CHAPTER 1

INTRODUCTION

The most common kind of dementia is Alzheimer's disease, which is characterized as a substantial loss of memory and other cognitive functions that interferes with everyday activities. Alzheimer's disease is a kind of dementia in which memory, reasoning, and spatial orientation are all affected. Symptoms often start gradually and intensify with time, making daily tasks difficult. Alzheimer's disease is a type of memory loss that occurs when brain cells die. Dementia sufferers are unable to continue their usual social life as a result. Alzheimer's disease is usually diagnosed by those who live with the patient because of changes in the patient's behavior and cognitive (loss of cognitive abilities).

Alzheimer's disease is a slow-progressing condition in which the patient becomes unpredictable and slightly disoriented, and dementia symptoms emerge over time. People with Alzheimer's disease lose the ability to carry on a conversation, react to their surroundings, and remember everyday things as the disease develops. Alzheimer's disease is the sixth leading cause of death in the United States, with 9.4 million people affected, and a total of 10 million people across Europe. It also aids in the detection of patient collapse and sends updates to the caregiver via the app. This system also uses the LED display on the handheld device to remind patients to take their pills on time. The objectives of GPS tracking system are:

1. Live Tracking
2. Alerts
3. Helps Maintain the Patient's Confidence
4. To provide real-time analysis of the sensor data and recommend appropriate corrective measures.

1.1 Problem Statement

Alzheimer's disease remains a significant global health concern, affecting millions of individuals and placing immense burdens on families and healthcare systems. As populations continue to age, the prevalence of Alzheimer's is expected to rise, increasing the demand for effective patient care and monitoring solutions.

Despite ongoing research, there is currently no cure for the disease, and existing treatments focus only on managing symptoms rather than addressing its underlying progression.

One of the critical challenges faced by Alzheimer's patients and caregivers is the **lack of continuous monitoring and assistance** to ensure patient safety and well-being. Many patients struggle with memory loss, disorientation, and difficulty in adhering to medication schedules, leading to potential risks such as wandering, missing medication, or accidental injuries. Caregivers, on the other hand, experience significant stress and difficulty in providing round- the-clock supervision, often leading to burnout and inefficiencies in patient care.

This project aims to bridge this gap by developing an **IoT-based Alzheimer's Patient Monitoring System** using **ESP32** and **various sensors** to provide **real-time tracking, cognitive assessment, and medication reminders**. By leveraging **wireless communication and IoT connectivity**, the system seeks to enhance patient care, reduce caregiver burden, and introduce a more efficient and proactive approach to Alzheimer's management.

1.2 PROPOSED SOLUTION

Our proposed solution aims to revolutionize Alzheimer's patient care through a sophisticated smart home system integrated with IoT sensors. These sensors will meticulously track patients' daily activities and behaviours, furnishing caregivers and family members with vital insights. A dedicated application will facilitate real-time access to this data, enabling efficient assessment of the patient's condition. Moreover, an instantaneous notification system will promptly alert caregivers when immediate intervention is warranted. Through the seamless integration of these technologies, our system endeavours to empower Alzheimer's patients to maintain their independence while equipping caregivers with indispensable tools for enhanced supervision and rapid response. This innovative approach not only promises to elevate the quality of care but also offers a semblance of normalcy and security to both patients and their support networks.

1.3 Motivation

The primary motivation behind this project is to develop a Smart Alzheimer’s Patient Monitoring System that leverages IoT technology and ESP32 to provide an efficient, real-time, and automated solution for patient care. By integrating sensors for movement detection, cognitive assessment, and medication reminders, this system aims to reduce caregiver burden while ensuring the patient’s well-being.

By developing this project, we aim to contribute to the field of smart healthcare solutions, making Alzheimer's care more accessible, effective, and technology driven.

CHAPTER 2

LITERATURE SURVEY

[1] Konstantinos Kalovrektis et al. (2022) developed a low-cost IoT testbed system for early stages diagnosis of Alzheimer's, showcasing the potential of IoT technologies in healthcare.

[2] Vijeeta Patil et al. (2022) introduced an advanced IoT solution for real-time monitoring in healthcare services, aiming to enhance patient care through continuous remote monitoring

[3] H.E. Adardour et.al, presented a novel IoT-based solution for tracking Alzheimer's patients outdoors. The system comprises a GPS receiver and a NodeMCU ESP8266 board that captures and transmits the patient's current location to a server through an HTTP request

[4] S. Saranya and Dr. P. Jesu Jayarin presented an efficient method for tracking Alzheimer's patients using the MiWi system. The system alerts caregivers when the patient goes beyond the range of the MiWi device. An alert message containing the patient's latitude and longitude coordinates is sent to the caretaker's mobile number. The system also provides a straightforward and user-friendly software interface for direct remote communication.

[5] Aseel Thamer Ebrahem et al. (2023) explored the utilization of IoT technology for monitoring Alzheimer's and elderly patients, demonstrating the potential for remote monitoring solutions in healthcare.

[6] Smita S. et.al, introduced a novel solution to enhance the safety of Alzheimer's patients developing advanced shoes equipped with position tracking and path guidance features.

[7] The paper discusses the framework of the system, emphasizing the importance of a safety monitor for Alzheimer's patients.

CHAPTER 3

SYSTEM REQUIREMENTS

3.1 SOFTWARE REQUIREMENTS

3.1.1 Arduino IDE: The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino Software (IDE) makes it easy to write code and upload it to the board offline. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. This software can be used with any Arduino board.

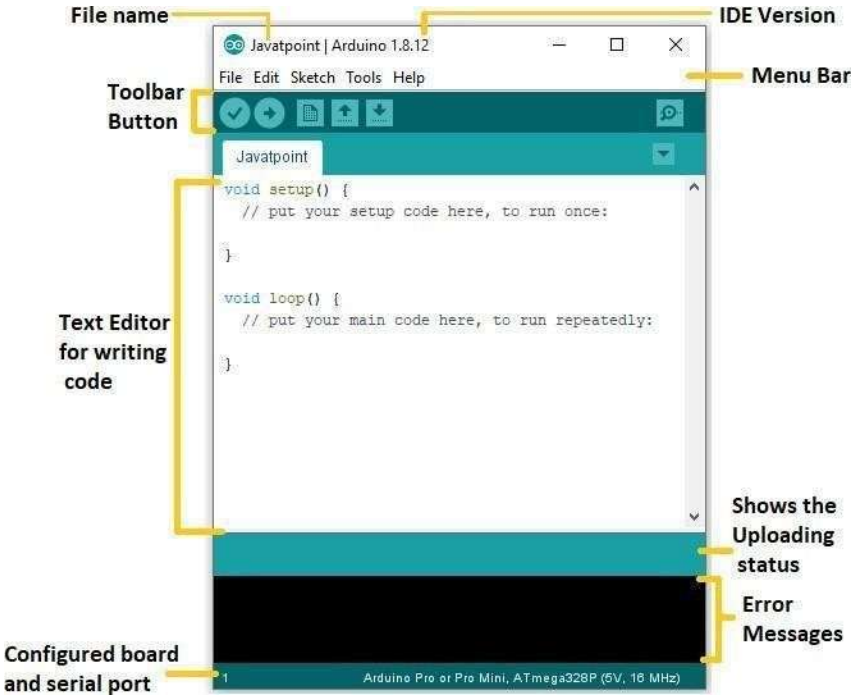

Fig 3.1: Arduino IDE

There are currently two versions of the Arduino IDE, one is the IDE 1.x.x and the other is IDE 2.x. The IDE 2.x is new major release that is faster and even more powerful to the IDE 1.x.x. In addition to a more modern editor and a more responsive interface it includes advanced features to help users with their coding and debugging. Arduino board designs use a variety of microprocessors and controllers.

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The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the Arduino language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) Most Arduino boards consist of Atmel 8-bit AVR Microcontroller (ATmega8, ATmega168, ATmega328 ATmega1280, or ATmega2560) with varying amounts of flash memory, pins, and features. The boards use single or double- row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an 12C serial bus Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. The Arduino IDE supports the programming languages C and C++ using special rules for code structuring. The IDE includes a software library from the Wiring project, which provides many common input and output procedures. User-written code requires only two basic functions: one to start the sketch and another for the main program loop. These functions are compiled and linked with a program stub "main" into an executable cyclic executive program using the GNU toolchain, which is also included with the IDE distribution. The Arduino IDE employs the program "argued" to upload the executable code to the microcontroller in a text file in hexadecimal format.

3.1.2 Adafruit :

Adafruit Industries is a globally recognized company that designs and manufactures open- source electronic components, development boards, and learning resources for engineers, hobbyists, and makers. Established in 2005 by Limor Fried (Lady Ada), Adafruit has played a significant role in simplifying hardware development by providing high-quality, reliable, and well-documented products. The company is known for its strong commitment to open-source hardware and software, offering extensive tutorials, libraries, and guides to help users integrate components seamlessly into their projects.

Key Features of Adafruit Products

1. Open-Source Hardware & Software ○ Adafruit provides open-source designs, allowing users to modify and customize their hardware.
2. Comprehensive Documentation & Tutorials ○ Adafruit offers detailed guides, code examples, and schematics for each product.
3. High-Quality Components ○ Adafruit products use gold-plated, durable PCBs with robust construction.
4. Strong Community Support ○ A vast online community helps with troubleshooting, knowledge sharing, and project development. ○ Forums and GitHub repositories provide constant updates and improvements.

Popular Adafruit Products and Their Applications:

1. Adafruit Microcontrollers & Development Boards

- Adafruit ESP32 Feather – A Wi-Fi + Bluetooth microcontroller used in IoT applications.
- Adafruit Metro (Arduino-Compatible Board) – Ideal for learning embedded programming.

2. Adafruit Sensors

- Adafruit BME280 – A sensor for temperature, humidity, and pressure monitoring.
- Adafruit MPU6050 – A gyroscope + accelerometer used in motion tracking applications.

3. Adafruit Displays

- Adafruit 128x64 OLED Display – Used for visualizing sensor data and creating user interfaces.
- Adafruit TFT Touchscreen – Suitable for graphical displays in embedded systems.

3.2 HARDWARE REQUIREMENTS

3.2.1 ESP32:

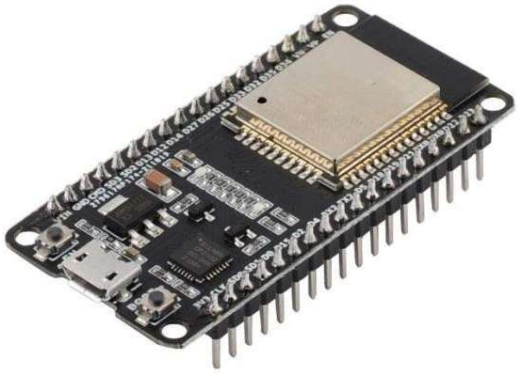

Fig 3.2.1 : ESP32

The ESP32 is a powerful, low-cost Wi-Fi and Bluetooth-enabled microcontroller widely used in IoT applications, smart devices, and embedded systems. Developed by Espresso if Systems, it features a dual-core processor, built-in Wi-Fi and Bluetooth, multiple GPIO pins, and support for various peripherals, making it highly versatile for real-time data processing and wireless communication.

Key Features of ESP32

1. High Processing Power:
    - Equipped with a dual-core processor that enhances multitasking and parallel execution of tasks.
    - Offers up **to 600 DMIPS** of processing power, making it suitable for real-time applications.
2. Integrated Wi-Fi and Bluetooth:
    - Supports Wi-Fi (2.4 GHz) for cloud connectivity, remote monitoring, and web-based applications.
    - Includes Bluetooth (Classic and BLE), allowing communication with smartphones, wearable devices, and other Bluetooth peripherals.

3. Multiple GPIO Pins and Peripherals:
    - Comes with 34 GPIO pins, which can be configured for various functions such as PWM, ADC, DAC, UART, I2C, SPI, and touch sensing.
    - Supports multiple analog and digital sensors, displays, motors, and actuators for enhanced versatility.
4. Compatibility with Development Platforms:
    - Can be programmed using Arduino IDE, ESP-IDF (Espressif IoT Development Framework), and MicroPython.
    - Supports OTA (Over-The-Air) updates, allowing firmware upgrades without physical access to the device.

Role of ESP32 in Our Project

For our project, the ESP32 acts as the central microcontroller, managing various functionalities, including sensor integration, real-time data processing, and wireless communication. The microcontroller collects data from sensors (such as temperature, motion, or heart rate sensors) and transmits it wirelessly to a cloud server or a mobile application for remote monitoring.

1. Wireless Connectivity for IoT Applications
    - The Wi-Fi module in ESP32 enables real-time data transmission to a cloud platform or web server, allowing users to access critical information from anywhere.
    - The Bluetooth (BLE) feature allows connectivity with smartphones and other nearby devices for short-range data exchange.
2. Real-Time Sensor Data Processing
    - The ESP32 reads inputs from multiple sensors connected to its GPIO pins and processes the data to make real-time decisions.
    - It can trigger alerts, send notifications, or take predefined actions based on sensor readings.
3. Remote Monitoring and Control
    - The microcontroller can be programmed to send live updates to a mobile app or a web dashboard, allowing users to monitor system status remotely.

- This is particularly useful in applications such as health monitoring, home automation, and security systems.

3.2.2 GPS NEO 6M:

Fig 3.2.2: GPS NEO 6M

The GPS NEO-6M is a high-performance Global Positioning System (GPS) module designed for accurate location tracking and navigation. It is widely used in IoT applications, vehicle tracking, drones, robotics, and real-time positioning systems. Developed by u-blox, the NEO-6M module provides precise geolocation data by receiving signals from multiple satellites and calculating the user's exact position in terms of latitude, longitude, altitude, and speed.

Key Features of GPS NEO-6M

1. High-Accuracy GPS Receiver
    - Supports up to 56 satellite channels for precise location tracking.
    - Provides an accuracy of 2.5 meters in normal conditions.
2. Supports UART Communication
    - Uses Serial/UART communication (9600 baud rate by default)
    - Outputs data in NMEA format, which contains information such as time, latitude, longitude, altitude, and speed.
4. Low Power Consumption
    - Operates at 3.3V to 5V, making it suitable for battery-powered applications.
    - Supports power-saving modes for long-term operation in IoT projects.

5. Built-in EEPROM and Backup Battery
    - Stores the last known location, allowing faster satellite acquisition after power

Role of GPS NEO-6M in Our Project

The GPS NEO-6M module plays a crucial role in our project by providing real-time location tracking and navigation data. It is interfaced with a microcontroller (e.g., ESP32 or Arduino UNO) to continuously receive and process geolocation data. The collected GPS data can be used for vehicle tracking, route monitoring, security applications, and automated navigation. 1. Real-Time Location Tracking

- The module fetches latitude, longitude, altitude, and speed and transmits it to a microcontroller for further processing.
- This information can be displayed on an LCD, OLED screen, or sent to a mobile app/cloud server for remote monitoring.

2. IoT-Based GPS Applications

- Using ESP32 with Wi-Fi, the GPS data can be uploaded to a cloud-based GPS tracking platform (e.g., Firebase, ThingSpeak, or a custom web server).
- Users can monitor live location updates from anywhere via a mobile application or a web dashboard.

3. Navigation and Route Optimization

- The GPS data can be integrated with mapping services (Google Maps API, OpenStreetMap) to calculate the best route in real time.
- Useful in autonomous vehicle navigation, drone guidance, and smart transportation systems.

4. Emergency Alert Systems

- Can be used in safety applications, such as sending an SOS location in case of an emergency.
- If an unexpected event occurs, the system can automatically send GPS coordinates via SMS or email to predefined contacts.

5. Low-Power and Long-Term Tracking

- The module operates in a low-power mode, making it ideal for battery-powered GPS trackers.
- Can be used in wildlife monitoring, asset tracking, and remote sensing applications.

3.2.3 LCD

Fig 3.2.3: LCD

LCD (Liquid Crystal Display) and Its Role in the Project

A Liquid Crystal Display (LCD) is a widely used electronic display module that provides a visual interface for embedded systems. It is commonly used in electronic projects, IoT devices, industrial applications, and consumer electronics due to its low power consumption and ease of use.

Types of LCDs

1. Character LCD (e.g., 16x2, 20x4
    - Displays text and numbers in a grid format.
    - Common models: 16x2 LCD , 20x4 LCD
2. Graphical LCD (e.g., 128x64)
    - Displays images, custom characters, and graphical content.
    - Used in complex interfaces and data visualization.
3. TFT/OLED LCD (Color Displays)
    - Higher resolution, supports colors and images.

- Commonly found in smart devices, wearables, and multimedia applications.

Key Features of a 16x2 LCD

- 16 columns × 2 rows for text display.
- Works with 5V power (compatible with Arduino, ESP32, etc.).
- Uses HD44780 controller (widely supported).
- Requires 4-bit or 8-bit parallel communication.
- Can display custom characters.

Role of LCD in Our Project

The LCD module in our project serves as a user interface for displaying important data.

1. Real-time Information Display

- Shows user ID, system status, and attendance details when an RFID tag is scanned.
- Displays GPS location coordinates if integrated with a GPS module.
- Provides live sensor readings, such as temperature, humidity, etc.

2. System Feedback & Notifications

- Displays messages like "Access Granted" or "Access Denied" for security applications.
- Provides real-time updates about system status and errors.

3. Menu Navigation & Selection

- Can be used for menu-driven interfaces for selecting options using buttons.
- Enables users to navigate system settings easily.

3.2.4 VIBRATION SENSOR:

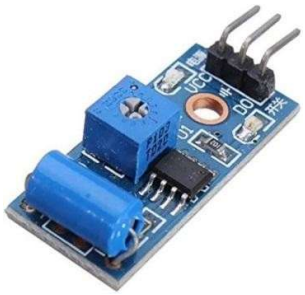

Fig : 3.2.4: Vibration Sensor

A **vibration sensor** is a device that detects vibrations or mechanical movements from an object or surface. It converts these vibrations into electrical signals that can be measured and analyzed by a microcontroller like an Arduino.

In this project, the vibration sensor is used to detect any physical movements or shocks. When the sensor experiences vibration, it generates a voltage signal. This signal is then read by the Arduino to perform specific actions, such as displaying a message on an OLED screen or triggering another output.

Working Principle:

- The sensor works on the principle of contact-based movement detection.
- It contains a spring-type sensor inside a metal casing (e.g., SW-420 module).
- When there is no vibration, the internal contacts remain apart, resulting in a LOW output.
- When vibration occurs, the internal spring shakes and makes contact, sending a HIGH signal to the microcontroller.

Key Features:

- Digital Output: Can be directly read by Arduino using a digital pin.
- Adjustable Sensitivity: Some modules include a potentiometer to adjust vibration sensitivity.
- Compact and Low Power: Small size and low power consumption make it suitable for embedded projects.

- Fast Response Time: Can detect even slight shocks or tremors.

Applications in Projects:

- Security Systems: To detect window/door break-ins.
- Wearable Devices: To sense motion or sudden impact (e.g., for fall detection).
- Robotics: For collision or obstacle feedback.
- Industrial Monitoring: To check vibrations in motors or machines.

3.3.5 PIR MOTION SENSOR: PASSIVE INFRARED SENSOR

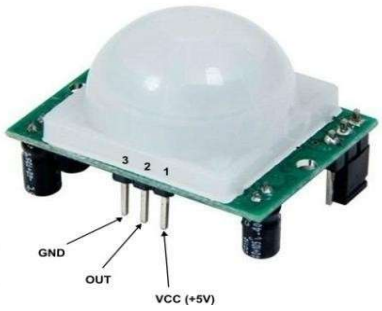

Figure 3.3.5 : PIR Motion Sensor: Passive Infrared Sensor

In our project, the PIR motion sensor plays a crucial role in detecting human presence and triggering necessary actions. The sensor is integrated with an ESP32 microcontroller, which processes the motion detection data and performs corresponding functions based on the detected activity.

Key Functions of PIR Sensor in Our Project

1. Human Presence Detection
    - The PIR sensor detects motion when a person enters a specific area.
2. Automated Alert System
    - When motion is detected, the sensor sends a signal to the ESP32, which can then activate a buzzer or LED indicator to notify users.

3. Data Logging & Processing
    - The PIR sensor's output can be recorded and stored, providing insights into movement patterns

4. Power Optimization
    - The system remains in a low-power state until motion is detected .

5.Security and Automation
    - If an unauthorized motion is detected, the system can trigger an alarm, send a notification, or turn on a security camera.

Role in Our Project

1. The PIR sensor continuously monitors for motion.
2. When movement is detected, it sends a HIGH signal to the ESP32.
3. The ESP32 processes the signal and triggers the assigned action, such as:
    - Turning on an LCD display.
    - Activating a buzzer.
    - Sending a wireless notification via WiFi or Bluetooth
4. Once no further motion is detected, the system returns to standby mode.

Benefits of Using PIR Sensor in Our Project

- Enhances automation by detecting human presence.
- Reduces power consumption by activating components only when needed.
- Improves security by triggering alerts or alarms upon unauthorized movement.

3.2.6 HUMIDITY SENSOR

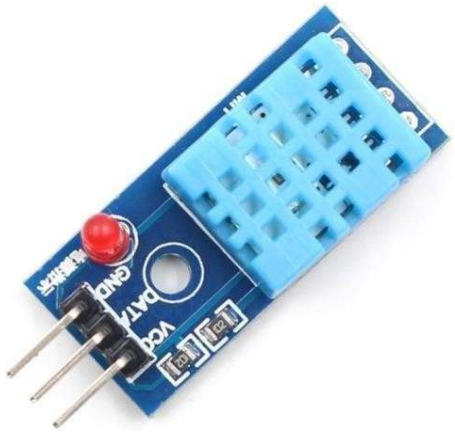

Figure 3.2.6 Humidity Sensor

A humidity sensor is a device used to measure the moisture content in the air. It is widely used in environmental monitoring, weather stations, and IoT applications. In our project, a humidity sensor is integrated with the ESP32 microcontroller to monitor humidity levels and trigger necessary actions based on the readings.

Types of Humidity Sensors:

1. Capacitive Humidity Sensors
    - Measure changes in capacitance caused by moisture in the air.
    - Common in weather stations and industrial applications.
2. Resistive Humidity Sensors
    - Measure changes in electrical resistance due to moisture absorption.
    - Used in HVAC systems and environmental monitoring.
3. Thermal Humidity Sensor.
    - Found in laboratory and industrial applications.

Role in Our Project

1. Monitoring Environmental Conditions ○ Continuously tracks humidity levels to ensure optimal conditions.
2. Automatic Control System ○ If humidity is too high, the system can trigger a fan or dehumidifier. ○ If humidity is too low, it can send an alert or activate a humidifier.
3. Data Logging & Wireless Transmission ○ The ESP32 can store and send humidity data via WiFi or Bluetooth for remote monitoring.
4. Weather-Based Automation ○ Can be integrated with temperature sensors to improve environmental monitoring and control.
5. By integrating the humidity sensor, our project provides real-time humidity monitoring, automated response mechanisms, and improved efficiency, making it ideal for weather stations, smart homes, and industrial applications.

3.2.7 MOISTURE SENSOR

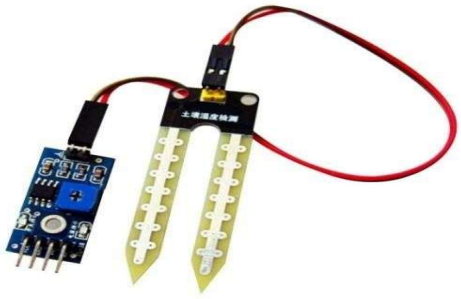

Figure 3.2.7 Moisture Sensor

The moisture sensor is a key component of our Alzheimer's Patient Monitoring System. Although traditionally used in agricultural and irrigation applications to measure soil moisture content, in this project the sensor is repurposed to detect wetness in a patient's bedding or clothing. This function is particularly beneficial for monitoring hygiene conditions in Alzheimer's patients, who may suffer from incontinence or mobility limitations.

By detecting the presence of moisture, the system enables timely alerts to caregivers, thereby enhancing patient comfort, reducing the risk of infections, and supporting efficient care management.

Types of Moisture Sensors

1. **Resistive Moisture Sensors**
   Resistive sensors operate by measuring the electrical resistance between two conductive probes. Dry conditions result in high resistance, while wet conditions decrease resistance. These sensors are simple and cost-effective, though the probes may corrode over time due to oxidation.

2. **Capacitive Moisture Sensors**
   Capacitive sensors detect changes in capacitance, which varies with moisture content. These sensors offer higher accuracy and durability compared to resistive types and are less prone to corrosion, making them suitable for long-term usage in sensitive healthcare environments.

Working Principle

- The sensor is placed in areas such as a mattress or chair cushion where wetness may occur.
- It detects moisture by measuring resistance or capacitance between electrodes.
- The ESP32 microcontroller reads the sensor's output — either as an analog voltage (resistive type) or digital signal (capacitive type).
- Based on the measured moisture level, the system can perform various actions:
  - Trigger an alert to the caregiver
  - Display a message on the LCD screen
  - Log the event for remote monitoring via

    MQTT

Role in Our Project

1. **Hygiene Monitoring**
   Continuous monitoring of the patient's bedding allows early detection of wetness due to incontinence. This helps maintain hygiene standards and reduces the chances of skin rashes or infections.

2. **Caregiver Alerts**
   When the moisture level crosses a predefined threshold, the ESP32 sends real-time alerts through MQTT protocol. This ensures immediate attention from caregivers, reducing delays and improving patient comfort.

3. **Data Logging and Wireless Transmission**
   The system logs every moisture detection event and transmits the data wirelessly via WiFi. This data can be accessed remotely, allowing caregivers or healthcare providers to review patterns and adapt care routines accordingly.

4. **Environmental Automation**
   The moisture sensor works in conjunction with other sensors (tilt, PIR, pressure) to form a comprehensive monitoring system. For instance, if the pressure sensor indicates the patient is on the bed and moisture is detected, the system issues a prioritized alert, enhancing situational awareness

CHAPTER 4

METHODOLOGY

1. System Design and Architecture

- **Objective**: Develop a multi-functional monitoring and control system for environmental sensing and security, featuring real-time feedback and remote control using the ESP32 microcontroller.
- **Components**: ESP32, PIR Motion Sensor, LCD Display, Humidity Sensor, GPS, Vibrate Sensor, Moisture Sensor.

2. Component Integration

- **PIR Motion Sensor**: Detects movement and triggers alerts when motion is detected within the sensor's range.
- **ESP32**: Acts as the central controller for reading sensor data, processing it, and communicating with other components (LCD, MP3 module, etc.).
- **LCD Display**: Shows real-time data such as temperature, humidity, pressure, and GPS coordinates, along with status updates.
- **Humidity Sensor**: Monitors humidity levels and sends alerts if the levels exceed a preset threshold.
- **GPS Module**: Tracks the location of the system (or the user, if mobile) and displays it on the LCD.
- **Vibrate Sensor**: Detects any tilt in the system, triggering alerts or activating specific actions based on orientation.
- **Moisture Sensor**: Monitors soil moisture levels and can trigger actions based on predefined thresholds (e.g., turn on water pump for irrigation).

3. Data Acquisition and Control Flow

- **Sensor Data Collection**: Each sensor (PIR, humidity, GPS, tilt, pressure, moisture) collects data periodically or upon triggering events.
- **LCD Display Output**: The LCD displays real-time data, such as humidity, temperature, GPS coordinates, and sensor statuses.

4. Communication Flow and Event Handling

- **Motion Detection (PIR Sensor)**:
- Upon motion detection, the system activates a predefined alarm via the MP3.
- Humidity and Moisture Sensing:
    - Humidity sensor readings are displayed on the LCD, and if levels go out of range, the system activates an alert or control action.
    - The moisture sensor triggers irrigation controls or an alarm if moisture is too low or high.
- **Vibrate Sensing**:
    - If the vibrate sensor detects a significant tilt, the system will alert the user through audio and visual feedback on the LCD.
- **GPS Tracking**:
    - Continuously tracks the system's or user's location and displays GPS coordinates on the LCD.
    - Alerts can be triggered if the GPS location moves outside a predefined boundary.

5. User Interaction

- **System Status Feedback**:
    - LCD continuously shows system status, including environmental parameters (humidity, pressure, moisture) and motion alerts.

6. Alert System

- **Local Alerts**: If a sensor detects a critical condition (e.g., motion, humidity out of range), the system triggers an audio alert using the MP3 module and displays a visual alert on the LCD.
- **External Communication (Optional)**: The system can be connected to a network (Wi-Fi via ESP32) to send notifications to a mobile app or email when certain thresholds are exceeded.

7. Power Management

- **Power Supply**: Ensure a stable power supply (either battery or mains) to the ESP32 and sensors.

- **Low Power Modes**: Utilize ESP32's low-power modes during idle periods to extend battery life, especially if the system is portable.

8. System Testing

- **Unit Testing**: Each component (sensor, keypad, MP3, LCD) should be tested independently to ensure functionality.
- **Integration Testing**: Test the integration of all components to ensure they work together seamlessly.

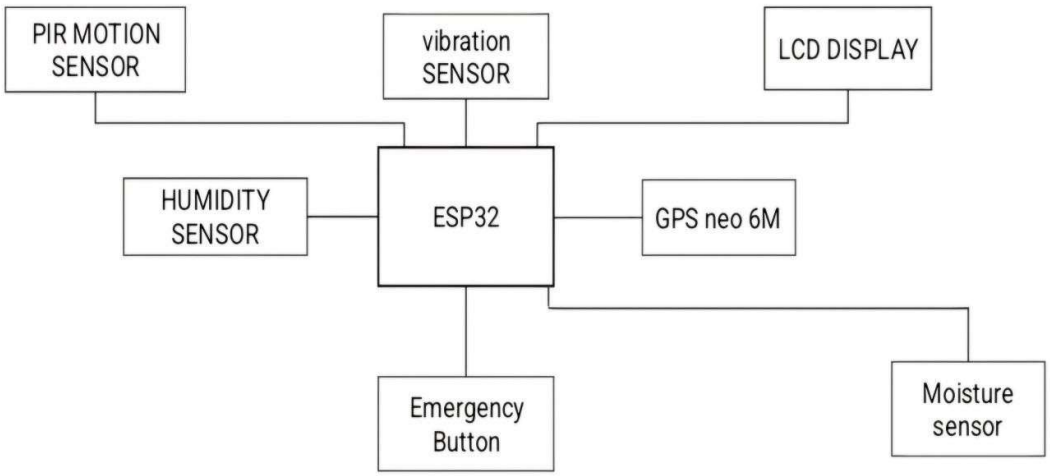

Fig 4.1:Block Diagram

This block diagram can be adapted for an **Alzheimer's Patient Monitoring System** using the ESP32 as the central controller. Here's how each component can contribute to patient care:

1. **ESP32 (Microcontroller)**
    - Acts as the central processing unit, collecting data from sensors and sending alerts via Wi-Fi or Bluetooth.
    - Can be integrated with a mobile app or cloud platform for remote monitoring.

2. **PIR Motion Sensor**
    - Detects patient movement, helping caregivers track activity levels.

- Can trigger alerts if the patient moves into restricted areas or if unusual inactivity is detected.

3. **LCD Display**
    - Displays important information such as time, medication reminders
    - Can be used to provide simple instructions to the patient.
4. **GPS Module**
    - Tracks the patient's location to prevent wandering, a common issue in Alzheimer's.
    - Caregivers can receive alerts if the patient moves beyond a predefined safe zone.
5. **Vibrate Sensor**
    - Detects if the patient has fallen or is in an unusual posture.
    - Triggers an emergency alert if a fall is detected.
6. **Humidity Sensor**
    - Monitors environmental conditions to ensure patient comfort
    - Helps in detecting excessive humidity, which can cause discomfort.

This system ensures continuous monitoring of Alzheimer's patients, reducing risks such as falls, wandering, and missed medication, while also aiding caregivers in providing timely assistance.

4.2 HARDWARE DESIGN:

1. Microcontroller: ESP32

- **Function**: Acts as the central processing unit, receiving and processing sensor data.
- **Features**:
    - Wi-Fi & Bluetooth for real-time data transmission
    - Multiple GPIO pins for sensor interfacing
    - Low power consumption, making it ideal for continuous monitoring.

PIR Motion Sensor

- **Function**: Detects patient movement within a specified range.
- **Working Principle**: Senses infrared radiation (heat) emitted by the human body.
- **Placement**:
  - Near doorways or restricted areas to detect wandering.
  - Near the patient's bed to detect movement.
- **Output**: Provides a digital HIGH signal when motion is detected.

2. LCD Display (16x2 or OLED Display)

- **Function**: Displays important reminders and alerts.
- **Working Principle**: Receives data from ESP32 and displays text messages.
- **Connections**:
  - I2C (SDA, SCL) or parallel interface for communication with ESP32.

3. GPS Module (Neo-6M or SIM808)

- **Function**: Tracks the patient's location to prevent wandering.
- **Working Principle**:
  - Communicates with satellites to determine real-time location.
  - Sends data to ESP32 via UART (TX, RX).
- **Output**: Latitude and longitude coordinates.

4. Vibrate Sensor (SW-520D or ADXL335 Accelerometer)

- **Function**: Detects if the patient has fallen.
- **Working Principle**:
  - Changes resistance or provides analog/digital signals when tilted beyond a threshold.
- **Connections**:
  - Digital or analog input to ESP32.

Humidity Sensor (DHT11 or DHT22)

- **Function**: Monitors room humidity for patient comfort.
- **Working Principle**: Uses a thermistor and humidity sensor to provide digital output.
- **Connections**:
  - Communicates with ESP32 via digital input pin.

5. Power Supply

- **Power Source**:
  - 5V DC adapter or battery backup for portability.
  - Voltage regulators (e.g., **AMS1117** for 3.3V conversion).
- **Connections**:
  - ESP32 operates at **3.3V**, while some sensors/modules use **5V**, so logic level converters may be required.

6. Communication & Alerts

- **Wireless Connectivity**:
  - **Wi-Fi**: Sends patient data to a cloud server.
  - **Bluetooth**: Connects to caregiver's smartphone.

SOFTWARE DESIGN:

1. Arduino IDE

- **Purpose**: Used to write, compile, and upload code to the ESP32 microcontroller.
- **Features**:
  - Supports **C/C++** programming. ○ Provides built-in libraries for sensors, LCD, GPS, and Wi-Fi.
  - Serial Monitor for debugging sensor data in real time.
- **Usage in Project**:
  - Writing the core logic for sensor data collection, decision-making, and alert generation. ○ Uploading firmware to ESP32 and testing system performance.

2. Adafruit (Adafruit IO Cloud Platform & Libraries)

- **Purpose**: Used for cloud-based data logging and visualization.
- **Features**:
  - Allows real-time monitoring of sensor values remotely.
  - Provides dashboards to display patient activity (motion, GPS location, alerts).
  - Works over Wi-Fi using MQTT or REST API.
- **Usage in Project**:
  - Storing sensor readings (motion, temperature, humidity) online.
  - Allowing caregivers to check the patient's condition from anywhere.

CHAPTER 5

RESULTS

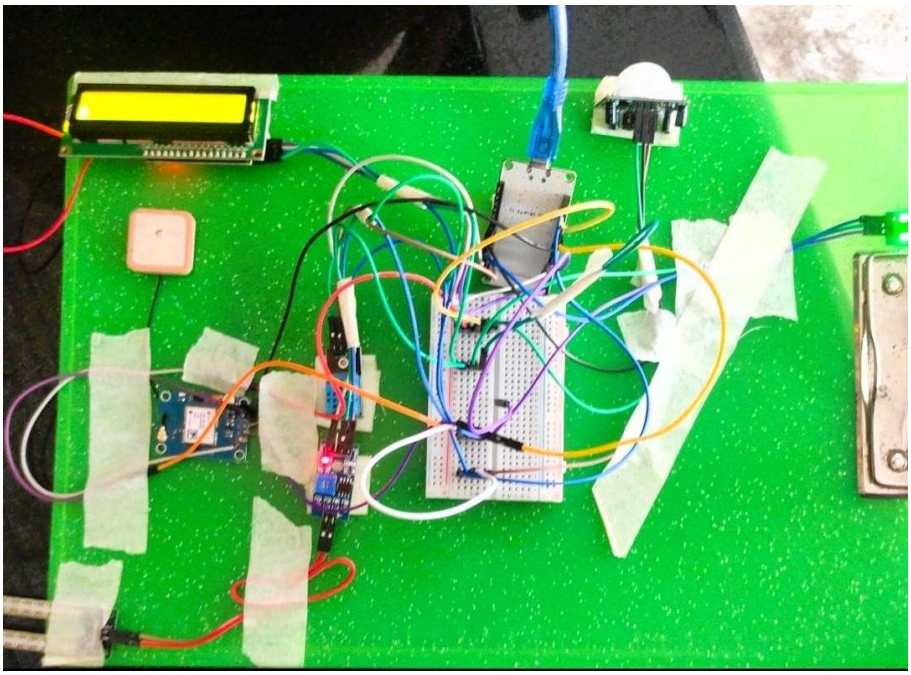

Fig 5.1 Implementation

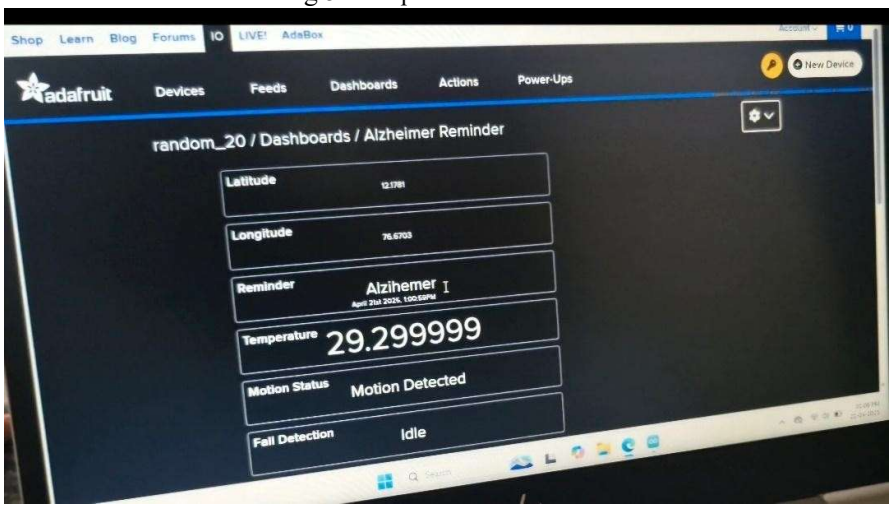

Fig 5.2 Adafruit Output

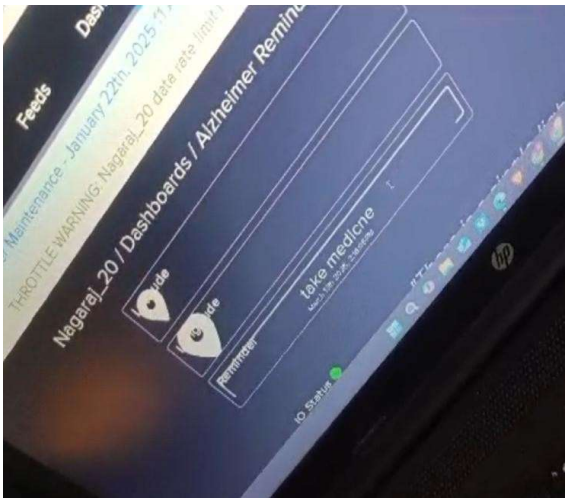

Fig 5.3 Setting Reminder

Fig 5.4 Reminder displayed on LCD

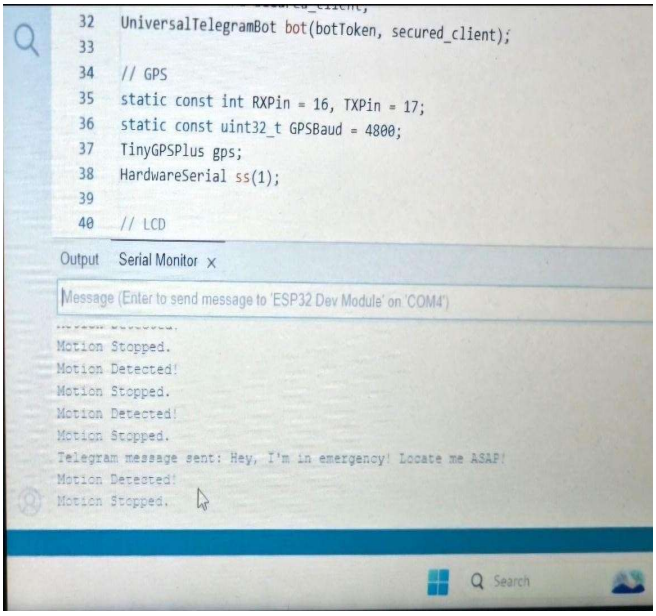

Fig 5.5 Serial Monitor Output

Fig 5.6 Emergency Alert Message

CHAPTER 6:

CONCLUSION

6.1 CHALLENGES

1. Cost: The initial implementation of an Alzheimer's Patient Monitoring System using ESP32, GPS, sensors, and cloud services can be expensive due to hardware, software, and cloud-based remote monitoring costs.
2. Technical Issues:
    - Sensor Accuracy: Sensors like PIR motion, tilt, and pressure sensors may give false readings due to environmental noise.
    - Connectivity Issues: The system depends on Wi-Fi, Bluetooth, or GSM for remote monitoring. Any network failure can disrupt real-time alerts.
3. Battery & Power Management: Continuous operation of sensors and communication modules requires efficient power management. A battery backup or solar-powered option may be necessary.
4. Data Privacy & Security: Storing patient health data on cloud platforms like Firebase or Blynk requires encryption and security measures to protect sensitive information.
5. User Adaptation: Elderly patients with Alzheimer's may find it difficult to interact with digital interfaces like LCD screens or mobile apps, requiring caregiver intervention.

6.2 ADVANTAGES

1. Real-Time Monitoring: The system continuously tracks patient movement, falls, and location, ensuring timely alerts for caregivers.

2. Safety & Emergency Response:
    - Fall Detection & Alerts: The tilt sensor detects falls and sends instant alerts.
    - GPS Tracking: Helps caregivers locate wandering patients, preventing accidents.

3. Automated Reminders: The MP3 module plays voice messages for medication, hydration, and daily routines, reducing caregiver workload.

4. Remote Access via IoT: The integration with Blynk, Firebase, or Adafruit IO allows caregivers to monitor the patient's condition remotely via a mobile app or web dashboard.

6.3 SUMMARY

The Alzheimer's Patient Monitoring System is a smart healthcare solution that integrates IoT, AI, and sensor-based monitoring to improve patient safety and caregiver efficiency. The system provides real-time tracking, fall detection, emergency alerts, and medication reminders, ensuring a secure environment for Alzheimer's patients. However, challenges like sensor accuracy, connectivity issues, and power consumption must be addressed for large-scale deployment. With further optimization and integration into smart healthcare systems, this solution has the potential to enhance elderly care, reduce risks, and improve the quality of life for patients and caregivers alike.

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