Intelligent Tracking and Alert System for Dementia Patients

Priyanka Mashetty[1], Ashwini[2], Abhinav Chapte[3], Abhishek[4], Kaveri Chavan[5]
[1]*Professor, Dept of Information Science and Engineering* Guru Nanak Dev Engineering College Bidar-585403 Karnataka
[2,3,4,5]*Dept of Information Science and Engineering* Guru Nanak Dev Engineering College Bidar-585403 Karnataka

***Abstract*—This project aims to create an Arduino UNO-based Smart Pill Reminder with Geo-Fencing and Health Monitoring System for dementia patients. This system uses sophisticated tracking and alerts to monitor the patient's health, remind them to take their medication, and assure their safety. The health monitoring system includes pulse, temperature, and MEMS sensors to detect heartbeat, body temperature, and falls. These sensors give data to the Arduino, which processes it and displays the status on an LCD module. A GPS module tracks the patient's location, while a GSM module alerts the designated cell phone number when sensor readings exceed the safe limit or an emergency arises. The system also uses geo-fencing to define a safe area. Immediately send the caregiver an SMS with the patient's GPS location and activate the buzzer for nearby assistance if the patient violates this barrier. The smart pill reminder's embedded timer reminds patients to take medications on time. A buzzer sounds when the designated time arrives, and if the medicine is not taken within a certain time, a GSM alert is sent to the caregiver. Main controlling unit Arduino UNO reads, processes, and displays sensor data and communicates with GPS and GSM modules. The system's control program is in Embedded C. Its real-time health monitoring, medication reminders, and safety tracking make it a trustworthy and clever dementia and aging support system.**

***Index Terms*—Dementia, GPS tracking, Alert system, Assisted living, Smart healthcare systems.**

I. INTRODUCTION

Healthcare monitoring and patient safety are crucial nowadays, especially for elderly and dementia patients who forget to take their prescription and wander off. The Arduino UNO-based Smart Pill Reminder with Geo-Fencing and Health Monitoring System addresses these difficulties. This smart device reminds patients to take their medications and monitors their heartbeat, temperature, and movements. GPS tracks location, GSM sends alerts, and geo-fencing creates a virtual safety limit. The technology quickly texts caregivers if the patient passes this border or their health metrics exceed the threshold. This revolutionary system monitors, protects, and reminds patients of their medications, improving their independence and well-being.

1.1 Objectives

Create a smart pill reminder system to help people take their prescription on time.
Create a temperature, pulse, and MEMS-based real-time health monitoring system.
To follow patients using GPS and deliver emergency GSM alerts.
To install a geo-fencing technology that establishes a virtual safety border and notifies when crossed.
Automation helps dementia and elderly patients manage drug schedules and safety.

II. LITERATURE SURVEY

[1] paper provides an Arduino-based automobile-controlling system that eliminates manual car control. This work makes two significant contributions. We demonstrate hand-gesture control of the car using hand movement and location. The hand-gesture system uses an Arduino Nano, accelerometer, and RF transmitter. The accelerometer on the hand glove detects hand acceleration forces and sends them to the Arduino Nano on the glove. After receiving data, Arduino Nano converts it to angle values (0°-450°) and sends it to the Arduino Uno RF receiver via the RF transmitter on the car. Second, an android-based

mobile app with touch button and speech recognition modes will control the suggested automotive system. The Bluetooth-enabled mobile-application system extends the hand-gesture system. In this scenario, the Arduino Uno receives a signal when the user taps an application touch button or speaks. Arduino will check the signal against its established instructions for driving forward, backward, left, right, and brake before sending the motor module the command to move the automobile. An autonomous obstacle detection system uses sensors in the front of the automobile to improve safety and avoid hazards. The suggested systems are lab-scale prototypes to test their efficiency, accuracy, and affordability. The experimental findings show that the suggested work integrates hand-gesture, touch buttons, voice-recognition with mobile app, and obstacle detection, is easy to use, and can be integrated in a basic hardware circuit. The proposed solutions can be applied under real settings at big scale in the future, which will benefit autos and robotics.

[2] Modern advanced civilizations are plagued by vehicle theft, which affects motorcycle and car owners. However, lost car monitoring devices can be expensive, making them difficult for low-income people to use. Owners of stolen automobiles typically depend on authorities to track signals, making them dependent on official involvement to retrieve their vehicles. Our study developed a comprehensive car monitoring system that allows owners to track their vehicles autonomously to address these difficulties. This innovative device uses the flexible PIC microcontroller to merge GPS and GSM technologies with a realistic implementation circuit. Our initiative aims to improve vehicle security, reduce dependence on external assistance, and give vehicle owners peace of mind in the difficult world of vehicle theft and recovery by providing an affordable and practical solution.

[3] The Internet of Things (IoT) is a fast-increasing network of sensors, actuators, smart appliances, and wearable gadgets. The growth of connected devices generates massive volumes of data and enables many applications and services, complicating IoT development processes. This complexity requires rigorous design patterns and modeling methodologies to make IoT systems scalable, flexible, and maintainable. Healthcare providers are using IoT-based solutions to improve patient care and lower expenses. IoT-based health parameter monitoring requires precise attention to detail, making these systems difficult. Even minor data errors can affect patient diagnosis and therapy. Failures or disruptions could delay critical interventions and harm patient outcomes. Thus, IoT-based healthcare systems must be properly designed and implemented to ensure accurate data collection and timely treatments. This paper describes how to construct IoT-based smart health monitoring systems to collect and evaluate patient health data. This project seeks to discover and analyse the best practices for constructing scalable and flexible IoT-based healthcare systems that meet remote patient monitoring concerns such continuous monitoring, real-time feedback, and early health issue detection.

[4] Science and knowledge in health care are based on wireless sensing. Node technology has enabled considerable advancement. Patients face the risk of unexpected death due to inadequate medical care during heart attacks and problems. This aims to monitor older folks and notify medical professionals and loved ones. Therefore, we suggest implementing a new project called Patient Health Monitoring. This method uses sensor technologies and the internet to interact with the patient's loved ones in case of issues. This method tracks a patient's health by measuring their heartbeat. The sensor has been connected to the NodeMCU (ESP8266). A microcontroller connected to a wi-fi link feeds patient health data to a web server, serving as a wireless sensing node. This network system displays real-time heartbeat data with timestamps for patients. A patient health monitoring system based on IoT utilizes the internet for effective monitoring. This allows users see their loved ones while working and saves lives.

[5] In the current landscape, the utilization of mobile phones and smart devices has proliferated significantly. The major objective of this project is to design and develop a "IoT-based Integrated Health Monitoring System" that will monitor essential patient parameters, including body temperature, respiratory rate, heart rate, and glucose levels. A microcontroller-based, Wi-Fi-enabled IoT controller was utilized to read and analyse sensory input.

Consequently, an IoT-based patient monitoring system can effectively oversee patients' health and preserve lives.

[6] Consequently, an IoT-based patient monitoring system can effectively oversee patients' health and preserve lives. A microcontroller-based, Wi-Fi-enabled IoT controller was utilized to read and analyse sensory information. The utilization of mobile phones and smart devices has significantly increased in the contemporary landscape. The principal objective of this project is to design and develop a "IoT-based Integrated Health Monitoring System" that will monitor essential patient metrics, including body temperature, respiratory rate, heart rate, and glucose levels.

[7] The healthcare business is undergoing a technological transition, with IoT devices being a promising answer for patient care. The study describes the design and implementation of an IoT-based Patient Monitoring System (PMS). Complete critical tracking and secure data access for healthcare providers and patients. The IoT-based PMS uses wearable, non-invasive sensors to collect real-time data on patients' vital indicators, such as heart rate, blood pressure, body temperature, and oxygen saturation. Encrypted communication protocols securely transport data to a centralized cloud platform. The cloud platform serves as the central hub for data storage and processing. Key aspects of the system include detailed vital tracking, allowing healthcare personnel to monitor patients' health problems with precision. Secure data access is achieved through robust authentication and encryption, following tight privacy legislation and standards. We use strong access control and encryption to protect critical patient data. This study covers technical aspects of system implementation, such as hardware, software, communication protocols, and database design. The system's scalability and reliability are reviewed to handle diverse healthcare environments and patient demographics. This research introduces an IoT-based Patient Monitoring System that improves patient care by enabling safe data access and complete tracking.

[8] The rise of IoT technology has led to a change in healthcare towards remote and continuous monitoring systems. An IoT-based health monitoring system is proposed to provide real-time monitoring of vital health metrics for individuals both home and clinic. The system uses sensors, wireless connection, and data analytics to collect, transmit, and analyse health data in real-time. The system monitors vital indications like heart rate, body temperature, blood glucose, and oxygen saturation levels, detecting anomalies and alerting for prompt response. Data is securely transported to a cloud-based platform for storage, analysis, and visualization, allowing healthcare providers to remotely monitor patients' health and deliver individualized care. The suggested approach provides early identification, proactive intervention, improved patient outcomes, and lower healthcare expenditures. This system integrates IoT technology with healthcare to improve accessibility, efficiency, and patient-centricity - revolutionizing healthcare delivery.

[9] The Internet of Things (IoT) has revolutionized smart sensing devices and brought practical solutions in many fields. The study connects gadgets via IoT and health care monitoring. Chronic metabolic disorder Diabetes is spreading worldwide. A monitoring mechanism is being implemented as proposed technique that monitors glucose, body temperature, heart rate, and oxygen.

[10] In recent years, IoT technology integration in healthcare has enabled real-time health monitoring and enhanced patient care. This paper describes the design and implementation of an IoT-based health monitoring system using the ESP32 microcontroller. Multiple biological sensors are on the system constantly monitor heart rate, body temperature, and blood oxygen. The data is sent wirelessly over Wi-Fi to a cloud server for distant analysis. The ESP32 is the core processing unit, offering dual-core performance, low power consumption, and built-in Wi-Fi, making it cost-effective and scalable. A web-based dashboard provides real-time data visualization for caregivers and medical professionals to follow patient health indicators and receive notifications for abnormal readings. This technology improves patient monitoring outside of clinical settings, especially for elderly and remote patients. The proposed solution shows how IoT-driven innovations can enhance healthcare accessibility and responsiveness.

III. PROPOSED SYSTEM

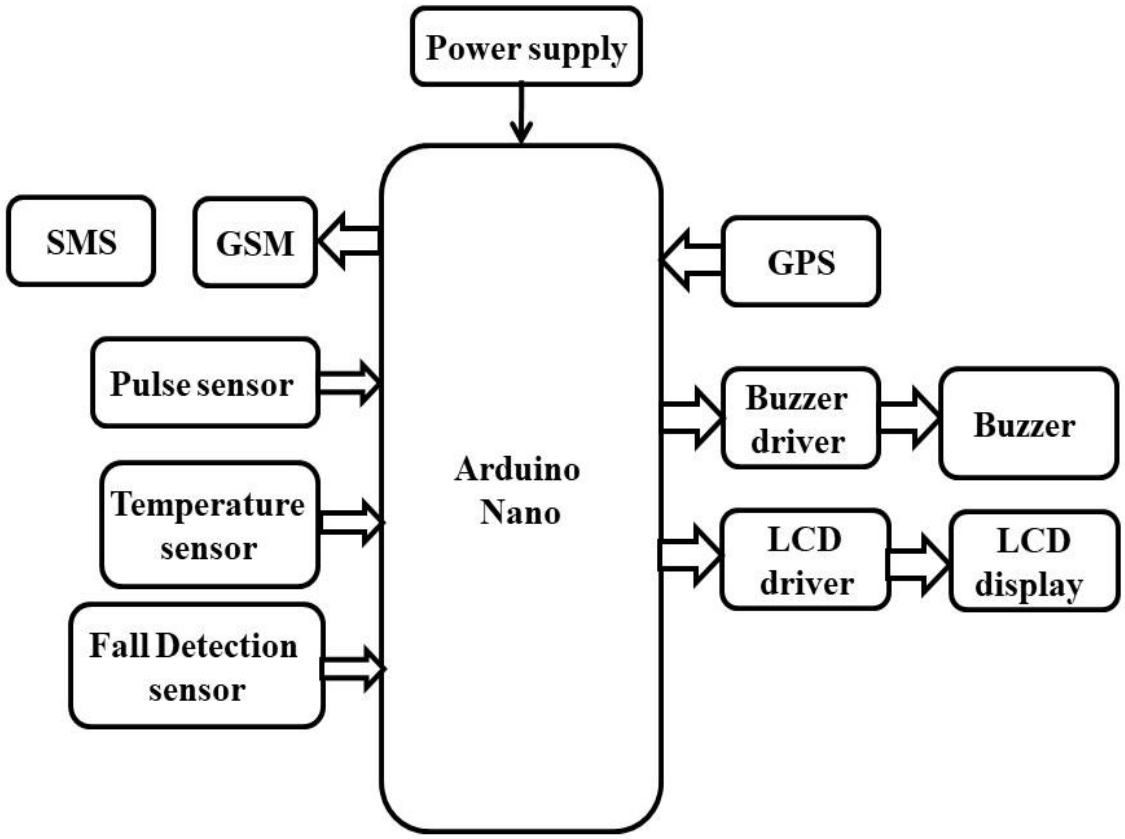

Figure 3.1: Block Diagram of Smart Pill Reminder with Geo-Fencing and Health Monitoring System

The primary components of this project are:

- Adapter power supply.
- Arduino Nano.
- Pulse Detector
- Temperature sensor. • MEMS sensor. • LCD display.
- Alarm.
- Global System for Mobile Communications (GSM).
- Global Positioning System (GPS).

The Smart Pill Reminder with Geo-Fencing and Health Monitoring System is built around the Arduino UNO microcontroller. The project uses a pulse sensor, temperature sensor, and MEMS sensor for continuous health data collection. A GPS module provides the real-time location of the patient, while a GSM module sends SMS alerts to a predefined mobile number when an abnormal situation is detected.

An LCD display is used to show system status, sensor readings, and alerts. The smart pill reminder function includes an inbuilt timer that activates a buzzer or LED at scheduled intervals to remind the patient to take their medicines. If ignored, the system automatically sends an alert to caregivers.

The geo-fencing feature defines a virtual safety boundary, and if the patient moves beyond it, an instant alert message containing their GPS coordinates is sent. The system is programmed in Embedded C, making it an efficient and reliable health support tool for remote patient monitoring.

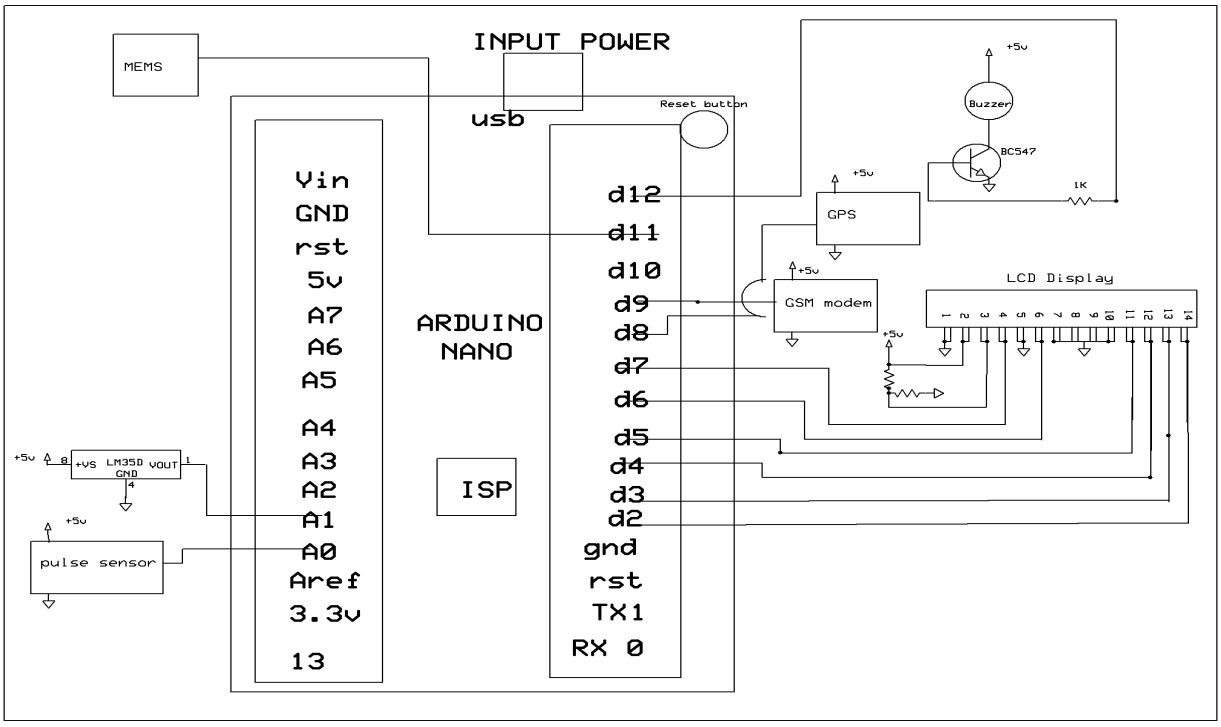

Figure 3.2: Schematic Diagram of Smart Pill Reminder with Geo-Fencing and Health Monitoring System

IV. HARDWARE AND SOFTWARE REQUIREMENTS

4.1 Hardware Description

4.1.1 Microcontroller

Small and versatile, Arduino Nano has many uses. This product is suitable for fast, tiny prototyping.

Arduino, an open-source hardware and software corporation, project, and user community, makes single-board microcontrollers and kits for digital devices. Arduino Nano uses ATmega328 SMD. It contains 14 digital input/output pins (6 of which are PWM outputs), 8 analog inputs, 1 UART, a 16 MHz crystal oscillator, a USB connection, and a reset button.

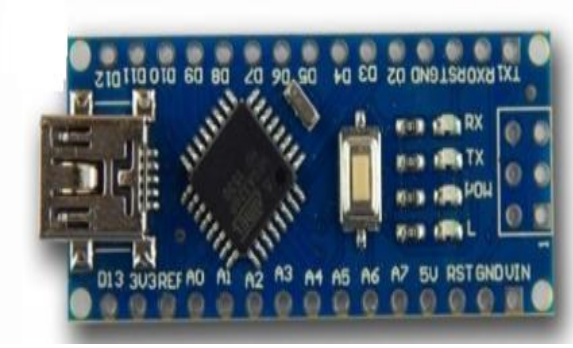

Figure: 4.1 Arduino Nano

4.1.2 Adapter power supply

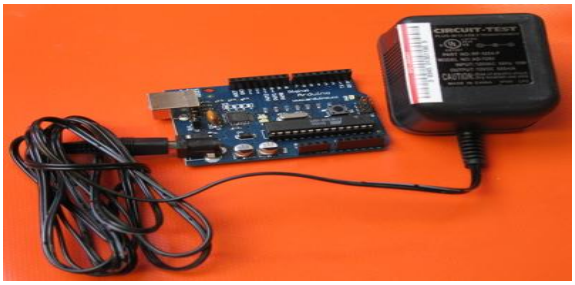

Figure 4.2: Power Adapter

AC adapters, AC/DC adapters, and AC/DC converters are external power supplies with AC plug-like cases. Other names include plug pack, plug-in adapter, adapter block, domestic mains adapter, line power adapter, wall wart, and power adapter. AC adapters provide voltage and power to devices without internal components from mains power. External power supplies have similar internal circuitry to built-in or internal supplies.

4.1.3 GSM

GSM, or Global System for Mobile Communications, is the most used cell phone technology. Cell phones look for nearby cell phone towers using a cell phone

service carrier's GSM network. GSM is the global standard for digital cellular communication.

4.1.4 GPS

GPS has transformed navigation and location. It is now crucial for aircraft surveying and marine navigation. The military developed GPS as NAVSTAR to guide missiles, ships, and aircraft to their objectives. GPS satellites send L-band signals modified by several codes. The coarse acquisition code is public, while the p code permits authorized users to attain high precision near 3m. This was not used by UN approved personnel. It delivers constantly accurate positioning, navigation, and time services to users worldwide in all weather, day or night, wherever on Earth with an unobstructed view of four or more GPS satellites.

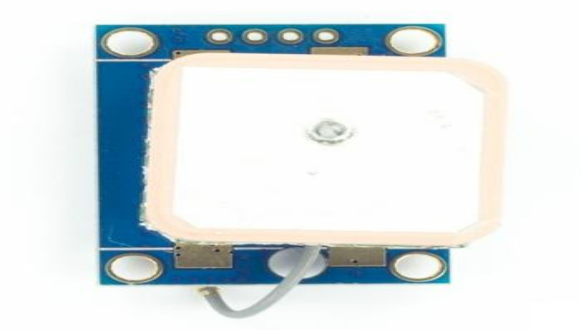

Figure 4.3: Neo 6 GPS Receiver

4.1.5 Pulse sensor

The well-designed plug-and-play Pulse Sensor measures heart rate. It lets students, artists, athletes, makers, and game & mobile developers effortlessly include live heartrate data. It features a real-time pulse graphing open-source monitoring tool.

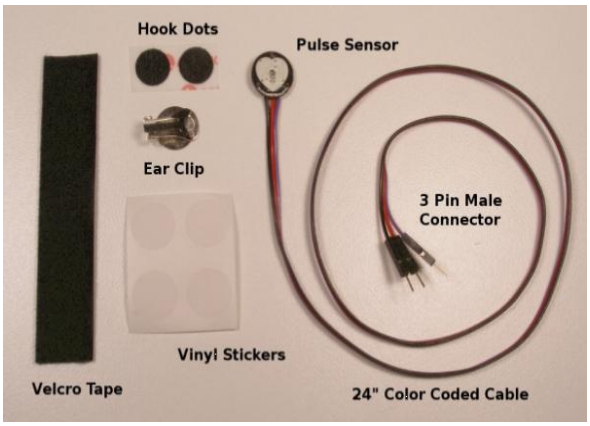

Figure 4.4: Pulse Sensor

4.1.6 Buzzer

A piezoelectric sound component's diaphragm generates sound. Piezoelectric diaphragms have a ceramic plate with electrodes on both sides and a metal plate. An adhesive holds a piezoelectric ceramic plate to a metal plate. Piezoelectric diaphragms distort mechanically when D.C. voltage is applied between electrodes. The distortion of a misshaped piezoelectric element expands radially. Piezoelectric diaphragm bends in that direction. The piezoelectric element-bonded metal plate does not expand. In contrast, the piezoelectric diaphragm bends in the direction of shrinkage. When AC voltage is placed across electrodes, the bending repeats, creating airborne sound waves.

Figure 4.5: Picture of buzzer

4.1.7 LCD display

LCD displays are commonly connected to micro controllers. Many microcontrollers use 16x2 and 20x2 LCDs. This indicates 16 and 20 characters per line by 2 lines, respectively.

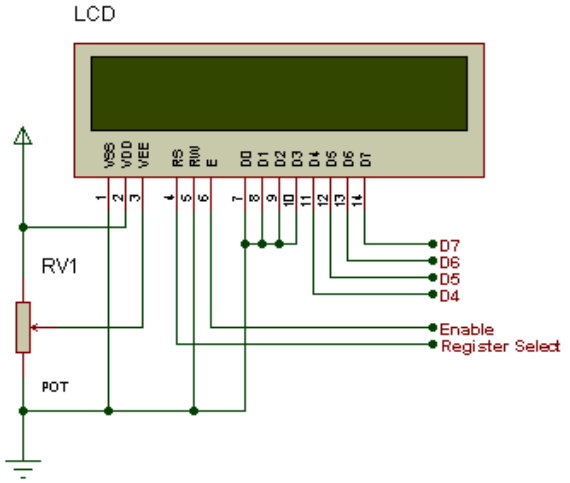

Figure 4.6: Basic 16x 2 Characters LCD

The LCD needs 3 control lines and 4 or 8 data bus I/O lines. The user can choose a 4-bit or 8-bit data bus for the LCD. LCDs with 4-bit data buses need 7 data lines (3 control lines and 4 data bus lines). LCDs with 8-bit data buses need 11 data lines (3 control lines and 8 data bus lines).

4.1.8 Temperature sensor

Figure 4.7: NTC Thermistor

NTC Thermistor temperature sensor module is cheap and compact. Ambient temperature affects it greatly. Usually used to measure ambient temperature. Adjusting the potentiometer changes the temperature sensing threshold. DO output can be directly connected to the micro controller to identify high and low by measuring environmental temperature changes. Modules measure temperatures between 20 and 80 degrees Celsius. Line temperature sensors can control water, tank, and other temperatures instead of this module. The 4-wire thermistor measurement method is the most accurate because neither cable wires carry current and contribute resistance.

4.2 Software Description

4.2.1 Arduino IDE Compiler

Any Arduino on a Breadboard instructible benefits from this.

1. You must load your own Bootloader or use a microcontroller with one.
2. Not every ATmega328 is equal.

(A bootloader is a program on the chip that uploads sketches)

Figure 4.8: Bootload the ATmega328

Figure 4.9: Burn the Bootloader

V. ADVANTAGES AND DISADVANTAGES

5.1 Advantages

- Offers real-time health status and safety alerts.
- Automation of medication reminders reduces supervision requirements.
- Geo-fencing safeguards patients from leaving designated areas.
- Compact, cost-effective, and user-friendly design. • Allows caregivers to respond quickly during crises.
- Improves safety, independence, and quality of life for dementia sufferers.

5.2 Disadvantages

System performance can be impacted by poor network signal.

5.3 Applications

- Overseeing and supporting individuals with dementia or Alzheimer's disease.
- Geriatric care and telehealth patient surveillance.
- Medical facilities, long-term care institutions, and rehabilitation establishments.
- Advanced healthcare and telemedicine applications.
- Personalized home-based healthcare help systems.

VI. RESULTS

The Smart Pill Reminder with Geo-Fencing and Health Monitoring System was effectively created and executed using Arduino UNO, using various sensors and modules for advanced health aid. The system incessantly monitored the patient's heartbeat, body temperature, and movement via pulse, temperature, and MEMS sensors, respectively. The readings were prominently exhibited on the LCD panel in real-time.

The intelligent pill reminder efficiently notified the patient at designated intervals by a buzzer and LED signal. Upon the patient's failure to provide the medication within the designated timeframe, an SMS notification was automatically dispatched to the caregiver's cell number via the GSM module.

```
[16:48:27] Pulse: 61 bpm | Temp: 37.6 °C | MEMS: 2.14 | GPS: 17.3905,78.4957
ALERT: Movement anomaly: 2.14
ALERT: Geofence breach at (17.3905, 78.4957)
------------------------------------------------------------
[16:48:30] Pulse: 114 bpm | Temp: 36.6 °C | MEMS: 1.15 | GPS: 17.3782,78.4889
ALERT: Geofence breach at (17.3782, 78.4889)
------------------------------------------------------------
[16:48:33] Pulse: 130 bpm | Temp: 35.4 °C | MEMS: 1.11 | GPS: 17.3921,78.4867
ALERT: Pulse abnormal: 130 bpm
ALERT: Temperature abnormal: 35.4 °C
ALERT: Geofence breach at (17.3921, 78.4867)
------------------------------------------------------------
[16:48:36] Pulse: 70 bpm | Temp: 36.2 °C | MEMS: 1.17 | GPS: 17.3938,78.4866
ALERT: Geofence breach at (17.3938, 78.4866)
------------------------------------------------------------
```

FIGURE 6.1: Parameter Readings

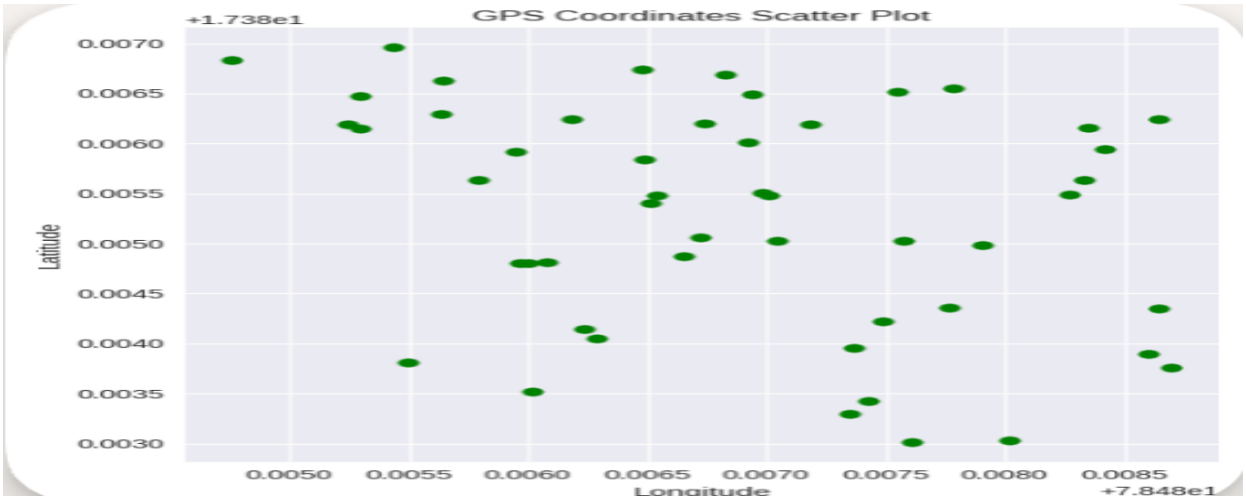

Figure 6.2: GPS Values for Scatter Plot

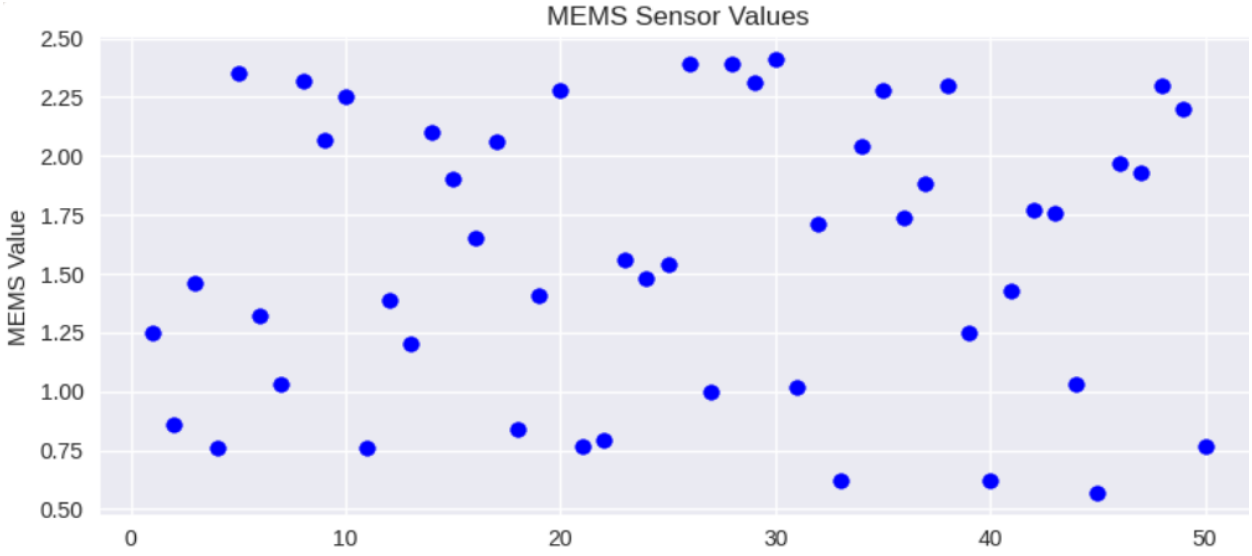

Figure 6.3: MEMS Sensor Readings

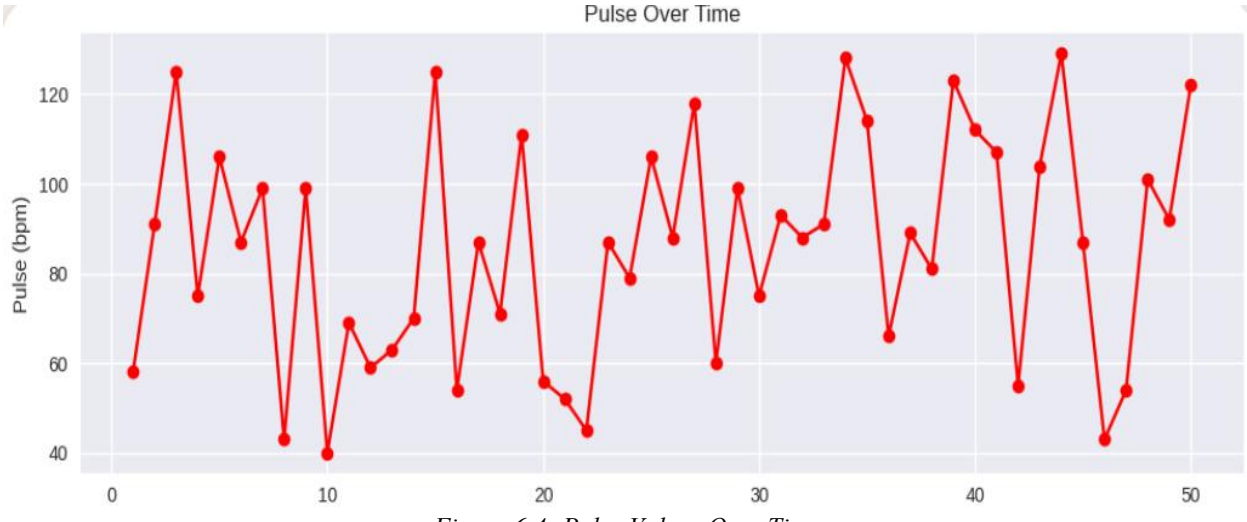

Figure 6.4: Pulse Values Over Time

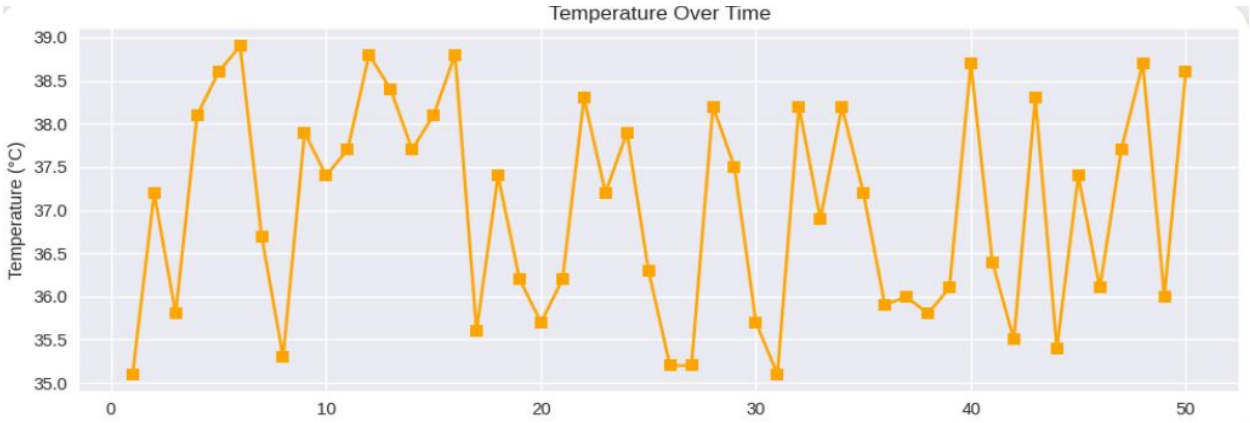

Figure 6.5: Temperature Values Over Time

The geo-fencing functionality precisely established a virtual safety perimeter utilizing the GPS module.
Upon the patient's departure from the designated zone, the system effectively transmitted an alarm message containing GPS coordinates, enabling the caregiver to promptly locate the patient. The project executed all intended functions—health monitoring, medication reminders, real-time tracking, and safety alert generation—efficiently and reliably. This illustrates that the technology can substantially assist dementia and elderly people in adhering to their prescription regimens and ensuring personal safety.

VII. CONCLUSION AND FUTURE WORK

The Smart Pill Reminder with Geo-Fencing and Health Monitoring System is a cutting-edge solution that integrates health monitoring, intelligent tracking, and medication management into a single compact system. The system employs sensors, GPS, GSM, and microcontroller technologies to guarantee timely medication adherence and maintain patient safety within designated parameters. It additionally offers real-time notifications during emergencies, enhancing the safety and quality of life for individuals with dementia and the elderly. The study effectively illustrates the crucial role of technology in contemporary healthcare and remote patient support.

VIII. FUTURE SCOPE

- Integration with mobile applications for real-time tracking and alerts.
- Utilization of IoT and cloud platforms for remote data storage and analysis.
- Incorporation of voice-activated medication reminders to enhance usability.
- Integration with smartwatches or wearable health monitoring devices.
- AI-driven predictive health assessment and automated physician notifications.

REFERENCES

[1] Ullah, S.; Mumtaz, Z.; Liu, S.; Abubaqr, M.; Mahboob, A.; Madni, H.A. Single-equipment with multiple-application for an automated robot-car control system. Sensors 2019, 19, 662.

[2] M. Patel and A. Aggarwal, "Low-cost GSM/GPS based tracking system," in IEEE Transactions on Consumer Electronics, vol. 58, no. 2, pp. 364-371, 2012.

[3] Ben Hassine, Mariem & Tounsi, Imen & Hadj Kacem, Mohamed. (2023). Developing IoT-based Smart Health Monitoring Systems using Design Patterns. 1-8. 10.1109/AICCSA59173.2023.10479310.

[4] S. Banka, S. Kancharla, T. Purnima, A. Thanvi, and L. Shatdarsanam, "Patient Health Monitoring System Using IoT Technology," International Journal of Creative Research Thoughts (IJCRT), vol. 11, no. 10, Oct. 2023.

[5] Dr. S. Durgadevi, R Anbazhagan, A. Vimonisha, R Harini, 2022, Design and Implementation of An Health Monitoring System using IOT, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) ICONNECT – 2022 (Volume 10 – Issue 09)

[6] A. Jemina, M. Pechiammal, M. Ponnarasi, R. Indhu, and V. Namakkani, "Design and Implement a Health Care Monitoring and Management System Using IoT," Data Analytics and Artificial Intelligence, vol. 3, no. 6, REST Publisher, 2023. ISBN: 978-81-948459-4-2.

[7] Ravishankar, V., Ibrahim, M., Jain, A., & Verma, N. (2024). Design and Implementation of an IoT-Based Patient Monitoring System for Comprehensive Vital Tracking and Secure Data Access. International Journal of Microsystems and IoT, 2(7), 1044–1049. https://doi.org/10.5281/zenodo.13332142.

[8] S. Birajadar, N. H. Aiwale, S. H. Chavan, D. M. Patil, and D. S. Patil, "IoT Based Health Monitoring System," International Journal of Novel Research and Development (IJNRD), vol. 9, no. 5, May 2024. ISSN: 2456-4184.

[9] B. Lakshmi, M. Lavanya, R. Haripriya, K. Sushma Sri, M. Teja, and M. Jayasri, "Design and Implementation of IoT Based Smart Health Monitoring System for Diabetic Patients Using Wireless Sensor Networks," International Journal of Information Technology (IJIT), vol. 8, no. 3, May–Jun. 2022.

[10] R. Baske, P. V. Jadhav, R. T. Shaikh, and S. S. Bondre, "IoT Based Health Monitoring System Using ESP 32," Journal of Emerging Technologies and Innovative Research (JETIR), vol. 12, no. 5, May 2025. ISSN: 2349-5162.