Name(s)

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Project Number

J0936

Project Title

Arduino-Based Foot Neuropathy Analyzer

Abstract

Objectives/Goals

Diabetes is one of the major causes of illness and premature death worldwide. Diabetes causes neurovascular complications, which result in the development of high pressure areas in feet and hands. Diabetic neuropathy causes nerve damage which can lead to amputation or ulceration. Locating abnormal pressure patterns under the foot enables early detection of neuropathy, preventing its serious consequences. My objective in this project is to design and build a low-cost pressure measurement and analysis system based on an Arduino microcontroller, which a patient can use at home to measure his or her foot pressure distribution. If the system detects a problem, it can send an alert to a doctor.

Methods/Materials

In my device, the foot pressure distribution is measured by a set of eight FlexiForce pressure sensors distributed under the shoe. The sensors are placed in the following areas: heel, metatarsal head1, metatarsal head (high pressure areas), metatarsal head5, toe, arch1 (medium pressure areas), fing, arch2 (low pressure areas). The FlexiForce pressure sensors are based on force-sensing resistors, whose resistance varies inversely with the applied force. By connecting it with an electrical circuit, this change in resistance is converted to a change in voltage, which is sensed by the Arduino microcontroller. This information is then transmitted through a wireless transmitter. A software application running on a cell phone, PC, or tablet can receive the signal and display it.

Results

I have successfully designed and built a prototype system using a set of eight FlexiForce sensors distributed on a shoe. An Arduino microcontroller is used to measure the pressure sensor outputs and transmit the information through an Xbee wireless transmitter. I have also built a display device that receives the wireless signal and displays the foot pressure information on an LED bar graph display.

Conclusions/Discussion

The device can be used to compare the pressure distribution against a reference distribution and show any anomalies. It can then alert a healthcare provider. The results show that such a device can be built at a low cost and can accurately measure the foot pressure distribution to detect anomalies.

Summary Statement

I designed and built a low-cost pressure measurement and analysis system based on an Arduino microcontroller, which a diabetic patient can use at home to measure his or her foot pressure distribution and detect neuropathy.

Help Received

Father helped buy components.