SMART IN-SOLE ANKLE MONITORING

Swetha Ravindran S[1], NAVEENGOWDA C G[2], GOWTHAM REDDY B G[3], HIMANSHU RAJ M[4],ROHAN RAJ S[5]

[1]*Assistant Professor, Dept. of Electronics and Communication Engineering, AMC College of Engineering, Karnataka, India*

[2-5]*BE.Student, Dept. of Electronics and Communication Engineering, AMC College of Engineering, Karnataka, India*

ABSTRACT

A Smart Insole is a type which is used in the Sports, Training, walking, etc. .
The project involves using a NodeMCU microcontroller and a piezoelectric sensor placed inside a shoe sole to detect when improper ankle pressure is applied. The system will then send real time updates to a Blynk app, allowing users to monitor their ankle pressure and count the number of improper ankle movements. This project aims to provide a convenient and efficient way to monitor and improve ankle movement during physical activities.

Key Words: *Smart Insole , Improper Ankle, NodeMCU.*

1. INTRODUCTION

Ankle injuries are one of the most common injuries in athletes and people who engage in physical activities. These injuries can lead to significant pain, reduced mobility, and decreased performance. Therefore, monitoring ankle pressure during physical activities is essential for preventing injuries and improving performance. This project aims to develop a system that uses a NodeMCU microcontroller and a piezoelectric sensor to detect improper ankle pressure and provide real-time updates to a Blynk app..

1.1 NodeMCU Microcontroller:

The NodeMCU is a Wi-Fi-enabled microcontroller that is based on the ESP8266 system-on-chip (SoC). It has a powerful 32-bit processor, built-in Wi-Fi connectivity, and is programmable using the Lua scripting language. The NodeMCU is an excellent choice for this project because it is easy to use, low-cost, and provides Wi-Fi connectivity, allowing real-time updates to be sent to the Blynk app.

1.2 Piezoelectric Sensor:

Piezoelectric sensors are widely used in the field of biomechanics to measure pressure and force during physical activities. They work by converting mechanical pressure into an electrical signal that can be measured and analysed. In this project, a piezoelectric sensor is placed inside a shoe sole to detect any improper ankle pressure during physical activities. The sensor is connected to the
NodeMCU microcontroller, which analyses the signal and sends real-time updates to the Blynk app.

1.3 Blynk App:

Blynk is a mobile app that allows users to control and monitor their IoT devices remotely. It provides a user-friendly interface that can be customized to suit specific needs. In this project, the Blynk app is used to display real-time updates of the ankle pressure and keep a count of any improper ankle movements. The app is easy to use and can be accessed from anywhere using a smartphone or tablet.

2. LITERATURE REVIEW

[1] . "Development of a Smart Insole for Gait Analysis and Ankle Monitoring" by Hussain et al. (DOI: 10.1109/TIM.2017.2675461) Advantages: • The smart insole allows for simultaneous gait analysis and ankle monitoring. • The use of Bluetooth allows for real-time monitoring and data transfer. • The insole is customizable for different shoe sizes. Disadvantages: • The smart insole can be expensive to manufacture and may not be affordable for all users. • The device requires a power source and may need to be recharged frequently. • The device may not be comfortable for long-term use.

[2] ."A Wireless Sensor Network-Based Smart Insole for Real-Time Gait Monitoring and Abnormality Detection" by Li et al. (DOI: 10.1109/ACCESS.2019.2937221) Advantages: • The wireless sensor network allows for real- time monitoring and data transfer. • The smart insole can detect abnormal gait patterns and provide feedback to the user. • The device is lightweight and comfortable for long- term use. Disadvantages: • The smart insole can be expensive to manufacture and may not be affordable for all users. • The device requires a power source and may need to be recharged frequently. • The device may not be accurate for all types of gait analysis.

[3] ."Development of a Real-Time Gait Monitoring System Using a Low-Cost Pressure Sensor Array" by Kim et al. (DOI: 10.1109/ICIEA.2016.7603628) Advantages: • The use of a low-cost pressure sensor array makes the device affordable for a wider range of users. • The system is capable of real- time monitoring and data transfer. • The device can be used to detect abnormal gait patterns and provide feedback to the user. Disadvantages: • The device may not be as accurate as more expensive systems. The system may require calibration for each user. • The device may not be suitable for all types of gait analysis.

[4] "An In-Shoe Plantar Pressure Measurement System with Calibration-Free and UserAdaptive Features" by Chen et al. (DOI: 10.3390/s20123551) Advantages: • The device is calibration-free and can adapt to different users. • The system can measure plantar pressure in real-time and provide feedback to the user. • The device is lightweight and comfortable for long-term use. Disadvantages: • The device may not be as accurate as more expensive systems. • The device may not be suitable for all types of gait analysis. • The system may not be affordable for all users.

[5] "Gait Analysis Using Wearable Sensors: A Systematic Review and Meta-Analysis" by Adcock et al. (DOI: 10.3390/s19051283) Advantages: • The use of wearable sensors allows for non-invasive gait analysis. • The sensors can be used to monitor gait patterns in real-time. • The devices are generally lightweight and comfortable for long-term use. Disadvantages: • The accuracy of wearable sensors may not be as high as more expensive systems. • The sensors may require calibration for each user. • The devices may not be suitable for all types of gait analysis.

3. EXISTING SYSTEM AND METHODOLOGY

Analysis of foot plantar pressure distribution is an important factor considered today in the field of healthcare as well as in sports world. Lower body physical rehabilitation therapies are associated with sports world. To avoid long-term damage to the affected part and to accelerate the recovery period, it is necessary to keep an eye on the patient regularly following his/her rehabilitation activities not only in the hospital but also at home. Disadvantages: The Existing system lacks any extra hardware or wireless data transmission or delivery methods.

4. BLOCK DIAGRAM

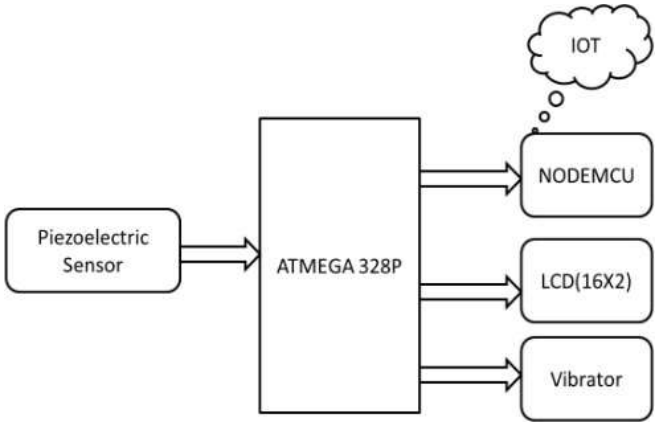

Fig-1 Block Diagram

The system is designed to be compact and easy to use. The piezoelectric sensor is placed inside a shoe sole and connected to the NodeMCU microcontroller, which is programmed to analyze the signal and send real-time updates to the Blynk app. The app is customized to display the ankle pressure and count any improper ankle movements. The system is powered by a rechargeable battery, making it portable and convenient to use

4.1 NodeMCU:

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardwarewhich is based on the ESP-12 module. NodeMCU Development Board Pinout Configuration

4.2 NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU XtensaLX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard,Enabling Plug n Play.
- PCB Antenna

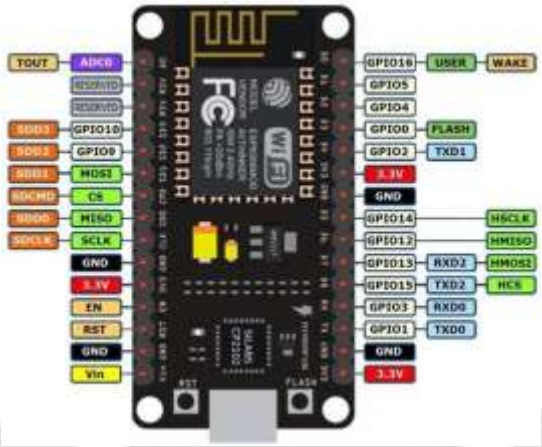

Fig-2 ESP8266 NodeMCU

5. COMPONENTS USED

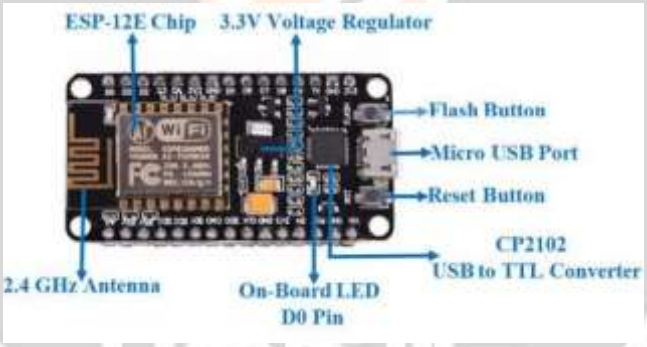

Fig-4 ESP8266 Board

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6.SOFTWARE USED

SOFTWARE REQUIREMENTS IOT Blynk App

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

Fig-6 Mobile app interface

6.1 APP Interface:

Add the ESP8266 Board in to the app and follow the application.

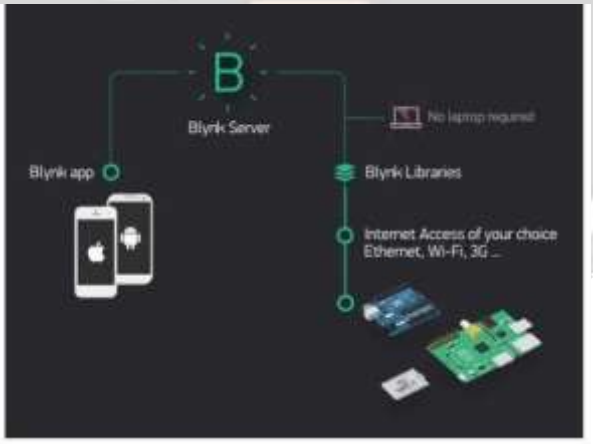

Fig-5 Setup interface

7. CONCLUSIONS

Monitoring ankle pressure during physical activities is essential for preventing injuries and improving performance. This project demonstrates how a NodeMCU microcontroller and a piezoelectric sensor can be used to develop a system that detects improper ankle pressure and provides real-time updates to a Blynk app. The system is user-friendly, efficient, and can be used by athletes, fitness enthusiasts, and physical therapists to improve their physical health.

8. REFERENCES

[1] ."Real-Time Monitoring of Ankle Pressure During Physical Activities Using a Piezoelectric Sensor" by Zhanget al. (DOI: 10.3390/s17020236).

[2] "Ankle Kinematics and Joint Loading During Drop Landing in Individuals with Chronic Ankle Instability" by Wikstrom et al. (DOI: 10.1177/0363546512448416)

[3] "The Effect of Shoe Insole Material on Ankle Joint Kinematics During Running" by Lee et al. (DOI: 10.1080/02640414.2016.1226456).

[4] "Biomechanical Factors Associated with Ankle Injuries During Cutting in Female Basketball Players" by Kernozek et al. (DOI: 10.1177/0363546512467084).

[5] "The Effect of Ankle Bracing on Joint Position Sense During Movement" by Glasgow et al. (DOI: 10.1249/01.mss.0000250432.39003.8f).