HUMAN POSTURE DETECTION SYSTEM USING REAL TIME SELF CALIBRATING ALGORITHM

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Abstract:

In order to detect and correct the posture we developed a wearable garment integrated device to sense the posture of the user and analyze the posture within the device to alert the user remotely. Further the posture data are sends to the server to analyze the data in detail. Device contains the accelerometer sensor to detect the angle of the user. From the angle the posture is calculated using the microcontroller in the device. The posture is analyzed and if bad posture is detected then the buzzer sensor present in the device alert the user to correct the posture. The bad posture data are sends to server through the wifi module present in the device. The data are stored in the database along with time, date and device id. The month wise statistical graph is developed from the data in the database. Daily analyzes of the posture data is done to provide the average posture of the user and worst posture of the user. The report of the analyzed data can be generated in the website through user authentication.

Keywords: human posture, alert,detect, tri-axial, accelerometer, posture correction, report, and wearable device

1.INTRODUCTION

Posture detection and alert system is used to monitor the posture of the users and alerting them to correct the bad posture. Posture is the position in which we hold our bodies while standing, sitting, or lying down. Good posture is the correct alignment of body parts supported by the right amount of muscle tension against gravity. Good posture helps us keep bones and joints in correct alignment so that our muscles are used correctly and reduces the stress on the ligaments holding the spinal joints together, minimizing the likelihood of injury.

The proposed project aims at providing a wearable monitoring system to monitor the user posture continuously using the accelerometer and sends the gathered data to sever by means of the internet the system connected with. By analyzing the data remotely on the system and providing the alert to the user by means of the buzzer and also analyzing the data collected in the sever and generating detailed report on the user posture

Internet of Things (IoT) is a sprawling set of technologies and use cases that has no clear, single definition. One workable view frames IoT as the use of network-connected devices, embedded in the physical environment, to improve some existing process or to enable a new scenario not previously possible. These devices, or things, connect to the network to provide information they gather from the environment through sensors, or to allow other systems to reach out and act on the world through actuators. They could be connected versions of common objects you might already be familiar with, or new and purpose-built devices for functions not yet realized. They could be devices that you own personally and carry with you or keep in your home, or they could be embedded in factory equipment, or part of the fabric of the city you live in. Each of them is able to convert valuable information from the real world into digital data that provides increased visibility into how your users interact with your products, services, or applications. After data is collected from a sensor, the device can provide data processing functionality before sending the data to the cloud. Multiple devices might handle the data before it gets to the cloud, and each might perform some amount of processing. Building Internet of Things solutions involves solving challenges across a wide range of domains. Cloud Platform brings device management, scale of infrastructure, networking, and a range of storage and analytics products you can use to make the most of device-generated data.

2,RELATED WORKS

Assessment of human activity and posture with triaxial accelerometers provides insightful information about the functional ability: classification of human activities in rehabilitation and elderly surveillance contexts has been already proposed in the literature. This paper is proposed by DavideCurone, Gian Mario Bertolotti, Andrea Cristiani, EmanueleLindoSecco,and Giovanni Magenes. In the meanwhile, recent technological advances allow developing miniaturized wearable devices, integrated within garments,which may extend this assessment to novel tasks, such as real-time remote surveillance of workers and emergency operators intervening in harsh environments. We present an algorithm for human posture and activity-level detection, based on the real-time processing of the signals produced by one wearable triaxial accelerometer. The algorithm is independent of the sensor orientation with respect to the body. Furthermore, it associates to its outputs a "reliability" value, representing the classification quality, in order to launch reliable alarms only when effective dangerous conditions are detected. The system was tested on a customized device to estimate the computational resources needed for real-time functioning. Results exhibit an overall 96.2% accuracy when classifying both static and dynamic activities. This paper presents a human activity classifier, based on the real time analysis of the signals detected with a triaxial accelerometer fixed to the trunk. Low-level routines, suitable for implementation on a low-power microcontroller, process the raw accelerometer signals in order to extract simple features, which are directly related to the posture and activity intensity.[1]

Postural change is an important factor in the care and rehabilitation of elderly patients. Changes in gait can signal the onset of neurological diseases such as Parkinson's,whilst changes in how routine tasks are performed – suchas getting out of a chair – can indicate an increase in frailty and a loss of muscle strength which can increase the chance of a fall . By characterizing motion within the home it becomes possible to provide a more accurate picture ofelderly patients' health and wellbeing. Unfortunately, there are various difficulties associated with monitoring specific activities, particularly those related to transitions. Firstly, these motions represent only a small percentageof daily activity. Secondly, they can occur anywhere within the home and the subject may be oriented in any direction. Finally, a high level of subject detail and context is required. In this paper, we present a motion characterizationframework based on the fusion of both wearable and ambient sensors. We use a probabilistic method for detailed posture extraction which utilizes only four cameras and provides a detailed, but privacy respectful, rotationally invariant signature of posture. Data from a wearable accelerometer is fused with optical flow to provide both local and global motion detection which is robust to the relative positioning of camera and subject. We further discuss our method for the fusion of gyroscope and video data which provides both the advantagesof detailed local posture features along with a global estimation of posture through an ear mounted gyroscope. The results derived demonstrate that complex motions can be detected and distinguished between accurately. In thispaper, we present a system for the accurate characterization of motion based upon the fusion of ambient and wearable sensors. A probabilistic, privacy respectful method for the extraction of detailed 3D posture information is proposed and fusion with an ear-worn accelerometer and gyroscope is discussed. We present results detailing high accuracy in the recognition of complex motions over four subjects.

With aging society coming, there are more and more elderly people having the aging-related chronic diseases, such as Parkinson's, and Alzheimer's diseases. In this study, a time-less linear transformation method is proposed to obtain tilting angles from single axis accelerometer data. By wearing the previous designed posture monitor vest and with the proposed algorithm implemented, this wearable system can detect the forward-flexed posture which is frequently seen in the early symptom of Parkinson's disease, the festination. Detection of this posture is the necessary function for the festination detectionsystem which can work as a quantitative tool for early detection of Parkinson's disease. In this work, a wearable forward-flexed posture detection is developed. The upper body lean forward angles are measured to detect the posture and also to indicate the severity of the posture by wearing the posture monitoring vest designed previously. Since the upper body lean forward angles are onlywithin certain tilting range, a time-less linear tilting angle transformation algorithm is proposed for fast angle linear transformation which takes only few amount of time.[5]

A ight-weight online classification method to detect smartphone user's postural actions, such as sitting, standing, walking, and running. These actions are named as "user states" since they are inferred after the analysis of data acquired from the smartphones equipped accelerometer sensors. To differentiate one user state from another, many studies can be found in the literature.[6]

However, this study differs from all others by offering a computational lightweight and online classification method without knowing any priori information. Moreover, the proposed method not only provides a standalone solution in differentiation of user states, but also it assists other widely used offline supervised classification methods by automatically generating training data classes and/or input system matrices. Furthermore, we improve these existing methods for the purpose of online processing by reducing the required computational burden. Extensive experimental results show that the proposed method makes a solid differentiation in user states even when the sensor is being operated under slower sampling frequencies.

Changes in the society workforce in the last decades has forced the adult population to spend long periods of time in a sitting position in the workplace that coupled with a sedentary lifestyle at home is associated to health problems, such as back and neck injuries . While a person is seated, most of their bodyweight is transferred to the ischialtuberosities, to the thigh and the gluteal muscles. The rest of the bodyweight is distributed to the ground through the feet and to the backrest and armrest of the chair when they are available. The adoption of a lumbar flexion position for long periods of time, can lead to a decrease of the lumbar lordosis, causing anatomical changes to the spine and degenerate the intervertebral discs and joints, disorders that have been linked to back and neck pain. In order to build an intelligent chair capable of posture detection and correction we developed a prototype that measures a pressure map of the chair's seat pad and backrest and classifies the user posture. The posture classification was done using neural networks that were trained for 5 standardized postures achieving an overall classification of around 98%. Those neural networks were exported to a mobile application in order to do real-time classification of those postures. Using the same mobile application we devised two correction algorithms that were implemented in order to create an intelligent chair capable of posture detection and correction. The posture correction is forced through the change of the conformation of the chair's seat and backrest by changing the pressure of eight pneumatic bladders.[7]

Measurement of human posture and movement is an essential area of research in the bioengineering and rehabilitation fields. It is motivated by different goals in clinical application, such as in comparing normal movements with pathological movements, planning and evaluating treatment protocols, and evaluating design of orthosis and prosthesis. Human postures and movements have been measured by using different image-based methods including photogrammetry (Weissman 1968; Bullock and Harley 1972; Thometz et al. 2000;Liu et al. 2001), optoelectric analysis (Pearcy et al. 1987; Dawson et al. 1993; Gracovetsky et al. 1995), and video analysis (Robinson et al. 1993; Masso and Gorton 2000;

Nault et al.2002; Engsberg et al. 2003). The characteristics of different image-based methods were summarized by Hsiao and Keyserling (1990). Photogrammetric systems have been used to record two- or three-dimensional image of posture. This type of system uses either light reflective markers or light-emitting diodes affixed to the human body, and captures data with cameras and films for measuring the orientation of body segments through data reduction processing. Optoelectric analysis applies the same principles as photogrammetric system to measure the position of joints and body segments. The optoelectric sensing unit is used for collecting the data instead of films. Video systems also use the similar basic principles as both Photogrammetric and optoelectric systems but capture data with optoelectric units or cameras of higher sampling rate. These systems can be used to capture and record three-dimensional body movements. The availability of these image-based methods has helped to achieve the goals of monitoring and analyzing human posture and movement. However, inherent limitations of these methods, which are complicated to set up, time-consuming to operate, and limited to the laboratory environment (Hsiao and Keyserling 1990), so the chance of using these methods in the clinical applications are restricted. In recent years, low-powered and miniaturized electronic sensors, which are for use in robotic, industrial, aerospace and biomedical applications, have been developed by using advanced electronic circuit technology. The use of these electronic sensors has been considered as alternative methods for human posture and movement analysis in clinical applications. The purpose of this article is to review the possible clinical applications of different types of electronic sensors and systems, and their problems and limitations which are faced in the human posture and movement measurements. Such information would help researchers and clinicians in developing and selecting the most appropriate measurement techniques of using the electronic sensors for clinical applications of human posture and movement analysis.[8]

3. PROPOSED SYSTEM

Product reminds the user to correct their posture Accelerometer calculate axis of user upper body. A Real-Time and Self-Calibrating Algorithm Based on Triaxial Accelerometer Signals is used for calculating human posture and activity Device compares the posture value with the threshold value. The threshold value normal human posture from Intelligent Chair Sensor – Classification and Correction of Sitting Posture is 7. If the value exceeds the threshold limit for duration of a minute the device remains the user to correct the posture through the buzzer/ vibrator.When buzzer/vibrator is activated then device sends posture value to the server using the wi-fi on these devices. From website user generate monthly report.Report contains the number of times device reminds to change the posture. The device can be worn anywhere, it is designed for user's comfort.

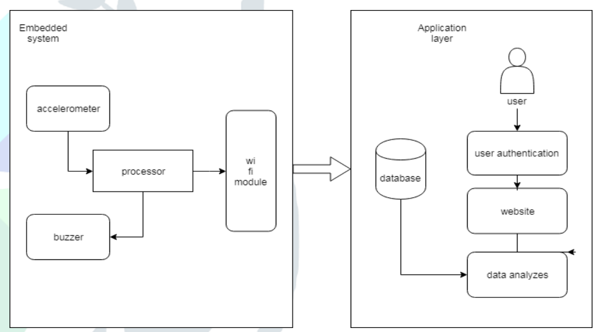


Fig 1.Posture Detection System Architecture

An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

3.1.Human Posture detection

The device gets the value from the accelerometer and the value from the accelerometer is converted into angle degree. For conversion from the accelerometer to angle degree real time self-calibrating algorithm is used. The accelerometer produces three analog signals (x(t), y(t), and z(t)), with values ranging between zero and the current power voltage (vss (t)).

$xG = (x - V0)/Sx yG = (y - V0)/Sy zG = (z - V0)/Sz$

The voltages are converted into angles (xG, yG, and zG), measured as multiples of g. From the converted values the human posture is figured.

3.2 User alert system

User is alerted if the posture of user is not good. The posture of the user is calculated from the accelerometer reading. If the reading is greater than the threshold value than the user is alerted using the buzzer sensor in the device. The user is only if the reading is greater than the threshold value for about and a minute. The buzzer is activated for five seconds and goes to idle.

3.3 Wi-Fi system

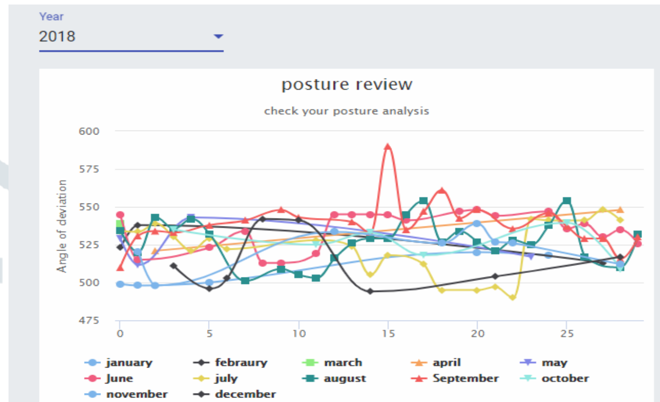
Device send the data collected from the device for the analyzing the posture of the user. Device as an wireless lan through which it is connected to the network. The device sends the data to the server only when the alert system is activated. The normal posture need not to be analyzed.

3.4 Login and register page

User can access the analyzed device data through the website. The website can be accessed only by the registered user. The user can register only if he has an unique device id. The registered user can use the login credential to access the website and access the data of the device. The website consists of homepage and report page to view and generated the report. User can also download the report as a pdf.

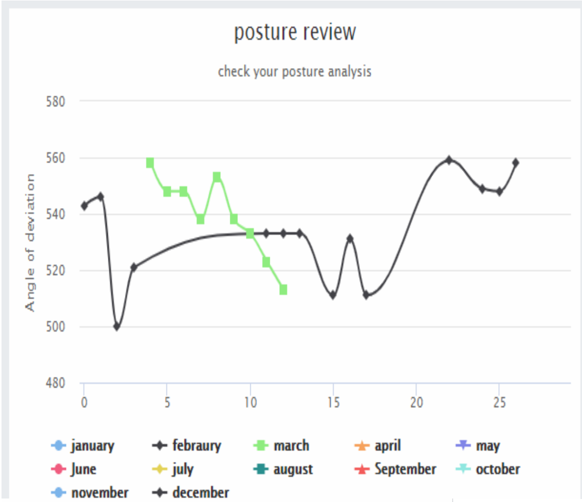
3.5 Analyzing and report generation

The data received in the server is analyzed to generate the report. The real time data is analyzed on daily and monthly based. Graphical representation of the data is generated as the report with maximum deviation of the angle and average angle in daily basis.



Graph 1

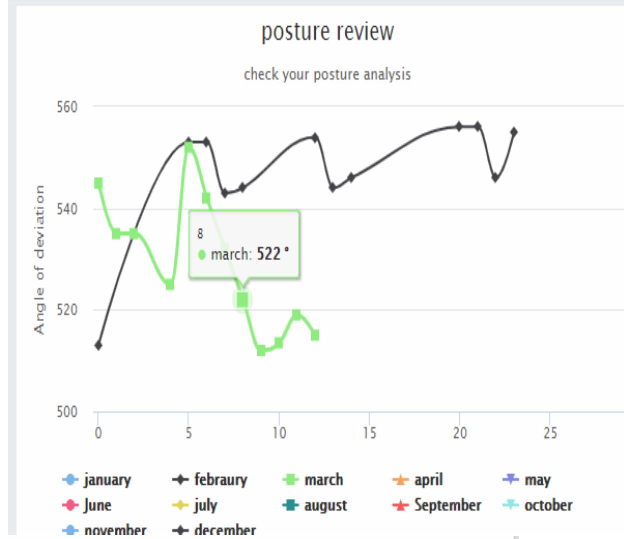
For the user1 the data from the year 2018 are analyzed. The data are obtained from the manual model, no actual user are used to measure the value. From the graph most of the posture readings are similar for every month.



date	maximum deviation	average
26/02/2019	548	548.00
25/02/2019	549	549.00
23/02/2019	559	559.00
18/02/2019	511	511.00
17/02/2019	531	531.00
16/02/2019	511	511.00
14/02/2019	533	533.00

Graph 2
table1

The prototype of the device is been tested on two user. The graph 2 contains analyzes of every bad posture data of the user on daily basis in month wise. The table 1 the average deviation of the posture and the maximum value of the bad posture are determined.



date	maximum deviation	average
13/03/2019	515	515.00
12/03/2019	519	519.00
11/03/2019	516	513.50
10/03/2019	512	512.00
09/03/2019	522	522.00
08/03/2019	532	532.00
07/03/2019	542	542.00

Graph 3
table 2

The graph 3 and table 2 are the data of another user. The both the user graph improves in the next month. But the maximum value of the posture of the day does not change much but the average value considerably decreases for both the user. This decrease in the average is due to the muscle memory. By continuously alerting the user the user remembers to maintain good posture.

4. CONCLUSION

Posture related problem is major problem in the modern world. The bad posture causes many health related problem. Thus our project provides a device to detect and correct the posture of the user. garment-integrated POF bend sensing provides an accurate and reliable measure of seated spinal posture through measurement of sagittal flexion. In addition, the POF sensor is inexpensive and well suited to wearable applications, because of its small size, flexibility, and easily-customized length. In this study, the sensor was evaluated in a wearable configuration designed to minimize the number of additional influencing variables. Removing these variables, however, often requires sacrifices in user comfort and social acceptability of garments.

5. FUTURE ENHANCEMENT

Future work will include analysis of the effects of garment ease and fit on the sensor's performance. Ultimately, this sensor will be integrated into a more complete bio-feedback posture monitoring system. By integrating multiple accelerometer sensor in the device the posture of the user can be measured with more accuracy. By reducing the size of the sensor and battery user comfort can be increased.

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