



IoT based Medicine Box Assistance for Elderly People

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Abstract

This system addresses the issue of medication adherence by providing timely reminders for patients to take their prescribed medication and ensuring only authorized users access the medication box. Combining physical and digital reminders, it offers a solution suitable for individuals of all ages, particularly on aiding elderly individuals who are prone to forgetting their medication schedules. Emphasizing ease of use and cost-effectiveness, the system integrates microcontroller technology, IoT systems, Facial recognition and an alarm system to prompt patients to take their medication as per their prescription. Designed to be portable and affordable, this smart medicine box is especially beneficial for elderly and illiterate patients, relieving family members of the burden of ensuring medication adherence. This paper describes an overview of a smart medicine box, which acts as an assistive device to avoid non-compliance with medicine. It consists of a hardware box with compartments for a week (three times a day), as well as an Android application for reminding the respective patient and informing the family members (caregiver) whether the patient has taken the medicines or not.

Keywords: AI; Arduino; Buzzer; CNN; Face recognition; IoT; LED; Medicine Box.

1. Introduction

Aging is a natural process that occurs as people enter old age, characterized by physical changes and altered behaviour. Elderly individuals experiencing declining body function often require medication to maintain their daily health. Due to degradation on their memory ability, some problems are experienced by elderly in maintaining their daily health which include difficulty in remembering what kind of medicine to consume, as well as, remembering medications schedule. There are chances that they may forget to take their medicines on time. So poor medication adherence is a major problem for the patient and medicine provider. In this situation, they will need to be assisted by a product which can help them to take medicine appropriately and provide assurance. When we researched, we found out that about 60% of people above 60 years have poor record of medical history. The major reason for these was not adapting proper medication. In response to these challenges, researchers have been actively seeking

innovative solutions and new technologies that could improve patient care quality while reducing costs. Healthcare services utilizing Internet of Things (IoT) and Artificial Intelligence (AI) hold great potential in the medical field. The primary aim is to bridge the gap between the medical and technology fields, fostering innovation to address current medical challenges. Therefore, our project uses sensors and timer system to notify patients when they should consume their medication. Additionally, by employing AI, we prevent unauthorized individuals, especially children, from accessing medications intended for the elderly.

2. Related Works

[1] Gurav et al proposed a basic LED and Buzzer Indication System. The Basic LED and Buzzer Indication System is a simple yet effective method for reminding patients to take their medication at specified times. By utilizing LED lights and a buzzer, the system provides a clear visual and auditory alert



to prompt the patient to take their medication. While the LED lights and buzzer effectively remind the patient to take their medication, they do not have the capability to verify whether the medication has been consumed. This lack of verification introduces a risk that the patient may forget or neglect to take their medication even after being reminded. Without a mechanism to confirm medication ingestion, there is no guarantee that the patient is following their prescribed treatment regimen. [2] Sarvesh Kulkarni et al, designed GSM Notification System, which is like having a personal medication reminder that goes beyond just beeping and flashing lights. It's a smart upgrade to traditional reminder systems, now using GSM technology to send reminders directly to your phone. Imagine your medicine box equipped with this system; it will alert you via text message whenever it's time to take your meds, making sure you don't miss a dose no matter where you are. First, you set up your medication schedule in the system. Then, at the specified times, the system sends out text messages to your phone, reminding you to take your pills. It's like having a personal assistant that keeps track of your medication for you [3]. This upgrade is especially handy for elderly folks or those with busy lives who might not always be near their medicine box when it's time to take their pills. With GSM technology, you can receive reminders wherever you are, whether you're at home, at work, or out running errands. It ensures that you stay on top of your medication regimen, reducing the risk of missed doses and improving your overall health outcomes. While the GSM Notification System is great at reminding you to take your meds, it doesn't actually know if you've taken them. It's like having a friend who reminds you to do something but can't check if you've done it. This means there's still a chance that you might forget or skip your medication, even after receiving the reminder. [4] Vidula V. MESHram et al. proposed the Sensor-Based System, that represents a significant advancement in medication management technology, integrating a range of sensors, including IR (Infrared), proximity, and ultrasonic sensors, with LED, buzzer, and GSM notification features. Unlike traditional reminder systems, this innovative solution goes beyond simple reminders by incorporating

sensors strategically placed around the medicine box to detect whether a person is in proximity to the box at the specified time of medication intake. When it's time for medication, the sensors spring into action, detecting the presence of someone near the medicine box. If the sensors detect that the medication has been accessed, the system acknowledges the successful intake and may trigger visual and auditory cues, such as LED lights and a buzzer, to confirm the action. Additionally, the system sends out GSM notifications to the designated mobile phones, providing an extra layer of assurance that the medication has been taken. However, what sets this system apart is its ability to detect instances where the medication is not accessed despite someone being near the box. In such cases, the system can initiate additional alerts or notifications, prompting further action or intervention. This feature is particularly valuable for caregivers and family members who may be concerned about the medication adherence of their loved ones. Despite these advancements, one critical consideration with the Sensor-Based System is the issue of unauthorized access, especially in households with children. While the system is designed to detect medication access and trigger alerts accordingly, there is a potential risk of unauthorized individuals, particularly children, gaining access to the medication box. This raises concerns about the safety of medications and the need for additional measures to prevent unauthorized access. [5] Harsha et al. designed the RFID (Radio Frequency Identification) based system, which revolutionizes medication management by introducing wearable RFID technology that seamlessly integrates with the medication box. In this innovative solution, patients wear a band embedded with RFID tags, which communicate with RFID readers integrated into the medication box. When the patient wearing the RFID band comes into proximity with the medication box, the RFID reader detects the presence of the RFID tag and initiates a secure authentication process. This authentication process is essential for ensuring that the right patient accesses the medication at the right time. Once the RFID reader verifies the identity of the patient, it checks whether it is the designated time for medication



intake. If the patient is authorized, and it is indeed the scheduled time for medication, the RFID reader triggers the unlocking mechanism of the medication box, granting access to the medication inside. The beauty of this RFID-based system lies in its simplicity and effectiveness. By leveraging RFID technology, it offers a hands-free and seamless user experience for patients, eliminating the need for manual input or interaction with the medication box. The RFID band serves as a personal identifier, uniquely linking each patient to their medication regimen, thereby ensuring accuracy and precision in medication management. However, while the RFID-based system offers numerous benefits, it also poses certain challenges and considerations. For instance, there may be concerns regarding patient privacy and data security, as RFID technology involves transmitting and storing personal information. Additionally, the initial setup and implementation of the system may require investment in infrastructure and training to ensure seamless integration and operation [6-10].

3. Proposed System

3.1. Methodology

The proposed system, representing a significant advancement in medication management by integrating advanced sensor-based technology with artificial intelligence (AI), specifically computer vision capabilities. This combination adds an extra layer of security and validation to ensure that only authorized users can access the medication box, thus reducing the risk of misuse or accidental ingestion by unauthorized individuals, particularly children. At the core of the system lies a camera module capable of capturing images of individuals attempting to access the medication box. These images are then processed using sophisticated AI algorithms for facial recognition. Prior to deployment, the system undergoes training with facial images of two to three authorized family members, along with the intended patient. This training enables the AI model to accurately identify and differentiate between authorized users and unauthorized individuals. When a person approaches the medication box, the camera captures their face, initiating the facial recognition

process. The AI model, deepface model compares the captured facial features with the stored images of authorized users. If a match is found, access to the medication box is granted seamlessly, without any intervention required. However, if the facial recognition process fails to match the captured face with any authorized user profiles, indicating potential unauthorized access, the system activates a series of responses to mitigate the risk. Firstly, an automatic warning message is sent to the designated caregiver or family member responsible for the patient's well-being, notifying them of the unauthorized access attempt. Concurrently, a buzzer alarm is triggered to draw immediate attention to the situation and prompt intervention. At the core of the system lies a camera module capable of capturing images of individuals attempting to access the medication box. These images are then processed using sophisticated AI algorithms for facial recognition, specifically employing the DeepFace model, which utilizes Convolutional Neural Networks (CNN) for highly accurate facial feature analysis and identification. By incorporating AI-powered face recognition technology, specifically the DeepFace CNN model, the proposed system significantly enhances the security and accountability of medication access. Not only does it verify the identity of users, but it also provides real-time alerts and warnings in cases of unauthorized access attempts. Due to the model's deep architecture and extensive training, DeepFace achieves high accuracy in facial recognition tasks, often approaching or surpassing human-level performance in controlled environments. This proactive approach helps safeguard against medication misuse and ensures the safety of vulnerable individuals, such as the elderly or children, who may be at risk of unintentional ingestion or misuse of medications. Overall, the proposed system offers a comprehensive solution that leverages cutting-edge technology to reinforce medication management protocols, promoting adherence and safety in caregiving environments. It represents a significant step forward in enhancing patient care and improving outcomes in the healthcare landscape [11-15].

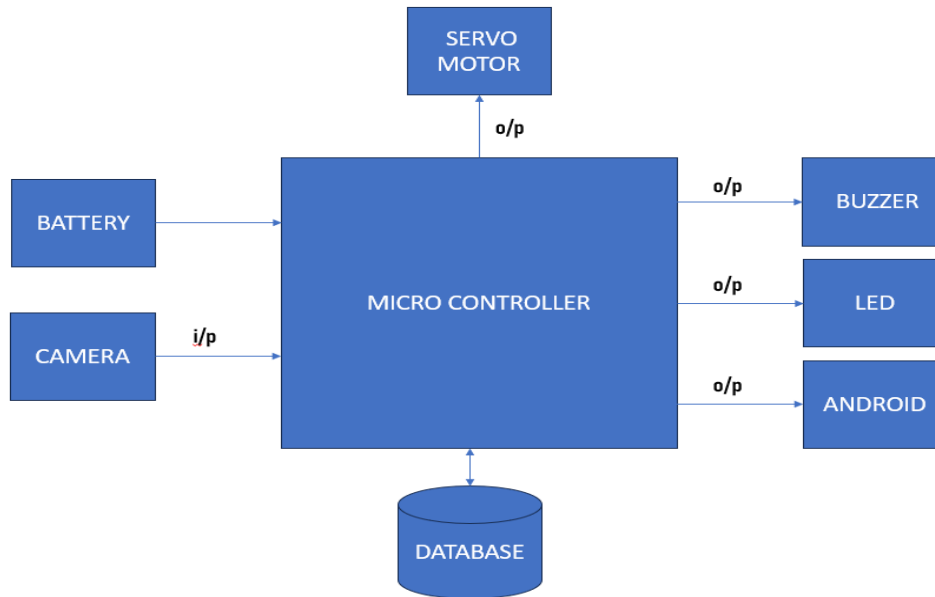


Figure 1 Architecture of The Proposed IOT Based Medicine Box Assistance System

3.2. Block Diagram

The Figure 1 illustrates the block diagram of the IoT-based Medicine Box Assistance System designed specifically for elderly individuals. At the heart of the system lies the microcontroller, serving as the central processing unit orchestrating the functionalities of various interconnected components. The microcontroller is interfaced with a WiFi module, establishing a wireless connection to facilitate communication with external devices and networks. The WiFi module serves as the gateway for data transmission between the microcontroller and the cloud-based database, as well as the camera module. The camera module, integrated with the system, is tasked with capturing images for facial recognition purposes. This module plays a pivotal role in verifying the identity of users attempting to access the medicine box, ensuring that only authorized individuals are granted entry. The camera module communicates with the microcontroller through the WiFi module, facilitating real-time image processing and analysis. Connected to the WiFi module, the cloud-based database serves as a repository for storing registered faces and associated data. This database houses the facial profiles of authorized users, enabling the system to compare captured images with the stored data for authentication

purposes. The WiFi module facilitates seamless data exchange between the microcontroller and the database, ensuring efficient retrieval and updating of information as needed. In addition to the camera and database, the microcontroller interfaces with other peripheral components, including LED indicators, a buzzer, and a servo motor. LED indicators provide visual reminders to users, signaling medication schedules or authentication status. The buzzer, on the other hand, offers auditory alerts, enhancing user awareness and prompting timely actions. The servo motor, functioning as a lock mechanism, regulates access to the medicine box by controlling its opening and closing based on authentication results. Overall, the block diagram delineates a comprehensive system architecture wherein the microcontroller serves as the central hub orchestrating the seamless integration and operation of various hardware components. Through effective communication and coordination facilitated by the WiFi module, the system leverages advanced technologies such as facial recognition and cloud-based storage to deliver a robust and user-friendly medication assistance solution tailored to the needs of elderly individuals.

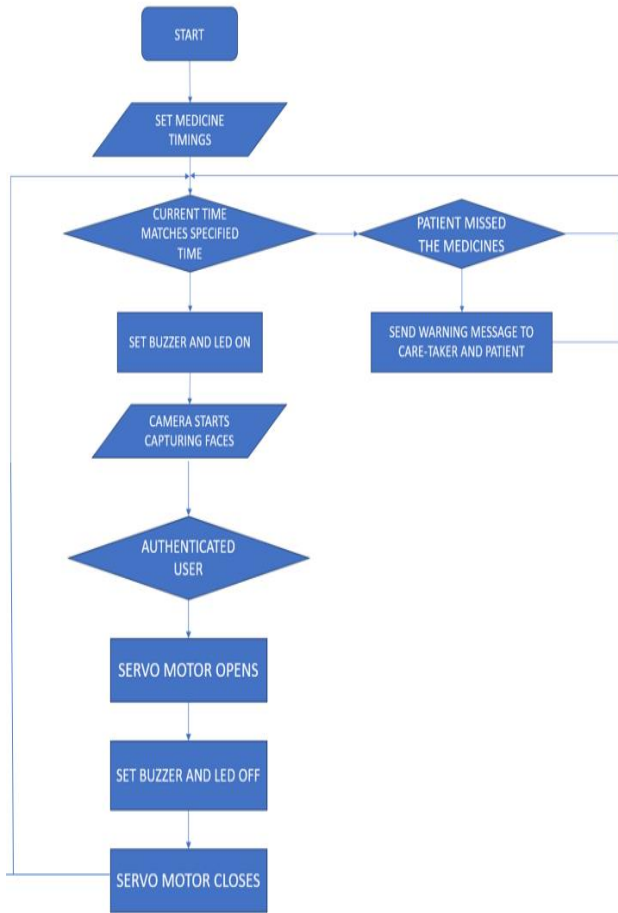


Figure 2 Flowchart of The Proposed IOT Based Medicine Box Assistance System

The Figure 2 outlines the operation of the medication box system. Upon activation, the algorithm prompts the user to set the time for medication intake via a webpage or app, which is then stored in the database. The microcontroller continuously monitors the current time and compares it with the preset medication schedule. When the current time matches the scheduled medication time, the system triggers a notification to remind the patient. Simultaneously, LED lights and a buzzer are activated to provide visual and auditory cues. Additionally, the system verifies the identity of the patient by scanning their face using a camera. If the authenticated face is detected, the designated section of the medication box allocated to the patient is unlocked, allowing access to the medication. Subsequently, the system logs the medication intake data as "DOSAGE

TAKEN" and resumes monitoring the current time. If the authenticated face is not detected within the specified timeframe, despite notification and reminders, the system logs the event as "DOSAGE MISSED." A warning message is then sent to both the patient and the caretaker to alert them of the missed dose. Following this, the microcontroller returns to monitoring the current time until the next scheduled medication time for another patient is reached. The entire process repeats for each user, ensuring timely medication reminders and data logging for adherence monitoring purposes.

4. Experimental Results

From the figure 3, the experimental result reveals that DeepFace model can identify faces with 97% accuracy, almost the same accuracy as a human in the same position. In our proposed system, We used DeepFace model, which is a deep learning facial recognition system created by a research group at Facebook. It identifies human faces in digital images. The program employs a nine-layer neural network with over 120 million connection weights. Dlib library is for face detection, which is a C++ library that offers a wide range of tools and algorithms for machine learning, computer vision, and image processing. It is known for its robust implementation of facial landmark detection, object tracking, and facial recognition algorithms.

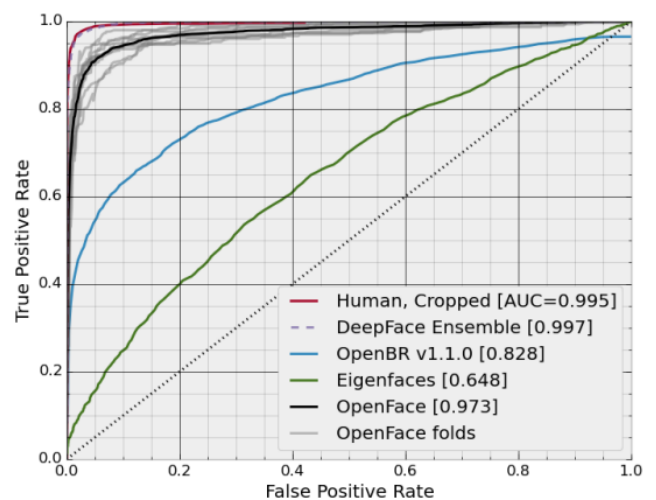


Figure 3 Comparison of Various Face Recognition Models



Conclusion

This paper proposed SmartMedBox for the elderly people for their medicine intake. By integrating IoT and computer vision technologies in a real-time environment, we have created a sophisticated yet user-friendly solution that not only ensures timely medication intake but also promotes independence and well-being among the elderly. With the implementation of IoT sensors, SmartMedBox offers real-time monitoring and tracking of medication adherence, providing caregivers and healthcare professionals with valuable insights into the patient's medication regimen. Furthermore, the incorporation of computer vision techniques enables SmartMedBox to accurately identify and verify users, ensuring that the right medication is dispensed to the right individual at the right time. This not only enhances medication safety but also alleviates the burden of manual medication management for both the elderly and their caregivers. As we look to the future, further research and refinement of SmartMedBox hold the potential to revolutionize medication management practices and enhance the quality of life for elderly individuals worldwide.

Future Scope

In future iterations, the project will focus on enhanced security features through advancements in AI and computer vision technology, improving facial recognition accuracy and incorporating biometric or retina scanning to prevent unauthorized access and medication exchanges. Additionally, integration with wearable health monitoring devices and IoT-enabled healthcare platforms will link medication management with real-time health metrics, providing caregivers and healthcare providers with insights into medication adherence and patient well-being. Enhanced software support will enable caregivers to remotely access the system, receive automated alerts for missed doses or unauthorized access attempts, and communicate with patients via integrated messaging or video conferencing. In the coming years, these pill boxes can be used in hospitals where huge manpower is not available for a group of patients. The project can be designed to be scalable and adaptable to various healthcare settings, including hospitals, assisted living facilities, and home care

environments. Modular hardware and software components will ensure easy customization and integration with existing infrastructure, facilitating widespread adoption and deployment.

References

- [1]. Gurav¹, Harshada Mohite, Radhika Khadake, Ajay Gurav, "Smart Medicine Reminder Box", International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), Volume 2, Issue 5, June 2022.
- [2]. Sarvesh Kulkarni, Shreyas kandgule, Vaibhav Katkar, Shrutika Tone, Chadchankar, Smart Medicine Box Using IOT, International Journal of Research in Engineering, Science and Management, Volume-1, Issue-10, October-2018.
- [3]. IOT Based Smart Medicine Box Pratiksha Katore¹, Kiran Wable¹, Kshirsagar Prashant¹, Surekha B. Puri², 2019 IJSRSET | Volume 6 | Issue 3.
- [4]. Vidula V. Meshram¹, Kailas R. Patil¹, Vishal A. Meshram, Shripad Bhatlawande, SmartMedBox: A Smart Medicine Box for Visually Impaired People Using IoT and Computer Vision Techniques, International Information and Engineering Technology Association, October 2022.
- [5]. Harsha B. Shejwal, Prajakta A. More, Automatic Medicine Dispenser, IJSRD - International Journal for Scientific Research & Development, Vol. 10, Issue 5, 2022
- [6]. Mohammed Asad Fasahate, "Smart Medicine box using IOT", International Journal of Scientific & Engineering Research, Volume 9, Issue 2, February 2018
- [7]. Roshani Talmale, Animesh Agrawal, Atharva Khokle, Nikunj Pahade, Pranay Khadgi, Ritila Bodhale, Mediminder - IOT based smart medicine box, International Research Journal of Engineering and Technology (IRJET), Volume 9, Issue 4, April 2022
- [8]. Anjana Bharadwaj, Upasana Sharama, Ranjeet Yadav "Review paper on Smart Medicine Kit" IOSR Journal of engineering (IOSRJEN) Vol.08, Issue 7 (July 2018)
- [9]. P.Raga Lavima, Mr. G. Subhramanya Sarma



- "An IOT based intelligent medicine box"
JCSMC, Vol. 04, Issue 10, Oct 2015
- [10]. Sanjay Bhati, Harshid Soni, Vijayrasingh, Zala, Parth Vyas, Mr.Yash Sharma"Smart Medicine Reminder Box" International journal of science tech. and engg., Vol. 3, Issue 10, April 2017
- [11]. Ekbal Rosli , Yusnira Husaini, "Design and Development of Smart Medicine Box" International Conference on Applied Electronic and Engineering 2017 (ICAEE2017)
- [12]. Viral Doshi, Shrishti Dey, Nirav Mehta, Rajesh Prasad, "An IoT based smart medicine box", International Journal of Advance Research, Ideas and Innovations in Technology, Volume 5, Issue 1.
- [13]. Suryadevara N.K, Mukhopadhyay S.C, "Wireless Sensor Network based Home Monitoring System for Wellness Determination of Elderly", IEEE Sensors Journal, Vol: 12, No:6, pp.1965 – 1972, 2012.
- [14]. Siddhartha Mohammad, Tapesh Bhowmick, Md. Shovon Uz Zaman Siddique, Mohammad Monirujjaman Khan, "Research and Development of a Artificial Intelligence based Smart Medicine Box", IEEE 6th International conference, 2022
- [15]. Abilesh K S, Naveen V, Pozhilan S, Shanmugaraja P, Raffik R, "AI Health – IoT based Smart Medicine Box", IEEE 2nd International conference, 2023