PHASE 1 - Project Proposal

Project Title: Smart Home for the Aged

Team ID: 8 (Table 13 N-104 & Table 40 N-125)

Introduction:

As the population ages, ensuring the safety and well-being of the elderly within their homes becomes paramount. To address this concern, our project proposes the development of a Smart Home for the Aged. Leveraging ESP32 microcontroller and innovative sensor technologies, our aim is to create a comprehensive smart home system tailored specifically to meet the unique needs of elderly individuals.

Key Objectives:

- Enhance safety and comfort for elderly residents within their homes.
- Implement a reliable gas leakage detection system to mitigate potential hazards.
- Integrate health monitoring devices for enhanced emergency response.
- Integrating this with alert and notifications in Phase-3.

Deliverables:

- *Enhancing Safety and Comfort:*

  The project aims to implement a centralized smart home system tailored for the elderly, integrating sensors and actuators to monitor and control environmental factors. A user-friendly interface and remote access capabilities will be developed, enabling caregivers to manage the system from anywhere, ensuring residents' safety and comfort.

- *Gas Leakage Detection System:*

  Implementation of gas sensors to monitor air quality for harmful gases, triggering timely alerts in case of leaks or hazards. Real-time notifications will enable prompt response and evacuation, ensuring residents' safety within the smart home environment.

- *Motion Sensor System for Incident Detection:*

  Installation of motion sensors to accurately detect falls or accidents, supplemented by health monitoring devices for enhanced incident detection. Sensor data will be analyzed and

suitable alerts will be triggered to caregivers or emergency services according to the situation, reducing response time during emergencies.

- ***Integration of Health Monitoring Devices:***

  The deliverables include a functional prototype of the smart home system equipped with motion sensors and health monitoring devices.

- ***Establishment of an Emergency SOS System:***

  For alert and emergency services we wish to implement a SOS system using ThingSpeak and OM2M services. In case of emergency an SOS message will be sent to the nearest hospital (contact needed) and caregivers.

Hardware Requirements:

1) Gas Leakage Detection System requirements:

- ESP32 Development Board
- Gas sensors (Model: MQ-2, MQ135)
- Buzzer
- Jumper wires
- Breadboard

Functionality:

- The gas sensor continuously monitors air quality for the presence of harmful gases such as LPG, methane, and smoke. Real-time alerts enable prompt response and evacuation if necessary, mitigating risks effectively.

- Upon detecting a gas leak, the sensor sends a signal to the ESP32 microcontroller, triggering an alarm through the buzzer.

- We will use smoke sensors to detect any kind of smoke. We will MQ135 sensor for smoke detection.

Cost Estimate (Approximate):

- ESP32 Development Board: ₹600
- Gas sensors (MQ-2): ₹250x2
- Smoke Sensor (MQ135): ₹500
- Buzzer: ₹150
- Breadboard: ₹150

Total Cost: ₹1900

2) *Health Monitoring Sensor requirements:*

- PIR Motion sensor.

- Health monitoring devices: DHT 11 (temperature and humidity sensor), Oximeter and heart rate sensor, body temperature sensor, motion sensor, PIR sensor.

- Microcontroller/IoT development board.

- Communication module (Wi-Fi module ESP8266).

- Enclosure: 1 unit (Universal housing for accommodating components).

Functionality:

- Health monitoring devices: Supplement motion sensors by providing additional health-related data, which can be correlated with motion sensor data for more accurate incident detection.

- Microcontroller/IoT development board: Process data from sensors, analyze patterns, and trigger alerts based on predefined criteria.

- Communication module: Facilitate communication with external devices such as smartphones or alert systems for timely notifications.

Cost Estimate (Approximate):

- DHT11(Temperature sensor for room temperature): ₹200
- Enclosure: ₹200
- Oximeter and heart rate sensor MAX30102: ₹200
- Body temperature sensor MAX30205: ₹300
- Motion sensor: ₹60
- PIR sensor: ₹200
  Total cost: ₹ 1200

3) *Emergency Alert System Requirements:*

Alert System:

- **_Remote Monitoring:_**

- Using Wi-Fi connectivity for remote monitoring of the medication reminder system's status and activity.
- Includes Emergency Messages for remote access.

- **_Alert Notifications:_**

- Utilizing Bluetooth connectivity to send alert notifications directly to users' smartphones or tablets.
- Broadcasting Bluetooth notifications to paired devices for timely alerts, even when users/caregivers are away.
- Publishing emergency guidelines/responses to caregivers.
- Serving as an SOS system.

- **_Cloud Connectivity:_**

- Integrating cloud services with ESP32, such as ThingSpeak, to integrate alerts with smart home sensors.
- Setting up control logic at the server-side for handling anomalies and triggering emergency messages.
- Implementing error handling for sensors.

Sensors:

- **_Button/Switch Sensor:_**

- Used to detect user interactions, such as acknowledging a medication reminder or triggering an emergency alert.
- Sensors Included from Medical Monitoring and Anomaly Checking Logic.

Actuators:

- **_Buzzer:_**

- Producing loud audible alerts or alarms for users with hearing problems.
- Changing frequency and amplitude for emergency alerts.

- **_LED Indicator:_**

- Offering visual feedback to indicate the status of the medication reminder system.
- Verifying messages displayed on LCD and other response devices.

- **_Display:_**

- Using LCD to display short alerts, reminders, and emergency alerts.

- ***Vibration Motor:***
- Alerting users with hearing problems through touch stimuli for emergency alerts and reminders.

Other Devices:

- Bread Board - for integration of the logic
- Real-Time Clock (RTC) Module - to keep track of time and date even when the main system is powered off.

Cost Estimate (Approximate):

- ESP32 Microcontroller (Already procured)
- LEDs -1x blue, 1x green, 1x red, 1x yellow ₹20
- LCD Display - LCD1602 Parallel LCD Display with Blue Backlight ₹91
- Buzzer - 5V Active Electromagnetic Buzzer ₹12
- RTC- DS3231 RTC Module Precise Real Time Clock I2C AT24C32 ₹130
- Bread Boards x 3 ₹450 (Total)
- Button- Blue R13-507 16MM 2PIN Momentary Round Cap Push Button Switch ₹16

    Total Cost- ₹ 720

Data Collection Plan:

Identifying User Patterns, Routines, and Anomalies:

- This involves implementing techniques to analyze the data collected from various sensors and devices within the smart home system. We need to set up a system that is capable of recognizing regular patterns and routines in the elderly person's activities, such as when they wake up, eat meals, or go to bed. By analyzing these patterns, the system can identify anomalies or deviations from the norm, which could indicate potential health issues or emergencies.

- Mainly the old people have a fixed routine (that is with less deviation). We could set up a system that monitors their schedule on weekdays and weekends and if a significant gap occurs in activity levels or prolonged inactivity, it could trigger an alert to notify caregivers or family members.

Sensors:

Environmental Sensors: Sensors such as temperature sensors, humidity sensors, and light sensors can provide additional context about the surroundings. For example, sudden changes in temperature or lighting levels could indicate unusual activity.

Like a fire spread could raise the temperature.

Environmental Sensors:

- Temperature and Humidity Sensor: We will be using DHT11 used for measuring temperature and humidity levels.in indoor environments. They provide digital output and are easy to interface with microcontrollers.

- Light Dependent Resistor (LDR) Sensor: LDR sensors change resistance based on the amount of light falling on them. We will use this sensor to detect whether the lights are turned on or off.

Digital Temperature Sensor: Sensors like the DS18B20 provide accurate temperature readings in digital format, making them suitable for integration into IoT systems

Implementation:

- Detect the trends within a suitable range of time (10-days). Handled at the server side.
- Set thresholds or criteria for identifying anomalies, such as prolonged periods of inactivity or unexpected deviations from the usual patterns.
- When an anomaly is detected, trigger appropriate actions such as sending notifications to caregivers or activating emergency response protocols (Using Alerts to User).
- Rest all errors will be handled at the server side at the time of data processing.
- For handling errors, the ten days data collection will be crucial and will be used as an initial data collection and then a feedback system (basically previously stored data will be integrated with the new incoming data) will be used to improve the error received in data collection.

Remote Monitoring and Management for Caregivers or Family Members:

The alert system will be used to receive notifications about any detected anomalies or emergencies. For example, caregivers can remotely receive alerts if the elderly person misses their medication reminder. This remote access can provide feasibility to the caregivers and ensures that they can respond promptly to any situations that may arise.

Sensors:

- Health Monitoring Devices: Devices such as blood pressure monitors, pulseoximeters and BP sensors can provide real-time health data to caregivers.

Cost Estimate (Approximate):

DS18B20 cost – ₹100

Implementation:

- Connect health monitoring devices to the IoT system to provide real-time health data to caregivers and user via Bluetooth/WIFI.

NET COST OF THE PROJECT: ₹4000 (Approximate)

Cost Breakdown (Final Sensor List):

- DS18B20 cost – ₹100
- LEDs -1x blue, 1x green, 1x red, 1x yellow ₹20
- LCD Display - LCD1602 Parallel LCD Display with Blue Backlight ₹91
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- Motion sensor: ₹60
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Conclusion:

By combining motion sensors with health monitoring devices, the data collection plan aims to enhance the accuracy and reliability of incident detection within the smart home system. This comprehensive approach ensures that the system can effectively respond to emergencies and provide timely assistance to the elderly residents.