International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 09 | Sept - 2021 ISSN: 2582-3930

FOOT ALIGNMENT DETECTION USING POSE ESTIMATION

Roshni A Ramesan[1]
Dept .Medical electronics
BMS College of Engineering

Prerana Ananda Murthy[1]
Dept .Medical electronics
BMS College of Engineering

Dr.Niranjan K R[2]
Assistant Professor,
Dept .Medical electronics
BMS College of Engineering

Abstract:
The agenda of this project was to perform an analysis method which gives a complete anatomical alignment about the foot. The method uses a raspberry pi camera that captures images of the foot to give a pose estimate of the foot. Pose estimation is a computer vision technique that predicts and tracks the location of a person or object. This is done by looking at a combination of the pose and the orientation of a given person/object. Pose estimation operates by finding key points of person or object. Taking a person, for example, the key points would be joints like the elbow, knees, wrists, etc. There are two types of pose estimation, multi-pose and single pose. Human pose estimation is the process of estimating the configuration of the body (pose) from a single, typically monocular, image. Human pose estimation is one of the key problems in computer vision that has been studied for well over 15 years. PoseNet is a deep learning TensorFlow model that allows you to estimate and track human poses (known as "pose estimation") by detecting body parts to determine body postures.

Keywords:

Pose estimation, foot alignment, GAIT analysis, Raspberry Pi, Pronation and Supination.

I. INTRODUCTION

In vertebrates' foot is one of the anatomical structures found. It helps in locomotion and is the terminal portion of the limb. Human foot is composed of 26 bones and 33 joints, also with many tendons, ligaments and muscles. The foot joint consists of subtalar joint which lies between point of talus and calcaneus, ankle, interphalangeal articulation which is between phalanx bones of toes. In a study it was found that the normal foot length is 26.3 cm and standard deviation was around 1.2cm.

Classification of foot

i. *Hind Foot*:
This mainly consist of talus bone which is the ankle bone and calcaneus bone which is the heel bone. At the top of the talus the two long bones tibia and fibula the lower bones are connected to form the ankle.

ii. *Mid Foot:*
The shock absorbers are the cuboid, navicular and three other cuneiform bones which forms the arches of the foot. The hid and fore foot are connected to the mid foot by the muscles and plantar fascia.

iii. *Fore Foot:*
The forefoot consists of five toes and the corresponding five proximal long bones forming the metatarsus. Toe bones are known as phalanges. The four toes have three phalanges and the big one has two phalanges. Phalanges has joints in between them and they are called

as interphalangeal .The joints between metatarsus and phalanges are called metatarsophalangeal.

Formed of tibia, fibula, seven tarsus, talus, calcaneus, three cuneiforms, cuboid and navicular, five metatarsus and fourteen phalanges.

A. Pronation

Rotational movement of the forearm or foot is called pronation. The distribution of the weight distributes as it cycles through the gait is what is pronation. Depending on the rare foot, fore foot function in different ways foot can pronate. Types of pronation are given in above.

B. Neutral Pronation

A person who strikes the ground on the lateral side of the heel neutrally pronates. When the weight is transferred from the heel to the metatarsus, the foot will roll in a medial direction in such a way that the weight is distributed evenly across the metatarsus. The rolling of inward motion of the foot progresses from heel to toe in such a way that the body naturally absorbs shock. Neutral pronation is the most ideal, efficient type of gait when using a heel strike gait in a forefoot strike, the body absorbs shock instead via flexation of the foot.

C. Over Pronation

When person transfers weight from the heel to the metatarsus, the foot will roll far in a medial direction, in such a way that the weight is distributed unevenly across the metatarsus, with excessive weight borne on the hallux. At this time the gait, the knee will generally, but not always, track inwards.

An overpronator does not absorb shock efficiently. Imagine someone jumping onto a diving board, but the board is so flimsy that when it is struck, it bends and allows the person to plunge straight down into the water instead of back into the air. Similarly, an overpronator's arches will collapse, or the ankles will roll inwards as they cycle through the gait. An individual whose bone structure involves external rotation at the hip, knee, or ankle will be more likely to overpronate than one whose bone structure has internal rotation or central alignment. An individual who overpronates tends to wear down their running shoes on the medial (inside) side of the shoe towards the toe area.

When choosing a running or walking shoe, a person with overpronation can choose shoes that have good inside support usually by strong material at the inside sole and arch of the shoe. It is usually visible. The inside support area is marked by strong greyish material to support the weight when a person lands on the outside foot and then roll onto the inside foot.

D. Under Pronation

Also known as supination. The person who under pronates also initially strikes the ground on the lateral side of the heel. The transfer of weight from the heel to the metatarsus, the foot will not roll far enough in a medial direction. The weight is distributed unevenly across the metatarsus, with excessive weight borne on the fifth metatarsal, towards the lateral side of the foot. At this time the gait, the knee will generally, but not always, track laterally of the hallux.

Like an overpronator, an under pronator does not absorb shock efficiently but for the opposite reason. The under pronated foot is like a diving board that, instead of failing to spring someone in the air because it is too flimsy, fails to do so because it is too rigid. There is virtually no give. An under-pronator's arches or ankles don't experience much motion as they cycle through the gait. An individual whose bone structure involves internal rotation at the hip, knee, or ankle will be more likely to under pronate than one whose bone structure has external rotation or central alignment. Usually those who are bow-legged tend to under pronate. An individual who under pronates tends to wear down their running shoes on the lateral side of the shoe towards the rear of the shoe in the heel area.

II. POSE ESTIMATION

Pose can be recognized by seeing the positions and locations of different parts of the body by humans. Somewhat similar way is done in computer vision as the problem of HPE is defined as a problem of localization of human joints. Poses of human body varies in different ways. It is not a simple task to find the location of body parts. Since there are a verity of different poses as well as some external conditions like light, clothes, multiple people in a single picture etc. Different poses estimation is these systematic processes. Hence, it is one of the interesting topics of researchers.

A concept was used by Fischler and Elschlager a part-based modelling for facial structure estimation which was known as PS model. Consisted of two important modules first was the identification of parts and second was configuration of parts to form a structure which discretised the search space and use of dynamic programming. PS framework is a general model because it neither depends on the training scheme of the individual parts, nor on the type of connections between them. The base of this method is representation of objects by a set of parts organized in a deformable structure. Each part is identified separately and then deformable structure is represented by a springlike connection between paired parts as shown in Fig.2.1.

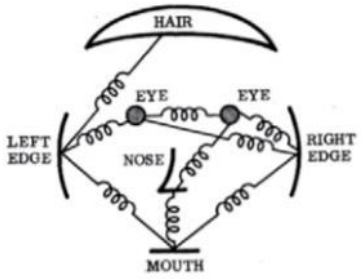

Fig 1 Representation of face, indicating components and their connections

III. MATERIALS AND METHODS

Hardware Components

A. RASPBERRY PI

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases). However, some accessories have been included in several official and unofficial bundles. According to the Raspberry Pi Foundation, over 5 million Raspberry Pi's were sold by February 2015, making it the best-selling British computer. By November 2016 they had sold 11 million units, and 12.5m by March 2017, making it the third bestselling "general purpose computer".

Fig 2: Raspberry Pi

IV.PROPOSED DESIGN

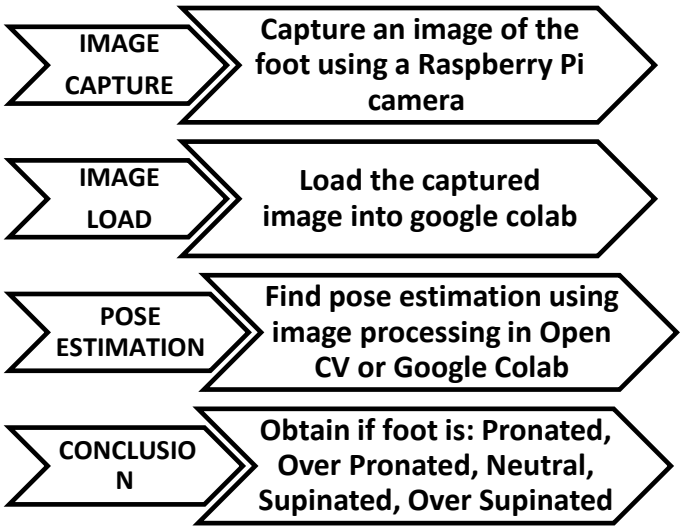

Fig 3: Flowchart

Block diagram

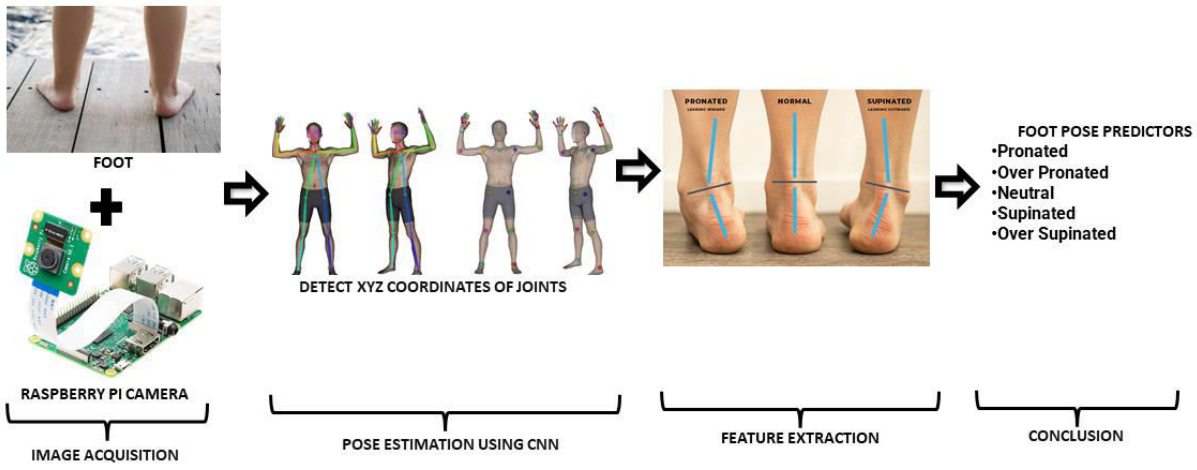

Fig 4: Block diagram

V. RESULT

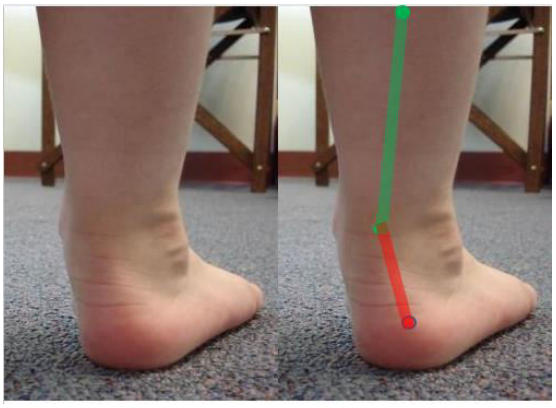

Fig 5: Over pronated foot

VI.CONCLUSION

Algorithm was able to identify pronated, over pronated or neutral or supinated or over supinated. Without an X-ray as well the diagnosis for misalignment can be obtained.

REFERENCE

[1] Naimat Ullah Khan and Wanggen Wan, "A Review of Human Pose Estimation from Single Image", China: ResearchGate, July 2018

[2] Alexander Toshev and Christian Szegedy, "DeepPose: Human Pose Estimation via Deep Neural Networks ",

[3] Ce Zheng, Wenhan Wu, Taojiannan Yang, Sijie Zhu, Chen Chen, Member, Ruixu Liu, Ju Shen, Senior Member, Nasser Kehtarnavaz Fellow, and Mubarak Shah, Fellow, "Deep Learning-Based Human Pose Estimation: A Survey ",

[4] M. A. Fischler and R. A. Elschlager, "The Representation and Matching of Pictorial Structures," IEEE Trans. Comput., vol. C–22, no. 1, pp. 67– 92, Jan. 1973.