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RESEARCH ARTICLE

Foot sens - foot pressure monitoring systems

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Abstract

Foot plantar strain is the tension field that acts between the foot and the help surface during regular locomotion and exercises. Data from such strains is significant in gait analysis and posture research for diagnosing lower appendage issues, footwear configuration, sport biomechanics, and injury anticipation and give an important understanding on the assortment of biomechanical and neurological problems, with treatment and prevention of wounds brought about by high foot pressure. The gadget will quantify the foot tension from FSR, force sensitive resistor sensors placed on the insole of the shoe. These sensors are associated with the Arduino UNO. It decides the foot pressure dissemination in genuine time, allowing us to imagine and dissect the data. A uniquely designed programming is made by utilizing LabVIEW. This method can be a real-time checking framework utilizing the pressure visualization program. The patient's details can be taken care of in and are saved in this product and when executed, the strain information gathered is changed over into an advanced pattern and a polarography is created. This framework gives incredible achievable oversight for wellbeing observation, injury counteraction, and athlete preparation. The plantar tension estimation framework offers the clinician a serious level of convey ability, allowing use among various clinical sites.

Keywords: Foot pressure, LabVIEW, Gait analysis, Locomotion, Exercises.

Introduction

The remedy for medical service industry application has hugely expanded because of the development and improvement of innovation in the healthcare sector. Hence, a ton of consideration and spotlight is provided particularly to biomedical and sports-related research areas. Walking is a human's daily action, and gait analysis has become a significant part of physical motion. The synchronization of both neural and outer muscle frameworks is fundamental to accomplishing firmness and equilibrium of the body during motion. Research on walk boundaries has a significant part in the assessment of various elements (Kenchgundi *et al.,* 2019). The feet are the significant support during walking, are related to the fast changes of the encompassing, and are revealed to have huge force. Detecting the human foot plantar pressure rationing can give fundamental data and help the clinical analysis (Vigneshwaran & Murali, 2020).

In senior citizens, weight-bearing limit on the horizontal side of the foot during the heel contact and the toe-off stages might influence steadiness during motion. The fundamental target of this review is to become familiar withthe normal information of the foot tension by embedding the insoles inside the shoes. The regulator algorithm will check this information. The regulator analyses the average foot pressure with information feed to it with appropriately unseen abnormal reference information. Jointinflammation is otherwise called Arthritis. It is being anticipated that practically 40% of the male and 47% of thefemale will experience the ill effects of joint inflammationduring their lifetime. While knee disengagement is perceived in sports persons and requires over 7 months of recuperation to recover full scope of movement. The beginning of this illness is typically from the years of 35 to 60, with abatement and compounding [(1)]. Negligence of beginning phase side effects of the knee disengagement and joint pain could affect the

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spine and pelvis, which further lead to osteoarthritis and spine dislocation.

The principle objective of this research paper is to dissect the foot plantar stress circulations to decide the interface stress among the foot plantar surface and the shoe bottom. Average applications are crafting footwear, investigating sports person performance and forestall injury, ameliorating balance control, and diagnosing sickness. We can distinguish the problems with the persons walking pattern. By changing our walk cycle with legitimate awareness, we can distinguish preparatory strides to shut down those secondary effects. With this finding, we can foresee all the infections of the skeleton framework that the patient may get affected with. It includes joint inflammation, knee separation, pelvic disengagement, spine separation.

Related Works

In 1990s, Zhu *et al.* fostered a framework for estimating the pressure circulation underneath the foot utilizing seven FSR (Force sensitive resistor) and they utilized it to discrete the strain between strolling and shuffling (Zhu *et al.*, 1991). In 1995, Hausdorff *et al.* constructed a footswitch framework fit for gait analysis utilizing two FSR sensors. In 1997, Cleveland Medical Devices Inc. made an in-shoe remote framework that could measure the period of foot contact, the load on each foot and the focal point of tension of each foot. This framework utilized a bunch of thick-film power sensors and from that point forward, there has been further advancement of in-shoe pressure sensor frameworks (Lawrence & Schmidt, 1997).

Ongoing distributions on remote frameworks for recovery applications incorporate work by Neaga *et al.* (2011) for observing the gradual stacking of the lower limb in post-traumatic restoration. Remote foot plantar frameworks have been applied to various regions including restorations, sports and day to day existences walk observing. This paper utilized F-Scan for the sensor, micro-controller based information procurement and RF transmitter and receiver for remote communication. This framework demonstrates the top stacking of the lower appendage through LED indicators. Wada *et al.* has worked on Foot pressure monitoring for a rehabilitation supportive network (Wada *et al.*, 2007). The research work by Edgar *et al.* on wearable shoe for the recovery of stroke patients provides a clear note on designing wearable shoes (Edgar *et al.*, 2010).

Description

Foot plantar strain is the tension field that acts between the foot and the help surface during regular locomotion and exercises. Data got from such strain is significant in gait analysis and posture research for diagnosing lower appendage issues, footwear configuration, sport biomechanics, and injury anticipation and give an important understanding on the assortment of biomechanical and neurological problems, just as helping with treatment and prevention of wounds brought about by high foot pressure. The FOOT SENS kit is shown is the given Figure 1.

The gadget will quantify the foot tension with the assistance of FSR, force sensitive resistor sensors placed on the upside of the shoe's insole. The standoff resistance of the sensor is >10M ohms. The positioning of the sensors depends on the size and shape of the foot of the respective person and are placed according to the foot reflexology chart as shown in Figure 2. These sensors are associated with the Arduino UNO. It incorporates a little sensor module that decides the foot pressure dissemination in genuine time that permits us to imagine and dissect the data. A uniquely designed programming is made by utilizing LabVIEW. The insole pressure sensor can be utilized as a real-time checking framework utilizing the pressure visualization program. The size of the FSR406 sensors are 43.69 * 43.69 mm and its force sensitivity ranges from 0.1 newton to 10.0^2 newton.

The original framework depends on exceptionally straight tension sensors with no hysteresis. This insightful insole framework gives incredible achievable oversight for wellbeing observation, injury counteraction, and athlete preparation. The plantar tension estimation framework offers the clinician a serious level of convey ability, allowing use among various clinical sites. According to the studies, our foot consists of 15 major pressure points. Each pressure points is connected to an organ or system in our body. Our walking and standing pattern shows the amount of pressure is applied in every pressure points. Whenever high or no pressure is applied on a pressure point, the connected system may get affected or lead to serious effects.

Overweight and obese people prefer slower walking speeds, larger stride widths, shorter steps, lower stride frequencies, higher ground reaction forces at a given speed, more time in double-limb support phases of gait, and less time in single-limb support phases.

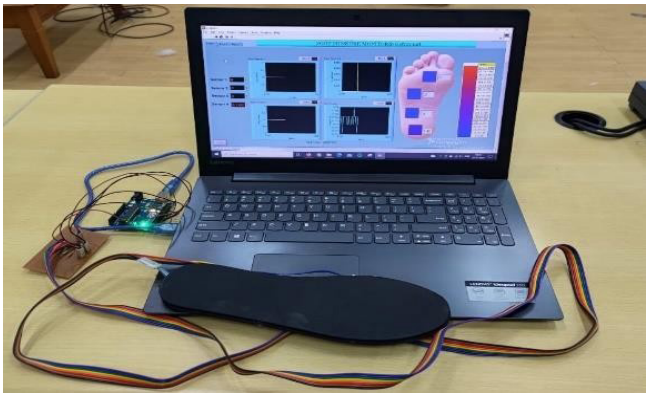

Figure 1: Foot Sens Kitc

Figure 2: Foot reflexology chart

Block Diagram

Figure 3 shows the block diagram of the process and working.

Working

This project uses four FSR (Force Sensitive Resistors). These sensors are connected with the reference resistance (here we used 10 kohm resistance) and are connected to theanalog pins of the Arduino UNO. Power supply for the sensors is connected in Arduino. The Arduino is connected to a Computer. The sensors are placed in an insole setup. When a person is made to stand on the insole,the force applied on the sensors (with reference to the usedreference resistance) will be obtained as analog signals from Arduino. These signals are fed as input signal to the LabVIEW Software. The software block diagram is shown in Figure 4. In the software, the input signal is analyzedin various types. From the resistance value obtained from sensors, the respective force applied is calculated using the formula y=200*x.

The color range is defined and graph chart is also made. The graph and color indication changes with respect to the force/pressure applied on the sensors by the person. The range of force/resistance (mega ohm) obtained from the sensor is 0 to 1000. Here, 0 and Blue color indicates that no pressure is applied. 1000 and Red color indicates that the maximum pressure is applied. We can analyze and find how the person applies pressure on their foot from the obtained data. The inbuilt LabVIEW signal processing sensors are used and no external filters were used to eliminate the noises acquired from the sensors. The software front panel diagrams are shown in Figures 5 and 6.

Outcome

We have obtained the results of the person's pressure analysis on foot. During movement, the foot is the principal

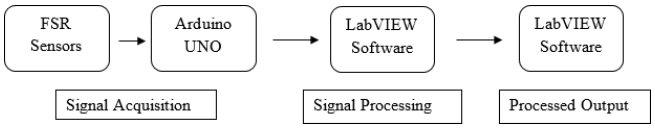

Figure 3: Block diagram of FOOT SENS

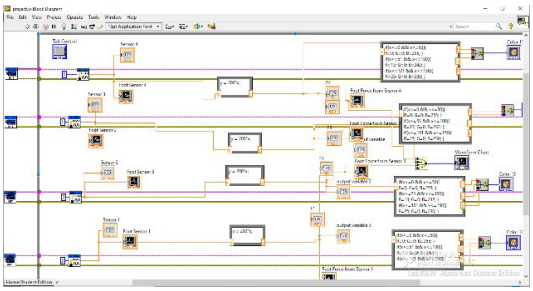

Figure 4: LabVIEW Block diagram panel

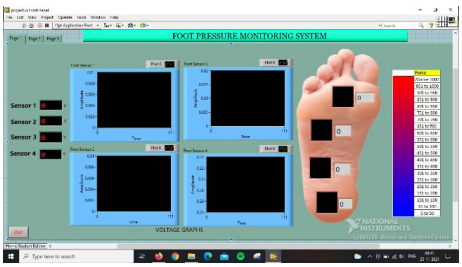

Figure 5: LabVIEW Front panel 1

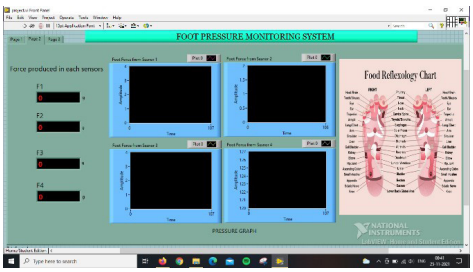

Figure 6: LabVIEW Front panel 2

surface of contact with the environment. Thus, our initiative tries to identify foot issues early on to prevent injuries.

- • Risk control and overall health
- • One method of assessing foot health
- • Balance enhancement in biological and sporting contexts,

Soccer balance training and forefoot loading during running are notable applications in sports. This foot pressure assessment has several uses, including spotting high-risk diabetic foot ulcerations, designing orthotics for people with diabetes and peripheral neuropathy, improving balance with footwear design, protecting athletes from sports injuries, and many more.

Future Work

Further, we will implement disease or disorder suggestion based on the person's analysis. It may weaken the connected system or organ whenever pressure is not applied or applied maximum on a particular pressure point. Based on analysis of a person's foot pressure data, we'll recommend adjusting their pattern of walking orstanding and also using alternatives of custom made slippers, in hard cases, we'll to consult doctors for further treatment.

With enhancements in sensor advances, it is normal that plantar strain gadgets will actually want to gauge both typical and shear power parts. Moreover, endeavors are in progress by a few gatherings to fuse movement investigation proportions of the foot with plantar tensions. This will permit segmental kinematic and energy of the foot to be concentrated on utilizing similar standards as full body stride examination is regularly performed. One issue to address for research is the normalization of veils to work with examinations between studies (MacWilliams & Armstrong, 2000).

Conclusion

A completely portable, microprocessor based insole pressure checking framework is portrayed. It is versatile and doesn't meddle with the regular gait pattern of the patient. It permits the examination of plantar strain time information during exercises of every day. The versatile framework has been utilized for concentrating on sensate and insensate plantar tensions, rearranging gait versus typical strolling. The framework has been interfaced with acompact electro tactile trigger to give tactile criticism to the insensible foot.

References

Edgar, S. R., Swyka, T., Fulk, G., & Sazonov, E. S. (2010, August). Wearable shoe-based device for rehabilitation of stroke patients. In 2010 Annual International Conference of the IEEE Engineering in Medicine and Biology (pp. 3772-3775). IEEE.

Hausdorff, J. M., Ladin, Z., & Wei, J. Y. (1995). Footswitch system for measurement of the temporal parameters of gait. Journal of Biomechanics, 28(3), 347–351. https://doi.org/10.1016/0021-9290(94)00074-e

Kenchgundi, A., Shah, S., & Damodar, D. R. (2019). Foot pressure measurement system and early detection of joint issues. International Journal of Advanced Technology and Engineering Exploration, 6(59), 241-247.

Lawrence, T. L., & Schmidt, R. N. Wireless In-Shoe Force System (for Motor Prosthesis). In Proceedings of the 19th Annual International Conference of the IEEE Engineering in Medicine and Biology Society; Chicago il USA. 30 October– 2 November 1997 (pp. 2238–2241).

MacWilliams, B. A., & Armstrong, P. F. (2000, July). Clinical applications of plantar pressure measurement in pediatric orthopedics. In Pediatric gait: a new millennium in clinical care and motion analysis technology (pp. 143-150). IEEE.

Neaga, F., Moga, D., Petreus, D., Munteanu, M., & Stroia, N. (2011). A wireless system for monitoring the progressive loading of lower limb in post-traumatic rehabilitation. Proceeding of International Conference on Advancements of Medicine and Health Care through Technology; Cluj- Napoca, Romania. 29 August–2 September (pp. 54–59).

Vigneshwaran, S., & Murali, G. (2020, December). Foot plantar pressure measurement system for static and dynamic condition. In IOP Conference Series: Materials Science and Engineering (Vol. 993, No. 1, p. 012106). IOP Publishing.

Wada, C., Sugimura, Y., Ienaga, T., Kimuro, Y., Wada, F., Hachisuka, K., & Tsuji, T. (2010). Development of a rehabilitation support system with a Shoe- type measurement device for walking. Proceedings of the SICE Annual Conference. Taipei, Taiwan, 2534–2537.

Zhu, H. S., Wertsch, J. J., Harris, G. F., Loftsgaarden, J. D., & Price, M. B. (1991). Foot pressure distribution during walking and shuffling. Archives of Physical Medicine and Rehabilitation, 72(6), 390–397.