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AIM :-

To Measure Foot Pressure Using Piezoelectric Sensors Interfaced with an ESP32 Microcontroller

INTRODUCTION :-

Foot pressure measurement is a valuable tool in fields such as *medical diagnostics, sports analysis, and ergonomics*. By tracking foot pressure patterns, one can gain insights into *walking, balance, and postural habits*, which are critical in identifying abnormalities or designing therapeutic interventions. This project leverages piezoelectric sensors interfaced with an ESP32 microcontroller to measure foot pressure, process the data, and display it on a web interface for real-time monitoring and visualization.

OBJECTIVE :-

The objective of this project is to design a low-cost and efficient system that captures and visualizes foot pressure data using piezoelectric sensors and an ESP32 microcontroller. The system should be able to measure pressure, process the data, and transmit it *wirelessly* to a web interface for easy interpretation.

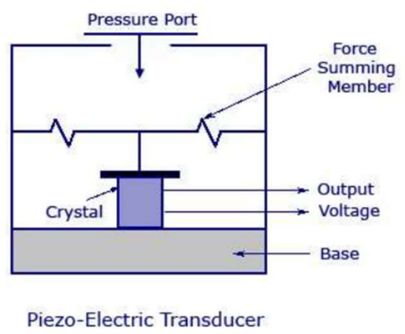
COMPONENTS AND THEIR ROLES:-

1. **Piezoelectric Sensors:**
   - Piezoelectric sensors are used to measure the pressure exerted by the foot. They convert mechanical stress (pressure) into an electrical signal, which the ESP32 microcontroller can interpret.
2. **ESP32 Microcontroller:**
   - The ESP32 microcontroller is the core processing unit in this system. It reads data from the piezoelectric sensors, processes it, and sends it wirelessly over Wi-Fi to a web interface.
3. **Power Supply:**
   - A rechargeable battery powers the ESP32 and sensors, enabling a portable setup. The ESP32's energy-efficient design ensures long operational periods on a single charge.
4. **Web Interface:**
   - A web interface built using HTML, CSS, and JavaScript displays the pressure data in real time. The pressure data is color-coded to provide a visual representation of the pressure distribution, making it easier for users to interpret

METHODOLOGY:-

The following steps outline the methodology of the project:

1. **Sensor Setup:**
   - Piezoelectric sensors are strategically placed under the foot area to capture pressure from different regions. The placement ensures that data gathered provides accurate pressure distribution information.



2. **Interfacing with ESP32:**
   - The sensors are connected to the ESP32's ADC (Analog-to-Digital Converter) pins. The ESP32 reads the electrical signals generated by the sensors and converts them into digital values.

3. **Data Processing:**

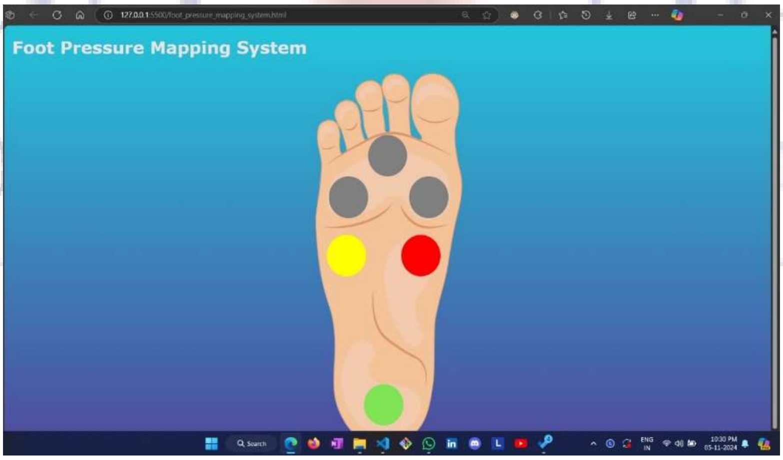
   - The ESP32 processes the raw sensor data to derive pressure levels. Signal conditioning techniques, such as filtering, are applied to reduce noise and enhance data accuracy.

4. **Data Transmission:**

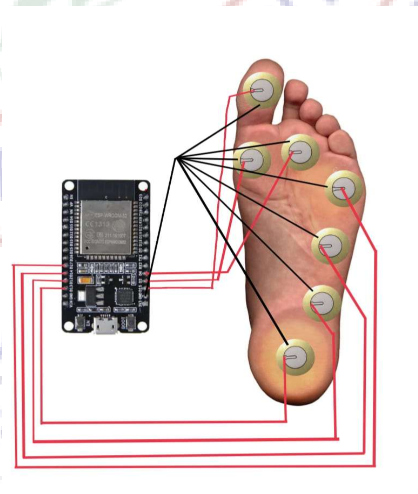
   - The ESP32 sends processed data over Wi-Fi to a web server, which hosts the interface. The data transmission is optimized to ensure real-time updates on the web interface.

5. **Web Interface Design:**

   - The interface uses HTML, CSS, and JavaScript to create a dynamic, color-coded visual representation of foot pressure. Different pressure levels are shown in varying colors, providing an easy-to-read heat map of the foot's pressure points.



PROJECT PROTOTYPE :-

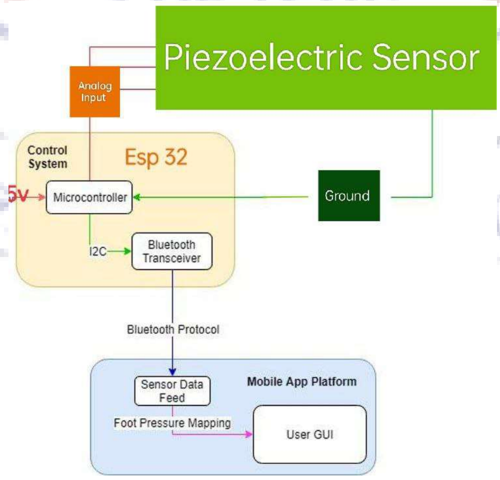


RESULTS AND ANALYSIS :-

The system successfully *captures*, *processes*, and *transmits foot pressure data in real time*. The color-coded web interface allows for quick identification of high and low-pressure areas. The real-time data transmission over Wi-Fi enhances the system's usability for applications that require continuous monitoring, such as gait analysis or rehabilitation.

Key Observations

- **Real-Time Visualization:** The color-coded indicators on the web interface clearly highlight areas of high and low pressure.
- **Wireless Connectivity:** The ESP32's Wi-Fi capabilities allow remote monitoring, making the setup portable and efficient.
- **Accuracy:** The piezoelectric sensors proved effective in accurately detecting pressure variations. Further improvements can be made by calibrating the sensors for more sensitive applications.



APPLICATIONS :-

This system can be used in a variety of fields, including:

- Medical Diagnostics: For monitoring foot pressure in patients with diabetic neuropathy, arthritis, or other conditions affecting gait and balance.
- Sports Science: To analyse the foot pressure distribution of athletes and optimize training methods.
- Ergonomics: For designing footwear or insoles that distribute pressure evenly to reduce foot strain and injuries.

CONCLUSION :-

This project *successfully* demonstrates a method for capturing and visualizing foot pressure using piezoelectric sensors and an ESP32 microcontroller. The web-based interface provides real-time monitoring, making it suitable for applications in medical and sports fields. Future improvements could further expand the system's capabilities, increasing its relevance and utility in various practical applications.

FUTURE ENHANCEMENTS :-

To enhance the functionality of this project, the following improvements can be considered:

- Enhanced Calibration: Implement calibration procedures to improve sensor accuracy across different pressure ranges.

- Data Storage and Analysis: Integrate a database to store historical data, enabling trend analysis over time.

- Mobile Application: Develop a mobile app for easier access and monitoring, improving portability and user experience.