

Mediguard Bot: Esp32 Based Surveillance Robot for Medicine Dispensing and Threat Detection

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Abstract— Timely medicine dispensing, real-time monitoring, and detecting threats are necessary in modern healthcare and home security, especially in patients of old age and those with chronic illnesses. Medi Guard Bot is a robot that is based on ESP32 as a healthcare and security assistive robot with automated medicine dispensing, environmental danger detection, and real-time monitoring in one module. It uses an RTC-controlled CD drive motor to provide scheduled and precise dispensing of medications, gas, and flame detectors to determine potential dangers and trigger instant notifications. It has a live video streaming capability that is offered by an IP camera, which enables a remote monitoring capability via an IoT-based web interface. Unlike autonomous robots, the Medi Guard Bot is only able to move when manually controlled, and offer precise navigation when delivering medicine. In case of emergencies, it sends real-time alerts through buzzer, voice module and LCD display. ESP32 microcontroller interprets sensor data and provides automatic tasks in a high efficient manner. The system can be remotely controlled and monitored by the users using Wi-Fi-based IoT connectivity with optional Bluetooth availability. The Medi Guard Bot is a smart, safe and effective healthcare automation and home security solution based on its usage in hospitals, old age homes, and smart homes.

Keywords: Smart Robot, IoT Enabled Sensors, Medical Dispensing, Threat Detection, Surveillance, Web-Controlled System, Medicine, health risk, public health

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1. Introduction

Automation has also been increasing today in the healthcare and home security to improve patient care, administration of medicine and environmental safety. Majority of the patients particularly the elderly and the chronically ill will require medication at the right time, yet human supervision will result in missed doses or incorrect administration. Leakage of gases and fire are also emergency hazards that can pose a threat to the safety of patients and should be detected in real-time and alerted by the system. The IoT, robotics, and automation have revolutionized the healthcare industry by providing smart services that support patients and monitor their safety. In response to the mentioned challenges, MediGuard Bot is created as an IoT-based, remotely controlled robotic system that integrates automated medication dispensing, threat detection and real-time monitoring into one system. The system will be created on the basis of ESP32 microcontroller, a programmed medication dispensing RTC module, live video surveillance IP Cam, and gas and flame sensor to detect any potential threats to the environment. The MediGuard Bot is only remotely controlled by a web

interface, as opposed to autonomous robots which move without human intervention, which allows users to remotely control the robot to deliver medication or protect a specific area. This project is an efficient healthcare and home security system that provides a high level of patient care and safety of the environment through the combination of automation, IoT connectivity, and smart surveillance. The MediGuard Bot is an Internet of Things dispensing, real time and threat detection robot. It is constructed using ESP32 microcontroller that guarantees on time medication with RTC module and detection of gas leaks and fire with sensors. The robot will offer IP Cam-based real time video surveillance and can be remotely monitored with the help of the IoT based web interface. To be more accessible it has autonomous navigation that covers predetermined places to deliver medicine. It also possesses multimode alerts such as the buzzer, LCD display and voice notifications, to ensure the safety and communication. It is an integrated project that integrates healthcare with security and automation into a single system that is applicable in the hospitals, elderly care and home care. MediGuard Bot is an

efficient and acceptable solution to the contemporary healthcare system by providing improved patient care through real time connectivity and automation, reduction of risk and enhancing remote access. The aged and chronically ill patients experience issues with compliance to drugs, health monitoring, and home security. The existing systems are neither automated nor real-time monitored, as well as not as accurate in drug delivery navigation. To address all of these issues with automated drug dispensing, danger detection, and live video streaming to ensure effective healthcare and protection in hospitals, nursing homes, and smart homes, the ESP32-based and IoT-based MediGuard bot is utilized. This project will primarily aim at developing an IoT-based healthcare helper robot with auto-medicine dispensing, threat detection, and real-time monitoring capabilities to enhance patient safety, home security, and automation of the healthcare system. The system ought to include an automatic bottle-feeding drug system via an RTC module to ensure precise timing of taking medicine, whereby one receives his or her medicine at the correct time. It has hazard detection sensors such as gas leak and fire to increase its safety, and this gives it instant alerts and reactions. The robot also incorporates real time video surveillance by using an IP Cam to give the remote users the capability of monitoring the environment to achieve enhanced security. It offers remote monitoring and control using IoT through a web interface, that is why it can be accessed anywhere. The buzzer, voice module and LCD display are used to generate the alerts and notifications and this allows the achievement of effective communication. The system offers easy IoT connectivity to support real-time communication and remote access, and this makes it an effective battery-powered, portable system, and space-saving device of medical and home security systems. The MediGuard Bot is an innovative product that can improve healthcare automation and home security through the program of medication dispensing, environmental hazard sensing, and real-time monitoring. It provides the administration of medicine in time with the help of an RTC-controlled motor and recognizes any danger such as gas leaks and fires with sensors and activates instant notifications. This bot enables remote control with the use of an IoT based web interface and live video streaming. It is also applicable in hospitals, elderly homes, and smart homes unlike autonomous robots that are manually controlled and can be used to navigate the area with accuracy. The project has an efficient, secure, and smart solution to enhance patient

care and home safety due to ESP32-based processing and Wi-Fi connection.

2. Literature Review

Adhikari, Manoj Singh et al. [1] wrote about an IoT-based smart medicine box that guarantees the timely intake of medications, leads to a higher patient safety level, and allows remote monitoring, which is essential during the pandemic to avoid the risk of spreading the virus and provides a higher medication adherence level with a minimum of human contact. Ahmad, Sultan et al. [2] addressed an IoT-based pill reminder and monitoring apparatus that improves adherence to medication by sending individualized alerts and monitoring the actual pill intake, allowing remote monitoring by medical professionals and improving information exchange through the fusion of the electronic health records. Boopathi, Sampath et al. [3] wrote about remote monitoring technologies based on the use of the IoT in patient health with references to the significance of monitoring vital signs. Although it does not explicitly focus on the issue of medical dispenser robotification, it also emphasizes the possibility of boosting medication compliance by means of intelligent device monitoring.

Budda Raju. H et al. [4] devoted their efforts to developing a portable medicine dispenser based on the IoT, which will not only help older or blind people to take medications on schedule but also track them in real-time at the request of the user. The solution to these urgent problems, Ch. Ravikumar et al. [5] have suggested that real-time patient monitoring and therapy require minimal delays. Chandramohan. P et al. [6] discussed the problem faced by the patient in taking their medication on time due to various reasons which could be addressed by the author to provide the solution for the stated problem by using the method of Automatic medicine dispenser system. Deepan. P et al. [7] introduces the use of IoT based intelligent pill dispenser to users who need to take their medication at the right time. The system comprises an intelligent pill dispenser that is a solid prescription and a mobile application in configuring and tracking the dispenser. El-Gayar, Omar. The article by F et al. [8] addressed the topic of IoT in healthcare, noting that remote monitoring is an effective way to enhance medication adherence and patient safety. Robots in medical dispensers can support continuous health measurements, improve doctor-patient communication and hospitalization by controlling medicine more effectively. Geethanjali. P et al. [9] have suggested a personal care robot navigation

system, which is to be used in a hospital setting and includes a basic robotic vehicle with the 4-wheel drive that enables it to move freely. The pillbox discussed by Haque, Md Sabit Shahriar, et al. [10] is intended to assist the patients in taking the appropriate medicines in the right amount at the appropriate times and also to assist in tracking the medical history of the patient. Malathi, J et al. [11] talked about the IoT-based remote patient monitoring devices that can promote drug compliance by offering real-time health data and alerts. Such systems enable informed decision-making and involvement of patients, which are essential in the management of chronic diseases and saving costs in healthcare. The proposed smart pill box by Mathina, P. A., et al. [12] is programmable, which means that the medical staff or a patient can specify the dosage and the time of medication, which is prescribed by the medical practitioner, and the number of hours of medications that could be chosen by the caregiver daily. It is a portable Android-based programmed aid box, which has a means of automatically setting up alarms. Peddisetti, Vinay et al. [13] discuss these crucial concerns, introduce a set of novel IoT-related solutions, including the Smart Pill Dispenser, Smart Cup, and an Android Application to provide real-time notifications. These combined devices provide a simplified method of controlling medication, with an accurate and timely intake with the main emphasis on medication in the form of pills. Ramakrishnan Raman et al. [14] talked of smart pill dispensers and how they relate with the IoT devices have enhanced the delivery of medication. Ramalakshmi. K et al. [15] described a smart medicine box which helps uphold medication through timely notifications and approved access, based on the IoT technology, facial recognition, alarm system, and also provides the caregiver with remote monitoring on how the patient takes medication. Singh, Aditya et al. [16] explained that smart medicine box has sensors that monitor the intake of medication and notify the patient or caregiver in case of missed medication. The system has also a mobile application, which gives patients customized medication timetable, notifications, and alerts. According to Tiwari, Pallavi et al. [17], Smart pill dispensers have revolutionized medication delivery through the use of the IoT. As discussed by Ullankala, Sri Lakshmi et al. [18], majority of older people/blind people cannot take their medications on time or not taking them correctly, which is detrimental to their health. Healthcare devices that are based on the IoT can be used to monitor the health of a patient. Varun, Mukka et al. [19] is geared towards designing a novel

solution to automated delivery of medicine to patients and vital monitoring of patients in healthcare facilities. Conventional approaches tend to be human-dependent when it comes to delivering medicine and monitoring patients, and this results in the inefficiency and possible error. The proposed study will solve these challenges by proposing a robotic system that can follow the line-following technique and real-time monitoring of health parameters. Wijesinghe et al. [20] talked about how the IoT-based smart medicine dispensers increase medication adherence as patients are reminded to take medications with audio messages and LCD displays. It also allows monitoring remotely through a mobile application, which alerts caretakers whenever medications are taken, which helps to manage their health.

3. Existing System

Robotics in healthcare has gone a long way, especially in dispensing of medicine and monitoring patients. Automated dispensers are timed and notified to adhere to medication but are not mobile and monitored. Robots involved in elderly care give reminders and health monitoring, but they do not move, which reduces their application. Healthcare systems with IoT enable remote monitoring and medication control but do not have real-time surveillance and hazard detection. Surveillance robots are mobile and have live video feeds, but lack medicine dispensing and health monitoring. Likewise, autonomous hospital logistics robots are efficient in transporting medical supplies, but they cannot be controlled manually and monitored to patients, so it is not as applicable to home care.

4. Proposed System

The MediGuard Bot is an IoT-based healthcare robot in the form of a manually operated medicine dispenser, real-time video, and environmental hazard detection device. Working with the help of a web based interface that runs on the mobile device or the computer, the user is able to navigate the bot, track live feeds and handle the medication schedules at any location. The system dispensing its medicine incorporates a CD drive motor and RTC module to dispense the pills on schedule, which is meant to ensure that the medication is taken. The bot is also able to identify hazards such as gas leakage and fire and inform users immediately through the interface. An IP Camera Live video surveillance can be used to increase security and the manual control enables one to navigate in complicated surroundings. The

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MediGuard Bot offers an effective and affordable solution to patient care and caregiver support at home and institutional level by offering remote-controlled mobility, automated healthcare capabilities, and real-time monitoring. MediGuard Bot is an IoT-linked controlled healthcare robot designed to simplify and improve patient care in three ways; smart dispensing of medications; video monitoring; and hazard detection. It can be used on any device that is connected to the internet. The MediGuard can be controlled by a user by moving, reviewing video feed of what was happening at a particular time and setting time and storing medications. In the assistive technology MediGuard, the medication will be dispensed according to time location and to the specific pill using an automatic medicine dispenser with RTC and CD drive motor.

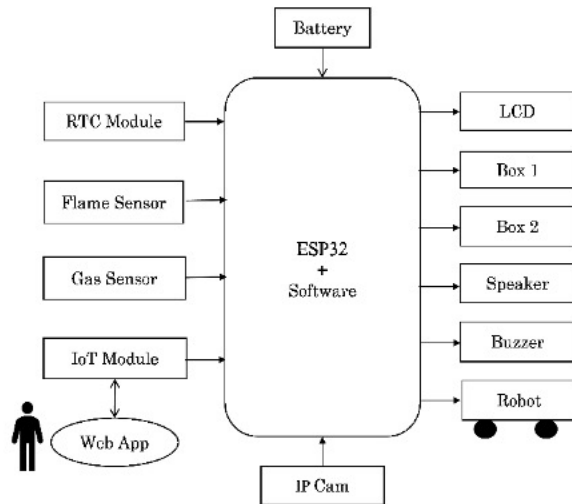


Fig. 1. Block Diagram

The advantage of this restricted care is that there is less missed dosing, since dosing can be scheduled on periodic recurring time schedules hence improving adherence. An IP Cam can also be used to monitor care recipients in real-time and this is what makes it possible to monitor care recipients by the caregiver with the added advantage of distance - thereby increasing patient safety and supervision. MediGuard also incorporates environmental hazard detection sensors to gas leakage, fire and unauthorized movements with instant alert notification to the user, which assures timely intervention. Figure 1 presents the block scheme of the proposed system that demonstrates the combination of different components, such as sensors, ESP32 microcontroller, communication modules, and the output devices. The diagram shows the direction of data flow of sensors to the IoT cloud and makes sure that the architecture of

the system is well understood.

5. Methodology

Medicine dispensing, surveillance in real-time, and hazard detection are all included in the MediGuard Bot, which is a manually operated IoT-based healthcare robot. It is also remotely operated through a web-based interface that can be accessed using mobile devices or computers and as such, users can maneuver the bot with accuracy in all types of healthcare settings. The ESP32 microcontroller evaluates commands, making it move with ease and be flexible in sophisticated environments. In the case of automated medicine dispensing, the bot exploits an RTC (Real-Time Clock) and a CD drive motor in order to provide the pills when it is time to do so. The web interface will allow caregivers to set up medication schedules, which will be dispensed in time, and the chances of missed doses will be minimized. Instead, notifications are provided in real-time upon dispensing of medicine to patients and their caregivers, enhancing the adherence and convenience.

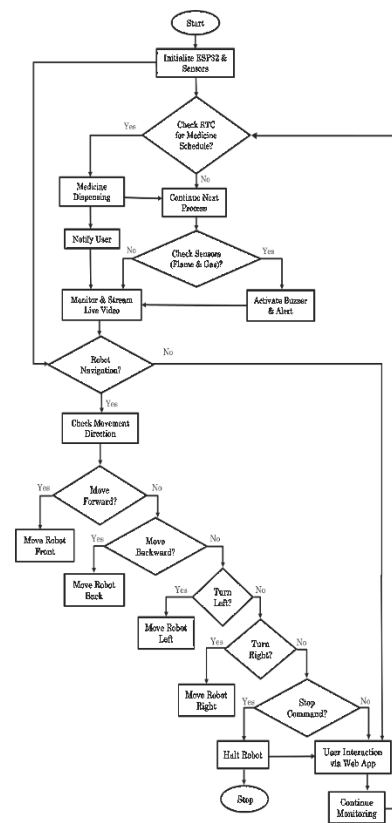


Fig. 2. Flow Chart

The flow chart of the proposed system as illustrated in figure 2 depicts the various actions that will take place in the proposed system. The IP Camera provides the

real-time video surveillance feature, which allows the caregivers to monitor the patients remotely, which increases security and control. This will enable medical practitioners and relatives to monitor the patient at any place. Also, the bot will be fitted with gas and flame sensors to identify environmental risks like gas leakage or fire. When a hazard is detected, the system will provide instant notifications through the web interface, and a buzzer and voice alert system will allow alerting the patient in his/her surroundings. The circuit diagram provided in figure 3 reveals that an integrated design comprises the use of an ESP32 in the health care and security interfaces. The power supply uses battery power which is regulated by a bridge rectifier, a 7805-voltage regulator and filter capacitors. Motor drivers are driven by ESP32 microcontroller and move the robot as well as dispense medicine. There are gas sensors and fire sensors to raise concerns on the potential threats as they will trigger the buzzer in case of an emergency. A real-time activity monitoring and a remote functionality is performed with the help of an IoT module. The LCD 16x2 will be used to display the status of the device as well as to notify users of any incoming alerts through the sensors over the I2C protocol. The voice module also comes in to aid in informing the user through voice as the medicines are dispensed.

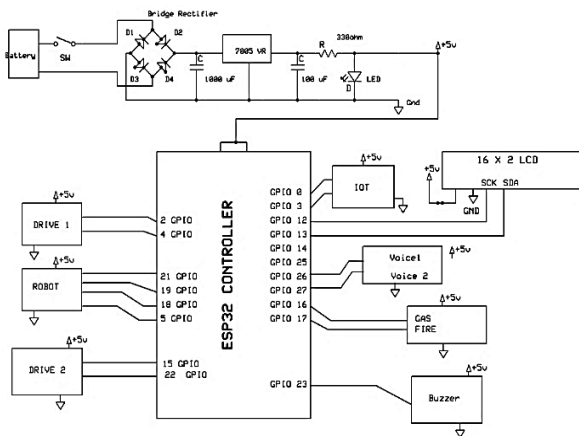


Fig. 3. Circuit Diagram

6. Hardware Components

Figure 4 presents ESP32, the microcontroller in the center of the MediGuard Bot, where the data is processed, and all subsystems are synchronized. The power for the whole circuit is generated by a single 12V rechargeable Li-ion battery that is regulated to provide a 5V output with 7805-voltage regulator for safe and stable output voltage for the more sensitive electronic.

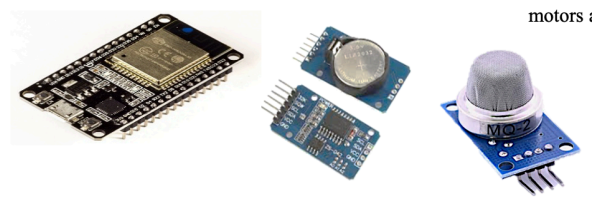


Fig. 4. (a) ESP32 Microcontroller (b) RTC Module (c) MQ-2 Gas sensor

The Fig. 4 represents the input devices of the system with a RTC module to schedule time to dispense medicines at the right time they need, Flame sensor and an MQ-2 gas sensor which will be used to give an early warning on the event of fire or gas leakage. All of the sensors will transfer the signals to the ESP32 to be processed, which will then activate suitable output response devices.

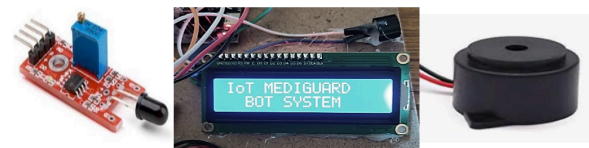


Fig. 5. (a) Flame sensor (b) LCD (c) Buzzer

The output devices are indicated by the figure 5: a buzzer as an alert device, a 16x2 LCD as an alert and real-time status message display, and a Voice Module (APR33A3) that will be used to receive audio notifications (e.g., medicine box was opened). The machine will be powered by the used CD/DVD drive loaders, which will serve as dispensing medicine boxes, which will open with the help of control signals via the ESP32. Motor drivers give locomotion and wheels connected on the chassis enables the bot to move manually to a patient to administer medicines. The video monitoring is being implemented by the use of the IP Camera to physically observe the patient in real-time, and it is acting as a stand-alone system that offers a safe variable to the system. The IoT Module (ESP8266) is for Wi-Fi communication that allows the MediGuard Bot to be connected to an Android or web-based application where remote monitoring can be done, and manual control commands can be issued. The data transfer between the system components is accomplished with the help of a variety of interfaces: the LCD module is connected with the help of I2C, the IoT and Voice Modules are connected with the help of UART, the motors are controlled with the help of the PWM based on the GPIOs, as shown in the figure 6. The hardware architecture is a platform with a solid, modular and scalable core of smart healthcare and security services.

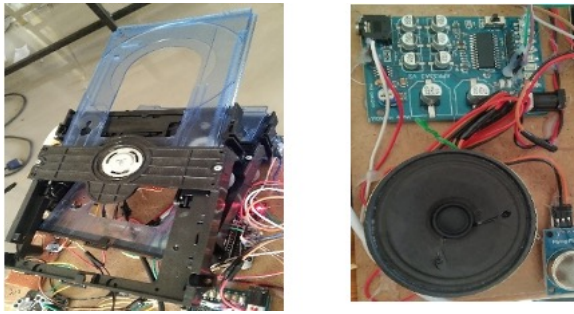


Fig. 6. (a) CD Driver (b) APR Module

7. Software Description

The MediGuard Bot software structure will be designed to fulfill the correct real-time operation, good control of hardware, and convenient remote monitoring. To this end, Arduino IDE is finally used to program and upload embedded C code to ESP32 microcontroller, which does all the pertinent tasks of reading a laser range finder to controlling a DC motor, voice module trigger, and displaying the general condition of the system on an LCD. The IDE is easy to control the concerned sensor data, user actuators, and form an IoT communication. The IDE is an environment that offers real-time debugging as well as firmware updates on the cloud. Embedded C is a programming language, which enables one to write the logic of MediGuard Bot to actuate and control all the hardware in real-time. It particularly performs to administer medicine, control sensors and initiate emergency alarms. Hardware functionality can offer the greatest amount of functionality which can be delivered in an accessible manner. Along with the IoT platform, the MediGuard Bot is a remote monitoring and control device, which is controlled through Wi-Fi and has a mobile/web application. The application interface will enable the user to monitor gas/ flame detecting alerts and to operate or operate the Bot manually that enhances further accessibility of the user to monitor the Bot and take on-the-fly action without necessarily being in the physical presence of the Bot.

8. Results and Discussion

The actuators like the buzzer and LCD are automatically turned on or turned off based on the sensor readings like the flame sensor and the gas sensor. The threshold can be configured by users to a particular level to provide a safe environment based on the requirements. In case any sensor readings fall out of the safe range, the system will raise an alarm, turn on the buzzer and inform the caregiver through the IoT web interface. This will guarantee proactive precaution over environmental dangers and patient medication compliance. These decision threshold

tables are very important in MediGuard Bot decision logic. Table 1 shows the detection state and activation state of the actuators of flame detection.

Table 1. Flame Detection Condition

Fire Detection	Buzzer Status	LCD Screen & App Interface
No (0)	off	F:NO
Yes (1)	on	F: YES

The graphical representation of relationship between Flame Detection and System Response of the MediGuard Bot is represented in figure 7. The X-axis depicts the actuator state as either "Off" or "On" hence, 0 represents the state of "Off" and 1 represents the state of "On" whereas the Y-axis depicts the state of flame detection as either "Flame Not Detected" or "Flame Detected".

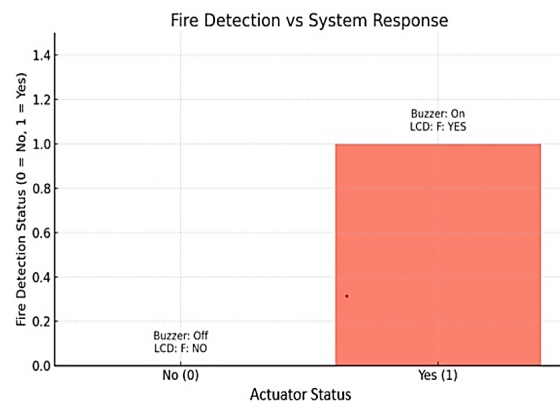


Fig. 7. Graphical Representation of Flame Detection Figure 8 shows the LCD Console when Flame detected near the MediGuard Bot. When no Flame is present, the buzzer will be Off, and the LCD/App interface will display F: NO. This is to enable good functioning of a particular system without a false alarm. Once the flame has been detected, the buzzer will change to on to give audible alerts in real-time. The same operational response will also be presented on the LCD and app interface where it will remain to indicate F: YES hence allowing users to respond in time, when required, accordingly, based on alerts.



Fig. 8. LCD Console when Flame Identified

Table 2. Gas Detection Condition

Gas Detection	Buzzer Status	LCD Screen & App Interface
No (0)	off	G: NORMAL
Yes (1)	on	G: DETECTED

The Table 2 outlines the gas detection condition and its corresponding activation status of the actuators.

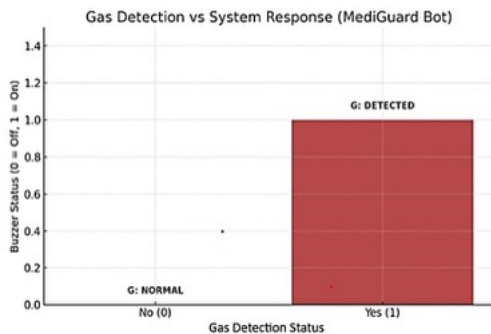


Fig. 9. Graphical Representation of Gas Detection

The graphical representation of the relationship between Gas Detection and System Response of MediGuard Bot is represented in Figure 8. The X-axis indicates that the gas detection status is either gas not detected or gas detected, whereas the Y-axis indicates that the audible signal (buzzer effects) is off, or on; therefore, a score of 0 implies off, and a score of 1 implies on".



Fig. 9. LCD Console when Gas Detected

The LCD Console is displayed in Figure 9 when Flame was detected close to MediGuard Bot. In the case when there is no Gas, the buzzer will be turned off, and the LCD/App interface will show G: NORMAL. This is supposed to enable normal functioning of a particular system without false alarm. The buzzer will be turned on when Gas is detected so that audible alerts can be given in real-time. The same operation response will also be indicated on the LCD and/or app interface where it will persist to indicate G: DETECTED and therefore will allow the users to act in time when required based on alerts.

Table 3. Box Closure Logic

Medicine Dispenser Status	Box Closing Status
Open ---- Close	Normal close by APP
Open ---- Not Closed	Auto-close after 20 seconds

The Table 3 explains the process of the pharmaceutical dispenser in the MediGuard Bot functioning. Once the user opens and closes the medication dispenser by using the app, the dispenser closes normally. But in case the dispenser is opened and the user fails to close the dispenser, the system will close the lid automatically after 20 seconds as a precaution and to reduce the exposure of medication. This system aims at making medication more secure and minimizing the chances of spillage or contamination. Safety is increased with the MediGuard Bot design and by using automation. Altogether, the MediGuard Bot provides a convenient, efficient and secure source of medication. Figure 9 depicts the prototype of the MediGuard Bot successfully developed and mounted on a mobile wheeled platform with the ESP32 controller and the figure 10 depicts the simpler parts that it consists of like a sensor (gas and flame), LCD, buzzer, camera, speaker, voice module, other assorted electronics.

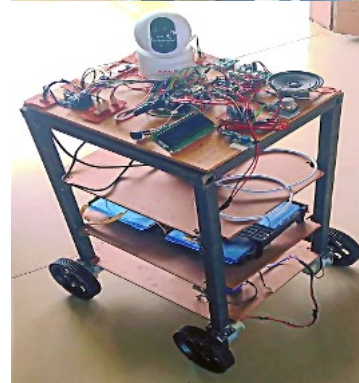
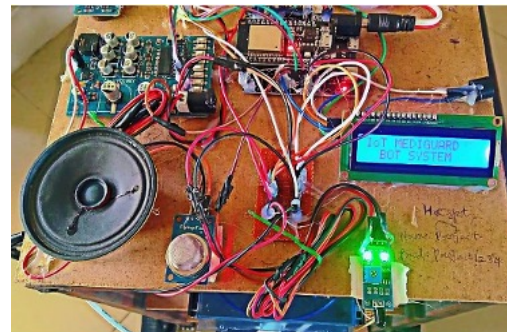


Fig. 10. (a) MediGuard Bot (b) Components and Circuit

The mobile interface of the IoT MediGuard Bot application can be seen in Figure 11. These verifies the installation and version of the app is successful and displays the control dashboard, allowing manual controls, which include opening and closing the medicine drives, gas and fire status, and navigation of

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the robot. This convenient app can be used to expand the remote access and real-time control of the MediGuard Bot.

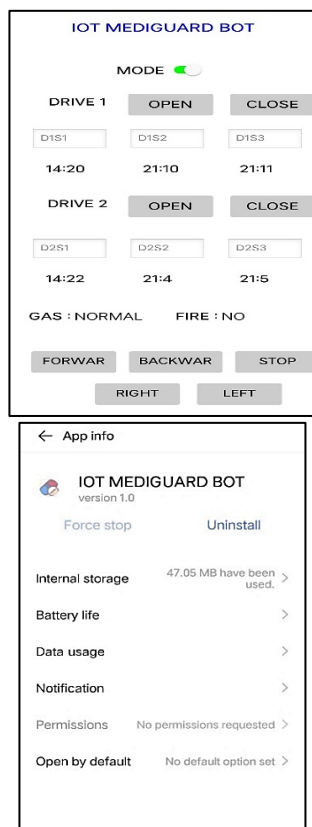


Fig. 11. App on Mobile Interface

9. Conclusion And Future Scope

MediGuard Bot is a multi-purpose device that encompasses medication dispensing, gas/fire hazard detection system, and its real-time observation system on an embedded ESP32 platform to offer support to the elders, hospitals, and smart homes. The Bot delivers drugs at the appropriate time and also handles the identification of gas or fire hazards to enhance patient safety and security on the environment of the patient. Another enhancement is a feature that allows the control of the vehicle by manual navigation as a way to offer the precision of delivery and reduce the number of mistakes linked to a complete autonomous delivery system. Caregivers can monitor patient condition and alerts with real time observation with the help of an IP camera and IoT application, respectively. The voice conversion module and LCD interface of the Bot enhanced notifications to the care receivers, and introduced new degrees of interaction with their caregivers. New additions to the autonomous system like obstacle avoidance and machine learning-based path planning may enhance

the capability of the Bots to operate autonomously. Besides, long-term health and security data logging with cloud storage would improve the provision of healthcare and security surveillance. It is possible to enhance the medical assistance of a Bot with extra sensors to scan the heart rate and other vital signs and to determine the sensitive body temperature based on the expansion of the healthcare application. Coupled with the fact that I will also make another report on hardware improvements to enable it to be used as a portable device in homes may be the last thing that will be developed with the Bot.

10. Conflict of interest

No

References

- [1] Adhikari, Manoj Singh, et al. "Design of An IoT Based Smart Medicine Box." 2023 IEEE Devices for Integrated Circuit (DevIC). IEEE, 2023.
- [2] Ahmad, Sultan, et al. "IoT based pill reminder and monitoring system." International Journal of Computer Science and Network Security (2023).
- [3] Boopathi, Sampath, et al. "Internet of Things-Integrated Remote Patient Monitoring System: Healthcare Application." Dynamics of Swarm Intelligence Health analysis for the next generation. IGI Global, (2023).
- [4] Buddaraju, H. R., Meegada, A., & Tallapalli, et al. "Live streaming smart pill dispenser to help elderly/blind people" (2023).
- [5] Ch. Ravikumar, et al. "An overview of remote patient monitoring for improved patient care and cost reduction: the Iot revolutionizing health care." International Journal of Education and Management Engineering (2023).
- [6] Chandramohan. P, et al. "Automated Medicine Dispenser with Personal Healthcare Monitoring Using IoT." 2023 Eighth International Conference on Science Technology Engineering and Mathematics (ICONSTEM). IEEE, 2023.
- [7] Deepan. P, et al. "Iot based intelligent pill dispenser for elderly people." 2023 3rd International Conference on Pervasive Computing and Social Networking (ICPCSN). IEEE, 2023.

- [8] El-Gayar, Omar F., et al. "The Impact of the Internet of Things in Healthcare Delivery: A Systematic Literature Review." *Impact of Digital Solutions for Improved Healthcare Delivery* (2025).
- [9] Geethanjali. P, et al. "Ai-enhanced personal care robot assistant for hospital medication delivery." *2024 5th International Conference for Emerging Technology (INCET)*. IEEE, 2024.
- [10] Haque, MdSabitShahriar, et al. "Design and Implementation of an IoT-based Smart Pillbox for Improving Medical Adherence." *2023 17th International Conference on Electronics Computer and Computation (ICECCO)*. IEEE, 2023.
- [11] Malathi. J, et al. "IoT-Enabled Remote Patient Monitoring for Chronic Disease Management and Cost Savings: Transforming Healthcare." *Advances in Explainable AI Applications for Smart Cities*. IGI Global Scientific Publishing, 2024.
- [12] Mathina, P. A., et al. "Enhanced Medication Reminder and Alert System using IoT." *2023 8th International Conference on Communication and Electronics Systems (ICCES)*. IEEE, 2023.
- [13] Peddisetti, Vinay, et al. "Smart medication management: Enhancing medication adherence with an IoT-based pill dispenser and smart cup." 2024.
- [14] Ramakrishnan Raman, et al. "Smart Pill Dispensers and IoT: Advancements in Medication Administration." *2024 International Conference on Emerging Systems and Intelligent Computing (ESIC)*. IEEE, 2024.
- [15] Ramalakshmi. K., et al. "Enhancing healthcare through remote patient monitoring using internet of things." *Technologies for Sustainable Healthcare Development*. GI Global, 2024.
- [16] Singh, Aditya, et al. "Design and Development of IoT Based Patient Monitoring System with Smart Medicine Box." (2023).
- [17] Tiwari, Pallavi, et al. "Smart Pill Dispensers and IoT: Advancements in Medication Administration." *2024 International Conference on Emerging Systems and Intelligent Computing (ESIC)*. IEEE, 2024.
- [18] Ullankala, Sri Lakshmi, et al. "Live streaming smart pill dispenser to help elderly/blind people." *2023 7th international conference on intelligent computing and control systems (ICICCS)*. IEEE, 2023.
- [19] Varun, Mukka, et al. "MEDROBO: Automated Medicine Delivery and Patient Monitoring System." *Journal of Electronics and Informatics* (2024).
- [20] Wijesinghe, et al. *IoT-Based Smart Medicine Dispenser*. In: *Proceedings of the 2024 International Conference on Image Processing and Robotics (ICIPRoB)*. 2024.