iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36988

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

An Introduction to Foot Planter Pressure Measurement System

Srishti Namdev[1], Dr. S. K. S. Yadav[2]
[1, 2]*Department of mechanical engineering Harcourt butler technical university Kanpur, India*

Abstract: ***Foot planter pressure is the area that is between the foot and the surface during daily life activities and other activities. It can help to solve the problems of such disease like gait, diabetes and foot ulceration. It also plays the main role in the patients who are at the risk of variety of foot problems. This paper is about to know the brief discussion on foot related problems. In this article we also discuss the types of foot planter pressure measurement and its future technology. Foot planter system is the system which is very helpful to the patients of foot problems. This system is not only for the patients of foot problems but also used in sports and our daily life. Future applications of the planter pressure to improve in design and more comfortable. High plantar pressures have been shown to be a key risk factor for foot ulceration in people with diabetes. Patients are generally prescribed insoles designed to reduce pressure. New technologies like plantar pressure measurement devices and 3D foot scanners have the potential to improve insole design. Still, it is not clear to what such technologies are currently using by physicians. After that, there has been previous research designed to understand how best to use technology to improve insole design for patients with diabetes.***

Keywords: pressure sensors, shoes, diabetes

I. INTRODUCTION

The development of area of micro channel, lightweight for healthcare sensors applications is increasing day by day. Researchers also gave the focus on this field of sensors, biomedical and healthcare. One area is sports and their related application which attracts the researchers is the analysis of foot planter pressure system to disclose the pressure between the shoe sole and foot. The applications of footwear design are to improve the balance control, diagnosing disease, and sports performance analysis and injury prevention. New creative applications have also been made to biometric, rehabilitation support systems, human identification.

Now it is clear that techniques capable of accurately and efficiently measuring foot pressure are crucial to other development. Especially for the study of foot function plantar pressure measurement has become an important research in human movement. The division of pressure between the sole and the ground or shoe offers valuable information for the estimation of various foot pathologies. Plantar pressure measurements have been appreciated as useful for the estimation of conditions like diabetes, arthritis, and many other problems related to the musculoskeletal system. Information about sensor characteristics and measurement technology is basic to the understanding of precise but significant differences between commercially available systems for both foot and in shoe measurement. Common issues for the use of plantar pressure measurement are discussed, such as the required laboratory setting, standardization of measurements and practical suggestions.

This system is available in market and in research laboratories where the different type of applications are required. The order to these is three types: Pressure distribution platforms, Imaging technologies and in-shoe systems. For designing of plantar pressure devices the main things are spatial resolution, sampling frequency, accuracy, sensitivity and calibration. These things will be discussed in next topic. In-shoe sensors have proposed the way to improve the efficiency, flexibility, mobility and low cost measurement systems.

For this system to be mobile and wearable for observing the activities of daily life, the system should be wireless and low power consumption. Wireless in-shoe foot plantar measurement systems have many qualities to transfer the data communication systems, miniaturized biomedical sensors and many more. This review will categories the many methods for measuring foot plantar pressure and the advantages and disadvantage of pressure sensors used in different ways. Further, the discussion will introduce a micro-electromechanical system pressure sensor that has considerably improves the performance features. Now many solutions presented by researchers to measure foot plantar pressure using in-shoe system will be shown in next topic. In this review, we propose an insole and platform based planter pressure devices.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

II. ENVIRONMENTS OF FOOT PLANTER PRESSURE MEASUREMENT

There are many types of planter pressure measurement systems but commonly they are classified into two types:

A. Platform System

Platform systems are made from a flat, rigid array of pressure sensing elements arranged in a matrix configuration in the floor to allow normal gait. Platform systems are used for static and dynamic studies. This system is easy to use because it is stable and flat. The disadvantage of this system is that the patient need to clear that he has natural gait problem. For the accurate reading it is necessary for the foot to contact the centre of the sensing area.

Figure 1. A platform-based foot plantar pressure sensor emed® by Novel [1]

B. In Shoe System

These sensors are flexible and placed in the shoe such that measurement reflects the combine between the shoe and the foot. This system is flexible and portable which allow a large variety of studies with different foot wear designs. These are most required for study of footwear design and orthotics but in this type of system there is a possibility of sensor slipping. For the accurate and reliable result sensor should be secured to prevent slippage.

Figure 2. An in-shoe based foot plantar pressure sensor by Pedar© Novel [1]

III. LATEST TRENDS IN FOOT PLANTER PRESSURE MEASUREMENT

Trends in biomedical applications are using real-time and in-situ measurement of daily life parameters to keep a fast-changing scientific environment. Researchers are concentrating on designing systems for the constant measurement of real life parameters which is important in understanding the effect of daily activities. The system to achieve this would be mobile, embedded in the shoe sole and have the ability to measure effectively in the selected environment.

Zhu et al. [46] developed a system for measuring the pressure distribution under the foot using seven force-sensitive resistors (FSR). They used it to differentiate pressure between walking and shuffling and climb on stairs. In 1997, Cleveland Medical Devices Inc. [49] created an in-shoe wireless system which measures time of foot contact, the weight on each foot and the centre of pressure (COP) of each foot. In this paper, a main criterion is on the recent development of the system.

A. Wired Systems Application

Last two years there has been growth in developing in-shoe foot plantar pressure systems and recently development in plantar pressure using wired and wireless systems. For human identification a paper employed dynamic planter pressure using an insole pressure sensor which named FlexiForce® (Tekscan, USA) in 2011. They compared the pressure at different positions of key points then identified and classified them using a support vector machine (SVM) running on a PC.

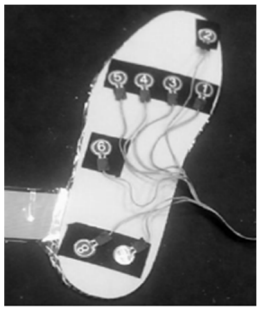
The system uses wire to transfer data from the sensor to a data acquisition card on a PC and the accuracy of this system is 96%. Some other researchers also proposed their own biometric identification in-shoe system and the platform system. The system used F-scan as the pressure sensor. Other application of in-shoe system is to measure triaxial stress in high-heeled shoes. In this paper we discussed the distribution of contact pressure and sheer stress in high-heeled shoes.

Figure 3. Biometric identification based on foot pressure pattern changes. Modified from [2].

Figure 4. Identification based on dynamic plantar pressure in-shoe system [3].

The system is named “WalkinSense” and consists of a data acquisition and processing unit and eight individual sensors. It appears that only the sensor part is their own development, the rest of the system is similar to F-Scan® (Tekscan, USA) hardware and software. The location of the sensors is illustrated in Figure 19, whilst the WalkinSense® System.

Figure 5. WalkinSense® sensor placement [4].



B. Wireless System Application

Now a day’s many new technologies are running in the market. The wireless system is needed. It provides a real-time and accurate result to measure the planter pressure. There has been some work in research area that concentrated on developing more automatic methods of measuring foot pressure. In shoe system is increasing day by day. The reason for this usefulness is that a system could measure the pressure distribution directly under the foot.

In the system there are three orthogonal gyroscope, three orthogonal accelerometers, four force sensors, two dynamic pressure sensors, two directional bend sensors. This device is used for detecting heel strike. There are microcontrollers, antenna and power supply is also attached to the shoes. Wireless system is mainly developed for posture and gait analysis.

Figure 6. Shoe-integrated wireless sensor system, GaitShoe [5], showing all the hardware components.

Figure 7. A wireless systems for gait and posture analysis based on pressure insoles and inertial measurement units [6]

IV. FUTURE WORK

This paper showed the major variety of planter pressure measurement system which is used in the market. Pressure sensors are being placed inside the shoe. Currently the scope of wireless system is increasing day by day. The latest research on wireless system is for gait and posture analysis. In future there are several chances of minimizing the size of the sensors. So that the shoes are more comfortable and will gives the better accuracy.

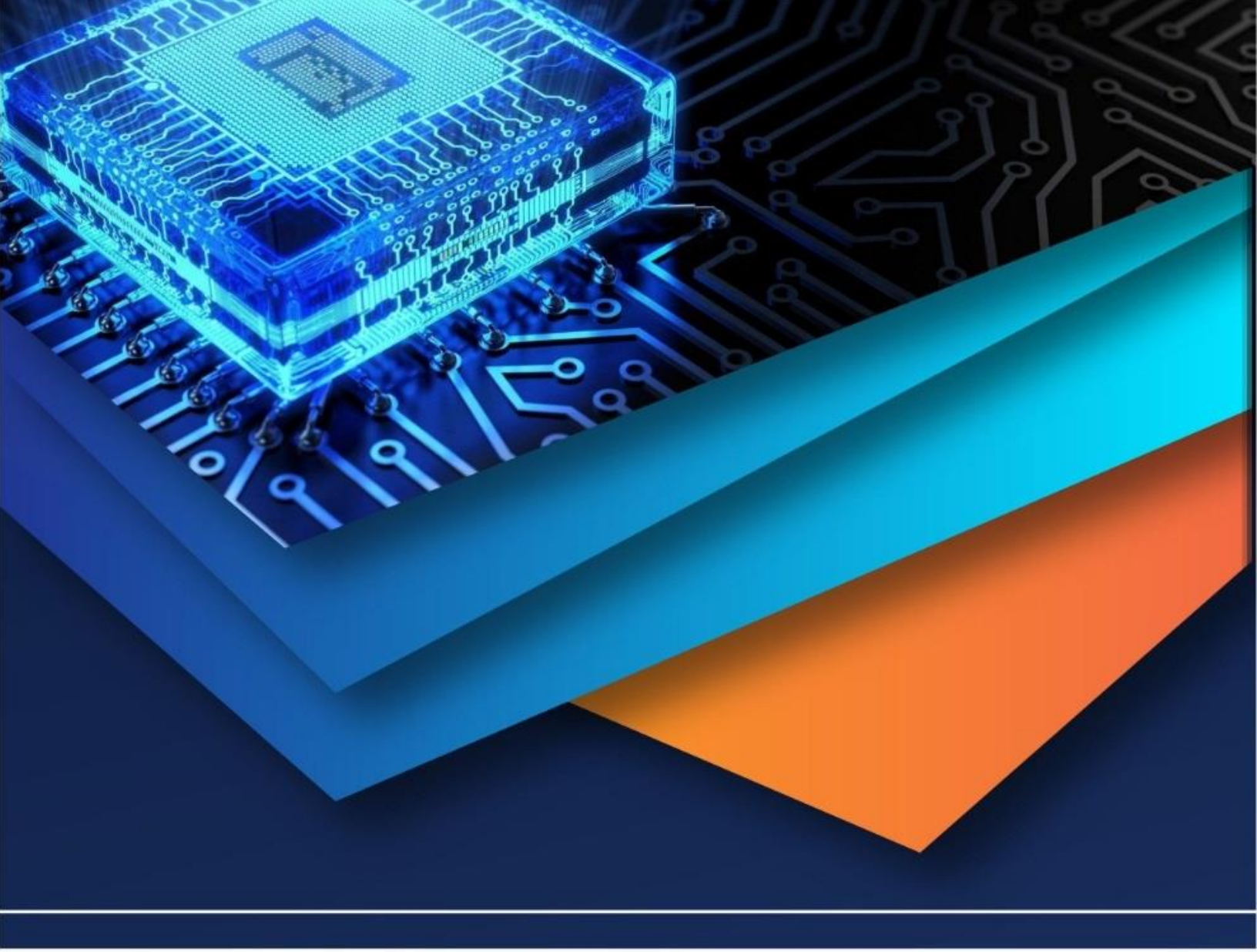
V. CONCLUSION

In this paper the research will based on this system that plays an important role in healthcare and sports area. Finally, it showed a solution for wearable wireless sensor system. The design of the system show some good result by the proposed in-shoe planter pressure system.

REFERENCES

[1] Abdul Razak, A. H., Zayegh, A., Begg, R. K., & Wahab, Y. (2012). Foot plantar pressure measurement system: A review. Sensors, 12(7), 9884-9912.
[2] Yamakawa, T., Taniguchi, K., Asari, K., Kobashi, S., & Hata, Y. (2010, September). Biometric personal identification based on gait pattern using both feet pressure change. In 2010 World Automation Congress (pp. 1-6). IEEE.
[3] Drugă, C., & Şerban, I. (2017). Study of foot pressure-sole pressure sensor.
[4] Healy, A., Burgess-Walker, P., Naemi, R., & Chockalingam, N. (2012). Repeatability of WalkinSense® in shoe pressure measurement system: A preliminary study. The Foot, 22(1), 35-39.
[5] Bamberg, S. J. M., Benbasat, A. Y., Scarborough, D. M., Krebs, D. E., & Paradiso, J. A. (2008). Gait analysis using a shoe-integrated wireless sensor system. IEEE transactions on information technology in biomedicine, 12(4), 413-423.
[6] Benocci, M.; Rocchi, L.; Farella, E.; Chiari, L.; Benini, L. A Wireless System for Gait and Posture Analysis based on Pressure Insoles and Inertial Measurement Units. In Proceeding of the 3rd International Conference on Pervasive Computing Technologies for Healthcare, 2009. Pervasive Health 2009, London, UK, 1–3 April 2009; pp. 1–6.
[7] Yang, C. M., Chou, C. M., Hu, J. S., Hung, S. H., Yang, C. H., Wu, C. C., ... & Yang, T. L. (2009, September). A wireless gait analysis system by digital textile sensors. In 2009 Annual International Conference of the IEEE Engineering in Medicine and Biology Society (pp. 7256-7260). IEEE.
[8] Zhu, H.; Wertsch, J.; Harris, G.; Loftsgaarden, J.; Price, M. Foot pressure distribution during walking and shuffling. Arch. Phys. Med. Rehabil. 1991, 72, 390–397.

[9] Tanwar, H.; Nguyen, L.; Stergiou, N. Force Sensitive Resistor (FSR)-Based Wireless Gait Analysis Device. In Proceeding of The Third IASTED International Conference on Telehealth, Montreal, QC, Canada, 31 May–1 June 2007.
[10] Praet, S.; Louwerens, J. The influence of shoe design on plantar pressures in neuropathic feet. Diabetes Care 2003, 26, 441–445.
[11] Hung, K., Zhang, Y. T., & Tai, B. (2004, September). Wearable medical devices for tele-home healthcare. In The 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (Vol. 2, pp. 5384-5387). IEEE.
[12] Bonato, P. Wearable sensors/systems and their impact on biomedical engineering. IEEE Eng. Med. Biol. Mag. 2003, 22, 18–20.
[13] Mueller, M. J. (1999). Application of plantar pressure assessment in footwear and insert design. Journal of orthopaedic & sports physical therapy, 29(12), 747-755.
[14] Urry, S. (1999). Plantar pressure-measurement sensors. Measurement science and technology, 10(1), R16.
[15] Tanwar, H., Nguyen, L., & Stergiou, N. (2007, May). Force sensitive resistor (FSR)-based wireless gait analysis device. In The Third IASTED International Conference on Telehealth (pp. 1-6).
[16] Cong, Y., & Zhang, M. (2010, October). Measurement of in-shoe plantar triaxial stresses in high-heeled shoes. In 2010 3rd International Conference on Biomedical Engineering and Informatics (Vol. 4, pp. 1760-1763). IEEE.
[17] Holleczek, T., Rüegg, A., Harms, H., & Tröster, G. (2010, November). Textile pressure sensors for sports applications. In SENSORS, 2010 IEEE (pp. 732-737). IEEE.
[18] De Rossi, S. M. M., Lenzi, T., Vitiello, N., Donati, M., Persichetti, A., Giovacchini, F., ... & Carrozza, M. C. (2011, August). Development of an in-shoe pressure-sensitive device for gait analysis. In 2011 Annual International Conference of the IEEE Engineering in Medicine and Biology Society (pp. 5637-5640). IEEE.
[19] Razak, A. H. A., Zayegh, A., & Begg, R. K. (2012, February). Design and simulation of a wireless DAQ-IC for foot plantar pressure. In 2012 Third International Conference on Intelligent Systems Modelling and Simulation (pp. 713-717). IEEE.
[20] Shu, L., Hua, T., Wang, Y., Li, Q., Feng, D. D., & Tao, X. (2010). In-shoe plantar pressure measurement and analysis system based on fabric pressure sensing array. IEEE Transactions on information technology in biomedicine, 14(3), 767-775.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY