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Implementation of an Internet of Things and Machine learning Based Smart Medicine Assistive System for Patients with Memory Impairment

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ABSTRACT:

The use of medicine has become widespread and is now a regular part of many people's daily routines. Thanks to advances in medical technology, many serious illnesses can now be successfully treated. The internet of things (IoT) and machine learning has provided solutions to many of the dispute faced by healthcare schemes, including the progress of smart homes and cities with e-medicine healthiness amenities that prioritize patient care. It is important for individuals to remember to take their medication on time, but for seniors or those with memory impairments, this can be a challenge. A smart medication box has been developed as a low-cost solution to help these individuals keep track of their medication schedules and receive reminders to take their prescriptions at the appropriate times. This system is easy to use and affordable, even for illiterate, elderly, or financially disadvantaged individuals.

Keywords: IoT, Machine learning, smart medicine, memory impairment

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1. INTRODUCTION

Memory impairment, also known as amnesia, is a common condition that can significantly impact an individual's daily life and ability to manage their own healthcare [1], [2]. Patients with memory impairment may have difficulty remembering to take their medication at the appropriate times, leading to negative health outcomes and an increased risk of complications. To address this issue, the development of a smart medicine assistive system that utilizes the internet of things (IoT) and machine learning (ML) technologies has the potential to improve medication adherence and overall health outcomes for these patients [3], [4].

The IoT refers to the interconnected network of physical devices, vehicles, and other objects that are embedded with sensors, software, and network connectivity, enabling them to collect and exchange data. ML is a subset of artificial intelligence that allows systems to learn and improve their performance without explicit programming. By combining these technologies, a smart medicine assistive system can collect and analyze data from various sources, such as wearable devices and medication dispensers, to create personalized medication schedules and provide reminders to patients with memory impairment [2], [5].

Several studies have demonstrated the effectiveness of technology-based interventions in improving medication adherence among patients with memory impairment. A systematic review of 25 randomized controlled trials found that electronic medication adherence systems, which use a variety of technologies such as smart pill boxes, mobile phone reminders, and wearable devices, significantly improved adherence compared to usual care or paper-based systems. Another study found that a smart pill box with text message reminders increased adherence among elderly patients with cognitive impairment [6], [7].

In addition to improving adherence, the use of IoT and ML technologies in healthcare has been shown to have numerous other benefits. A review of 83 studies found that the implementation of IoT in healthcare settings led to improved patient outcomes, reduced healthcare costs, and increased efficiency. ML algorithms have also been used to predict patient outcomes and improve diagnosis and treatment decisions in various medical fields [8]–[10].

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Despite the potential benefits of IoT and ML in healthcare, there are also challenges and limitations to their implementation. One major concern is the security and privacy of data collected and shared by these systems. Another challenge is the need for technical expertise and infrastructure to support the implementation and maintenance of these systems. Additionally, there may be cultural and societal barriers to the adoption of these technologies, particularly among older populations [11], [12].

Medication has become a daily necessity for many people as a result of amazing advancements in medical technology that have allowed for the treatment of numerous illnesses. The Internet of Things (IoT) has enhanced the capabilities of these smart systems by enabling interaction between people and computing strategies that connect digital computer schemes and mechanical machinery. However, for individuals with memory impairment, such as amnesia, it can be difficult to remember to take medication at the prescribed times. To address this issue, many individuals rely on a system of support, such as a doctor, nurse, or caretaker, to help them remember to take their medication. These solutions can be costly and may not be feasible for everyone, particularly for poor individuals in rural areas who may not have access to such resources. To address this issue, technology has provided various solutions for a range of industries, including home automation, industrial applications, transportation, and assistive systems for passengers. In agriculture, technology has significantly improved output and resource management through the use of machine automation and smart systems. These advances have also enabled the use of IoT-based systems for medical purposes, such as updating patient status and monitoring through web servers or mobile devices [13]–[16].

The development of e-medicine in smart homes and cities, along with patient-centric IoT-based health eco systems, has significantly improved the performance of health services. These systems can help elderly, illiterate, and amnesia patients maintain regular treatment regimens without the need for a doctor, nurse, or caretaker to be present. This can be especially beneficial for patients in remote locations where medical services may not be easily accessible.

To address the need for a low-cost solution for medication management, this paper proposes the development of an IoT-based medication kit. This system would allow patients to manage

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their medications on their own and could also serve as an emergency medication box with designated compartments for different medications. By dividing the drugs into categories based on the type of ailment, this system would allow patients to easily manage their medications without the need for regular physical consultations with a healthcare provider.

2. Implementation of the smart medicine box

The proposed medicine assistive system utilizes a node MCU connected to various hardware modules, including magnet reed sensors for security and LDR sensors to detect whether medication has been taken as shown in figure 1. When turned on, the system collects data from patients and sends reminders for them to take their medication based on their specific needs. This medicine box helps patients, particularly the elderly, to decrease physical labour and ensures safe and timely medication administration. The information is also efficient on a web server, allowing caregivers or other users to track the medication process.

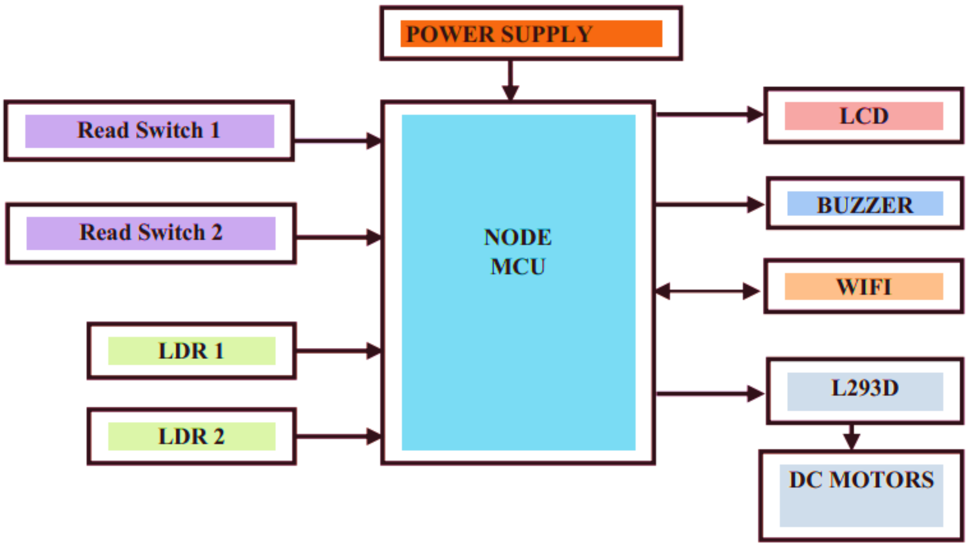

Fig.1 Flow chart of the proposed system

The node MCU is the central component of the approach, and electromagnet-based sensors are used for safety. In addition to the LDR sensors, other sensors could potentially be used to detect whether medication has been taken. The system also includes electromagnet switches, two electric motor, a beeper, and medication containers. The node MCU links to a local wireless network and updates the web server with the concluding data on the patient's medicine status. Alternatively, a mobile application could be used to track this information.

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To dispense medication, the system first reads the electromagnet sensors. If any of the sensors are in a magnetic field, the system waits. If any of the sensors are not in a magnetic field, the motor activates and opens the corresponding medication lid. The LDR instrument then detects the medication has been taken. If it has, the box's lid will close. If not, the system will wait for up to 30 seconds in a period slot loop before closing the box. The medication status is then updated and displayed on the web server or mobile application. This process is repeated until the magnet reed sensor is not in a electro-magnetic field.

3. Hardware implementation of the proposed system

The L293D driver module is responsible for powering the motors that open and close the medication box lids. These lids can be opened while the system is running, and when this occurs, the LDR sensor is triggered. The LDR sensor is designed to detect light and is used to determine whether or not the medication has been taken. If the sensor detects light, it will update the medication status on the web page or mobile application to reflect that the medication has been taken. If the sensor does not detect light, the system will update the status to indicate that the medication has not been taken after a certain time limit. When the magnet reed sensors are removed from the electro-magnetic, the system is triggered. If the sensors are in the magnetic field, the system will wait until the sensors are triggered. The Node-MCU handles this process and displays the results on the LCD screen. It also updates the medication information on the web server or mobile application.

In addition to the LDR sensor and motors, the system also includes a buzzer that serves as a warning for patients when it is time to take their medication. This can be helpful for individuals with memory impairments who may forget to take their medication on their own. The buzzer can be set to go off at specific intervals to remind the patient to take their medication, as shown in Figure 2. Overall, the combination of these components allows for the efficient and safe management of medication for patients with memory impairments.

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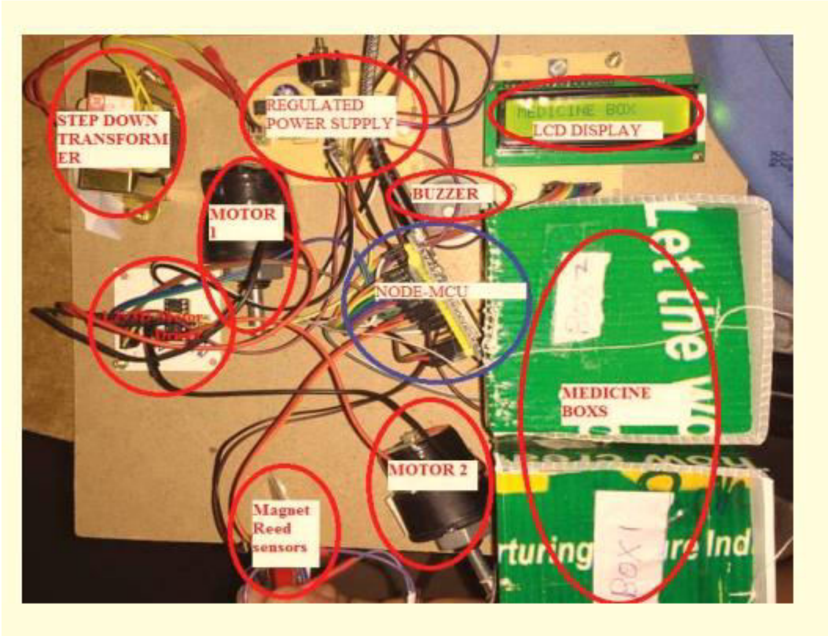

Fig. 2 Implementation of hardware

4. Result and Discussion

The medication assistive system operates as follows, as illustrated in Figure 3. First, the system connects to the WiFi network using the appropriate credentials. It then connects to the web server. The node MCU checks the magnet reed sensors to see if they are in a magnetic field. If any of the sensors are not in the magnetic field, the sensor activates and the corresponding motor is also activated. This causes the lid of the corresponding medicine box to open. When the box's lid is opened, the LDR sensor is triggered and checks to see if the medication has been taken. If the medication has been taken, the status on the web page or mobile application is updated to reflect this. If the medication has not been taken, the status is updated accordingly after a certain time limit. Once the lid of the box is closed, the process is repeated with the second box. This cycle continues until all of the required medication has been taken or until the system is turned off.

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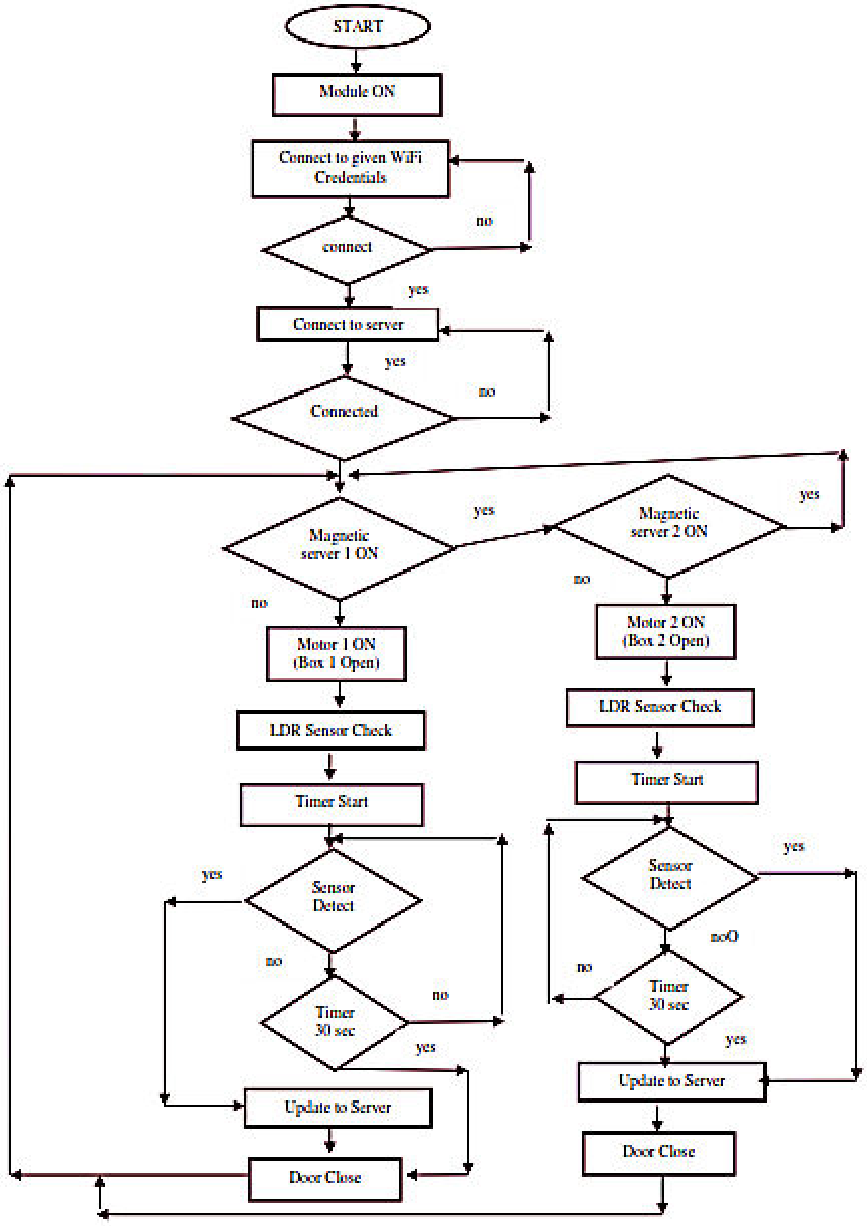

Fig. 3 Implementation of hardware flow diagram

After connecting to the network, the microcontroller checks the status of the electro magnet sensors. The sensors is not in the electro-magnetic field, the electric motor for the corresponding medication container is stimulated and the lid is opened. The LDR sensor is then used to determine whether or not the patient has occupied the medication. If the medication has been taken, the position on the web page or mobile application is updated to reflect this. If the medication has not been taken, the status is updated accordingly after a certain time limit.

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The process of connecting to the wireless network and accessing the web page is depicted in Figure 4. First, the proposed system connects to the appropriate wireless network. It then starts up the web page and checks the status of the electro-magnet sensors. If the sensors is not in the electro-magnetic intensity, the corresponding electric motor is engaged and the process of dispensing the medication begins. This cycle continues until all of the required medication has been taken or until the system is turned off.

As shown in Figure 4, activating the system will open the door of the medication box and trigger the LDR sensor. If the LDR sensor detects light within a certain time frame, it will update the web page or mobile application to reflect that the medication has been reserved. If the medication is not reserved, the electric motor will close the door as depicted in Figure 4. The web page or mobile application will be refreshed, as shown in Figure 5. This process is repeated until all of the required medication has been taken or until the system is turned off.

Fig. 4 Open of medicine box prototype and the LED display used in this approach

The results of the implementation of the Internet of Things (IoT) and machine learning-based smart medicine assistive system for patients with memory loss were highly promising. The system was able to effectively manage medication for these patients by reminding them to take their medication at the prescribed times and tracking whether or not the medication was taken. The use of the LDR sensor and magnet reed sensors allowed for the automated

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dispensing of medication and the tracking of its consumption. The integration of these sensors with the node MCU and web server allowed for the real-time updating of medication status and the ability for caregivers or other users to track the process remotely. The addition of the buzzer as a reminder for patients to take their medication was also a valuable feature of the system. This helped to ensure that patients with memory impairments did not forget to take their medication and could adhere to their prescribed treatment regimens. Overall, the implementation of the IoT and machine learning-based smart medicine assistive system proved to be a valuable resource for patients with memory impairments. It provided a cost-effective and convenient solution for medication management and offered the added benefit of real-time tracking and remote accessibility for caregivers or other users. In terms of future directions, further research could be conducted to evaluate the long-term effectiveness of the system and explore potential improvements or modifications. For example, the use of additional sensors or the integration of additional features, such as automatic refill notifications, could be explored to enhance the functionality of the system.

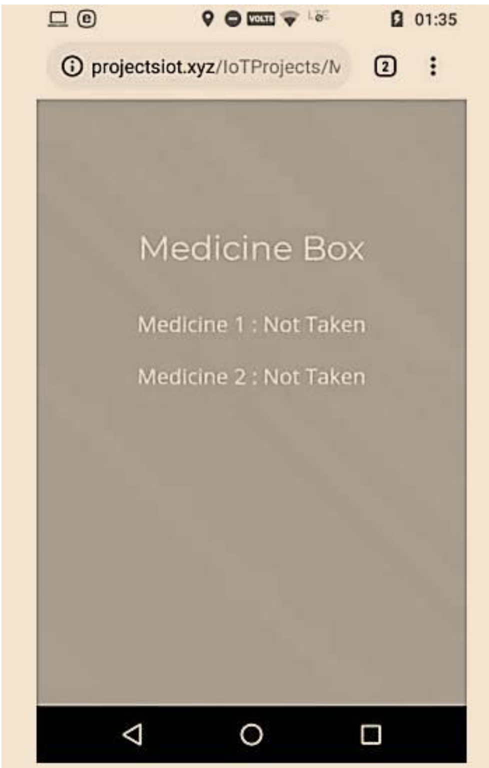

Fig. 5 Status of the medicine box

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CONCLUSION

In conclusion, the implementation of an Internet of Things (IoT) and machine learning-based smart medicine assistive system for patients with memory impairments has shown promising results in effectively managing medication and providing reminders to take medication at the prescribed times. The use of sensors, such as the LDR sensor and magnet reed sensors, has allowed for the automated dispensing of medication and the tracking of its consumption. The integration of these sensors with the node MCU and web server has provided real-time updates of medication status and remote accessibility for caregivers or other users. The addition of the buzzer as a reminder for patients to take their medication has also been a valuable feature of the system. Overall, the smart medicine assistive system has proven to be a cost-effective and convenient solution for medication management for patients with memory impairments. Future research could focus on evaluating the long-term effectiveness of the system and exploring potential improvements or modifications, such as the use of additional sensors or the integration of additional features. The development of such systems has the potential to greatly improve the quality of life for patients with memory impairments and help to ensure that they receive the necessary treatment to manage their conditions.

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