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Wearable Beacon Architectural Based Design With BLE Core Processor For A Smart Device To Women Safety

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ABSTRACT :

This project proposal presents a real-time tracking architecture concerning a compact wearable device that will help make women safer. Ensuring the safe movement of women through IoT software and database development is thus done. The system division into four necessary parts brings this to fruition: server communication, user interaction, cross-platform communication, and outdoor localization. The system mainly consists of the wearable device. Teamed with Beacon technology and MEMS accelerometers and a pulse sensor, it joins forces with a smartphone. values for sensors. Collect all such alterations in sensor readings, including the readings of the accelerometer, and feed these into an advanced Least Square Estimation method to calculate the given user's RSSI or Received Signal Strength Indicator. After determining the RSSI correctly, the system then communicates with the Android application to acquire the GPS location of the mobile device as returned by the server. This will make it possible to track location accurately and measure ibeacon's distance, which the app further develops with integration with Google Maps for monitoring something in real time.

Keywords: Real-time tracking, wearable device, women Child safety, IoT software, GPS location

1.INTRODUCTION

Over the past few years, the need for sophisticated women's safety solutions has gained increased importance. To meet this challenge, a new solution employs wearable technology, focused on a Beacon-based system that incorporates Bluetooth Low Energy (BLE) processors. This technology aims to enhance personal safety through real-time monitoring and location-based services. With integration of wearable devices and sophisticated communication protocols, it provides a tangible and effective solution to improve the safety of women in different circumstances. The entire philosophy of the wearable Beacon system relies on implementation of BLE technology, which has low power requirement and effective transmission of data capabilities. The BLE processor built into the wearable allows for effortless communication with connected smartphones or other devices, enabling users to remain connected without the need for constant recharging, making it ideal for extended daily use. The design of this wearable device incorporates several components to maximize safety features. With sensors such as MEMS accelerometers, the Beacon-enabled device tracks physical activity and identifies abnormal movement. These sensors collect user and environment information and send this over BLE to an accompanying smartphone application. This app analyzes this information to make live tracking and sends notifications should something out of the ordinary happen or an emergency. Additionally, the system takes the use of complex data algorithms like Least Square Estimation, ensuring accurate estimates of signal quality and location tracking. This accuracy is essential in order to provide the reliability of alerts and location tracking. GPS technology added in the system increases the strength by offering precise locations, which are sent to a central server to monitor and react quickly.Overall, this wearable Beacon-based system seeks to deliver a strong and reliable method for personal safety. By integrating BLE technology with real-time data handling and accurate location tracking, the device provides not just peace of mind but also ensures quick action in case of emergencies. With technology developing further every day, innovations such as these will prove to be essential to create a safer and more secure environment for women.

2.LITERATURE SURVEY

The development of wearable technology has significantly impacted personal safety solutions, especially for women. Current research highlights the integration of Beacon-based systems with Bluetooth Low Energy (BLE) processors as a viable way to enhance security and facilitate real-time tracking. Such solutions leverage BLE's effective data transfer and low power consumption to provide seamless communication between wearables and smartphones, making them feasible for everyday use. Studies show that Beacon-powered wearables with MEMS accelerometers can track and analyze user movement, offering vital information for safety.

These sensors collect sensor data and forward it to mobile applications, where the data is processed to detect unusual behavior or potential emergencies. For enhanced accuracy in signal strength and location tracking, sophisticated analytical techniques such as Least Square Estimation are utilized,

providing reliable alerts and monitoring. GPS integration also adds strength to these systems by providing accurate location information, which is crucial for emergency services and real-time monitoring.

The marriage of BLE technology, sophisticated data analysis, and GPS integration represents a major breakthrough in wearable safety technology. Through continuous development and growth, future research and innovation are focused on fine-tuning these systems even further to enhance their impact on advancing personal security among women

3.PROPOSED SYSTEM

The system puts forward a new portable hardware implementation for real-time project development that incorporates an inbuilt MEMS accelerometer and pulse sensor. This system improves the tracking of the user through landmark data for accurate location calibration. Through the exploitation of iBeacon technology, the device achieves convenient deployment, minimal power use, and low cost. This integration of elements guarantees high accuracy in positioning, thus making the system efficient and convenient for use in real-time applications.

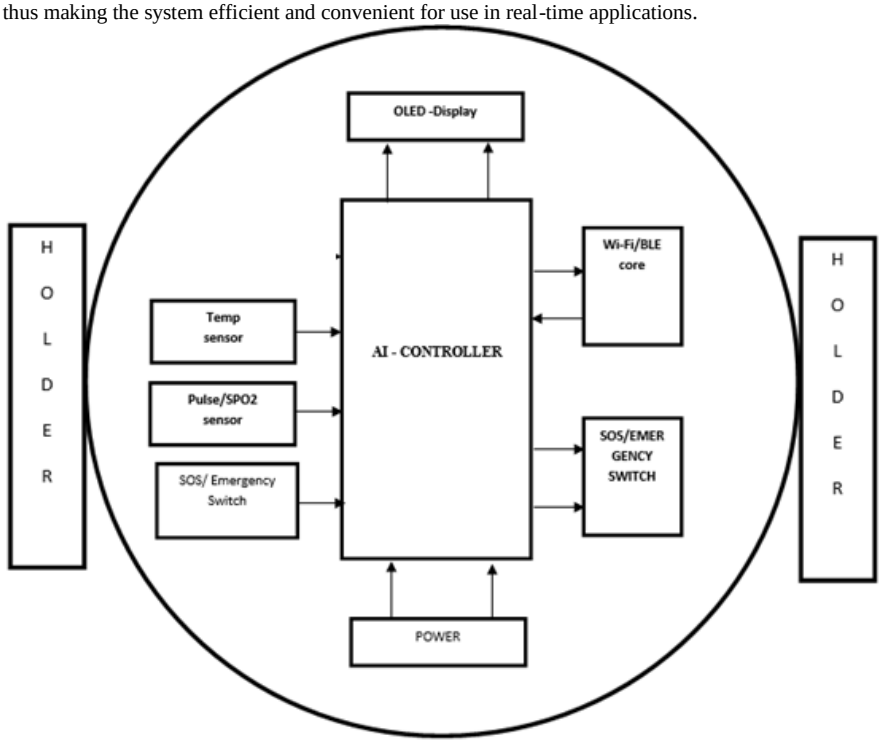


Figure 1: System Architecture of the proposed system

3.1 METHODOLOGY

The subsequent sections present an overview of the main modules that constitute the basis of the suggested system. All of these modules collectively form a complete unit. The core of the system is the Controller module, which is constructed on the AI-Tensilica platform. This module has an ESP32 microcontroller with onboard Wi-Fi, Bluetooth, and BLE support, enabling it to handle sensor inputs and control other modules via programmable GPIOs and communication interfaces. iBeacon Module incorporates location-based features through BLE communication with nearby devices for sending and receiving data based on proximity. To monitor movement and identify anomalies, we employ a MEMS Accelerometer and a Pulse Sensor that feed data continuously to the controller in real time. An OLED Display is added to offer a visual interface that displays system status, sensor information, and alerts from the connected application.

The Control Switch enables manual triggering of emergency call alerts, while the Relay handles high-power loads and provides circuit protection. Lastly, the Power Supply stabilizes the system by regulating and converting voltage, thereby powering all the components. Together, when integrated, these components function in harmony to form a complete system that is meant for real-time monitoring and safety purposes.

4.IMPLEMENTATION

4.1 TOOLS USED

HARDWARE COMPONENTS:

- Power Supply
- MEMS sensor
- Temp sensor

- Pulse/SPO2 sensor
- AI- controller
- OLED – display
- Emergency SW
- BLE-WIFI SUPPORTED AI – CONTROLLER

SOFTWARE COMPONENTS:

- Arduino IDE
- Embedded C
- Android, I beacon App

4.2 HARDWARE EXPLANATION

1.AI BOARD AI LSAI48266x

TENSILICA'S PROCESSOR-WROOM-32 is an extremely performance-intensive MCU module with Wi-Fi+BT+BLE and represents a high-performance, yet extremely energy-efficient platform for applications that vary from the most demanding activities, such as voice processing and MP3 decoding, up to those requiring minimum power consumption. The core of this module is TENSILICA'S PROCESSOR-D0WDQ6 chip*, designed to be highly scalable and flexible. The chip comes equipped with two CPU cores, which can be controlled separately, and the CPU clock speed can be set within the range of 80 MHz-240 MHz, among other things. And users have the possibility of shutting down the CPU to operate the low-power co-processor in polled mode, constantly checking peripherals for threshold events. TENSILICA'S PROCESSOR comes with a complete set of peripherals, including capacitive touch sensors, Hall sensors, SD card support, Ethernet, high-speed SPI, UART, I2S, and I2C.

2.I BEACON

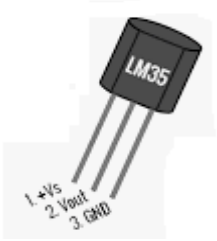
Although not strictly synonymous, the term iBeacon and the term Beacon are employed interchangeably. There is a difference, though. iBeacon is the standard for Apple, enabling any mobile app both on the iOS and Android to sense signals from beacons in the world and make appropriate actions. In the nutshell, iBeacon technology allows the mobile applications to know their location micro-locally so as to be able to send very relevant, location-based contents to its users. It relies on Bluetooth Low Energy for communications. Using an iBeacon network, any brand, retailer, app, or platform can track the exact location of a customer inside a physical store, opening doors to highly targeted, location-specific messages and advertisements to be sent to their smartphones.

3.HEART BEAT SENSOR

A beat in a human refers to the sound created by the valves within his or her heart as it contracts and expands in sending blood from one part of the body to another. Heart rate is the frequency of the beats per minute, while the pulse is any beat that the person feels within an artery close to the skin.

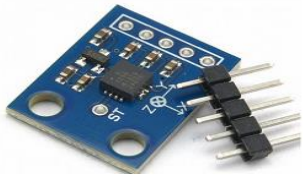
4.TEMPERATURE SENSOR

The LM35 series comprises precise temperature sensors built as integrated circuits, producing an output voltage that is directly linked to the Celsius temperature scale. This feature provides a significant benefit over linear temperature sensors calibrated in Kelvin, as there is no need for users to offset a substantial constant voltage to achieve convenient Celsius-based readings. The LM35 delivers typical accuracy levels of ±0.25°C at room temperature and ±0.75°C across its full operational range of −55°C to +150°C, without requiring external calibration or adjustment. Its trimming and calibration are performed during the wafer manufacturing process, ensuring affordability. With a low output impedance, linear response, and inherent precise calibration, it integrates seamlessly with readout or control circuits.The LM35 operates on single power supplies or dual supplies (both positive and negative) and consumes a mere 60μA, which minimizes self-heating to less than 0.1°C in stationary air. It is engineered to function effectively within a temperature range of −55°C to +150°C, while the LM35C variant is optimized for −40°C to +110°C (or −10°C for enhanced precision). These sensors are available in TO-46 transistor packages, including hermetically sealed versions, and the LM35C, LM35CA, and LM35D models are offered in plastic TO-92 transistor packages.



5.MEMS

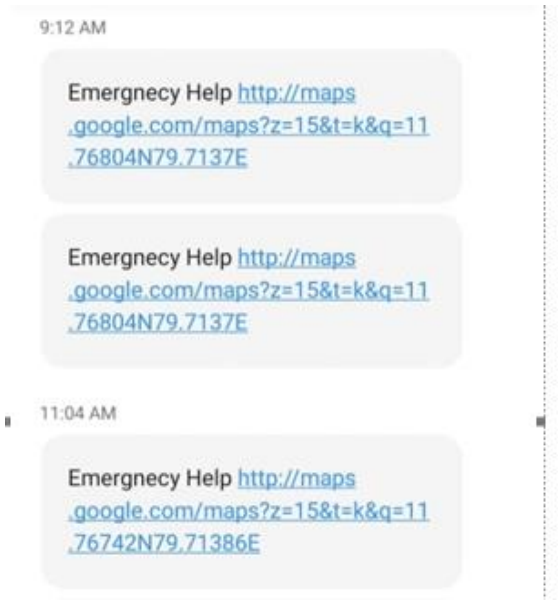
The MPU6050 is a compact, lightweight, and low-power device that integrates a complete 3-axis accelerometer with signal-conditioned voltage outputs. This module measures acceleration with a minimum full-scale range of ±2g. It is capable of detecting both static acceleration due to gravity in tilt-sensing applications and dynamic acceleration resulting from motion or impacts. The breakout board includes a built-in voltage regulator, enabling it to operate at 5V. A MEMS accelerometer is an electromechanical device designed to measure acceleration forces effectively.



RESULTS AND DISCUSSION

The results of the proposed system indicate successful integration of the hardware and software components to provide effective real-time tracking and safety features. The AI-Tensilica's Controller effectively managed sensor data and communication, while the iBeacon Module reliably facilitated proximity detection. The MEMS Accelerometer,Pulse,temp Sensor accurately captured movement data, which was displayed on the OLED screen and used to trigger sms and call alerts . The Control Switch enabled manual emergency notifications, and the Relay ensured reliable power management.
Server Monitoring System

Kit screen shot



Result

CONCLUSION

It's this advanced gadget designed to assist women in traumatic circumstances through the inclusion of sophisticated tracking and alerting features. It presents a small smart security gadget that is extremely accessible in potentially dangerous circumstances against women, hence striving to enhance their protection and health. In achieving such an objective, we employed iBeacon technology, which is very commonly used in real-world applications. It is inexpensive as well as has high-speed data transfer and is energy-efficient, making it the best choice for our requirements.

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