Clinical Research on Foot & Ankle

Short Communication Open Access

Hand-Held Multimodal Skin Detection for Diabetic Feet

Aleena S*

Department of Surgery, Afghanistan

Abstract

Currently, diabetic foot ulcers are difficult to detect accurately and timely, leading to a lot of pain and expense. Current best practice is daily follow-up by people with diabetes along with scheduled follow-up by the incumbent care provider. Although certain indices have been shown to be useful in detecting or predicting ulcers, there is currently no single indicator that can be relied upon for diagnosis. We have developed a prototype multivariable scalable sensor platform that we demonstrate the ability to collect signals about acceleration, rotation, skin electrical response, ambient temperature, humidity , force, real-time skin temperature and bioimpedance data, for later analysis, using the low-cost Raspberry Pi. And Arduino devices. We demonstrate the usefulness of the Raspberry Pi computer in this study of particular interest in electronics - the Raspberry Pi version. We conclude that the presented material shows potential as an adaptive research tool capable of synchronous data collection across multiple sensing modalities. This research tool will be used to optimize sensor selection, placement and algorithm development before translating to a later sock, insole or platform diagnostic device. The combination of several clinically relevant parameters will provide a better understanding of the tissue condition of the foot, but further testing and analysis in volunteers beyond the scope of this article will be reported in the desired time.

Keywords: Clinical; Diabetic foot; Ulcer

Introduction

In this article, we focus on the design and implementation of a shoe sensor prototype to study diabetic foot disorders. We have tried to use low-cost core technology because cost is a significant barrier to the adoption of new technologies. This approach has made Raspberry Pi an attractive option for controlling data collection with low purchase cost, private python environment with LAN connection, multiple USB ports and desktop environment significantly reduces development time [1, 2]. The Rasbian operating system has proven to be a very stable data collection platform with few background tasks running, greatly improving the stability of critical tasks compared to PCs or Apple computers. Diabetes is a chronic endocrine disease that can develop at any stage of life and affects the body's production and/or use of insulin, leading to blood sugar regulation. Unless well controlled, it can cause vascular and neurological disease throughout the body, often leading to serious comorbidities such as retinopathy, kidney failure, and diabetic foot disorders. Diabetic foot disorder is classified as a medical emergency because it can become severe enough to require amputation and is the second most feared diabetic comorbidity after blindness. Diabetes is also a financial burden, and now the NHS consumes 10% of its annual budget, which is expected to rise to 17% by 2035 in direct costs [3-5]. Current best practice recommends that patients perform daily foot monitoring supported by regular physical examination by trained professionals, with the use of non-contact temperature measurement for those most at risk. Although non-contact thermography reduces the risk of ulcers, it is still a significant risk. Many unique parameters such as temperature, pressure, or force in various forms, gait changes, and blood flow have been shown to be indicative of ulcers, but none are predictive of ulcers. Commercial devices such as the Sensoria socks, which incorporate three force sensors and a three-axis accelerometer, are available as base devices. Devices such as the TekScan Mat and F-Scan are intended exclusively for laboratory or clinical use. We present a new portable and scalable synthetic sensor system, capable of measuring multiple factors simultaneously, providing an alternative multifactorial pathway for tissue failure prediction. This device increases the number of metrics measured at the same time in predicate devices from 3 to 8 [6-8]. Biological impedance is a complex measurement consisting of real and imaginary components. The extracellular fluid forms the resistive path while the intracellular fluid forms the capacitive component with the plasma membrane in between acting as the dielectric. Inflammation is a systemic response to soft tissue injury as increased blood flow and vascular permeability lead to extravasation. Fluid entering the intracellular space changes the balance of resistive and capacitive pathways. Impedance tests the response of a material to a range of induced frequencies, with phase difference and gain as measurements. The outer layer of the skin, the stratum corneum, consists of a dense layer of dead cells with a high resistivity. Because the thickness, humidity, density and activity of sweat glands vary from person to person and are affected by disease, the skin's resistance is also very different. To overcome this, techniques such as peels and/or conductive gels have been used to normalize resistance to skin contact. Short-term use of these means of contact is a minor inconvenience, but they are known to cause skin irritation if used for long periods of time [9,10]. By using capacitive coupling, we have eliminated the need for electrical contact media, reducing the risk of skin irritation with prolonged use.

Discussion

The occluded blood flow test was performed with an occlusion time of 1 min, providing an appropriate change in signal that could be measured to demonstrate the effectiveness of the device with minimal volunteer discomfort. As can be, the signal frequency has changed from 0.16 Hz before occlusion to -0.26 Hz after occlusion in the given example, with some variation in the amplitude of the phase measurement. Similar to the post-obstruction reactive hypertension test, it is noted that pre-test stabilization takes several minutes, this is due to the time required

***Corresponding author:** Aleena S, Department of Surgery, Afghanistan, E-mail: eela@gmail.com

Received: 03-Apr-2023, Manuscript No: crfa-23-96670, **Editor assigned:** 05-Apr-2023, PreQC No: crfa-23-96670 (PQ), **Reviewed:** 19-Apr-2023, QC No: crfa-23-96670, **Revised:** 21-Apr-2023, Manuscript No crfa-23-96670 (R) **Published:** 28-Apr-2023, DOI: 10.4172/2329-910X.1000410

Citation: Aleena S (2023) Hand-Held Multimodal Skin Detection for Diabetic Feet. Clin Res Foot Ankle, 11: 410.

to normalize O2, CO2, NO and tissue metabolites after restoration of blood flow. We are currently investigating the usefulness of this new metric because we can observe a measurable impact in tissues in vivo.

Conclusions

Previous devices incorporate up to three measurement modes. The device shown measures eight, 42 individual, bilateral sensors plus ambient temperature and humidity. This provides an opportunity to assess the interdependence in the metrics used and thus to quantify the value of each measure and the multifactor detection algorithm. Evaluating the interrelationships of some factors is always difficult because multifactor data cannot be measured without restriction, this device will overcome this limitation. With eight measurements taken, it is now possible to collect comprehensive data from the footwear environment. This development will lead to a better understanding of the biological mechanisms and local environmental considerations that influence foot health. With the growing understanding of diabetic foot-related problems, it will be necessary to modify sensor networks to tailor them to specific investigations. The instrument is a scalable and adaptive measuring system that can be modified to optimize sensor selections and positions as needed. The standout instrument demonstrated multi-element data measurement using both analog, 10-bit and I2C interfaces in real time. These interfaces can be quickly adapted to measure other sensors as required by each investigator allowing for customization of the measurement network.

Conflict of Interest

None

Acknowledgment

None

References

1. Jeffcoate WJ, Harding KG (2003) Diabetic foot ulcers. Lancet 361(9368): 1545-1551.
2. Harjutsalo V, Groop PH (2014) Epidemiology and risk factors for diabetic kidney disease. Adv Chronic Kidney Dis 21: 260-266.
3. Hyslop E, McInnes IB, Woodburn J, Turner DE (2010) Foot problems in psoriatic arthritis: high burden and low care provision. Ann Rheum Dis 69(5): 928-963.
4. Chandratre P, Mallen C, Richardson J, Rome K, Bailey J, et al. (2012) Prospective observational cohort study of Health Related Quality of Life (HRQOL), chronic foot problems and their determinants in gout: a research protocol. BMC Musculoskeletal Disord 13(1): 219-254.
5. La Li J, Shangguan H, Chen X, Ye X, Zhong B, et al. (2020) Advanced glycation end product levels were correlated with inflammation and carotid atherosclerosis in type 2 diabetes patients. Open Life Sci 15: 364-372.
6. Choi H, Koo D, Yim J (2022) Correlation of advanced glycation end products and heme oxygenase-1 in Korean diabetic patients. J Nutr Health 55: 348-358.
7. Chandratre P, Mallen C, Richardson J, Rome K, Bailey J, et al. (2012) Prospective observational cohort study of Health Related Quality of Life (HRQOL), chronic foot problems and their determinants in gout: a research protocol. BMC Musculoskeletal Disord 13(1): 219-254.
8. Wickman AM, Pinzur MS, Kadanoff R, Juknelis D (2004) Health-related quality of life for patients with rheumatoid arthritis foot involvement. Foot Ankle Int 25(1): 19-26.
9. Bergin SM, Munteanu SE, Zammit GV, Nikolopoulos N, Menz HB (2012) Impact of first metatarsophalangeal joint osteoarthritis on health-related quality of life. Arthritis Care Res 64(11): 1691-1698.
10. Polachek A, Li S, Chandran V, Gladman D (2017) Clinical enthesitis in a prospective longitudinal psoriatic arthritis cohort: incidence, prevalence, characteristics and outcome: Enthesitis in psoriatic arthritis. Arthritis Care Res 69(11): 1685-1691.