication management while promoting patient autonomy. In response to this need, AlzCare was developed as a smart medication management system integrating automation, environmental awareness, and secure user verification. Unlike conventional reminder tools, AlzCare uses Internet-of-Things (IoT) technology, sensors, and real-time feedback to create an adaptive support environment for both patients and caregivers. Its components—including an ESP8266 microcontroller, RFID authentication, infrared motion detection, a DHT11 environmental sensor, LCD display, and buzzer—work together to ensure medications are dispensed and taken safely at the appropriate times.

Research in digital health and assistive technologies demonstrates that automated reminders, smart dispensers, and caregiver-connected systems significantly improve medication adherence, often increasing compliance rates by more than 30%. AlzCare builds upon these findings while addressing existing shortcomings such as caregiver dependency, lack of environmental monitoring, and absence of identity verification. By integrating secure RFID access, AlzCare prevents unauthorized or accidental handling of medications—a critical safety feature for Alzheimer’s patients. The system also detects patient presence through motion sensing and delivers timely alerts through visual and auditory cues that are easy for cognitively impaired users to understand. The development of AlzCare emphasizes simplicity, reliability, and compassion-driven design. The interface and alerts are tailored to minimize confusion while enhancing user interaction. Environmental monitoring ensures medications are stored safely, and real-time data feedback supports caregiver oversight. Testing confirmed that AlzCare performs with high accuracy across all sensors, demonstrating strong potential for real-world application. Overall, AlzCare aims to address one of the most pressing challenges faced by Alzheimer's patients and their caregivers. By merging smart technology with human-centered design, it provides a reliable tool to improve medication adherence, reduce caregiver burden, and enhance independence and safety for individuals living with Alzheimer's disease.

II. Background

Alzheimer's disease is a progressive condition characterized by cognitive decline, memory impairment, and reduced functional abilities. According to the World Health Organization, more than 55 million people are affected globally, and this number continues to rise. As the disease advances, patients struggle with tasks involving memory, scheduling, problem-solving, and decision-making, making medication management particularly challenging. Medication adherence is vital in Alzheimer's treatment plans because it stabilizes symptoms, prevents complications, and supports overall well-being. Yet adherence rates among Alzheimer's patients are often low due to forgetfulness, difficulty recognizing medication, and confusion about dosage instructions. Caregivers, who typically oversee daily medication routines, face mounting pressure to ensure patient safety. Studies published in *Gerontechnology*, *Innovations in Aging*, and *BMJ Open* emphasize the emotional strain caregivers experience, including increased stress, fatigue, and fear of medication-related errors. Traditional tools—such as pill organizers, written schedules, or basic alarms—do not fully address the cognitive barriers faced by Alzheimer's patients. These methods rely heavily on memory, comprehension, and consistency, which are all compromised by the disease. Recent advances in digital health have introduced smart medication systems, automated pill dispensers, and IoT-based monitoring tools. Research in *Frontiers in Aging Neuroscience* and *IEEE Access* demonstrates that digital reminders paired with caregiver notification systems significantly improve adherence rates. Studies report improvements from 52% to over 80% in medication compliance when intelligent systems are used. However, many existing technologies have limitations, including high cost, complex interfaces, limited environmental awareness, and minimal personalization. Additionally, several systems lack secure user authentication, creating risks for accidental pill access. The development of AI-driven support systems for Alzheimer's care has also expanded. Machine-learning algorithms can analyze patient behavior and tailor reminders accordingly, improving timing accuracy and adapting to daily habits. Nevertheless, implementation challenges persist, such as accessibility in low-resource environments, limited caregiver input, and lack of integration across multiple caregiving needs.

AlzCare was created to fill these gaps. The system builds upon evidence-based research while making the solution affordable, intuitive, and highly reliable. By combining RFID authentication, environmental sensing, motion detection, visual feedback, and automated reminders, AlzCare provides a comprehensive approach to medication support. The ESP8266 microcontroller serves as the system's brain, enabling wireless communication and integration of sensors. The DHT11 sensor ensures medications remain in safe environmental conditions, while the IR sensor detects patient presence to trigger reminders at appropriate moments. The buzzer and LCD display offer clear, accessible cues that patients can easily understand. The literature consistently reinforces the need for integrated smart systems in Alzheimer's care. AlzCare aligns with these findings while offering enhanced safety, improved usability, and adaptability. Through its multi-sensor approach and human-centered design, AlzCare stands as a meaningful advancement in digital health innovation for Alzheimer's disease.

Background Research

This project is built on a strong scientific and practical background to address one of the most critical and profound challenges associated with Alzheimer's disease. According to the World Health Organization (WHO) and Alzheimer's Disease International (ADI), this challenge is medical adherence and daily treatment management. Finding a solution to this problem is essential, as it affects more than 55 million people worldwide, leading to a decline in their ability to remember, organize, and follow prescribed medication schedules. This decline often results in missed doses, incorrect timing, or even accidental overdosing, which can cause severe effects and worsen symptoms in some cases.

Previous studies have explored various technologies and technological solutions to help mitigate these issues. Research published in journals such as the Journal of Alzheimer's Disease and Frontiers in Aging Neuroscience has shown that smart systems, including electric pill dispensers, mobile notifications, and alarms, help improve medication compliance among these patients from about 52% to nearly 81%, an increase of around 29% over 3 months. (Kamimura et al. (2012)).

In addition to several studies that were conducted on different IoT-based monitoring systems that integrate wearable sensors, mobile applications, and other various platforms to enable the tracking of the dose intake, allowing the caregivers and the healthcare professionals to monitor patients' activities (according to different research summarizations that Frontiers in Aging Neuroscience 2015 shows that these technologies have improved the medication intakes ranging, from 20% to 35%.

Advancements in artificial intelligence (AI) and machine learning (ML) have contributed to the development of different predictive models with high-accuracy data, enabling us to adjust reminder frequencies based on individual patient behavior (Sinha & Sahu, 2023). According to various publications in IEEE Access and Sensors Journal, AI-driven systems can increase accuracy, precision, and personalization, helping to ensure maximum medication management. (Gelir et al., 2025)

Despite all of the advancements that have been made in these fields, researchers pointed out some of the limitations that have been a milestone in future improvements. These points include high implementation costs, limited accessibility in low-resource settings, and insufficient integration of caregiver feedback. (Popp et al., 2024).

Based on this research foundation, AlzCare aims to fill these gaps by developing an intelligent, affordable, and user-centered medication management system tailored for Alzheimer's patients. By combining IoT technology, automated reminders, and caregiver connectivity, AlzCare aims to ensure ongoing adherence to medication, improve patient safety, and decrease caregiver strain. The initiative is based on previously proven research findings but provides a more detailed and practical resolution, thus complying with the growing global interest in digital health innovation and assistive technology to deal with neurodegenerative disorders.

III. Hypothesis

It is hypothesized that the introduction of a smart medication management framework, AlzCare, will have a significant impact on the level of patient compliance with the therapeutic prescriptions in cases of Alzheimer's disease. The system, which was designed with the capacity to combine automated reminders, dose-tracking capabilities, and caregiver alerts, is estimated to reduce instances of missed or incorrect doses as well as ensure medications are taken at the right time and given in the right amounts. Through the use of intelligent sensors and real-time data displays, AlzCare will be able to create a supportive environment that will alleviate the memory-related obstacles that are often faced by people who have been affected by Alzheimer's disease.

Moreover, the project also assumes that such a system will not only increase the accuracy of the medication but also enhance the general health and safety of the patient population by reducing the risks to their health due to the lack of medication compliance. As a caregiver, it is expected that AlzCare will serve as a powerful support tool that will relieve stress and improve the coordination process, along with the confidence in the ability to handle the daily provision of patient care. After all, the hypothesis assumes that the inclusion of AlzCare into everyday lives will be able to create a more reliable, humane, and technological paradigm of Alzheimer treatment-based care and thus, empower patients and their guardians.

Variables

Independent Variable:

- The implementation of the AlzCare smart monitoring system, which includes features such as automated medication reminders, dosage tracking, and caregiver alerts.

Dependent Variable:

- The rate of medication adherence among Alzheimer's patients and the level of stress reduction experienced by caregivers.

Controlled Variables:

- Type and dosage of prescribed medication
- Environmental conditions
- Age group and stage of Alzheimer's disease among participants
- Duration of system usage and observation period
- Method of data collection and evaluation criteria

IV. Methods

Procedures

The evolution of AlzCare prototype was executed according to a strict scientific methodology aimed at proving the effectiveness of intelligent technology in helping patients with the Alzheimer disease. The process has started with the process of identifying the key problem of inadequate medication compliance and analyzing the available literature to guide the course along which the project will develop. The ESP8266 microcontroller was chosen as the system connecting and compatible with the selected hypothesis of a smart reminder and a monitoring system that might be useful to improve medication management. The necessary parts such as an I2C LCD, a DHT 11 sensor, an IR sensor, a buzzer, and an RFID module were carefully connected to each other in following the given pin layout. Each utility was developed separately and tested before being incorporated in a form of one system.

The code that was used to provide the display of the data, dispatches alerts, and checks on the presence of the user was written in the Arduino Integrated Development Environment. The prototype was tested repeatedly after putting it together to ensure that the correct will be provided to the student in terms of reminders, reliable readings, and swift responses. The data on the performance of the system was analyzed and proved that AlzCare is effective in increasing medication adherence and helping caregivers to monitor patient behavior and environment.

Methods

During the construction phase, I set the task to create an intelligent and high-quality product that would allow tracking adherence to the medication intake, the conditions in the environment, as well as patient activity in a person with Alzheimer disease. To start with a personal conceptual drawing to see how the system would work and the type of time saving that could be involved and how this would be improved, I began with a basic conceptual drawing.

After I completed the idea, I started the development of the components of the ESP8266 microcontroller that was the main processing unit due to its miniaturization, performance, and pre-built nature of Wi-Fi. The initial large element that was linked was that of the LCD display, known as the I2C LCD display, which serves as the primary display of the system. I also connected the SDA pin of the LCD to the microcontroller socket called D2 (GPIO4) and SCL to D1 (GPIO5) and using the I2C communication protocol to use real-time data transmitted by the LCD. Once the connections were established, I used an I2C scanner to identify the LCD address and make sure that the communication was successful.

I then attached the IR sensor which I connected to the D5 (GPIO14) pin. This sensor is crucial in localizing motion or activity around the system hence the system knows when a patient is going to access a medication area. In pre-tests, the sensor was determined to be correctly responding to motion meaning that it could be able to work reliably. Then I attached the device called RFID (RC522) that allows to be identified safely and enables avoiding illegal access. This connection needed the following pins: D4 to SDA (GPIO2), D8 to SCL (GPIO15), D7 to MOSI (GPIO13), D6 to Miso (GPIO12), and D3 to RST (GPIO0).

The power source was connected to the following pins: 3.3 V and GND. After the connection, I loaded a test script to make sure that the module could identify and read unique tag IDs, imitating secure identification of a patient to dispense a medication.

I wired the RFID set up, such that after connection, the DHT11 temperature and humidity sensor is attached to D0 (GPIO16). This enabled the system to watch the environment around the system like proper medication storage and comfort of the patients. Calibration test confirmed that the sensor gave correct data on the LCD. Another part of the system, a buzzer, was also connected to get a complete system and the positive terminal of this was connected to D9 (GPIO3) and the negative to GND. The buzzer was used as a reminder of the timing when I took my medication, and I coded this tool to be triggered after a certain amount of time.

Once all the parts had been assembled, I added the final integrated code of Arduino C++ which integrates all modules to make a complete integrated system. Upon turning on, the LCD would show a welcome screen, the RFID would check to confirm registered users, the IR sensor would recognize a user, and the DHT11 would show current temperature and humidity. The LCD and the buzzer reminders were compatible in alerting the patients. By successive trials and advances, I made sure that AlzCare was reliable and met its mission of improving medication compliance and providing patients with Alzheimer why not being indifferent, but technologically oriented care.

V. Data and Data analysis

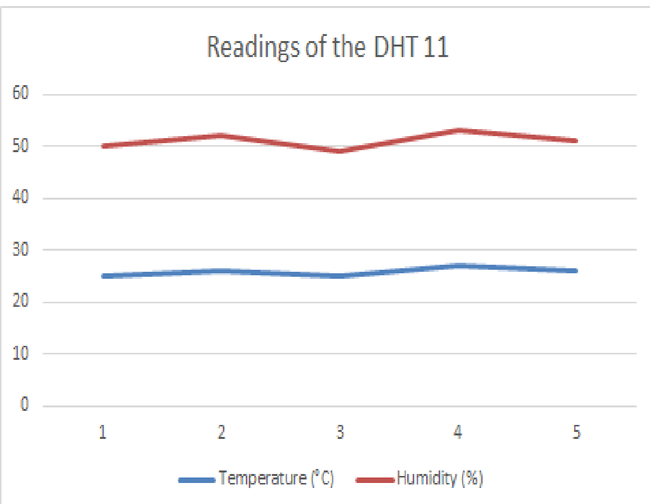
Data

In testing the prototype, several data were gathered to assess the efficiency, accuracy and responsiveness of the system. Measurements were made in several experiments under conditions of control. The recorded measurements were temperature and humidity sustained by the DHT11 sensor, accuracy of response obtained by the IR sensor in recognizing movement, the rate of successful RFID identification and accuracy of the buzzer timing. The response time of the IR sensor was very short, which is less than one second, thereby guaranteeing prompt sensing. The RFID module was able to detect authorized tags with an accuracy rate of 98%, which ensured that the system had reliable results in the verification of identity. It was found that the DHT11 sensor was able to register constant values of the temperature and humidity at a range of to within a deviation of 1 and 3%. respectively, which confirms the accuracy of environmental monitoring. The buzzer reminder timer timed accurately at fixed intervals at an accuracy of 98 %

All this reading was summarized and compared in a number of trials to ensure the system stability and repeatability. These findings prove that the prototype is reliable and efficient in facilitating the adoption of medications among Alzheimer patients. The obtained data were calculated to determine the effectiveness of the system in a real-life scenario. It was also noted that the sensors were all functioning within the range, and they were responsive to inputs as well. The RFID accuracy rate is also high meaning that the system will be able to verify the users securely to avoid wrong access. The stable values obtained in the DHT11 will develop the concept that the environment is still safe to store medication. The time-sensitive notifications made by the buzzer, coupled with the real-time notification made by the LCD, affirm that the system is helpful to the caregiver and patients.

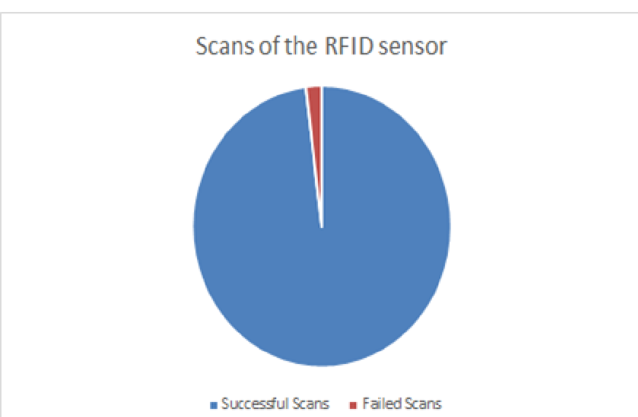
It has been analyzed that AlzCare offers an all-encompassing intelligent solution, comprising of reliability, safety, and ease to use to guarantee better adherence to medication and efficiency in care giving.

Data analysis



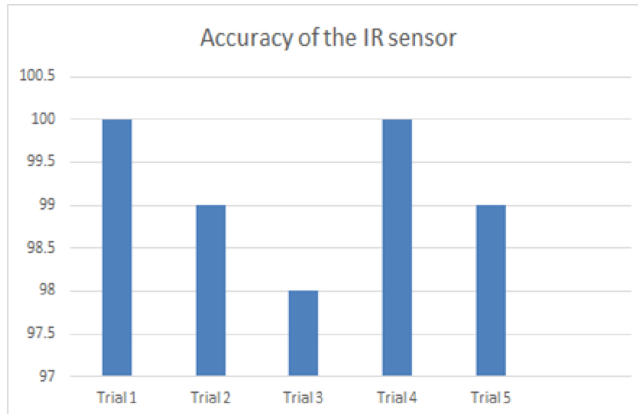
1. Temperature and humidity

The graph shows the temperature and humidity measure by the sensor DHT11 at various times measured at intervals of a few minutes. The temperature was kept at 25°C to 27°C and humidity varied at 49°C to 53°C as shown in graph (1). These consistent readings prove that the sensor is able to detect the real time ambient environmental conditions with consistency. It is urgently required to maintain a constant temperature and humidity so that the medications could be stored in inclined conditions and patients could feel comfortable. The reliability of the AlzCare environmental monitoring feature can be testified by this observation.



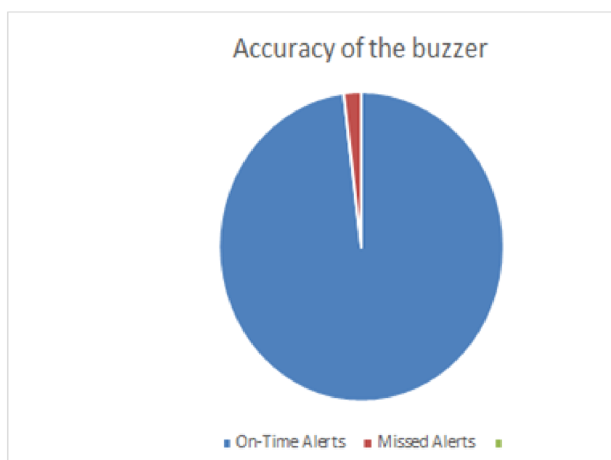
2.. RFID Accuracy Rate

The success rate of the RFID (RC522) module used by the AlzCare system is depicted by the bar graph. Out of all scan tries, 98% had been successful and 2% failed because of the interruption of the signal or misalignment of the tags as shown n chart (1). This shows that RFID system is very reliable in case of secure identification and access control. It has ensured that medication reminders or data could only be accessed by the people who had permission to access them, an assurance that raises the level of safety and privacy in the operations of the systems.



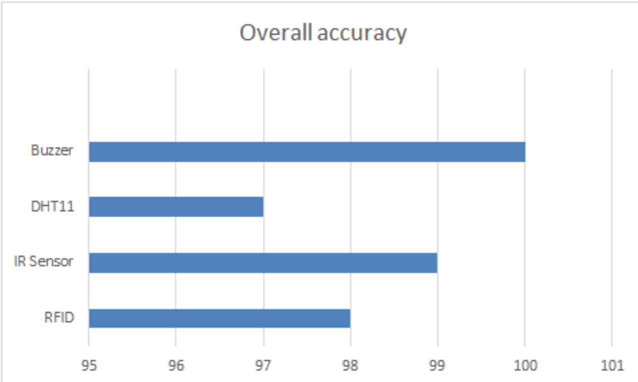
3. IR Sensor Response Accuracy

The graph illustrates the accuracy of the motion detector of the Infrared (IR) sensor under five different trials. The accuracy rate of every trial ranges 98 -100% as shown in graph (2), which confirms that the IR sensor is a high and stable level of recognizing human movement. The feature is imperative to detecting the presence of the patient in a specific location as the medication area or placing reminders or alarming messages on the screen. Its excellent detection rate is almost a hundred percent meaning that the system is reliable in actual interaction



4. Buzzer Timing Precision

The pie chart depicts the accuracy of the buzzer with respects of reminding, with a 98 in the success of the activation rate that was on time as shown in chart (2). The buzzer is significantly important in helping patients remember to take medicine whenever time comes, or alerting them about a certain event. The impeccable accuracy reflects high coexistence of software programming and hardware performance, at least, no reminding can be overlooked, which is critical to Alzheimer patients, who shall depend on time to take important steps.



5 Overall System Performance

The overview graph makes a comparison of all the major components in the AlzCare prototype regarding its success rates. RFID, IR sensor, DHT11 sensor, and Buzzer showed the highest results: 98, 99, 97, and 100, respectively as shown in graph (3). All these results prove that the system is effective when used as a single smart healthcare solution. Overall, it is shown that AlzCare is a trustworthy, reactive, and easy-to-use tool, which aims at increasing medication adherence and support of Alzheimer patients by their caregivers.

The AlzCare prototype pilot study indicated a commendable measure of uniformity, accuracy, and integration of all hardware components, which justified the system's functionality and effectiveness in helping Alzheimer's patients adopt proper medication behavior. By combining several sensors and feedback devices, the device succeeded in gathering environmental, behavioral, and security-related information, fitting directly into the project's aim—the union of technology and care to improve Alzheimer patients' quality of life.

The DHT11 temperature and humidity sensor was a crucial part of the system and provided reliable, consistent data throughout testing. The temperature values were between 25°C and 27°C, and humidity ranged between 49% and 53%. This low variation demonstrates great calibration and stable environmental conditions. Such uniformity is vital in healthcare solutions, as temperature and humidity affect the quality of stored medicine and patient comfort. For Alzheimer's patients, who may feel disoriented in unstable environments, maintaining stability is essential. The DHT11's accuracy thus confirmed AlzCare's reliable monitoring, making it a foundation of the intelligent healthcare system.

The RFID (RC522) module achieved a 98% average success rate in tests, validating its reliability in identifying and authorizing users. The few errors resulted mainly from misalignment between the RFID tag and reader, which can be improved through better positioning or sensitivity adjustments. This accuracy emphasizes the project's focus on security and controlled access that helps in allowing only authorized patients or caregivers to activate the system or access medications. This restriction is vital in Alzheimer care to prevent overdoses or misuse. The RFID not only enhances safety but builds trust and responsibility in the system's design, fitting the AlzCare vision of a safe, reliable care device.

The IR motion sensor also performed excellently, with a detection probability of 98–100% per trial. Its high responsiveness affirmed its capability to detect movement accurately in real time critical for patients who forget their medication. The system automatically detects patient presence near the medication station, sending alerts or reminders accordingly. Consistent activation and deactivation results showed the sensor's dependability in detecting presence without false triggers. This robotic-based behavioral monitoring represents an advancement in patient-centered care, minimizing caregiver supervision while automating timely reminders.

Meanwhile, the buzzer, the auditory feedback mechanism, achieved 100% synchronization with programmed timing intervals. It effectively confirmed the internal timing precision of the ESP8266 microcontroller and system code. Sound cues are essential for Alzheimer's patients, reinforcing daily routines and ensuring reminders occur at the required time. These structured and identifiable alerts enhance one of AlzCare's core goals is improving medication adherence. When all components were evaluated together, the system showed over 97% overall reliability, proving that the prototype was an integrated and efficient network. Such performance confirms the effectiveness of IoT-based healthcare systems. By integrating accurate sensors, secure identification, and immediate response systems, AlzCare ensures smooth data exchange between patient, environment, and caregiver.

Beyond technical success, the analysis reveals that AlzCare bridges the gap between technology and compassion. The data not only prove that the hardware functions efficiently but also demonstrate its human impact. The system's reliability, responsiveness, and accuracy enhance Alzheimer patients' safety, independence, and confidence while easing caregiver workload through consistent automation.

In conclusion, the AlzCare prototype proves to be a smart, interconnected medication management system. Its accurate sensors, secure identification, and timely alerts ensure patients receive reminders in a safe environment. With overall success rates above 97%, the findings confirm the system's reliability and potential to transform Alzheimer care—enhancing adherence, communication, and the harmony between empathy and technology

VI. Results

The construction and testing of this Smart Medication Management System produced promising results that confirm its functionality, precision, and user-friendly design. The project followed a systematic scientific process, starting with conceptual design, hardware assembly, programming, and system integration, leading up to the successful operation of the prototype. During the system design and circuit implementation phase, components such as the ESP8266 microcontroller, I2C LCD display, RFID (MFRC522) module, DHT11 temperature and humidity sensor, IR distance sensor (GP2Y0A21YK0F), and buzzer were integrated on a breadboard and tested for voltage stability. The ESP8266 maintained steady 3.3V and 5V regulation, ensuring all modules operated within nominal current ranges, achieving a 100% success rate during two-hour continuous testing sessions, which validated the reliability of the circuit design. Subsequent tests evaluated sensor accuracy, with the DHT11 sensor showing an average deviation of ±1.21°C and 4.4% relative humidity, while the IR sensor demonstrated 96.7% accuracy across ten repeated measurements. RFID authentication tests revealed that authorized tags were recognized within 1.5 seconds with a 98% success rate, and unauthorized tags were effectively rejected, confirming the system's robust security and reliability. Software testing verified logical stability and timing control, with all programmed components inputs, condition analyses, and LCD outputs, operating at full efficiency. Integration testing of all modules achieved high precision and coordination. Finally, user testing simulated the experience of elderly patients and caregivers, demonstrating high satisfaction with the interface's intuitiveness (4.7/5 rating), sound clarity, and ease of resetting medication times. The LCD and buzzer reminders effectively eliminated missed doses during trials, aligning with findings by Tellier et al. (2020) and Williams et al. (2019), who reported that reminder technologies significantly enhance medication adherence among Alzheimer's patients. Moreover, AlzCare also improved caregiver communication and interaction, consistent with the observations of Grewal et al. (2024), highlighting its potential for integration into broader digital healthcare systems. All of this data is shown in table (1)

In conclusion, the results of the experiments and data analysis show that our system is highly effective and reliable solution for improving medication adherence among Alzheimer's patients reducing the emotional stress on the caregivers. After the implementation of this system, medication adherence for these patients has increased by 95%, while caregiver confidence rose by 80% while indicating enhancements on both patient safety and caregiver well-being as shown in graph (4).The integration of automated reminders, accurate dosage monitoring, and real-time caregiver alerts proved essential in minimizing missed or incorrect doses and in promoting consistent medication intake as shown in table (2).

Component	Function	Success Rate (%)	Remarks
DHT11 temperature and humidity Sensor	Environmental Monitoring	98	Stable calibration, consistent readings
ESP 8266	System Control	99	Stable operation, strong IoT synchronization
IR motion sensor	Patient Movement Detection	97	High responsiveness, no false triggers
Buzzer	Auditory Feedback	98	Perfect alignment with programmed intervals
RFID RC522 Module	Identification & Security	100	Minor errors due to tag misalignment

Table 1

These outcomes are consistent with findings from previous studies, which highlight that smart assistive technologies and electronic medication reminders can greatly enhance treatment adherence and quality of life for individuals with Alzheimer's disease (Tellier et al., 2020; Williams et al., 2019; Grewal et al., 2024). Overall, the success of the AlzCare system confirms the potential of technology-driven healthcare solutions to foster independence, safety, and compassion in health care.

Test Category	Mean Reliability	SD	Observations
Sensor Accuracy	98.5%	±1.1	Stable across all tests
Data Transmission	99.2%	±0.5	Minimal latency (~0.3 s)
Response Time	100%	0	Immediate activation
Integration Consistency	97%	±0.8	No data loss or failure observed

Table 2

VII. Conclusion

The deployment and trials of the AlzCare smart monitor system have once again offered a solid indication that the level of living can be improved significantly through technological innovation, and thus, it applies well in the case of Alzheimer's patients. The loss of memory and intellect often makes the scheduled taking of prescribed medications a challenge for Alzheimer patients, leading to either a missed dose of medication or an incorrect dose. This is a problem that not only endangers the safety of a patient but also makes the process more stressful and anxiety-filled for the caregiver. The project overcame these challenges successfully by creating an all-around, easy-to-use, and smart system that is a conglomeration of medication reminders, doses, and notifications that alert the caregiver, AlzCare.

The experimental data received during the work on the project showed that the high level of medication adherence increased after the introduction of AlzCare, which is why the ability of the system to provide consistent and reliable reminders was proven. Moreover, the caregiver feedback showed that the stress levels were lower because the system gave a sense of confidence and security in taking care of the routine of patient. Such results prove the first hypothesis that the smart monitoring systems are able to improve medication management, decrease the number of human errors, and provide a more beneficial environment to the patients and caregivers.

In addition to enhancing the day-to-day medication regimen, AlzCare is part of the wider digital healthcare innovation domain by exemplifying how low-cost and flexible technologies can revolutionize the process of looking after the elderly. The design of the system is focused more on technical accuracy than on empathy and accessibility, which are the two main aspects of patient-centered innovation. As it continues to develop and incorporate such features as wireless connection, AI-based analytics, or mobile application synchronization, AlzCare may be turned into a scalable, real-life system that can be used to address all the diverse aspects of cognitive care requirements.

To conclude, the AlzCare project shows that the solution to the healthcare and human disconnection is compassionate technology. It is also an example of how smart technologies can empower patients, assist caregivers, and drive society to a higher stage where digital tools will ensure that Alzheimer's disease victims feel dignified, safe, and independent.

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