Development of Foot Pressure Monitoring System Using Force Sensor

Nor Kharul Aina Mat Din
Politeknik Sultan Salahuddin Abdul Aziz Shah
nkaina82@gmail.com

Nik Nor Afifah Nik Mohammad Jafri
Politeknik Sultan Salahuddin Abdul Aziz Shah
niknorafifah472@gmail.com

Abstract
Foot pressure measurement has the potential to be a useful tool in a variety of situations, including improving athletic performance, identifying disorders, and improving foot comfort when wearing shoes. The goal of this research is to monitor force pressure in order to determine the optimal weight for improving body balance while performing leg exercises. The strengths and boundaries of current-day structures are reviewed, and a foot pressure monitor device is suited for monitoring excessive stress distributions under the foot with excessive accuracy and dependability. This device employs a force pressure sensor to identify if the weight is normal or not by measuring the pressure on the foot. An Arduino UNO is required to run the programme for the force pressure sensor and LCD in the development of this device. The LCD shows the force pressure result when we place our feet on the sensors. This project will assist the community in measuring force pressure while performing leg workouts and will help them enhance their body balance.

Keyword: foot pressure, force sensor, foot plantar

1.0 Introduction

This paper outlines the design and analysis of the actions involved in producing the prototype foot pressure monitor. Given the fast-technical improvements in healthcare monitoring equipment, micro fabrication methods, and wireless communication, the development of small, lightweight, and energy efficient circuit solutions for healthcare sensor applications is becoming an increasingly essential research topic. The analysis of foot pressure monitors distributions to disclose the interface pressure between the foot plantar surface and the shoe sole has piqued the interest of researchers in biological and sports-related applications. Typical uses include footwear design, improved balance control, and illness diagnosis. Based on this research, it is obvious that approaches capable of precisely and effectively sensing foot pressure are critical for future advances.

The design, testing, and evaluation of the foot pressure monitor prototype are the goals of this project. For research and product development purposes, this project employs sensors to monitor and analyse the pressure distribution

on a person's foot. Knowing the pressure range will help us choose the right weight to use when exercising our legs to enhance our body's balance. Additionally, it can detect the signs of disorders affecting the lower extremities, including osteoarthritis, ligament and cartilage damage, shin splints, and sprained ankles. Furthermore, it can improve the quality of the user's shoes for use in everyday activities.

2.0 Research Background

This project has developed a method for monitoring foot pressure. After studying a research article on foot pressure plantar, it is discovered that it has various functions and applications that we may design using this device. This foot pressure monitor can identify the appropriate weight for improving body balance while conducting leg exercises by monitoring the pressure range. It can also detect symptoms of lower limb disorders such osteoarthritis, ligament/cartilage injuries, shin splints, and sprained ankle. Furthermore, it can increase the comfort of the user's shoes when doing regular activities.

Previous research worldwide has been done to measure foot plantar for many applications such as for diabetic patients (Keukenkamp et al. 2021 and Altayyar, 2021), person identification (Keatsamarn et al., 2021), walking (Peng et al., 2021), during daily activities including standing, sitting and moving around (Tsutsui et al., 2021) and also for sports (Keivanfar et al., 2021 and Miguel-Andrés et al., 2021). Kenchgundi et al., 2019 calculated the average foot pressure by placing the sole inside the shoes. The controller algorithm will keep track of this data. Therefore, in this study, we placed the foot sensor inside the shoes to monitor foot pressure to determine the optimal body weight.

3.0 Research objectives

The goal of this research is to create, test, and evaluate a foot pressure monitor prototype. In order to analyse the pressure distribution on a person's foot and improve body balance while exercising the legs, this project used force pressure sensors to measure and record data.

4.0 Methodology

It is crucial to determine the approach followed throughout the research process before any work is done. Based on the findings of the study and observations made from the living environment, this monitoring foot pressure device was self-designed. Next, this project's design is not excessively complex. People are typically attracted to new artifacts, such as the shape and function of a device. The phases are organized into four steps: requirement listing, design principles, decision making, and systematic design foot pressure monitor control. The testing procedure is critical in the development of a project design. Testing also establishes the usefulness, marketability, and safety of the equipment developed in relation to the objectives. This project's installation and testing work is completed once the measurement and cutting processes are completed. The installation work is completed in accordance with the initial

planning. Furthermore, experiments are critical in ensuring that every measurement produced is accurate and appropriate for usage by all persons.

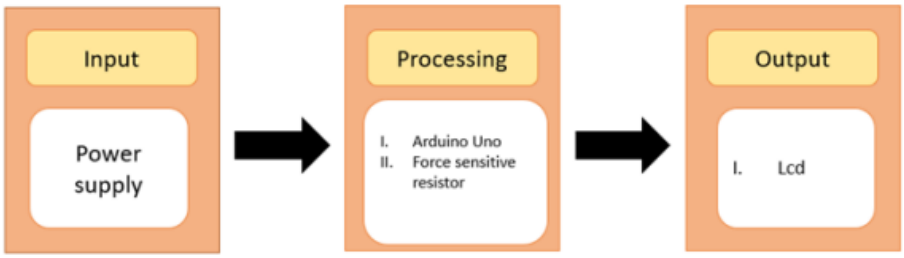

Figure 1: Block Diagram of the Foot Pressure Monitoring System

The block diagram of the Foot Pressure Monitoring System is shown in Figure 1. The block diagram illustrates how a force sensing resistor works. First, the battery will identify the microcontroller from the source and provide power. The microcontroller is turned on and the force sensitive resistor is activated. It will then enter the force sensitive resistor to measure the pressure on the feet. Following that, the result of the foot pressure system programmed in Arduino Software will be shown on the LCD.

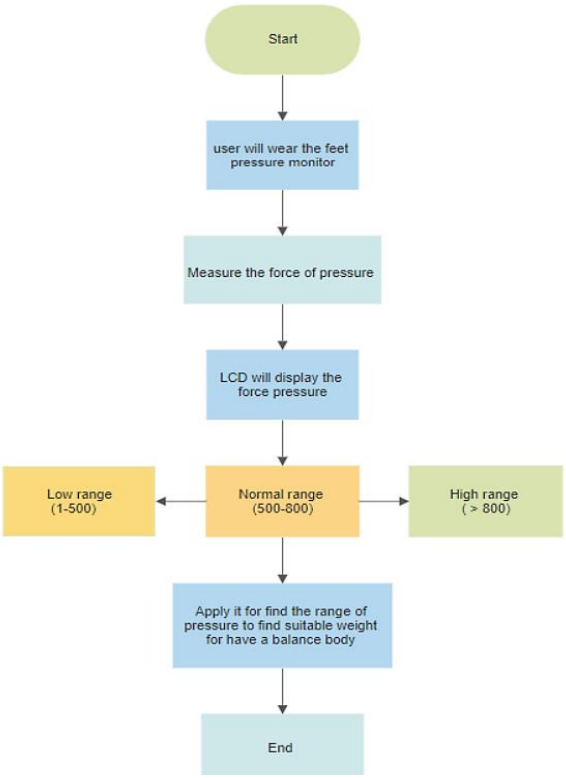

Figure 2: Flow Chart of the Foot Pressure Monitor

The flow chart of the foot pressure monitor is shown in Figure 2. The method of measuring pressure with a force, pressure sensor. The user will wear

the equipment to determine whether they are of normal weight or not. As a result, the person will be aware of their body's imbalance or balance.

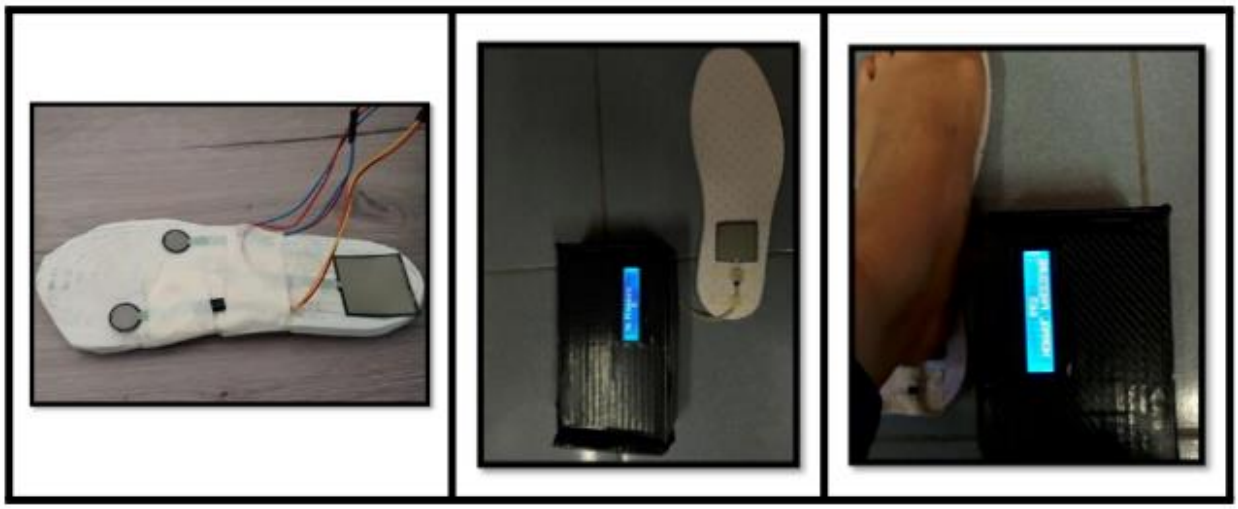

Figure 3: Development of foot pressure monitor and how it is applied to human foot

For this design, the force resistive sensor will be placed on the soles, and the LCD will be positioned on the top of the casing project. The foot pressure monitor circuit will be installed in the casing box as shown in Figure 3.

5.0 Results and discussion

There are 5 people that have been test used this project. The data are in the Table 1 below:

Table 1: Result interpretation

Respondent	Weight (kg)	Height (cm)	Pressure (N/m^2)	Balance	Condition of weight	Suggestion
1	63	168	590	Balance	Normal weight	Maintain weight
2	65	180	669	Balance	Normal weight	Maintain weight
3	70	156	821	Unbalanced	Overweight	Need to lose weight
4	51	160	433	Unbalanced	Underweight	Gain more weight
5	83	165	850	Unbalanced	Overweight	Need to lose weight

Results are listed in a table along with how to refer to them regarding force pressure, body balance, and weight condition. For force pressures ranging from 1 to 500 N/m^2, the result is low pressure, indicating that the patient has an

unbalanced body and is underweight. Therefore, the patient must put on extra weight to have a balanced body. The person has a balanced physique and normal weight, as evidenced by the typical pressure range of 500 to 800 N/m^2. Finally, a result of greater than 800 N/m^2 indicates a high force pressure result. It will demonstrate that the person has an unbalanced physique and is overweight. To have a balanced body, they need to shed weight. This table will inform the individual whether their body is balanced or not, allowing them to perform leg balance exercises more simply. If not, they should eat to maintain a healthy weight. This will encourage the subject to live a healthy lifestyle since they will be able to exercise on a regular basis and keep a normal weight.

6.0 Conclusion

As conclusion, this project can help the community measure and keep monitoring their foot pressure especially while doing legs exercise. The force of their leg will notify them to improve their body balance and have better body weight.

8.0 References

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