S.T.E.M.: Wearable spine posture protective vest using IoT

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ABSTRACT –Posture requires cognizant hard work to maintain and long term incorrect posture may cause serious health complications. Human tends to slouch due to lack of proper ergonomic seat design and implementation of good habit during daily activities. With the increase use of technologies in the Industrial Revolution 4.0, sitting at computer desk to complete daily tasks has become a trend. While employers are seeing increases in productivity, worker are experiencing health issues i.e. side effect from sitting all day long. The side effect is called postural kyphosis. This condition may cause pain in the shoulders and neck area. Therefore, this research presents an innovation in the development of a wearable spine posture protective vest using IoT that can help users to correct bad posture in order to treat their back pain and indirectly implement daily correct posture. The vest should be able to be worn by the user without any external assistance. The wearable spine posture protective vest also incorporated IMU sensors that enable users to track their posture in real-time thus allowing the user to correct their posture via Blynk apps.

1. INTRODUCTION

A posture corrector is a device that helps to improve body's alignment. According to experts in the industry, a corrective brace retrains the body's musculature system. Over long period hours of sitting and engaging in activities that effect human upper body muscle tone, human posture will deteriorate with time. Recently, incorrect human posture has become normalized due to lack of proper ergonomic seat design and lack of good habit during daily activities [1]. Although workspaces are required to implement ergonomic workspace environments, it is impossible for them to monitor their posture habit [2]. There are many physical activities that can cause postural kyphosis also such as driving, watching television, reading, biking, sitting at desk, long hours using computer and wearing a backpack. Sports are not the only way to develop these muscle imbalances, any sort of exercise or strength training done without proper posture or without appropriate post activity stretching can cause this muscle imbalance issue. Therefore, the aim of this research is to develop a wearable spine posture protective vest that can assist user to monitor and correct their posture in real-time. The vest should be able to replace physical therapy session.

2. METHODOLOGY

In developing the product architecture, the functional elements and physical elements are group into modules. Figure 1 below shows the elements that have been clustered into modules from the schematic diagram of the wearable spine posture protective vest. There are four modules for the design of the wearable spine posture protective vest; i.e.: (i) vest module, (ii) sensor module, (iii) IOT module and (iv) motor & supply module.

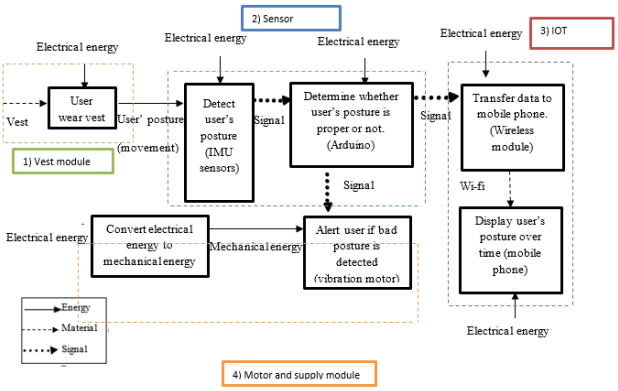

Figure 1 Product architecture of wearable spine posture protective vest

In order to translate the product architecture into prototype, a rough geometric layout was constructed to investigate the interference between the elements and modules in order to construct an acceptable layout. In this research, the interactions between the four modules, which are the vest module, sensor module, IOT module, and motor & supply module are physically interconnected. To ensure the sensor can accurately detect the bending posture, the placement of the sensor is crucial. Figure 2 below shows the components geometric layout of the wearable spine posture protective vest.

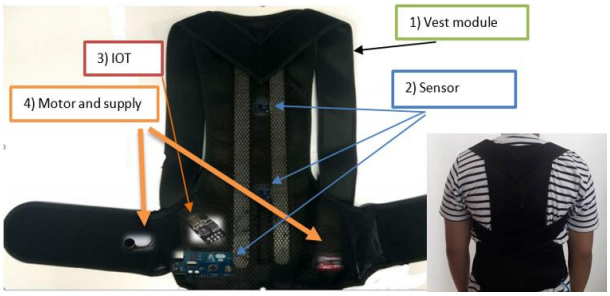

Figure 2 Modules for the Wearable Spine Posture Protective Vest

3. RESULTS AND DISCUSSION

Based on Figure 1, the function structure highlights the real process of the wearable posture spine protective vest from the input until it reach of desire output. Table 1 shows the functionality test of inputs and outputs of the system. The monitoring process start when user wears the vest where the data is collected continuously as shown in Figure 3. The IMU sensor will automatically be activated when user press the "ON" switch. If the sensor detects incorrect posture, it will send an electrical signal to Arduino and vibrate the motor to give an indication of incorrect posture as shown in Figure 4 (a). This vibration will give an alert to user to manually adjust their posture. For the IOT module, the data signals are being displayed continuously via the Blynk apps as shown in Figure 4 (a) and (b). The posture data were collected from the IMU sensors (MPU 6050) and plotted in the Blynk apps via the wireless module, which is the crucial part of the IoT module.

Table 1 Functionality test of inputs and outputs

Input & output	Result	Remarks
IMU sensors (MPU6050)	Pass	Able to detect bend angle and obtain results
Wireless module (NodeMCU)	Pass	Able to display user interface on smart phone
Vibration motor	Pass	Able to vibrate on desired speed

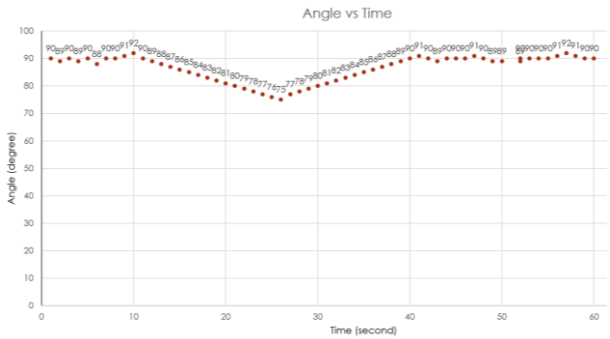

Figure 3 Graph of angle versus time (IMU sensor)

(a) Incorrect posture (b) Correct posture

Figure 4 User interface shown on Blynk apps via smart phone.

4. CONCLUSION

In conclusion, a wearable spine posture protective vest prototype using IoT was successfully developed and tested to correct incorrect posture. The wearable spine posture protective vest was able to detect and monitor incorrect posture by using IMU sensors and directly sending an alert to user via vibration motor. Also, the posture can be monitor via Blynk apps in real-time applications.

5. ACKNOWLEDGEMENT

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