



EMBEDDED BASED KNEE SUPPORT AND FOOT STRESS ANALYSER BY USING AURDINO

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ABSTRACT

This project focuses on analyzing foot pressure and the stress developed on the foot using piezoelectric sensors and silicon foam inlays to enhance comfort. Real-time information on stress distribution is provided by the force sensing resistor (FSR) sensor, which gauges the force and pressure applied to the foot during movement. Through uniform pressure distribution and the reduction of localized tension, the silicon foam inlay is intended to enhance foot comfort. The combination of these technologies seeks to deliver a more comfortable and supportive foot experience, perhaps aiding persons with foot-related ailments or those who require greater foot support.

Key Words: Foot pressure, stress analysis, piezoelectric sensor, silicon foam inlay, foot comfortability.

I.

INTRODUCTION

Analysis of foot pressure and tension is essential for comprehending a variety of medical disorders and enhancing foot comfort. Uneven stress distribution or excessive stress on the foot can cause pain, injuries, or chronic musculoskeletal problems. Piezoelectric sensors, which offer accurate measurements of the dynamic forces during movement, will be used in this project to examine the pressure and force applied to the foot. The footwear's inbuilt piezoelectric sensors gather data in real time, making it easier to see how pressure is distributed throughout the foot. Additionally, by eliminating localized stress spots and uniformly spreading pressure, silicon foam inlays are employed to improve foot comfort. In addition to providing insightful information about foot biomechanics, the combination of these technologies aids in the creation of footwear that reduces discomfort and foot-related ailments. People with foot conditions, athletes, or those looking for more comfortable shoes will find this study especially helpful. The initiative intends to aid in the creation of ergonomic footwear for increased comfort and support as well as better foot care solutions by evaluating the data gathered.

II.

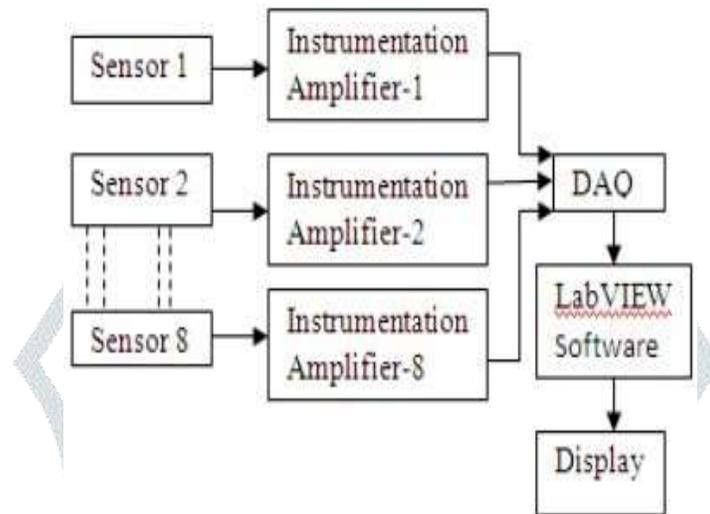
OBJECTIVES

The objective is to improve rehabilitation procedures, increase user comfort and mobility generally, and assist in the diagnosis and prevention of injuries related to the knee and foot. This gadget seeks to enable individuals and healthcare professionals to make well-informed decisions for the treatment of musculoskeletal health by offering precise and ongoing feedback.

II.

EXISTING SYSTEM

In contrast to the available recent review articles related to the smart prosthetic knee joints, which have typically focused on individual aspects, such as specific actuators or control methods for active prosthetic knee joints, this paper fills a gap in the existing literature by providing a more comprehensive understanding of the field. It will do this by exploring the entire mechanical design, including mechanisms, materials, actuators, numerical analysis, and control design, including sensing system, control method, and microcontroller. Existing Block Diagram



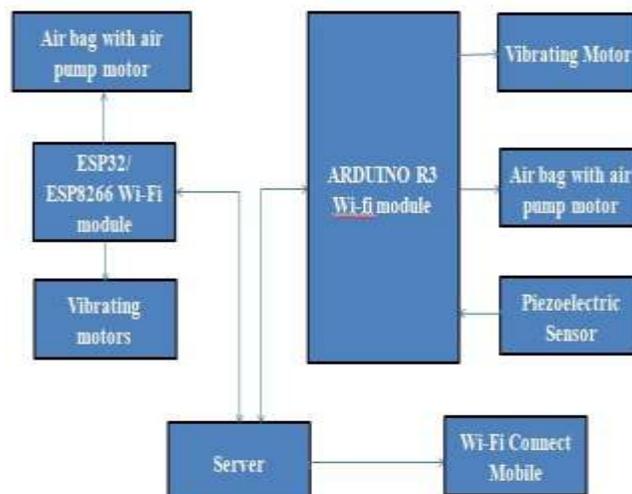
III.

PROPOSED SYSTEM

The goal is to create and put into use a novel tool that can track and evaluate pressure and tension in the foot and knee areas. In order to gather and interpret data in real time, this system combines flex sensors, pressure sensors, and Arduino-based microcontrollers. The device will provide insights into stress distribution, joint movement, and foot posture, which can be used to evaluate performance during physical activities, detect abnormalities, and assist in rehabilitation. Additionally, the system includes a user-friendly interface to display the analyzed data, allowing users or healthcare professionals to track progress and make adjustments to enhance mobility, reduce stress-related injuries, and optimize recovery strategies.

IV.

BLOCK DIAGRAM



In this block diagram we are using Arduino R3 wifi module, ESP32 Wifi module, Air bag with air pumping motor, vibrating motor, Piezoelectric sensor, as the major components. Silicone foam inlay, Knee braces with aligned set the minor component but it helps to make comfort while setting these with the comfort. We are going to measure the force exerted by our body to the foot . By measuring the foot pressure can give how much of pressure is creating in the knee region. Piezoelectric sensor which gives the measure of foot pressure. The formula we are using is $P=F/A$ Where F denotes the force exerted by the body to foot ,A denotes area covered by the foot. Piezoelectric sensor, silicone foam inlay, air bag with pumping motor are layered in manner.

V. HARDWARE IMPLEMENTATION

5.1. Fixed Voltage Regulators

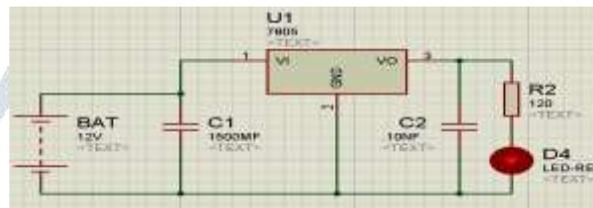


FIG 1.3 Voltage Regulators

7812, is coupled to offer voltage regulation with the output from this unit of +12V Dc. and 7805, is coupled to offer voltage regulation with the output from this unit of +5V Dc. Capacitor C1 filters an unregulated input voltage V_I , which is then linked to the IN terminal of the IC. The capacitor C2 filters the regulated +12V from the IC's OUT terminal, mostly for high-frequency noise.

5.2. Micro Controller

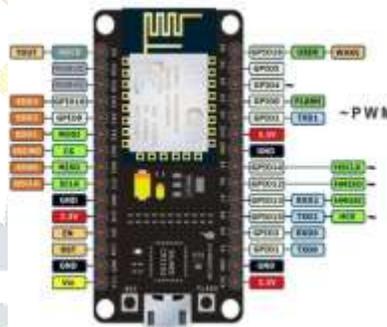


FIG 1.4 Node MCU

Selecting the "NodeMCU" circuit is the most efficient method of rapidly developing an Internet of Things application with less integrated circuits to add. We will provide a thorough introduction to NodeMCU V3 today. It is an open-source development kit and firmware that is essential to creating a suitable Internet of Things device with just a few lines of code. The ESP8266, a low-cost Wi-Fi microchip with a complete TCP/IP stack and microcontroller functionality, serves as the module's primary foundation.

5.3. LCD DISPLAY

A liquid crystal display (LCD) is a digital visual display, video show, or flat-panel monitor that utilizes the light-modulating properties of liquid crystals. Light cannot be directly reflected by liquid crystals. LCDs can show fixed images that can be shown or hidden, including preset words, numbers, and seven-segment displays like in a digital clock, or they can show random images, like in a general-purpose computer display.



FIG 1.5 LCD Display

5.4. IR INTRODUCTION

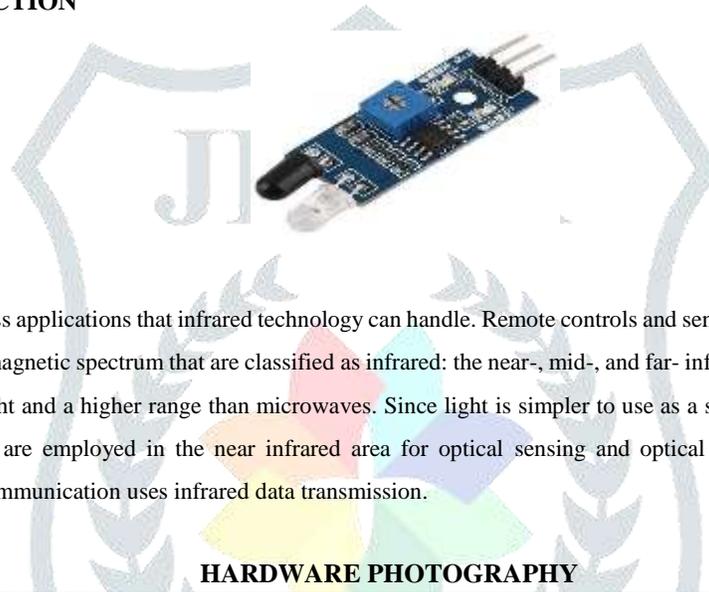


FIG 1.6 IR Sensors

There are many different wireless applications that infrared technology can handle. Remote controls and sensing are the primary topics. There are three sections in the electromagnetic spectrum that are classified as infrared: the near-, mid-, and far- infrared regions. Infrared has a lower frequency range than visible light and a higher range than microwaves. Since light is simpler to use as a signal source than radiofrequency (RF), photooptics technologies are employed in the near infrared area for optical sensing and optical communication. For short-range applications, optical wireless communication uses infrared data transmission.

VI.

HARDWARE PHOTOGRAPHY

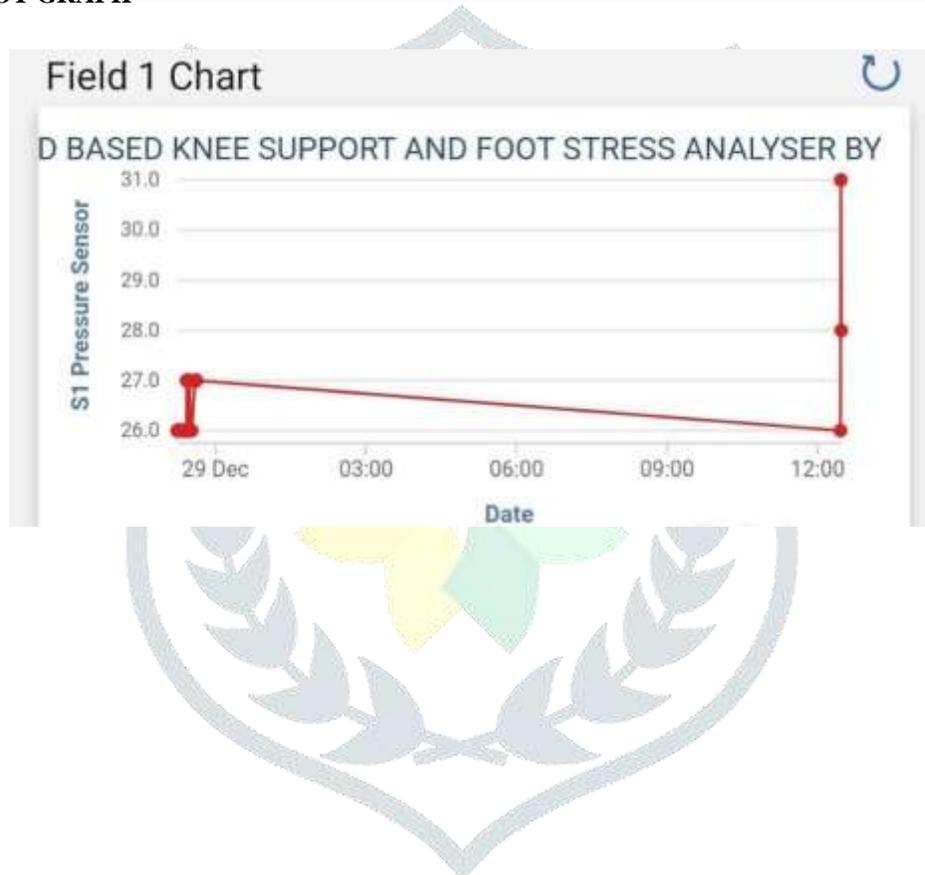


The experimental results of the "Embedded-Based Knee Support and Foot Stress Analyzer Using Arduino" demonstrate the effectiveness and reliability of the system in monitoring stress and pressure distribution. The device was tested on a diverse group of participants during various physical activities, including walking, running, and standing. Key findings include:

1. **Accurate Data Collection:** The sensors successfully captured real-time stress and pressure variations in the knee and foot regions with minimal latency.
2. **Stress Distribution Analysis:** The system provided clear visual representations of pressure points, highlighting areas of high stress during motion and static postures.
3. **Rehabilitation Monitoring:** For participants undergoing therapy, the device accurately tracked progress over time, showing improvements in stress distribution and joint movement.
4. **Device Performance:** The Arduino-based system exhibited consistent performance across trials, with efficient power consumption and reliable connectivity.

The results validate the proposed system's capability to serve as a practical tool for injury prevention, rehabilitation, and performance enhancement. Further optimization and long-term testing are recommended to refine its functionality and broaden its applications.

VII. OUTPUT IOT GRAPH





II.CONCLUSION

A modified GWO-based MPPT algorithm has been introduced. The Matlab/SIMULINK environment has been used to model the PV system, which comprises of a PV array with an MPPT tracker and a Li-ion battery. By employing a variable sampling time, the suggested approach seeks to minimize the amount of time lost during the exploring phase. The findings of the simulation demonstrate a significant improvement in the global peak tracking speed. The suggested approach effectively and highly accurately follows the global peak in any environmental situation, including partial shade. Furthermore, the suggested algorithm is easy to use and quick to calculate. For MPPT applications with

partial shading, the GWO technique is generally regarded as one of the better options.

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