Posture Monitoring Belt

Article · June 2015

Parnika Gupta
National Taiwan University of Science and Technology

Niharika Thakur
Manav Rachna Educational Institutions

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & STUDIES

Posture Monitoring Belt

ISSN 2319-9725

Khushi Arora
Department of Electronics and Communication
Manav Rachna University, Faridabad
Parnika Gupta
Department of Electronics and Communication
Manav Rachna University, Faridabad
Shefali Chopra
Department of Electronics and Communication
Manav Rachna University, Faridabad
Niharika Pathak
Department of Electronics and Communication
Manav Rachna University, Faridabad

Abstract: *Our daily activities like sitting on the computer in our workplaces, working at home, studying, playing etc.. lays a lot of strain on our spine and back. Most of the people suffer from poster disorders while they are not aware of the fact that their daily activities have contributed to this state. So, we have developed a posture belt monitoring system that is attached as a belt on our lower spine and when activated, starts monitoring the human body positions with the reference of the spine position with respect to ground surface. The belt has a sensor network attached to it which accumulates the data from the 3-axis accelerometer and 3-axis gyrometer and compiles the data to send it to the cloud storage, from where it reaches the mobile phone application alerting the user of his/her bad posture and thus motivating the person to transform his/her posture. The posture belt system thus provides a means to spread awareness among the people about the good posture that they should inculcate in their body movements.*

Keywords: *Accelerometer, gyrometer, sensor network, mobile application.*

1. Introduction:

Our posture changes every second throughout our lives and it is also known that some postures if practiced for a long period of time may cause severe spine diseases and adversely affect our health. Now a days, in fast growing industrial age, every company needs speed in manufacturing to cope up with the customer enhancement and flourishment of the company they work for a long period of time in incorrect posture without noticing.[9] Incorrect posture for a long period of time is responsible for major back related problems. The estimated number of working days lost in 2013/14 due to back disorders was 2.8 million (UK). These sort of problem keep on increasing day by day as the people are quite busy in their schedule.

People often ignore their body posture while doing their daily activities, but our posture should actually stand at the top of our health concerns but mostly people are not able to make a conscious effort towards maintaining their correct posture. Negligence towards maintaining a posture that does not put our spine at risk is important, as not doing so can cause shoulder, back pains, reduced lung function, gastrointestinal pains, scoliosis, and postural syndrome and there are a range of other diseases that can severely affect our day to day lives.

2. Sensor Networks Implementation In The System:

There are three main components used: Accelerometer, Gyrometer and Bluetooth module. The work carried out for the project has established links between each of these elements. In this project, accelerometer measures the tilt of the body, gyrometer measures the movement in the body and Bluetooth helps in connecting the belt with the phone app designed to display the readings. Serial port programming has been done to get the particular output on the arduino. The arduino has been programmed for different gestures and positions of the body that a person undergoes in routine life.

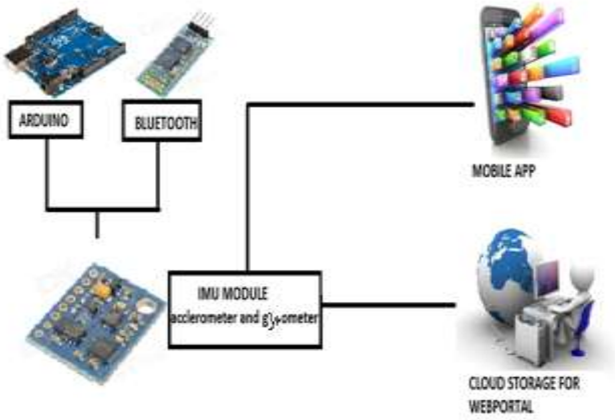

Figure 1: Schematic structure of Posture Belt

3. Modules Implemented In Design Flow Of Posture Belt:

3.1. IMU (Inertial Measurement Unit) Module:

The inertial measurement unit is used to measure and give the velocity, orientation and gravitational forces acting on an object as the feedback reading to the cloud storage from where the data is further accessed by the user. This is accomplished by using a combination of accelerometer and gyroscopes. These modules are designed on a much larger scale to be used for the motion control of aircrafts, satellites and landers etc. This unit performs the task of manoeuvring the above mentioned vehicle by detecting the current rate of acceleration and the change of pitch, roll and yaw through the use of gyroscopes. It consists of a 3 axis MEMS digital gyrometer with a programmable range of +250 to +2000 degrees/sec. It also has a secondary i2c port that interfaces with the digital accelerometer to deliver a complete 6- axis sensor output from its primary i2c port. The fusion output offloads the intensive motion processing computation requirements from the host processor, reducing the need for frequent polling of the motion sensor output and enabling low cost, low power microcontroller.

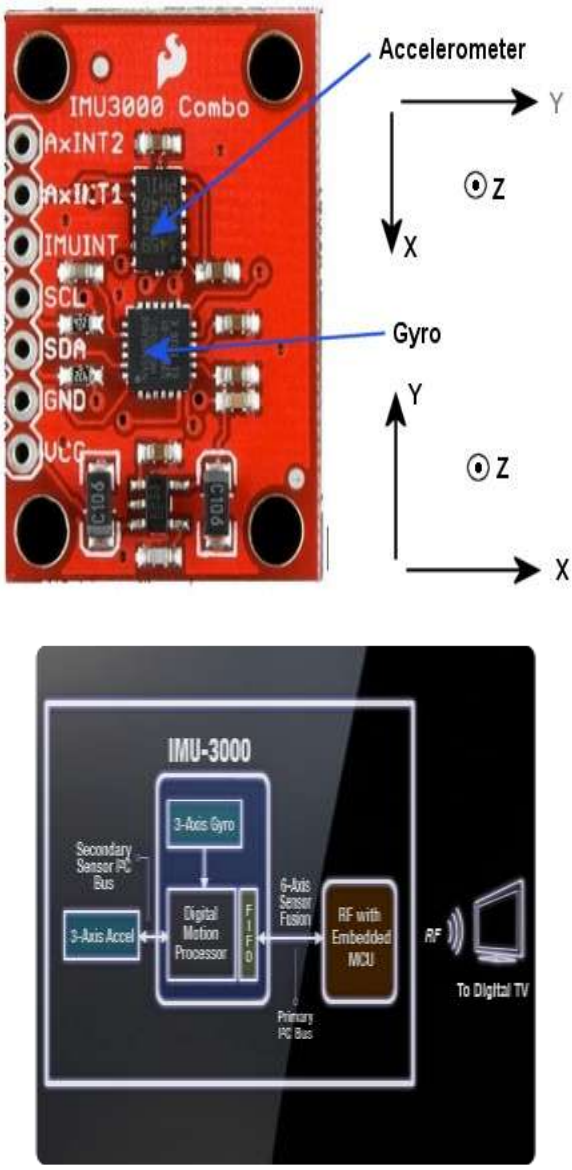

Figure 2: Pin Functions and Working of IMU Module

3.2. Accelerometer (Adxl345) And Gyrometer Sensor:

ADxl345 is the onboard digital accelerometer on the imu module and it can measure the tilt, motion and even vibrations in all three axes and can afford upto 13- bit measurement at up to +-16g.[1] These are mostly used where sensitive data is required and that too at low power consumption. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt sensing application as well as dynamic acceleration resulting from motion or vibration.

The gyro meter sensor which inbuilt in the imu module is being used to sense rotational motion or the change in orientation of the belt. If the person changes his/her orientation with respect to the ground surface then the data obtained from imu gyro gives the measurement of this change in orientation. In reference to [7]The MEMS (microelectromechanical systems) gyroscope present in our present in our present imu module gives an inexpensive and efficient way of measuring even the minutest of vibrations because they allow six full degrees of freedom.

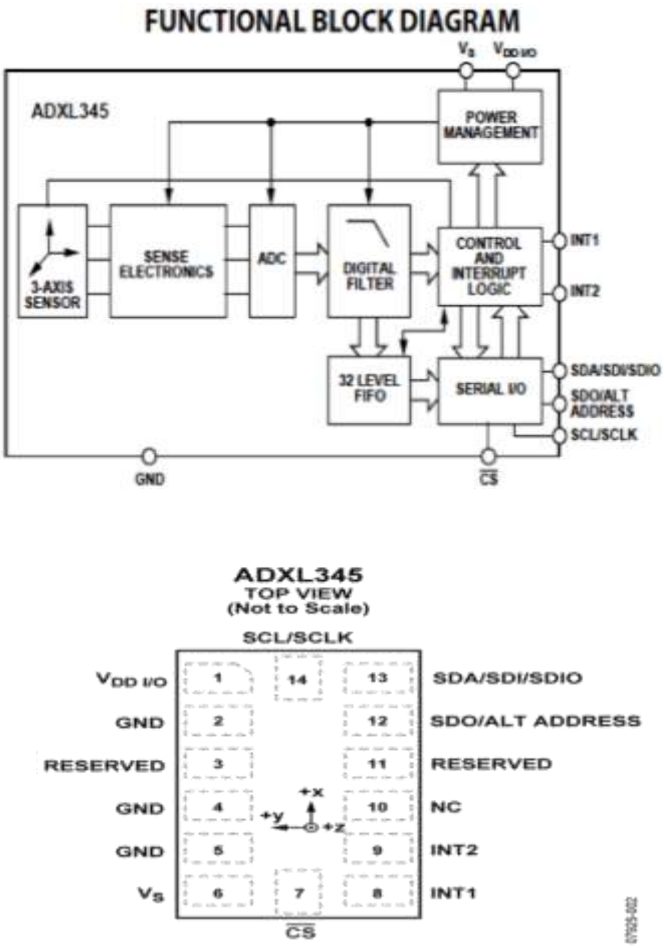

Figure 3: Functioning and pin layout of accelerometer adxl345

3.3. Bluetooth Device:

We have this class-2 Bluetooth module with serial port profile, which can configure as either Master or slave along with in Drop-in replacement for wired serial connections, transparent usage. We are using it to establish a connection for transferring the data on our computer system to the cloud storage and eventually to our computer application. The Bluetooth communication specification is v2.0 +EDR. The frequency used here is 2.4 GHz ISM band. The modulation technique being used is GFSK (Gaussian Frequency shift Keying)[8]. The emission power is less than or equal to 4dBm and the sensitivity is less than or equal to -84dBm at 0.1% BER.

3.4. Arduino Uno:

The Arduino Uno is a microcontroller based on the Atmega 328. It has 14 digital input/ output pins of which 6 are used as PWM outputs, there are 6 analog inputs, 16 MHz ceramic resonator, a USB connection, ICSP header, and a reset button and a power jack. In our device, the arduino uno is being used for programming the imu module attached to the belt and for providing the platform for controlling the Bluetooth communication from the transmitter side. [4]The transmitter Bluetooth device is attached to the belt and the receiver that is present in our mobile application receives the data.

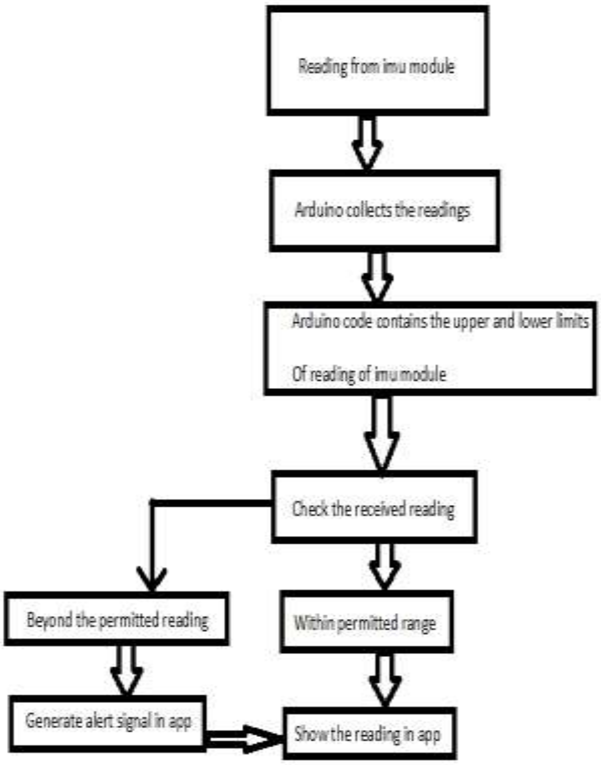

Figure 4: Flow model of Posture Belt

The whole system works like this, the IMU module i.e the accelerometer and gyrometer and the arduino uno are attached to the belt. The imu module consisting of the accelerometer and gyroscope measures the tilt or rotational or angular movement of our spine relative to the ground surface and this imu module being programmed by the arduino uno give the output on the serial data output port which is then available on the serial monitor. This data available from the serial monitor is then transferred to the mobile application with the help of Bluetooth attached with arduino through python programming and interfacing. The output is also stored in the cloud storage with which the person can operate its web portal designed for the belt operators and can review his/her activities for improving the posture. Whenever the body tilt or rotation goes beyond some predefined values that are given as the upper limits while programming the code in Arduino Uno then an alert message is generated in the mobile application along with the information which part of the spine is being affected the most, this information which part of the spine is being affected the most, this information is already fed into our application as derived from the orthopaedic reports.

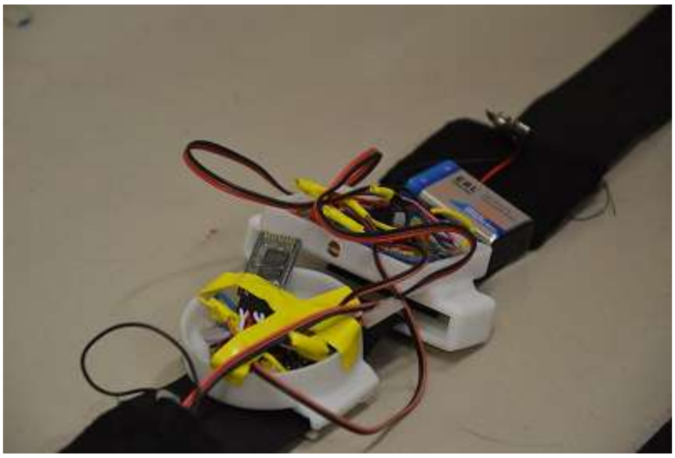

Figure 5: Posture belt

3.5. Features Of Cloud Storage And Mobile Application:

The device is connected to the mobile app and to the webportal via cloud. The Bluetooth communication is being used to move our device data to the cloud storage. The google cloud storage is a model of data storage where the digital data is stored in logical pools, the physical storage spans multiple servers (and often locations), and thus the data can be stored and accessed in real time by the device users. The cloud storage keeps a large stack of data concerning the daily activities of a person and this provides as a patient report for the physiotherapists.

The mobile application contains all the necessary information about the person. [11]The sensors are connected to a mobile app through which the person would know the defect in their posture and hence can correct the improper posture. This app would contain an avatar, similar to human which will perform all those functions which the person is performing. For example, the way person is walking, the way he stands etc. Everything will be performed by the avatar. This would help the person to know that they are in an incorrect posture so they can improve it. The app would also contain an expert advice column. It is a network of physiotherapist all around. The physiotherapist would be giving some advice so as to improve the posture and get rid of the pain.

The app will contain these features:

1. Score card for motivating to be correct posture.
2. Avatar to minimise your current activity
3. 24*7 monitoring
4. Gentle vibration for wrong posture
5. User best caliberation
6. Correct posture training
7. Expert advice
8. Expert advice doesn’t work you can schedule appointment with physiotherapist.

3.6. Webportal:

All the data of the cloud system will be transferred to cloud network. Every user will be provided with a user id and password via which they can access their data across the globe anytime, anywhere. This provide the aspect of user accessibility and accountability and allow the users to access the data in the cloud storage in a tabular form, this webportal is designed in such a manner that only the device users that are assigned the username and password for operating the belt are allowed to access the information that is stored from th cloud storage.

4. Conclusion And Scope:

1. Person would be able to look after his health properly.
2. He can take advance precautions.
3. Time saving for a person as he doesn’t have to go for checkups.
4. On the spot doctor consultancy.
5. Mimic avatar in app helps in understanding things well.

6. The webportal helps in keeping medical history saved at one place and can be used wherever whenever required.

References:

1. A. Dittmar, A. Lymberis, ”Smart Clothes and Associated Wearable Devices For Biomedical Ambulatory Monitoring”, *Proc. Transducers’05*, pp 221-227, Seoul, Korea, 5-9 June, 2005.
2. R. Paradiso, G. Loriga and N. Taccini, ”A Wearable Health Care System Based on Knitted Integrated Sensors”, *IEEE Trans. Inf. Technol. Biomed.*, 9 (2005), pp 337-344.
3. F. Lorussi, E.P. Scilingo, M. Tesconi, A. Tognetti and D. De Rossi, ”Strain Sensing Fabric for Hand Posture and Gesture Monitoring”, *IEEE Trans. Inf. Technol. Biomed.*, 9 (2005), pp 372-381.
4. IEEE Std 802.15.4-2003, Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANs), October 2003.
5. Crossbow Technology, Inc: MPR/MIB User’s Manual, April 2005, available at http://www.xbow.com.
6. L. A. Rocha, J. A. Afonso, P. M. Mendes, J.H. Correia, A body sensor network for e-textiles integration, Proc. Eurosensors XX, pp.1-4, 17-20 September 2006, Gotemburgo, Sweden.
7. L. A. Rocha, J.H. Correia, Wearable sensor network for body kinematic monitoring, Proc. ISWC 2006, pp.137-138, 11-14 October 2006, Montreux, Switzerland.
8. J. A. Afonso, L. A. Rocha, H. R. Silva, J. H. Correia, MAC Protocol for Low-Power Real-Time Wireless Sensing and Actuation, to be presented in ICECS 2006, 11-12 December 2006, Nice , France
9. B.C. Amick, M.M. Robertson, K. DeRango, L. Bazzani, A. Moore, T. Rooney and R. Harrist. Effect of Office Ergonomics Intervention on Reducing Musculoskeletal Symptoms. *Spine* 28(24):2706-2711, 2003.
10. C.M.A. Ashruf. Thin flexible pressure sensors. *Sensor Revie*w 22(4):322-327, 2002.
11. D. Ayers and M. Shah. Monitoring human behavior from video taken in an office environment. *Image and Vision Computing* 19(12):833-846, 2001.
12. M. Baldauf and S. Dustdar. A Survey on Context-aware systems, 2004.
13. BuyOnlineNow. Hon Perpetual Mid-Back Swivel Chair. 4300 Series, Raven Black Fabric With Titanium Frame.

http://www.buyonlinenow.com/viewproduct.asp?sku=HON4321BE11C. Accessed on Mar, 15th 2008.

14. M.P. De Looze, L.F.M. Kuijt-Evers and J. Van Dieeën. Sitting comfort and discomfort and the relationships with objective measures. *Ergonomics* 46(10):985-997, 2003.
15. R. Ellegast, R. Hamburger, K. Keller, F. Krause, L. Groenesteijn, P. Vink and H. Berger. Effects of Using Dynamic Office Chairs on Posture and EMG in Standardized Office Tasks. *Lecture Notes in Computer Science* 4566, 34-42, 2007.