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Guardianai: Intelligent Wearable Assistant For Real-Time Safety And Support

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Abstract: The smart wearable assistant GuardianAI was created with the elderly and the blind in mind. It combines real-time GPS monitoring, medication reminders, obstacle detection, and fall detection into one gadget. It offers location sharing, audio feedback, and emergency notifications using Raspberry Pi and ESP32. A caregiver dashboard guarantees improved safety and assistance in day-to-day living by enabling remote monitoring, reminder management, and alert notifications. By providing a strong assistive technology platform designed for healthcare and personal safety applications, this project seeks to improve independent living, lower risks, and guarantee quick reaction in an emergency.

IndexTerms - Obstacle detection, Fall Detection, Medicine Reminder, GPS Live Tracking.

I. INTRODUCTION

Wearable technology has become an effective tool for improving healthcare in recent years, especially for the elderly and those who are blind or visually impaired. These people frequently struggle on a daily basis with emergency response, medication adherence, and mobility. These demands are met by GuardianAI, a smart wearable assistant that uses GPS-based live location tracking, fall detection, real-time obstacle recognition, and scheduled medication reminders. To provide constant monitoring and communication, the system makes use of sensors, camera modules, GSM/GPS connection, and Raspberry Pi and ESP32 microcontrollers. The caregiver dashboard, which allows for remote tracking, scheduling voice reminders, and checking emergency alerts, is an essential part. The goal of this project is to improve the safety, independence, and quality of life for vulnerable people by offering an affordable, effective, and dependable assistive solution.

II. METHODOLOGY

The GuardianAI system is developed by integrating multiple hardware modules including Raspberry Pi, ESP32, MPU6050, GPS, and GSM for real-time sensing and communication. Obstacle detection is handled using a camera and OpenCV on Raspberry Pi, while fall detection is managed by ESP32 with motion data from the MPU6050 sensor. Medicine reminders are scheduled via a Firebase-connected caregiver dashboard and announced using text-to-speech. GPS coordinates from the NEO-6M module are sent to Firebase through SIM800L for live tracking. All data is visualized and controlled through a secure web dashboard, enabling remote monitoring and support.

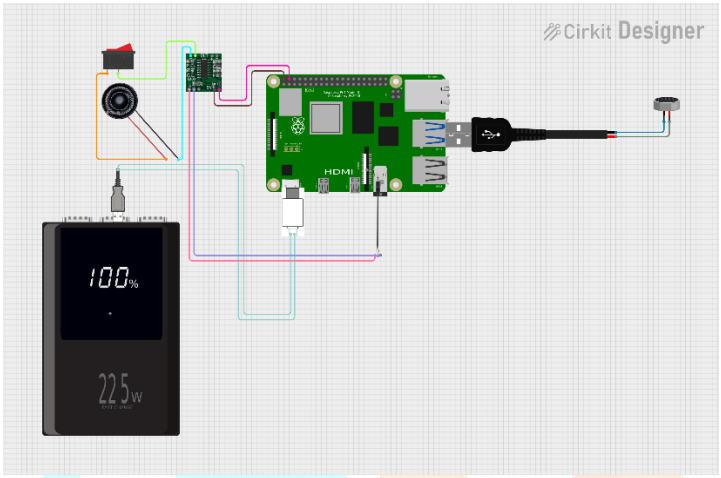
III. FEATURES OF THE GUARDAI

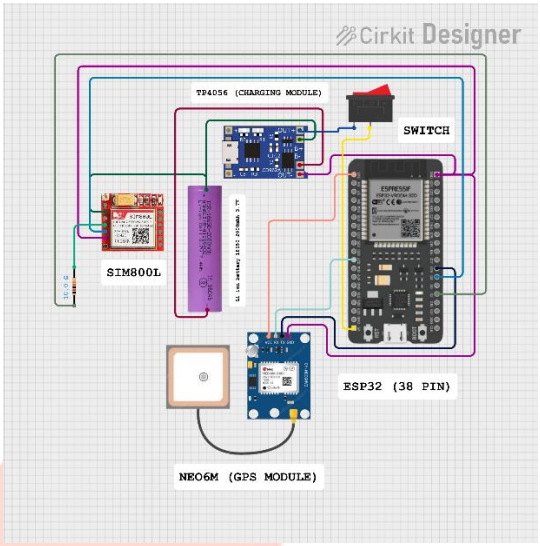
The GuardianAI system begins when the device is powered on, initializing both the Raspberry Pi and ESP32 modules. The Raspberry Pi continuously processes visual data from the connected camera to detect nearby obstacles using computer vision techniques and provides real-time audio feedback through a speaker. It also functions as a voice assistant, allowing the user to ask queries such as the date or time, which are processed offline and responded to using text-to-speech.

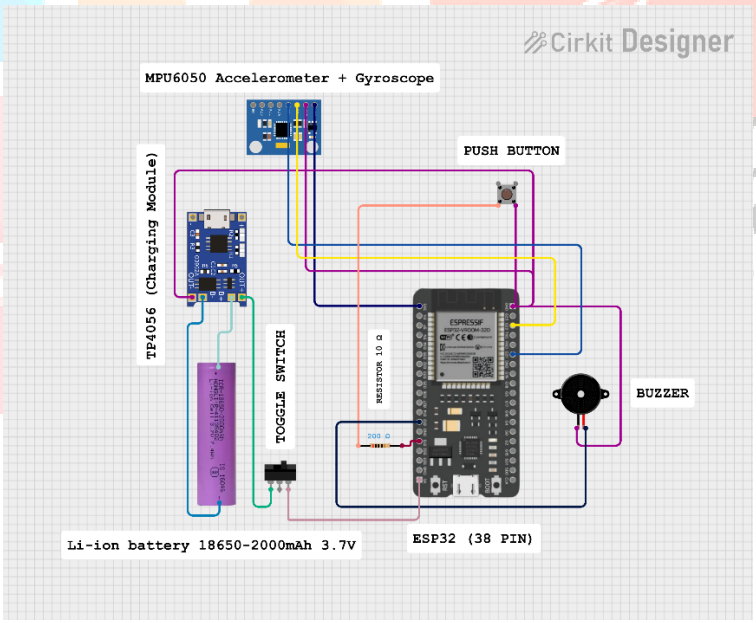
Simultaneously, the ESP32 monitors body motion using the MPU6050 sensor to detect falls. If a fall is detected, it triggers an audible buzzer alert. The ESP32 also receives live location data from the NEO-6M GPS module and transmits it via the SIM800L GSM module to a Firebase Realtime Database, ensuring constant location tracking without relying on Wi-Fi.

Medicine reminders are either scheduled directly on the device or updated remotely via a secure caregiver web dashboard. This dashboard allows caregivers to monitor the user's status, update reminders, view live location, and receive alerts in real-time, creating a comprehensive, connected safety assistant tailored for vulnerable users.

IV. CIRCUIT DIAGRAM







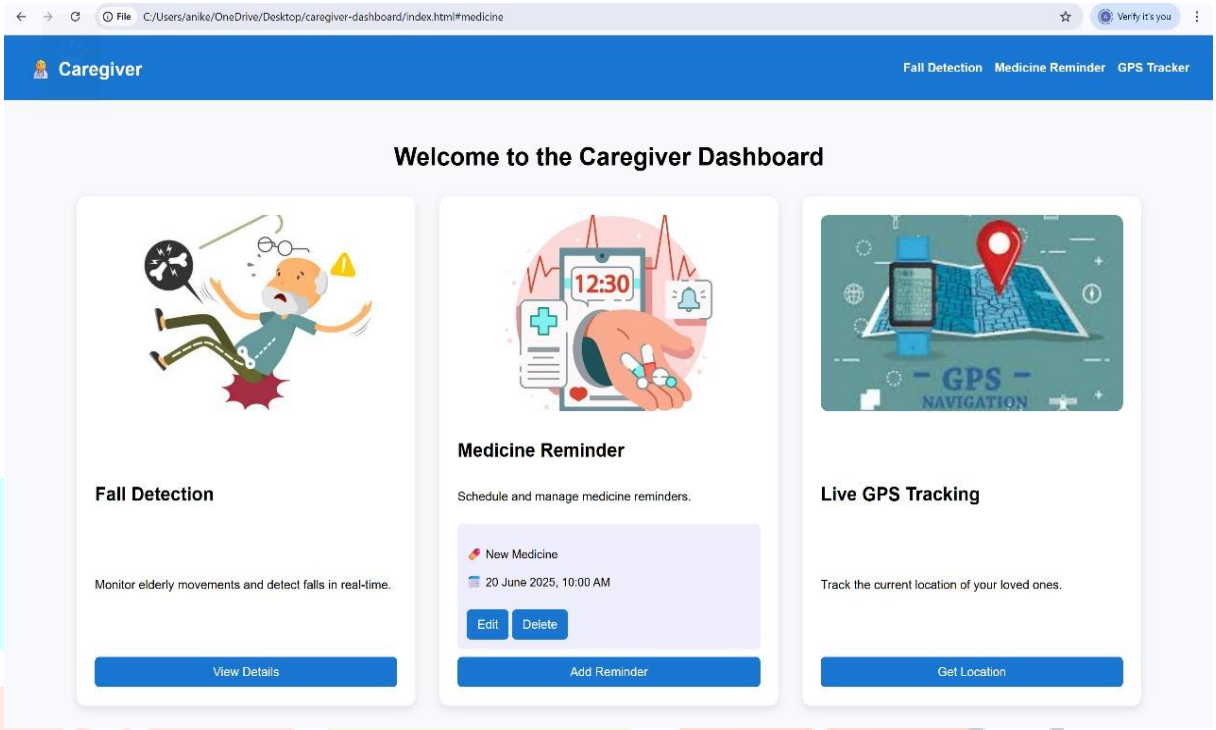
V. DASHBOARD

All of the modules are easily accessible using a navigation bar located in the upper-right corner. This design encourages usability, particularly for older users or caregivers who are not tech-savvy. A unified dashboard that combines crucial safety and health components into a single interface is a feature of the suggested senior care system. In order to ensure that caregivers can effectively monitor and help older people, the design places a strong emphasis on simplicity, accessibility, and real-time responsiveness.

Fall Detection: The fall detection module tracks senior users' bodily movements by using motion sensors or inputs from wearable technology. It can detect abrupt falls in real time and send out signals to medical professionals or caregivers. This feature is essential for decreasing reaction times in the event of an accident, which lowers the possibility of harm or extended unattended falls.

Medicine Reminder Module: The goal of this module is to encourage senior citizens to take their medications as prescribed. Entering the name of the medication and the associated time of intake enables patients or caregivers to set up reminders. Reminders can be edited or deleted via the UI, providing flexibility in the event that a prescription changes. Avoiding missed doses and controlling chronic conditions depend heavily on timely notifications.

GPS Tracking Module: The device has a live GPS tracking feature to improve location-based safety. This module makes it possible to track an elderly person's whereabouts in real time utilizing integrated mapping APIs like Google Maps or device-based GPS. Patients with cognitive impairments benefit most from it since it lowers their chance of getting lost and allows for prompt emergency intervention.



A. Fall Detection System

Through detecting rapid and unexpected movements that suggest a fall, the GuardianAI wearable assistant's Fall Detection System helps to protect the elderly and physically frail. The MPU6050 sensor, a small module that combines a 3-axis accelerometer and a 3-axis gyroscope, is used in the system. In real time, this sensor continuously records the user's angular velocity, acceleration, and body orientation.

An ESP32 microcontroller gathers and processes the sensor data, then uses threshold-based logic or lightweight machine learning models to understand the motion patterns. Usually, a fall is defined by a sudden acceleration shift that is followed by a pause. The system instantly initiates a response upon detecting such a pattern.

The device also has a manual SOS push button, which enables users to actively sound an alarm if they need help or feel unsafe. For people who live alone or in high-risk situations, this feature is essential since it ensures prompt assistance in an emergency and lowers the possibility of injuries going unnoticed. In order to provide constant security, the system is also made to automatically reset and switch back to monitoring mode following a warning. AI-based fall classification or wearable integration with health sensors for multi-factor event analysis are examples of potential future improvements.

B.Obstacle Detection System

The Obstacle Detection System in the GuardianAI wearable assistant is designed to aid visually impaired individuals by identifying objects in their path and providing audio feedback in real-time. The system is built using a Raspberry Pi 4B as the central processing unit, equipped with a camera module that continuously captures live video frames of the user's surroundings. These frames are processed using computer vision techniques to detect the presence of objects. Once an object is detected, the system estimates its distance from

the user. This can be achieved by analyzing the size of the object within the frame or using an additional sensor like an ultrasonic module for more precise measurement.

After detecting the object and estimating its distance, the system generates an audio message using text-to-speech libraries like pyttsx3 or espeak. This message is then played through a speaker connected to the Raspberry Pi, informing the user of the type and approximate location of the obstacle. This module is crucial for enabling safe and independent mobility for blind users, especially in unfamiliar environments. Its performance can be further enhanced through the integration of stereo vision, additional sensors, or cloud-connected AI models for improved accuracy and adaptability.

C. GPS Live Tracking System

The GuardianAI wearable assistant's Live GPS Tracking feature tracks a user's the location in real time to guarantee their safety and traceability, especially for elderly, blind, or cognitively impaired people. In order to ascertain the user's current latitude and longitude, the GPS module continuously receives satellite signals. The ESP32 parses and processes these coordinates before sending them to a Firebase Realtime Database via the GSM module. To guarantee ongoing location tracking, the data is updated on a regular basis to reflect the user's movements.

A web-based dashboard that displays the user's journey on an interactive map gives caregivers access to this real-time location data. Family members or medical professionals can remotely check on the user's safety thanks to the dashboard's real-time updates and accessibility from any location with internet access. Since it can quickly determine the user's location and provide prompt assistance, this function is essential in emergency situations like falls or distress events. By facilitating passive supervision without requiring constant communication, it also gives caretakers piece of mind. Geofencing notifications, historical path monitoring, and connectivity with emergency response systems for quicker intervention are possible future enhancements.

D. Medicine Reminder

The medicine reminder system in GuardianAI ensures timely medication adherence for users, especially the elderly or those with memory impairments. Caregivers can schedule voice-based reminders through a web dashboard connected to Firebase. These reminders are synced with the Raspberry Pi, which processes the schedule and uses text-to-speech (TTS) to announce the reminder through a speaker at the appropriate time. This feature reduces dependency, prevents missed doses, and enhances user health management in a non-intrusive, accessible manner.

VI. Hardware and Software Used

Hardware Requirements:

ESP32 – Controls fall detection & GPS
Raspberry Pi 4B – Voice assistant, obstacle detection, dashboard processing
MPU6050 Sensor – Detects fall via motion and orientation
NEO-6M GPS Module – Provides real-time GPS location
SIM800L GSM Module – Sends emergency SMS/calls
TP4056 – Li-ion battery charging module
3.7V Li-ion Battery – Power supply
Camera Module – Object detection for the blind
Speaker + Buzzer – Voice alerts and emergency sounds
USB Microphone – Captures voice commands
DS3231 RTC Module – Timekeeping for reminders
Push Button – Manual SOS trigger

Software Requirements:

Operating System: Raspbian OS / Linux / Windows
Programming Languages: Python, C/C++ (for ESP32)

Libraries and Frameworks:
OpenCV – Object detection.
HTML, CSS, JavaScript – Web dashboard frontend.
SpeechRecognition – Voice command processing.

VII. Conclusion

The GuardianAI system demonstrates a comprehensive, real-time solution for enhancing the safety, independence, and well-being of elderly, blind, and differently-abled individuals. By integrating obstacle detection, fall detection, medicine reminders, GPS live tracking, and a caregiver dashboard, the project addresses multiple critical needs through a single wearable platform. The use of affordable components and open-source technologies ensures scalability and cost-effectiveness, making it accessible for widespread deployment. With its proactive alerting and remote monitoring capabilities, GuardianAI not only empowers users but also provides peace of mind to caregivers, showcasing the true potential of assistive wearable technology in healthcare and daily support systems.

VIII. Acknowledgement

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