Smart Sensing of Foot Plantar Pressure by using Raspberry Pi

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ABSTRACT
The human foot is an important part of our body's movement. Peak pressure measurement on the plantar surface of the human foot is critical for illness diagnosis and research for biomedical engineers. Human feet may be classified into Flat Foot, Normal Foot, and High Arch Foot based on footprint imaging metrics such as A intercept, B intercept, Footprint Index(FPI), and Footprint Geometry Index(FGI). As a result of this outcome, a more accurate diagnosis and therapy for that specific patient is achievable. These findings can be used in gait analysis and sports biomechanics.
Keywords—plantar pressure distribution, Weight, Age

I. INTRODUCTION

Plantar pressure distribution study is one of the most well-studied aspects of clinical foot diagnosis and gait evaluation. There are a variety of commercially available plantar pressure monitoring methods, each with its own set of limitations, such as high cost and data linking once gathered by the computer.

The terminal part of the leg, below the ankle joint, on which the body stands and moves. A few of the "criteria for normalcy" proposed by Root and colleagues include that the distal one-third of the leg is vertical, the subtalar joint rests in its neutral position and the calcaneal bisection is vertical during bipedal stance. People care about their feet, and regular personal foot care can help people stay active, mobile, and independent. People with foot disorders may have discomfort, soreness, infection, ulceration, and an increased risk of falling. Personal foot care is possible. Contribute to the lowering of these issues by preventing them or detecting them early on. A few of the "criteria for normalcy" proposed by Root and colleagues include that the distal one-third of the leg is vertical, the subtalar joint rests in its neutral position and the calcaneal bisection is vertical during bipedal stance. Flat feet are caused by a variety of conditions including injuries, obesity, and arthritis. Aging, genetics, and pregnancy can also contribute to flat feet. You're also more likely to have flat feet if you have a neurological or muscular disease such as cerebral palsy, muscular dystrophy, or spina bifida. A high arch is an arch that is raised more than normal. The arch runs from the toes to the heel on the bottom of the foot. It is also called pes- cavus. A high arch is the opposite of flat feet. Therefore, in this paper, we can see how to implement Foot images in calculating weight and age.

II. LITERATURE SURVEY

There have been previous studies that differentiated plantar pressure equipment based on the technique of sensing used: pictures or electronic sensors [4,5]. The ink-based plantar pressure system may not be able to measure dynamically collected data in most cases. The image-based method, on the other hand, relies on calculations based on the light intensity of a grayscale image captured using a camera installed within a barograph device [6]. In the 1980s, factors such as system cost and resolution prohibited such devices from being extensively adopted, even though a few researchers were actively researching at the time.

In gait analysis, the information derived from the captured photographs was regarded as a reliable and relevant metric. Using static and dynamic plantar pictures, one study described the differences in characteristics of a joint ankle's angles [7]. [8] conducted research into the relationship between foot anatomy and the static balance system to analyze a child's footprint image. Also, based on the image measurements in [9], it was found that the foot arch from the bearing area ratio of the plantar measurement. A plantar shape was considered for personal identification as mentioned in [10]. Shine et al. proposed a method to find the relation between the deformation of the foot plantar skin and the stability during the gait based on a foot plantar image [11].

The bulk of researchers who use plantar pressure to analyze data nowadays employ electronic-based sensors. Sensors come in a variety of shapes and sizes, including mats [12], insoles [13], treadmills [14], and compact three-seal kinds [13]. Traditional commercial sensors, on the other hand, lack the resolution to anticipate pressure in small areas like the toes. This can be solved by analyzing the brightness value distribution of a greyscale plantar image acquired while walking, as reported in the work of [15].

III. SOFTWARE IMPLEMENTATION

Using PYTHON,

Python is a high-level, interpreted, interactive, and object-oriented scripting language. Python is designed to be an easy-to-understand programming language. It typically uses English terms instead of punctuation, and it has fewer syntactical structures than other languages.

Python is a must-have skill for students and working professionals who want to become exceptional software engineers, especially if they work in the Web Development field. I'll go over some of the primary benefits of learning Python, Python is Interpreted Python is handled by the interpreter during runtime. Before running your software, you do not need to assemble it. This is similar to the programming languages PERL and PHP.

Python is interactive in the sense that you can sit at a Python prompt and write your programmes by interacting directly with the interpreter.

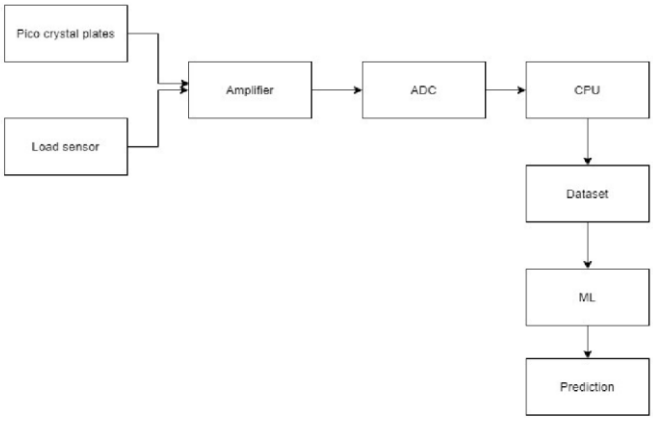


Fig 1: Block Diagram of Software part

IV. MACHINE LEARNING

NUMPY

The most popular Python package for scientific computing is NumPy. It's a Python library with a multidimensional array object, derived objects (like masked arrays and matrices), and a variety of routines for performing fast array operations like mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation, and more.

NAIVE BAYES ALGORITHM

Classifiers are built using the probabilistic Naive Bayes approach. The naive Bayes classifier assumes that the value of a single feature is independent of the value of any other feature given the class variable.

Despite the simplifying assumptions mentioned earlier, naive Bayes classifiers perform effectively in complex real-world situations. Because naive Bayes only requires a small amount of training data to predict the parameters required for classification, the classifier can be taught gradually.

A Naive Bayes classifier, in simple terms, posits that the existence of one feature in a class is unrelated to the presence of any other feature.

P (class| data) = (P (data| class) * P(class)) / P(data)

Where P (class| data) is the probability of class given the provided data.

For binary (two-class) and multiclass classification issues, Naive Bayes is a classification algorithm. Because the computations of the probability for each class are simplified to make their calculations tractable, it is known as Naive Bayes or idiot Bayes.

METHODOLOGY

Machine learning-based detection is done. High-resolution Vibration and pressure detection is done from which we get the greyscale images. Bayesian Algorithm implementation helps us to process from image to Pressure values from Referral Image. NumPy is the fundamental package for scientific computing in Python that is used in the programming part. Huge datasets canbe accessed, which can also provide high accuracy to find the Weight and Age.

V. HARDWARE IMPLEMENTATION

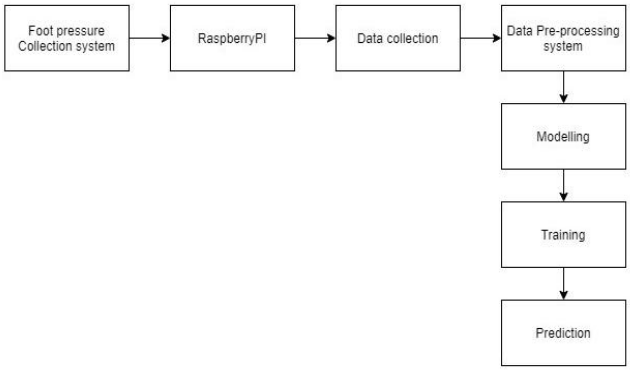
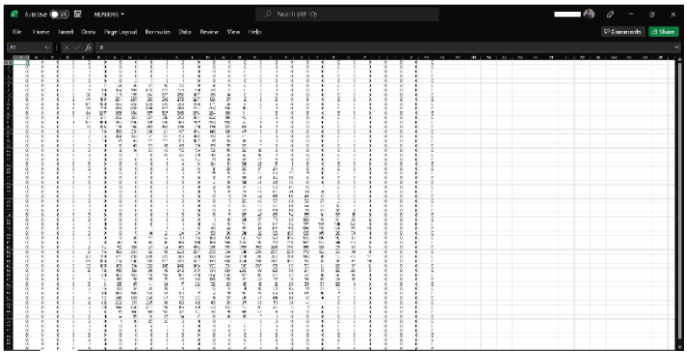


Fig 1: Block Diagram of Hardware part

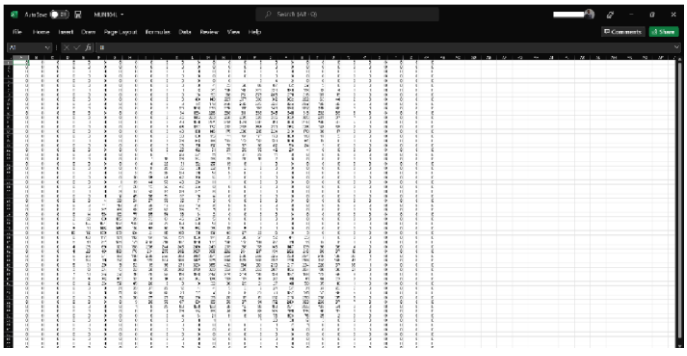
FOOT PLANTAR PRESSURE

To calculate the Foot pressure, we are using the Piezoelectric plates. These plates are based on the pressure of the foot placed above them and it generates electric signals due to the pressure exerted on it thus these plates, then the signals are digitallyconverted by the Raspberry pi 3 B+.The data collected is generated as RGB Grayscale imageas in figure 2: (c). The collected inputs are also processedbased on the ML. Based on the Naïve bayes algorithm.

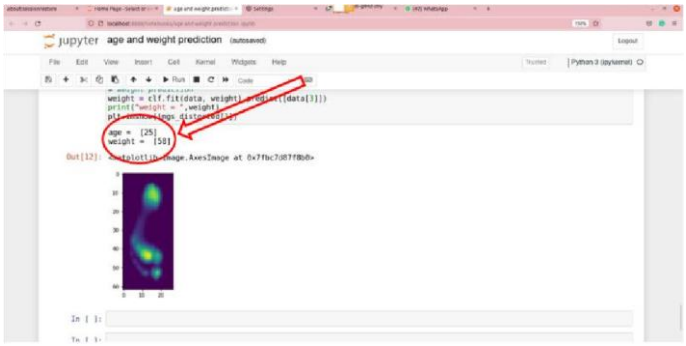
VI. RESULTS



(a)



(b)



(c)

Fig 2: (a)&(b)- Inputs Extraction from foot print ; (c)Result Extracted for Weight and age of a Human

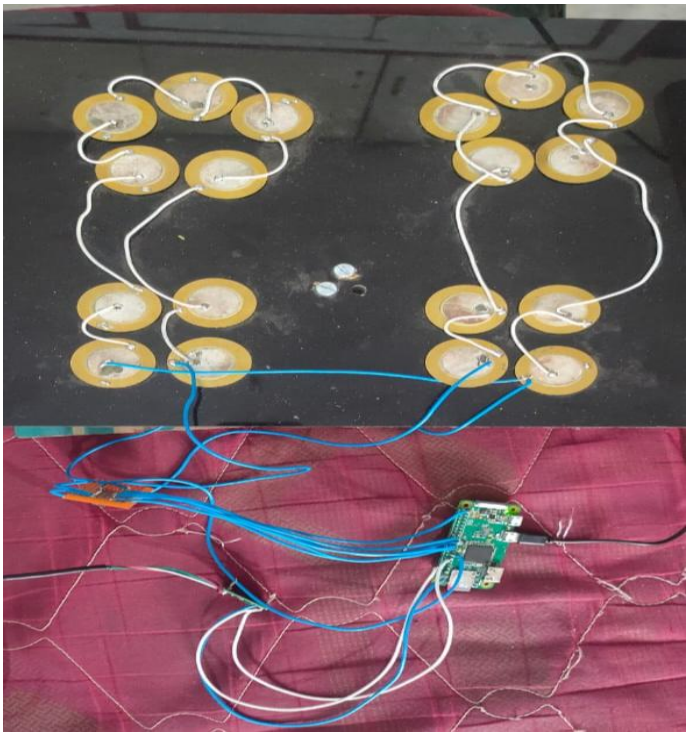


Fig 3: Image of the Foot Plantar Pressure System

VII. CONCLUSION

Foot plantar pressure modelling is useful for assessing gait, hospitals, clinics, shoe manufacturing, and early diagnosis of ulceration in diabetic patients. Plantar pressure analysis to analyse foot pressure distributions is possible using a variety of instruments and methodologies. From the above results using the Machine learning technique, we can analyse the Weight and age of a human using a pressure distribution image. But w the get the some Similar range of outputs with weight and age.

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