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A BIOMEDICAL SYSTEM FOR ON-LINE MEASUREMENTS OF GAIT PARAMETER

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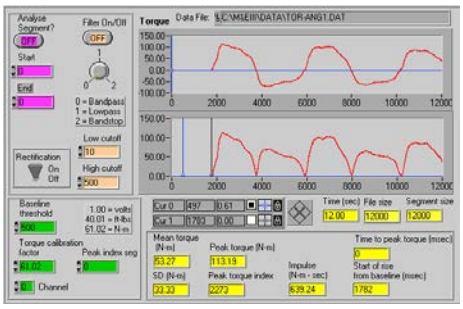
Abstract

Introduction: Healthcare cost continues to increase globally partly due to the surge in the occurrence of falls among the human being. The rehabilitation monitoring is a method to access and identify human body events and the measurements of dynamic and motion parameters involving the lower part of the body. This significant method is widely used in rehabilitation, sports and health diagnostic towards improving the quality of life. This research focuses on the development of a portable shoe integrated with wireless sensors and microelectronic based system.

Materials and Methods: The important gait parameter that influences the risk of falling among the human is foot clearance. The foot ground reaction forces produced by human body is very important in gait analysis. It is the natural parameter of the foot during the swing phase of the gait cycle that represents the distance of shoe sole above the ground. A recent study involving the analysis of the tripping and falling risks among the elderly and individuals during walking, showed that the motion of the foot during mid-swing phase is the most critical issue that can initiate the possibility of trip-related decline. The trip or fall is an event which may lead someone to collapse accidentally due to unstable position. It is a very dangerous incident among the elderly as it may cause critical injury and death. This important stage of foot movement is referred to as minimum foot clearance (MFC). Studies shows the MFC is below 5 cm while the foot trajectory during gait may go up to 17 cm. The selections of sensors and hardware are depending on the requirement of the foot clearance measurement. The sensors that are used in this research are ultrasonic sensor and IMU for determination of the MFC as well as the orientation of foot position respectively. The hardware design consists of Arduino microcontroller, 2.4 GHz IEEE 802.15 transceiver and power supply unit. Ultrasonic detectors are devices that are utilized for distance measurement which operates almost similar to how the radar is working where the distance is deduced from the total time of flight of the signal waves and the signal speed. An inertial measurement unit (IMU) is a device that contains accelerometer and gyroscope used to measure angular rate and acceleration data.



Results: The graphical human movement pattern of subjects during walking is shown in figure 1. The graph shows the several cycle of gait pattern including the gait phase such as MFC, toe off and landing phase. The measurements still due to the offset start reading point and the angle of the feet during walking. The ultrasonic system gives the direct distance reading instead of the foot clearance reading. The display of the human movement pattern of subject during walking shows the applicability of the system.

Figure 1 Human movement graph pattern.

Conclusions: This system has high potential to be marketed especially for rehabilitation centers, sports centers, health centers, hospitals, research organizations and the elderly. The medical specialist are also able to monitor the elderly gait, weakness identification and injury prevention for their patients.