Development of a Wearable Instrumented Vest for Posture Monitoring System

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***Abstract*—Body posture and activity are important indices for assessing health and quality of life, especially for elderly people. Therefore, an easily wearable device or instrumented garment would be valuable for monitoring elderly people's postures and activities to facilitate healthy aging. In particular, such devices should be accepted by elderly people so that they are willing to wear it all the time. This paper presents the design and development of a novel, textile-based, intelligent wearable vest for real time posture monitoring and emergency warnings. The vest provides a highly portable and low-cost solution that can be used both indoors and outdoors in order to provide long-term care at home, including health promotion, healthy aging assessments and health abnormality alerts. The usability of the system was verified using a technology acceptance model based study of 50 elderly people. The results indicated that although elderly people are anxious about some newly developed wearable technologies, they look forward to wearing this instrumented posture-monitoring vest in the future.**

Keywords—wearable; posture monitoring; accelerometer; tilt angle; motion sensing.

I. INTRODUCTION

Human posture and activity levels are crucial indices for assessing health and quality of life. Such indices can provide information for targeted health promotion. Around 50 billion dollars is spent yearly on therapy for low back pain in the United States alone. Low back pain is one of the most common reasons for doctor visits. Having poor posture has been found to be a main cause of lower back pain as it impacts the transverses abdominis muscle. Maintaining a good posture and changing one's position from time to time is considered to significantly improve and maintain one's health. The world has witnessed a vast amount of smart monitoring devices that are used to enhance the quality of life by providing different types of support. For example, they can be used to monitor the number of steps walked per day, to remind people to maintain proper postures, and to alert them when they do not maintain healthy postures in sitting, walking, standing positions, and others. Such indices can also be used to assess healthy aging and for the early detection of certain chronic diseases such as Parkinson's disease, Kyphosis disease and stroke. Furthermore, they can be used for health abnormality alerts. The typical applications are fall detection and fall-risk estimation, because falling is a major cause of injury and often leads to death in elderly people. The detection of posture change from lying to sitting could even be used to prevent patients or elderly people from bed-fall, see in the future. This study presents the design and development of a wearable instrumented vest for posture monitoring that was proposed in. This garment can process information, such as the tilting angles of sensors and event detection, internally. The application scenarios and software for this vest are described and developed herein for the purposes of health promotion, healthy aging assessments, and health abnormality alerts. Usability of the vest by elderly people was analyzed through a survey using the microcontroller technology.

II. STUDY OF SIMILAR PROJECTS OR TECHNOLOGY\ LITERATURE REVIEW

"A survey on sitting posture monitoring system" by Ferdewstlili, Youssef Ouakrim published in the year of 2018. In this paper, we studied the a valuable source of recent reference for future research in the field of sitting posture monitoring systems. These system defines the body posture using sensing technologies and provide feedback to the user in order to improve the body posture.

"Smart phone-centric human posture monitoring system" by Reza Samiei-Zonouz, Hamidreza Memarzadeh-Tehan and RouhollahRahmani published in the year of 2014. In this paper, they present the design and implementation of a smartphone-centric software for monitoring the human posture by using the acceleration sensors which are embedded in smartphones. Additionally, an emphasis is given to interpreting the obtained data from the acceleration sensors to achieve context-awareness suitable for health care applications. Such the smartphone-centric monitoring softwares are also more cost-effective and less complex compared to its conventional counterparts where multiple wearable sensors are incorporated.

"A new posture monitoring system for preventing physical illness of smartphone users" by Hosublee, youngsang choi and Eunsoo shim in the year of 2013. In this paper, they proposed a mobile posture monitoring system which estimates the tilt angle of the user's neck with built-in sensors in the smartphone. They proposed a new technology to monitor the posture of smartphone users with built in sensors and also to prevent the user from the diseases.

"Research of a system for monitoring body posture based on wireless sensor network" by HuTao, Zhangyong, wangGuozhu, wang Lei in the year of 2011. In this paper, to

distinguish abnormal posture from daily activities through the posture position and acceleration vector threshold so that system can successfully distinguish between normal posture and abnormal in real time.

From this literature survey, they use multiple type of technology to monitor the body posture but in our project only one sensor is used for monitoring the body posture which will use for the patients and also youths to prevent the spinal diseases.

III. PROPOSED MODEL

The sensors positioned at various locations on the vest can be used to detect multiple types of information about the body but in our project only one accelerometer is used to detect posture. For example, the tilting angles of the sensor located on the spine provide information on the bending of the neck and upper back. The sensor on the spine detects positions such as sitting, standing, lying, leaning forward while walking, and degree of trunk bending. It can also detect body activities such as sitting up in bed, body turning while sleeping, and trunk bending. The Accelerometer at the spine position monitors the X,Y,Z Positions. The X,Y,Z data from Accelerometer is stored in memory bank/Registers of microcontroller. The stored data can be fetched from memory bank of microcontroller and that parameters will be send to user and doctor mobile numbers which already stored as default numbers.

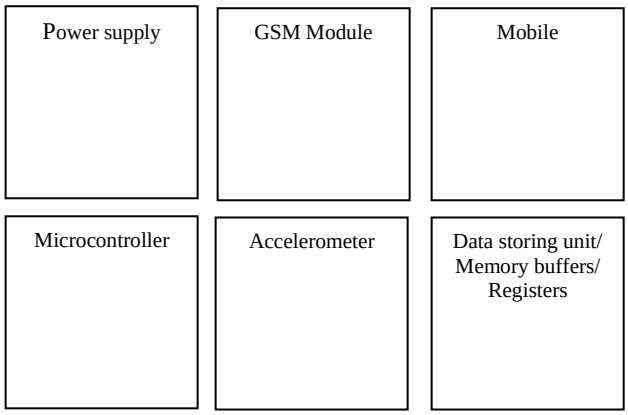

Fig: Block Diagram of entire system

IV. IMPLEMENTATION AND RESULTS

- Reduce chronic pain that results from poor posture.
- Decrease the stress and pressure on the spine.
- Prevent musculoskeletal disorders and structural deformity of spine.
- Train users to maintain good back posture until it becomes a daily routine.

V. CONCLUSION

This study presents the design and development of a wearable instrumented vest for posture monitoring with single channel accelerometer-based motion sensing technologies. With the assistance of accelerometer the system was integrated with conductive textile to produce a vest that is suitable for indoor and outdoor wear and has all the same benefits as regular clothing: specifically, it is comfortable, washable, and easy to wear.

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