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EXSEL
EXperiential and SErvice Learning

AUTOMATED PILL REMINDER AND DISPENSING SYSTEM WITH CONSUMPTION VERIFICATION

A COURSE LEVEL PROJECT REPORT

Submitted by

III-year students of Bachelor of Technology

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in partial fulfillment of the course of

215EXS3201 / EXSEL – DESIGN-BUILD-OPERATE

Academic Year 2024 – 2025 (Even Semester)

DECLARATION

We affirm that the project work titled **"AUTOMATED PILL REMINDER AND DISPENSING SYSTEM WITH CONSUMPTION VERIFICATION"** being submitted in partial bonafide for the award of the degree of **Bachelor of Technology in Computer Science and Engineering** is the original work carried out by us. It has not formed part of any other project work submitted for the award of any degree or diploma, either in this or any other University.

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BONAFIDE CERTIFICATE

Certified that this project report **"AUTOMATED PILL REMINDER AND DISPENSING SYSTEM WITH CONSUMPTION VERIFICATION"** is the bonafide work of **"YAKKALURU BHARATH KUMAR (9922005075), HEEREHAL DHEERAJ KISHORE (99220040269), GOWLLA NARENDRA (99220041481), THEPIREDDY AKASH REDDY (99220040209), THANIKONDA GIRISH SWAMY (99220040207)"** who carried out the project work under my supervision.

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PROJECT SUMMARY

Project Title	Automated Pill Reminder and Dispensing System with Consumption Verification	
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Guide Name/Designation	Mr. V. Aravindarajan / Assistant Professor	
Program Concentration Area	Community Well-Being (Health Sector)	
Technical Requirements	Microcontroller, Keypad Authentication, Servo Motor and Real Time Monitoring System	
Engineering standards and realistic constraints in these areas		
Area	**Codes & Standards / Realistic Constraints**	**Tick ✓**
Economic	Use of Low-Cost Components, Minimal Operational Cost, Long-Term Affordability	✓
Environmental	Low Power Consumption, Energy-Efficient Sensors and Microcontrollers	✓
Social	Assists Elderly and Mentally Challenged Individuals, Improves Healthcare Access	✓
Ethical	Secure Patient Authentication, Data Privacy, Non-Discriminatory Access	✓
Health and Safety	Real-Time Caregiver Alerts, Prevention of Medication Errors, Emergency Support	✓
Manufacturability	Use of Readily Available Components, Simple Modular Design for Easy Assembly and Maintenance	✓
Sustainability	Durable System Design, Possibility of Component Upgrades, Support for Long-Term Use	✓

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PROBLEM STATEMENT

Timed Medicine Administration - Design a solution to ensure prescribed medicines are taken on time by patients who are often drowsy or unwilling to take them. The solution should incorporate reminders, patient monitoring, and a mechanism to ensure medicine consumption.

Many elderly and mentally challenged patients have trouble with medication compliance because of forgetfulness, confusion, or lack of supervision, resulting in severe health consequences. Conventional pill reminders are not verified and do not provide caregiver feedback, compromising the risk of missing or taking the wrong dose. There is a requirement for an intelligent, automatic system that reminds patients and also confirms drug intake. The system needs to alert caregivers in real-time, record intake logs, and provide patient safety through emergency alerts. A solution based on IoT can resolve these issues by delivering automation, monitoring, and verification to enhance healthcare outcomes.

ABSTRACT

Adherence to medication is an important aspect of chronic disease management, especially for the elderly and mentally disabled who might have difficulty adhering to prescribed timelines. To tackle this problem, we suggest an Automated Pill Dispensing and Reminder System with Consumption Verification, an Internet of Things (IoT)-based system that guarantees punctual medication intake and offers real-time feedback to caregivers. The system comprises a microcontroller, buzzer alarm, Light Emitting Diode (LED) display, keypad, Infrared (IR) sensor, servo motor, and ultrasonic sensor in a sequential operation. Upon the set time, the system gives an alarm through a buzzer and shows instructions on an LED display. The patient is required to input a special password through the keypad to confirm identity prior to the dispenser dispensing the medication. An IR sensor records the hand of the patient under the dispenser so that the right dosage is released. An ultrasonic sensor at a specific location confirms if the patient has swallowed the medicine. Upon confirmation, an alert is transferred to the caregiver, and all intake logs are recorded into an Excel sheet for tracking. An emergency button is also integrated to warn caregivers in case of emergency situations. This system improves medication compliance, patient autonomy, and caregiver tracking with decreased health risks of omitted doses.

Key words – Medication Adherence, Automated Pill Dispenser, Ultrasonic Sensor-Based Verification, Caregiver Notification System, IoT-Based Healthcare.

CHAPTER 1

INTRODUCTION

Compliance with medication is an important part of care, particularly in the elderly and intellectually disabled patients, for example, mentally challenged patients. Most patients do not comply with medications at the appropriate time because they forget, are confused, or receive inappropriate supervision. Compliance with medication can result in severe health complications, deterioration of illness, and readmission to the hospital. Although there are conventional approaches like pill boxes, alarms, and reminders, they are lacking since they are dependent on the patient remembering to take the medication without double-checking. There must be something more advanced and automatic to guarantee proper medication adherence and improve patient care.

To eliminate this problem, we suggest an Automated Pill Reminder and Dispensing System with Consumption Verification, an Internet of Things (IoT)-based device that guarantees the patient takes their medication at the right time and gives caregivers real-time feedback. The system operates in a sequential manner: at a pre-set time, a buzzer alarm and LED indicator signal the patient, asking them to type in a specific password on a keypad to confirm their identity. Upon verification, an Infrared (IR) sensor picks up the presence of a hand beneath the dispenser, causing a servo motor to dispense the proper dose. An ultrasonic sensor confirms if the patient has consumed the medication from a specific location, and once confirmed, a message is sent to the caregiver.

In addition, the system has an emergency button through which the patient can alert caregivers in the event of distress. To enable long-term monitoring, all data on medication intake is logged in an Excel sheet, allowing caregivers to monitor adherence over time. Through the combination of automation and real-time monitoring, this system supports patient independence without compromising on adherence to dosing schedules. The intended solution seeks to eliminate or minimize medication errors, enhance improved health outcomes, and give caregivers a convenient means of monitoring medication compliance from a distance.

CHAPTER 2

PROBLEM DEFINITION

Description of identified problem:

Medication non-adherence among elderly and mentally challenged individuals is a severe problem, resulting in worsening health, hospitalization, and increased caregiver burden. Pill box and alarm reminder systems are ineffective because they do not have actual verification of consumption and inability to give immediate feedback to caregivers. An automated, intelligent system is therefore needed that reminds, verifies consumption, and informs caregivers in real-time.

Scope

The system provides timely medication reminders, validates pill taking with sensors, authenticates the user, records intake history, and sends real-time caregiver notifications. It improves patient safety, independence, and remote health monitoring.

Limitations

The system relies on sensor reliability and patient compliance. It presently accepts only a low number of medicines per day and demands password manual entry, which might not be appropriate for profoundly disabled patients. Scalability and AI-driven authentication need improvement in the future.

CHAPTER 3

OBJECTIVES

The main objective is to design and deploy an IoT-based system that ensures the timely intake of medication by elderly and mentally challenged persons. It should confirm consumption through sensors and provide real-time alerts to care providers. The system seeks to minimize missed doses, enhance healthcare outcomes, and improve patient safety and independence. To achieve this, the following specific objectives have been identified:

- Facilitate on-time medication taking via automated reminders using buzzer and LCD display.
- Securely authenticate patients using a keypad-entry password system prior to pill dispensing.
- Automatically dispense the right dose via IR sensor detection and servo motor control.
- Track medicine intake via ultrasonic sensors and alert caregivers in real time.
- Record all medication events methodically into an Excel sheet for long-term tracking.
- Offer an emergency alert system to instantly notify caregivers during emergency situations.
- Increase compliance with medication, decrease dose misses, and increase patient independence.

CHAPTER 4

COMMUNITY IMPACT

Improving Healthcare for Vulnerable Populations:

The Automated Pill Reminder and Dispensing System with Consumption Verification is a valuable addition to enhancing the outcomes of health care, particularly among vulnerable patients like the aged, mentally ill, and patients with chronic ailments. By administering drugs in proper dosages at the right times, the system directly minimizes the dangers related to missed doses or improper medication, including further disease progression, hospital readmissions, and emergencies. The addition of real-time caregiver alerts enables families and healthcare professionals to track patients from a distance, enabling safer independent living for patients who otherwise would need to be constantly supervised. This technology facilitates increased autonomy and dignity for patients, alleviating some of the psychological and emotional stress typically experienced by aging or disabled individuals.

Reducing Caregiver Burden and Enhancing Public Health:

From the perspective of a wider community, such a system reduces the burden and pressure on caregivers who are often handling multiple tasks. Through automated reminders, authentication, dispensing, and verification of consumption, caregivers are guaranteed that medication schedules are being complied with without the necessity for repeated manual checks. Not only does this save time, but it also enables the caregivers to spend more time providing quality personal interactions and less time on routine supervisory tasks. Public health systems also stand to gain from universal use of such devices by eliminating avoidable hospitalizations and complications arising from drug use, which put a strain on healthcare resources. Also, by promoting medication compliance on a mass scale, the system indirectly helps in better management of disease in the community, improved therapeutic results, and less healthcare expenditure overall. It is a scalable solution that is in consonance with the worldwide goals of enhancing health infrastructure, promoting independent living, and leveraging technology to enhance medical care accessibility.

CHAPTER 5

MARKET ANALYSIS

Growing Demand for Healthcare Automation:

The world healthcare sector is experiencing a robust move towards automation and intelligent medical devices due to the growing aging population, increase in chronic diseases, and need for patient-centric care. As per industry reports, the worldwide smart pill dispenser market is expected to grow at a CAGR of more than 8% during the period from 2023 to 2030. The main target segments are elderly people, patients with cognitive impairment, and those who need strict medication compliance. Our device — medication reminding, dispensing, authenticating, and intake verifying — is effectively meeting all these demands, making it an extremely competitive product in the growing smart healthcare segment.

Competitive Advantage of Our System:

With respect to standard pillboxes, alarm reminder drugs, or mere smart dispensers, our device has multi-tiered functionality in the form of password-based authentication, hand presence detection, consumption tracking, caregiver notifications in real time, and emergency calls — all merged within a single package. These additional layers of security, automation, and caregiver assistance make our system unique compared to other products currently in the market. A majority of competitors offer reminders but fail to check actual pill ingestion or possess strong emergency handling features, thus placing our system in a strong competitive position.

Potential Customer Segments:

- Elderly people living alone
- Care homes and assisted living centers
- Hospitals and rehabilitation centers
- Families of chronically ill or mentally challenged patients

Moreover, insurance companies and healthcare agencies can encourage such systems as preventive measures to decrease hospitalization rates and improve patient compliance.

Future Market Opportunities:

With increased adoption of mobile applications, cloud storage, and analytics based on artificial intelligence, the system could penetrate larger markets like telemedicine assistance, home-based healthcare services, and remote patient monitoring schemes. Collaborations with hospitals, pharmacies, and providers of eldercare services could provide new channels for distribution. Further, government efforts in the areas of eldercare and digital health uptake

could enhance demand further, and our system would be a scalable and sustainable healthcare solution in the future.

SWOT Analysis:

Strengths:

- Complete automation with reminders, authentication, dispensing, and consumption verification under one system.
- Easy-to-use design appropriate for older and mentally challenged patients.
- Caregiver notifications in real time guarantee timely monitoring and action.
- High degree of accuracy in pill dispensing and intake verification using IR and ultrasonic sensors.
- Potential for future upgrades such as cloud storage, voice control, and mobile app integration.

Weaknesses:

- Increased initial cost relative to standard pillboxes and simple reminder systems.
- Older users might need to be trained on how to effectively use the password authentication system.
- Latest version restricts remote caregiver access in the absence of cloud and mobile app connectivity.

Opportunities:

- Ageing population creates higher demand for in-home healthcare solutions.
- Potential collaborations with hospitals, pharmacies, and aged care centers.
- Telemedicine and remote patient monitoring programs as opportunities for expansion.
- Increased support from government healthcare programs encouraging digital health technologies.
- Incorporation of AI for predictive analysis and smart medication management.

Threats:

- Competition from large technology firms entering the healthcare automation industry.
- Technological advancements at a rapid pace can result in system obsolescence if updates are not kept up to date.
- Privacy issues about patient health information can result in regulatory and compliance issues.

CHAPTER 6

LITERATURE SURVEY

Table 1: Literature Survey & its Key Findings

S. No.	Author(s)	Year	Title	Key Findings
1.	Raj, A. N., Kumar, G. S., Srinivasan, V., Reddy, D. L., Justin, B. V. F., & Priyadharshini, R.	2024	Analysis of IoT-based Medication Dispenser Reminder and Drug Expiration Health Monitoring and its Applications	IoT-driven portable medicine box ensures timely pill ingestion using Blynk app and Wi-Fi connectivity.
2.	Savvides, M., Kyriacou, C., Kassianides, V., Markides, C., & Tatas, K.	2024	PDU: A Pill Dispenser Unit for an IoT System for Monitoring and Controlling the Pharmaceutical Treatment	IoT-based Pill Dispenser Unit records and monitors drug compliance for psychiatric patients with real-time physician access.
3.	Vaish, A.	2024	Automated Pill Dispenser to Improve Medication Compliance, Efficiency, and Accuracy	Smart dispenser using Arduino and Android app automates pill sorting and improves medication accuracy for elderly and disabled.
4.	Marrapu, A	2024	Project Pill Tracker: An Advanced and Automated Pill Tracking & Dispenser	Arduino-based system provides accurate pill dispensing, tracking missed doses and refill reminders with Android interface.
5.	Harini, A., Thejasvi, S., Abinaya, V. U., & Sumathi, S.	2023	Curie–A Smart Voice Assistant Based Hospital Companion with Medicine Dispenser	Combined pill dispenser, voice assistant, and health monitoring for stress detection, enhancing patient care.

6.	Gargioni, L., Fogli, D., & Baroni, P	2024	A Systematic Review on Pill and Medication Dispensers from a Human-Centered Perspective	Compared various dispenser systems focusing on user-friendliness, hardware, software, and design improvements.
7.	Dayananda, P., & Upadhya, A. G.	2024	Development of Smart Pill Expert System Based on IoT	SPEC 2.0 sends SMS reminders without subscription fees, preventing overdoses and improving patient compliance.
8.	Peddisetti, V., Kandregula, P. K., John, J. A., Poomdla, S., George, K., & Panangadan, A.	2024	Smart Medication Management: Enhancing Medication Adherence with an IoT-Based Pill Dispenser and Smart Cup	Real-time tracking system with Bluetooth integration improves dispensing accuracy and patient adherence.
9.	Dheerthi, N., Kumar, A. K., Priyadharsheni, J. M., & Murugarajan, A.	2023	IoTAAMD: Experimental Analysis of IoT Assisted Systematic Medicine Dispenser	Designed for 24/7 access to medications, especially useful in remote areas and emergencies.
10.	Alnajjar, K. A., Altamimi, A., Altamimi, K., Alshehhi, A., Ansari, S., Mahmoud, S., & Hussain, A. J.	2023	Smart Medical Pills Dispenser	Mobile-platform-based system offering timely reminders, caregiver scheduling, and improved hospital-patient communication.
11.	Praveena, H. D., & Geetha, P.	2023	A Smart Medication Box with Regular Medications and In-Time Refilling	Intelligent box with LED, sound alerts, GSM module for consumption alerts, and auto-refill notifications.

12.	Deepan, P., Hemavarshini, J. P., Kowsalya, P., & Rajasekaran, C.	2023	IoT Based Intelligent Pill Dispenser for Elderly People	Mobile, visual, and audio reminders integrated with cloud-based storage for clinician access and better elderly care.
13.	Harshini, D. A., Amiritavarshini, S., Sudha, V., & Raja, R	2023	Development and Deployment of an IoT Enabled Intelligent Medication Dispensing Solution	Blynk app-based pill monitoring system improving patient safety through real-time tracking and automation.
14.	Aziz, S. A., Sajak, A. A. B., Ramly, R., & Zulfakar, M. H.	2022	IoT Automated Pill Dispenser for Elderly Care	Facial and fingerprint recognition ensures secure access and automatic dispensing, improving medication safety.
15.	Rajan, B. P. T., Brightny, A., Rebeak, C. D., Poojasen, S., Vijay, P., Suresh, M., & Alex, R. R.	2021	Smart Pill Box with Reminder to Consume and Auto-Filling Process Using IoT	GSM and IoT-based smart pillbox with reminders for pill intake and refill, with temperature and humidity monitoring.

CHAPTER 7

SOFTWARE AND HARDWARE

Hardware Components:

- Arduino UNO
- 4x4 Keypad
- Buzzer
- LCD (Liquid Crystal Display)
- Infrared Sensor
- Ultrasonic Sensor
- Servo Motor
- Emergency Button/Switch
- Wires and Connectors
- Power Supply Unit
- Medication Compartment/Dispenser Unit

Software Components:

- Arduino IDE

CHAPTER 8

METHODOLOGY AND ALGORITHM

Automated Pill Dispenser System:

The Automated Pill Dispensing and Reminder System with Consumption Verification is an IoT-enabled healthcare innovation that is aimed at helping the elderly and mentally disabled take medication at the right time. The system combines Arduino UNO, sensors, and actuators to offer an automated, systematic drug regimen. The system dispenses pills at the right time and confirms consumption via an ultrasonic sensor. The system also has an emergency alert function to ensure patient safety. Reducing human error and ensuring compliance, the device significantly contributes to the enhancement of drug compliance, eliminating missed doses, and promoting improved patient health overall.

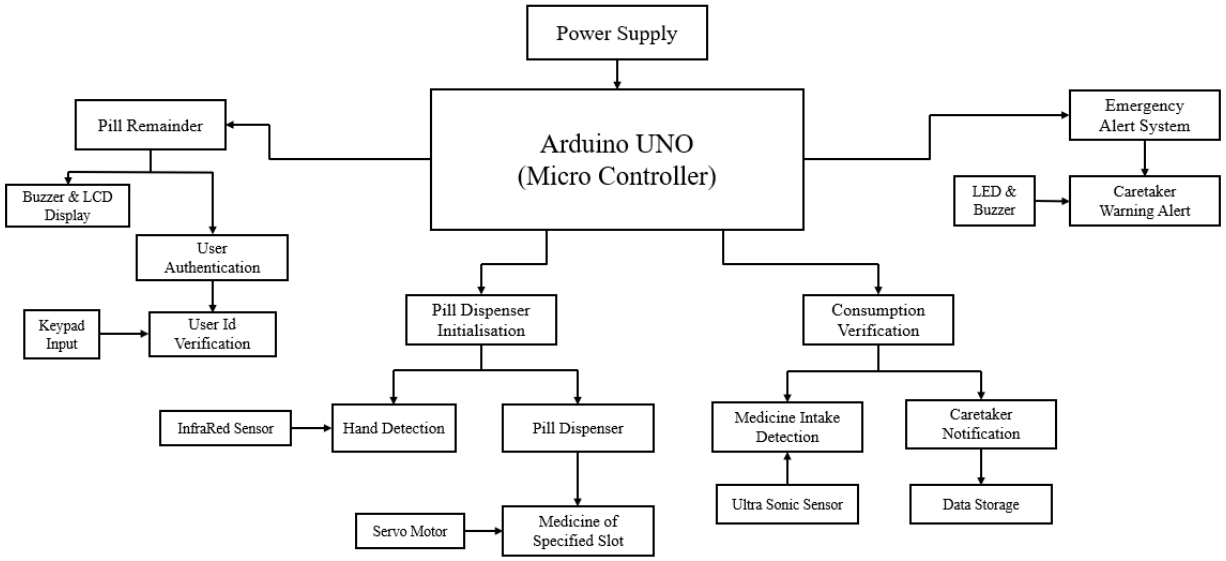

Fig 1: The Block Diagram of Automated Pill Remainder and Dispenser with Consumption Verification

Pill Reminder and User Authentication:

The system reminds the patient of a drug in a timely manner through a buzzer and Liquid Crystal Display (LCD) screen. To differentiate among various patients, the system employs a keypad-based authentication system. The patient inputs a customized password to ensure that only those authorized are given the drug. The buzzer continues beeping until the correct password is inputted to ensure the patient is reminded. This authentication function prevents unauthorized usage, reduces chances of drug mistake, and injects an ingredient of safety within

the system. The reminder scheme ensures patients do not forget about taking medication, hence resulting in better health care.

Pill Dispensing Mechanism:

After successful authentication, the process of pill dispensing is initiated. The dispenser has individual slots for morning, afternoon, and evening pills. An infrared (IR) sensor identifies the position of a hand below the dispenser prior to the release of pills. The opening of the dispenser is controlled by the servo motor, and it releases the correct dosage at the right time. This automated system reduces dosage errors in administration and guarantees that every patient gets their prescribed drug at the appropriate time, avoiding missed or duplicate doses, which are typical hazards in manual pill management.

Medicine Intake Verification:

To verify that the patient has actually taken the medicine, the system involves a process of medicine intake verification. A sensor ultrasonic is installed in a position where the patient must stand to take the drug. When the patient is detected at the correct position, the system logs the successful intake. In the event that the patient fails to adhere to the drugs, the caretaker is sent an alert. This confirmation enhances drug regimen adherence, prevents involuntary dose omission, and helps track patient behavior for the purposes of enhancing overall care monitoring and intervention where necessary.

Caretaker Notification and Data Logging:

The system also supports a real-time reminder system for reminding caretakers about medicine intake. If the patient can consume the medicine, a success notification is sent to the caretaker, and compliance is made known to them. In the event of missed dosages, the system generates an alert, and the caretaker is notified in real time. The functionality enables caregivers to properly track medicine routines, identify compliance trends, and respond immediately when necessary. By continuous tracking, the system enhances drug control, reduces health risks due to missed doses, and enables prompt care and assistance to the patient.

Emergency Alert System for Patient Safety:

There is an emergency alert feature incorporated in the system for immediate help in case of necessity for the patients. There is an installation of a special emergency switch, and the patient may press it whenever they require help immediately. Once pressed, there is an LED light and buzzer alarm in the caretaker's room indicating an emergency. This is particularly useful for elderly and mentally challenged patients who might have medical emergencies or other types of emergencies. With the inclusion of this emergency response feature, the system adds further security and assures that patients get prompt medical care when required.

Hardware and Software Implementation:

The hardware is developed with Arduino UNO, which is the microcontroller for operating all the functions. The major hardware elements are a keypad for verification, IR sensor for detecting hand, ultrasonic sensor for verifying medicine intake, buzzer and LCD for indication, and a servo motor for dispensing pills. The software is developed in Arduino Integrated Development Environment (IDE), and real-time data is recorded in an Excel sheet through serial communication. The system has a sequential flow, with each process initiating the next one to provide smooth operation. The combination of hardware and software provides automation, reliability, and efficiency in medication management.

User Training and System Deployment:

For the successful implementation of the system, patients and caretakers should be trained on how to use it. Patients should be taught how to input their passwords, pick up pills properly, and activate the emergency alert switch when necessary. Caretakers should be trained on how to retrieve data, troubleshoot, and respond to alerts. The system is made user-friendly with a minimal interface to make it easy to use. Adequate training and routine maintenance checks are necessary to ensure long-term reliability and efficiency. Through user education, the system can really make a considerable contribution towards medication compliance and patient independence in general.

CHAPTER 9

SYSTEM IMPLEMENTATION

Hardware Integration:

The Automated Pill Dispensing and Reminder System is based mainly on the Arduino UNO microcontroller that controls all functionalities in a systemized manner. The basic hardware components are buzzer and LED display for reminders to patients, 4x4 keypad for password entry, infrared (IR) sensor to sense hand position, servo motor for controlled releasing of pills, and ultrasonic sensor for validation of medicine ingestion. The IR sensor is such that pills are only released when a hand is properly placed, avoiding wastage or loss. The emergency button is connected to a buzzer system in the caregiver's room, sending immediate signals in situations of distress. Each component of hardware was chosen with concern for reliability, precision, and affordability. The servo motor has been programmed to dispense a measured dose from pre-filled reservoirs labeled morning, afternoon, and evening dosages. The ultrasonic sensor located at the patient's medicine station confirms proper medicine ingestion and sends real-time alerts to caregivers.

Software Development:

The system's software was written employing the Arduino Integrated Development Environment (IDE). Step-by-step programming guarantees seamless running, where the occurrence of a particular event automatically leads to another — from reminders for medication, through dispensing and confirmation of consumption. Information logging is handled by serial exchange between the connected PC and the Arduino, logging time-stamped medication events onto an automatically refreshed Excel sheet. Error-handling processes are utilized to deal with situations such as incorrect password entry, forgotten medication events, or emergency button presses. The system ensures real-time caregiver notification through simple buzzer or LED notifications.

User Interaction and Testing:

Ease of use was the main concern at system deployment. The system is accessed by patients using the LCD screen, buzzer signals, and keypad input, all made with simplicity in mind. Long-term testing under different conditions validated the system's capacity to provide timely reminders, identify users, release the right dosage, and confirm consumption accurately. Real-time notifications and data logging offered insightful information, making the system dependable for day-to-day medical use.

CHAPTER 10

RESULTS AND DISCUSSION

The Automated Pill Reminder and Dispensing System with Consumption Verification was successfully deployed and tested to assess its effectiveness in ensuring drug compliance among elderly and mentally challenged individuals. The system was subjected to different conditions to examine its accuracy, reliability, and real-time caregiver notification.

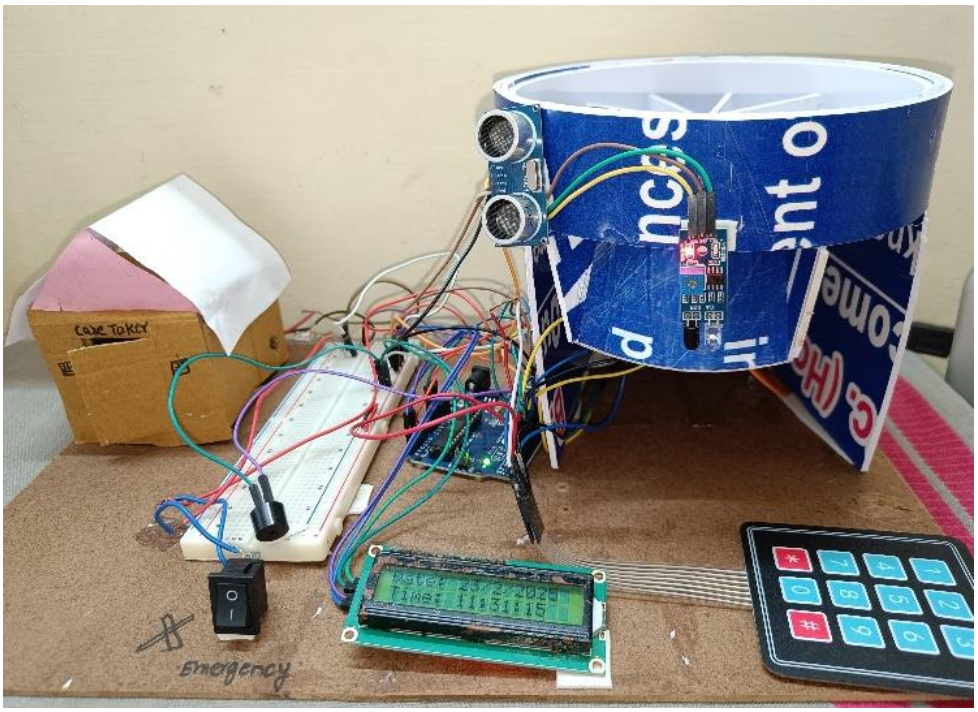

Fig 2: Fully Functional Model Setup of the Automated Pill Reminder and Dispensing System (Front view)

During the testing process, the buzzer alarm and LED display successfully notified patients at the specified times, reminding them of their medication routine. The password authentication system worked perfectly, only opening for the intended user. The buzzer remained beeping until the proper password was given, to avoid missed doses by mistake. The IR sensor was able to sense the patient's hand beneath the dispenser, indicating accurate hand positioning prior to dispensing the pills. The servo motor worked effortlessly, dispensing the right dosage at the right time.

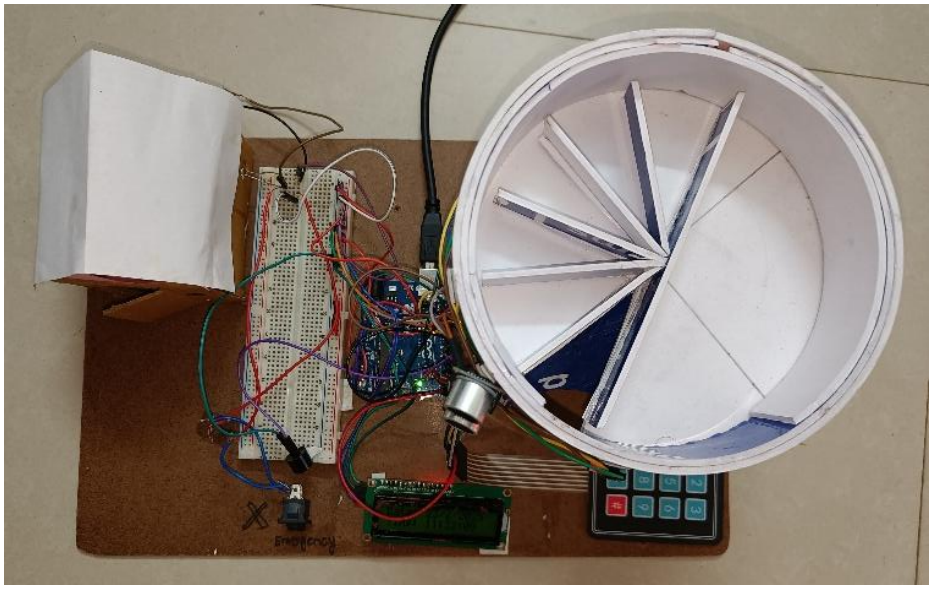

Fig 3: Complete Working Model Setup of the System (Top view)

The ultrasonic sensor was essential in checking medication ingestion. As the patient stood at the position where the pill was administered, the system was able to confirm ingestion and record the data on an Excel sheet. Where the patient did not take the drug, the system did not record confirmation, enabling the caregivers to take action. Real-time alerts were effectively sent to caregivers, making it possible for them to remotely monitor compliance. Also, the emergency button was checked to confirm immediate alerts. When activated, the buzzer in the caregiver's room sounded instantly, indicating an emergency. This feature adds patient safety by ensuring immediate assistance in case of emergencies.

```
22:30:01.027 -> Time: 11:37:0
22:30:01.027 -> Reminder: Night Meds
22:30:01.061 -> Enter Password to Stop Buzzer...
22:30:04.753 -> Password Correct! Servo Moving...
22:30:05.768 -> Waiting for Hand Detection...
22:30:06.938 -> Servo Rotated to: 180
22:30:08.743 -> Medicine Taken Successfully!
22:30:10.770 -> All Doses Completed. Resetting Servo...
22:30:13.513 -> System Ready for Next Day.
22:30:13.549 -> Time: 11:37:1
```

Fig 4: Timely alert, notification and verification of the system

On the whole, the system exhibited very high accuracy in pill dispensing, consistent patient authentication, and efficient intake verification. The feature of real-time monitoring and emergency alerts was advantageous in enhancing compliance with medication. Future developments may involve cloud-based storage of data for remote accessibility and voice prompts to further enhance user convenience.

CHAPTER 11

CONCLUSION

Sustainable goals

- SDG 3: Good Health and Well-being - Facilitates timely drug administration, enhancing health outcomes and minimizing avoidable health complications.
- SDG 9: Industry, Innovation, and Infrastructure - Incorporates IoT and automation technologies in healthcare, facilitating innovation in patient care systems.
- SDG 11: Sustainable Cities and Communities - Enables independent living among elderly and disabled people, enhancing community safety and quality of life.

Automated Pill Reminder and Dispensing System with Consumption Verification effectively solves the very important issue of medication compliance, particularly that of elderly and mentally impaired patients. Traditional alternatives such as pillboxes and alarm clocks cannot promise on-time and accurate drug consumptions. Coupled with the technologies of the Internet of Things (IoT), this system makes reminder, dispensing, verification, and caregiver notification procedures automated, bringing a secure and holistic solution to the table.

The project successfully illustrates the sequential process: the system reminds the patient with a buzzer and LCD, authenticates via a keypad password, detects the hand with an infrared sensor, and dispenses the proper dosage through a servo motor. An ultrasonic sensor verifies patient presence and ensures medication intake. On successful intake, an immediate alert is sent to the caregiver, and the intake data is logged into an Excel sheet. The addition of an emergency button also increases patient safety by allowing instant caregiver alerts.

System testing showed high accuracy in pill dispensing, patient verification, intake confirmation, and caregiver communication. In addition to minimizing missed doses, the system promotes patient independence and enhances caregiver efficiency, enabling independent living without compromising safety.

By and large, the project meets its goals by providing an intelligent, user-friendly, and affordable healthcare solution. Additional upgrades in the future such as cloud-based storage of data, voice assistance for visually challenged users, AI-driven biometric authentication, and auto-refill reminders will further enhance the system. The given solution has tremendous potential to improve healthcare outcomes, reduce healthcare costs, and significantly assist patients as well as caregivers in the community.

CHAPTER 12

FUTURE WORK

While the Automated Pill Reminder and Dispensing System with Consumption Verification has proved to be highly effective in encouraging medication adherence, there are some potential areas of further development. Future projects will seek to enhance the system's flexibility, ease of use, and compatibility with contemporary healthcare infrastructures. One of the key enhancements is the integration of cloud-based storage for data. Medication intake information is currently recorded on a local Excel file. With the adoption of a cloud database, caregivers and healthcare staff would have remote access to real-time medication information, facilitating improved monitoring and timely interventions. This would also facilitate long-term storage, trend analysis, and production of compliance reports for clinical reviews.

Another potential upgrade is the creation of a mobile app. A custom app can send caregivers and patients immediate notifications, compliance tracking, emergency notifications, and customized reports. Customizable medication schedules, voice reminders, and health tips are some additional features that can be added to make the system more interactive and helpful for the users. To render the system more accessible to visually challenged or physically disabled patients, the inclusion of voice assistance is strongly suggested. Voice instructions can assist users through password authentication processes, pill intake protocols, and emergency functions, thereby rendering the device more accessible.

The system currently uses password-based authentication, which may not be ideal for users with cognitive impairments. Therefore, biometric authentication in the form of facial recognition or fingerprinting can be implemented. This will improve security, usability, and discourage unauthorized access to medication. Furthermore, automated refill reminding could be implemented. When the drug level in the dispensers is low, the system can remind caregivers or pharmacies to organize refills. This would make sure that patients never go without a dose because supplies are running low.

Integrating with electronic health records (EHRs) and physician databases would make the medication regimen dynamic and personalize it based on treatment updates. It would also enable automatic synchronization if doctors modify prescriptions. Finally, the system would use AI-driven analytics to forecast and detect non-compliance patterns based on patient activity. Predictive intelligence would enable caregivers to intervene preemptively before complications develop in their health.

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APPENDIX

RESEARCH PAPER SUBMISSION PROOF

Gmail Bharath Kumar Yakkaluru <yakkalurubharathkumar@gmail.com>

International Conference on Electronics, AI and Computing : Submission (723) has been created.

1 message

Microsoft CMT <email@msr-cmt.org> Thu, Mar 20, 2025 at 6:22 PM
Reply-To: Microsoft CMT - Do Not Reply <noreply@msr-cmt.org>
To: yakkalurubharathkumar@gmail.com

Hello,

The following submission has been created.

Track Name: Track 8: Antenna, Microwave Techniques, Communications, Networks and IoT

Paper ID: 723

Paper Title: Automated Pill Reminder and Dispensing System with Consumption Verification

Abstract:
Adherence to medication is an important aspect of chronic disease management, especially for the elderly and mentally disabled who might have difficulty adhering to prescribed timelines. To tackle this problem, we suggest an Automated Pill Dispensing and Reminder System with Consumption Verification, an Internet of Things (IoT)-based system that guarantees punctual medication intake and offers real-time feedback to caregivers. The system comprises a microcontroller, buzzer alarm, Light Emitting Diode (LED) display, keypad, Infrared (IR) sensor, servo motor, and ultrasonic sensor in a sequential operation. Upon the set time, the system gives an alarm through a buzzer and shows instructions on an LED display. The patient is required to input a special password through the keypad to confirm identity prior to the dispenser dispensing the medication. An IR sensor records the hand of the patient under the dispenser so that the right dosage is released. An ultrasonic sensor at a specific location confirms if the patient has swallowed the medicine. Upon confirmation, an alert is transferred to the caregiver, and all intake logs are recorded into an Excel sheet for tracking. An emergency button is also integrated to warn caregivers in case of emergency situations. This system improves medication compliance, patient autonomy, and caregiver tracking with decreased health risks of omitted doses.

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Secondary Subject Areas: Not Entered

Submission Files:
Automated_Pill_Reminder_And_Dispensing_System_With_Consumption_Verification.pdf (407 Kb, Thu, 20 Mar 2025 12:50:36 GMT)

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1 message

Microsoft CMT <email@msr-cmt.org> Wed, Apr 9, 2025 at 12:22 AM
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Hello,

The following submission has been created.

Track Name: ICCRTEE2025

Paper ID: 1045

Paper Title: Automated Pill Reminder and Dispensing System with Consumption Verification

Abstract:
Adherence to medication is an important aspect of chronic disease management, especially for the elderly and mentally disabled who might have difficulty adhering to prescribed timelines. To tackle this problem, we suggest an Automated Pill Dispensing and Reminder System with Consumption Verification, an Internet of Things (IoT)-based system that guarantees punctual medication intake and offers real-time feedback to caregivers. The system comprises a microcontroller, buzzer alarm, Light Emitting Diode (LED) display, keypad, Infrared (IR) sensor, servo motor, and ultrasonic sensor in a sequential operation. Upon the set time, the system gives an alarm through a buzzer and shows instructions on an LED display. The patient is required to input a special password through the keypad to confirm identity prior to the dispenser dispensing the medication. An IR sensor records the hand of the patient under the dispenser so that the right dosage is released. An ultrasonic sensor at a specific location confirms if the patient has swallowed the medicine. Upon confirmation, an alert is transferred to the caregiver, and all intake logs are recorded into an Excel sheet for tracking. An emergency button is also integrated to warn caregivers in case of emergency situations. This system improves medication compliance, patient autonomy, and caregiver tracking with decreased health risks of omitted doses.

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Primary Subject Area: Computing and processing

Secondary Subject Areas:
Robotics and control systems
Signal Processing and analysis

Submission Files:
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Fig 6: Research Paper Submission Proof - 2

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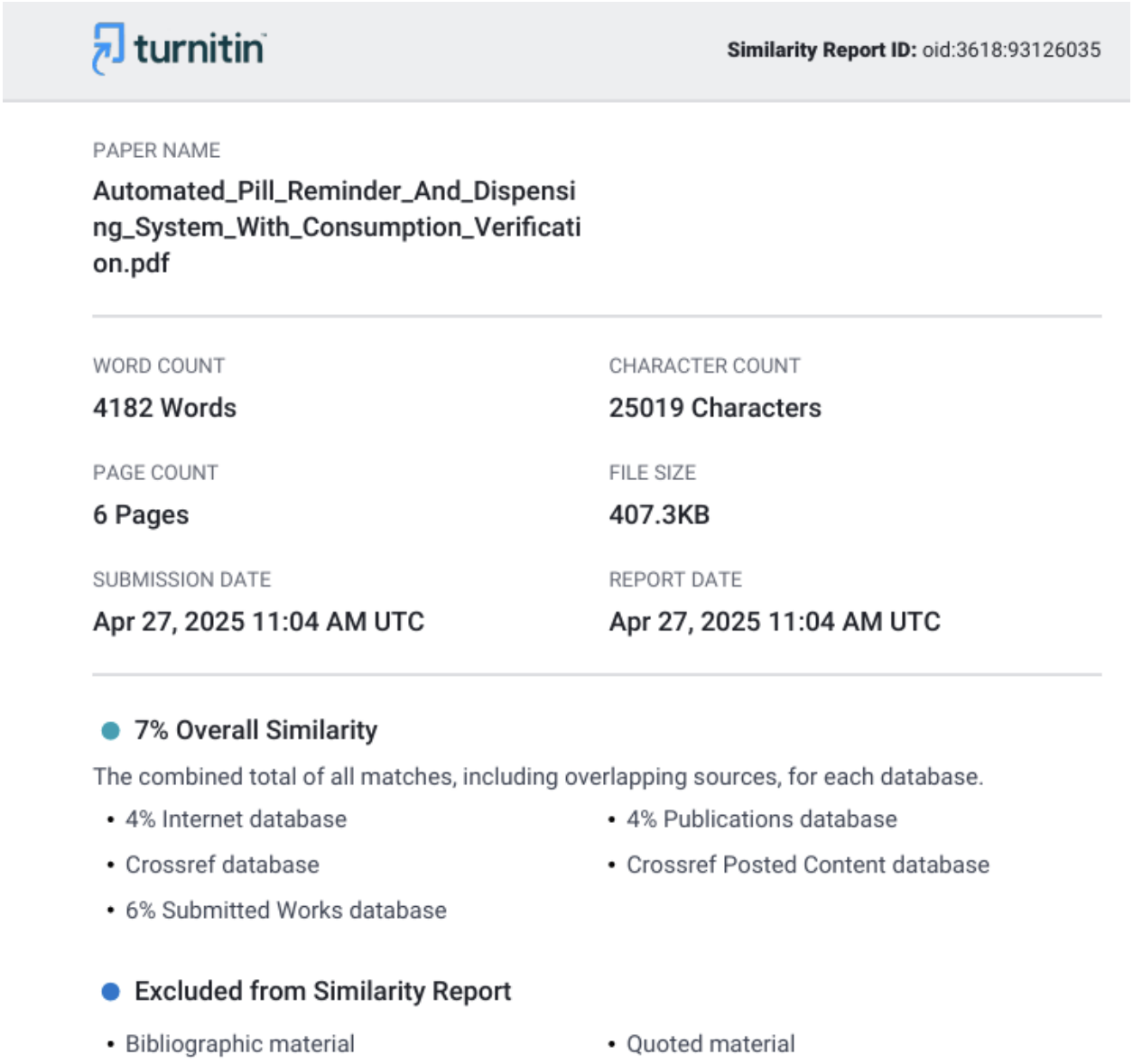
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Fig 7: Report plagiarism report

CODING/PROGRAMMING

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Servo.h>
#include <Keypad.h>

#define TRIG_PIN 10
#define ECHO_PIN 11
#define IR_SENSOR_PIN 2
#define BUZZER_PIN 9

LiquidCrystal_I2C lcd(0x27, 16, 2);
Servo myServo;

bool medicineTakenFlag = false;
int currentServoAngle = 0;
int doseCounter = 0;
String enteredPassword = "";
String correctPassword = "258";

unsigned long previousMillis = 0;
int seconds = 0, minutes = 31, hours = 11;
int days = 23, months = 2, years = 2025;

const byte ROWS = 4;
const byte COLS = 3;
char keys[ROWS][COLS] = {
  {'1', '2', '3'},
  {'4', '5', '6'},
  {'7', '8', '9'},
  {'*', '0', '#'}
};
byte rowPins[ROWS] = {8, 7, 6, 5};
byte colPins[COLS] = {1, 4, 3};
Keypad keypad = Keypad(makeKeymap(keys), rowPins, colPins, ROWS, COLS);

struct Reminder {
  int day;
  int hour;
  int minute;
```

```
  int angle;
  const char *message;
};

Reminder reminders[] = {
  {23, 11, 32, 30, "Morning Meds"},
  {23, 11, 33, 60, "Afternoon Meds"},
  {23, 11, 34, 90, "Night Meds"},
  {23, 11, 35, 120, "Morning Meds"},
  {23, 11, 36, 160, "Afternoon Meds"},
  {23, 11, 37, 180, "Night Meds"}
};

void setup() {
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(IR_SENSOR_PIN, INPUT);
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);
  digitalWrite(BUZZER_PIN, LOW);

  lcd.begin(16, 2);
  lcd.backlight();
  myServo.attach(12);
  myServo.write(0);
  currentServoAngle = 0;

  Serial.begin(9600);
  Serial.println("Medicine Dispenser Initialized...");
}

void loop() {
  unsigned long currentMillis = millis();
  if (currentMillis - previousMillis >= 1000) {
    previousMillis = currentMillis;
    seconds++;
    if (seconds == 60) { seconds = 0; minutes++; }
    if (minutes == 60) { minutes = 0; hours++; }
    if (hours == 24) { hours = 0; days++; }
    if (days > 30) { days = 1; months++; }
    if (months > 12) { months = 1; years++; }
```

```
    displayDateTime();
  }

  if (doseCounter < 6) {
    checkReminders();
  }
}

void displayDateTime() {
  lcd.setCursor(0, 0);
  lcd.print("Date: "); lcd.print(days); lcd.print("/"); lcd.print(months); lcd.print("/");
lcd.print(years);
  lcd.setCursor(0, 1);
  lcd.print("Time: ");
  if (hours < 10) lcd.print("0"); lcd.print(hours);
  lcd.print(":");
  if (minutes < 10) lcd.print("0"); lcd.print(minutes);
  lcd.print(":");
  if (seconds < 10) lcd.print("0"); lcd.print(seconds);

  // Serial Monitor Display
  Serial.print("Date: "); Serial.print(days); Serial.print("/");
  Serial.print(months); Serial.print("/"); Serial.print(years);
  Serial.print(" Time: ");
  Serial.print(hours); Serial.print(":");
  Serial.print(minutes); Serial.print(":");
  Serial.println(seconds);
}

void checkReminders() {
  for (int i = 0; i < sizeof(reminders) / sizeof(Reminder); i++) {
    if (days == reminders[i].day && hours == reminders[i].hour && minutes ==
reminders[i].minute && seconds == 0) {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print(reminders[i].message);
      Serial.println(reminders[i].message);
      triggerBuzzer(reminders[i].angle);
    }
```

```
  }
}

void triggerBuzzer(int angle) {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Enter Password");
  Serial.println("Buzzer ON - Enter Password");

  // Continuously ring the buzzer until password is correct
  while (true) {
    tone(BUZZER_PIN, 1000);
    enterPassword();
    if (enteredPassword == correctPassword) {
      noTone(BUZZER_PIN);
      Serial.println("Password Correct - Buzzer OFF");
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Password Correct");
      delay(1000);
      waitForIRSensor(angle);
      break;
    } else {
      Serial.println("Wrong Password Entered!");
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Wrong Password");
      delay(1000);
    }
  }
}

void enterPassword() {
  enteredPassword = "";
  lcd.setCursor(0, 0);
  lcd.print("Enter Password:");

  while (enteredPassword.length() < 3) {
    char key = keypad.getKey();
    if (key) {
```

```
      lcd.setCursor(enteredPassword.length(), 1);
      lcd.print('*');
      enteredPassword += key;
    }
  }
  Serial.print("Password Entered: ");
  Serial.println(enteredPassword);
}

void waitForIRSensor(int angle) {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Place Hand...");

  while (digitalRead(IR_SENSOR_PIN) == HIGH);
  delay(500);
  rotateServo(angle);
  waitForMedicine();
}

void rotateServo(int angle) {
  if (angle == currentServoAngle) return;
  for (int pos = currentServoAngle; pos <= angle; pos++) {
    myServo.write(pos);
    delay(15);
  }

  currentServoAngle = angle;
  Serial.print("Servo Rotated to: ");
  Serial.print(angle);
  Serial.println(" degrees.");
}

void waitForMedicine() {
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Take Medicine...");

  unsigned long startTime = millis();
  medicineTakenFlag = false;
```

```
  while (!medicineTakenFlag && millis() - startTime < 60000) {
    float distance = getUltrasonicDistance();
    Serial.print("Ultrasonic Distance: ");
    Serial.print(distance);
    Serial.println(" cm");
    if (distance >= 1 && distance <= 5) {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Medicine Taken");
      Serial.println("✅ Medicine Taken Successfully");
      medicineTakenFlag = true;
      doseCounter++;
      break;
    }
  }

  if (!medicineTakenFlag) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Missed Dose");
    Serial.println("❌ Missed Dose!");
  }

  delay(2000);
  lcd.clear();
}

float getUltrasonicDistance() {
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);
  long duration = pulseIn(ECHO_PIN, HIGH);
  return duration * 0.034 / 2;
```

PHOTOS OF NGO VISIT

Fig 8: Surveying on NGO people

Fig 9: Recording the data on their bases