"WRONG POSTURE & MUSCLE STRAIN DETECTOR"

SUBMITTED TO

SAVITRIBAI PHULE PUNE UNIVERSITY

FOR PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND TELECOMMUNICATION

BY

STUDENT NAME	SEAT NO.
1. AKSHADA KALOKHE	B190553020
2. SEJAL MATE	B190553025
3. NIKITA DESHMUKH	B190553013

UNDER THE GUIDANCE

OF

PROF. BALIKA TAWADE

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

NUTAN MAHARASHTRA INSTITUTE OF ENGINEERING & TECHNOLOGY,

TALEGAON DABHADE, PUNE

A

Project Report (Phase- 2)

"WRONG POSTURE & MUSCLE STRAIN DETECTOR"

Submitted by

Student Name	**Seat No.**
1. Akshada Kalokhe	B190553020
2. Sejal Mate	B190553025
3. Nikita Deshmukh	B190553013

Under the Guidance

of

Prof. Balika Tawade

Department of Electronics & Telecommunication Engineering

Nutan Maharashtra Institute of Engineering & Technology,
Talegaon Dabhade

(2022-2023)

Nutan Maharashtra Institute of Engineering and Technology, Talegaon Dabhade, Pune.

CERTIFICATE

This is certified that the project entitled

"WRONG POSTURE & MUSCLE STRAIN DETECTOR"

Under the Guidance of

Prof. Balika Tawade

By

Student Name	Roll No.
1. Akshada Kalokhe	B190553020
2. Sejal Mate	B190553025
3. Nikita Deshmukh	B190553013

Prof. Balika Tawade
(Project Coordinator)

Prof. Balika Tawade
(Project Guide)

Nutan Maharashtra Inst. of Engg & Tech. PUNE 410507

Dr. Nitin Dhawas
HOD (E&TC)

Dr. Vilas Deotare
(Principal)

External Examiner

Department of Electronics & Telecommunication Engineering

(2022-2023)

ACKNOWLEDGEMENT

All the accomplishments in the world require the effort of many people and this project is no different. Regardless of the source we wish to express our gratitude to those who have contributed to the success of this project.

We gratefully acknowledge and express heartfelt regards to all the people, who helped us in making the idea of the project, a reality.

We express our gratitude towards **Prof. Balika Tawade** for her guidance and constant supervision as well as for providing necessary information regarding the project and also for their support in completing the project.

We have been lucky to have a H.O.D. like **Dr.Nitin Dhawas**, whose reviews, comments, corrections & suggestions have enormously enriched our project.

We are also grateful to our principal **Dr.Vilas Deotare** for his constant encouragement and support

I am also glad to express my gratitude and thanks to my parents and friends for their constant inspiration and encouragement.

Finally, we express our appreciation & sincere thanks to lab assistance, Department of Electronics & Telecommunication, for their constant involvement at every step of the project which has led this project to the path of success

Akshada Kalokhe
Sejal Mate
Nikita Deshmukh

CONTENTS

ABSTRACT

Low back pain treatment costs a billion dollars every year. One of the most common causes for doctor visits is low back pain and neck pain. Lower back pain and neck pain is frequently caused by poor posture, which affects the transverses abdominal muscle. Regularly altering postures and maintaining excellent posture are supposed to help enhance and to maintain one's fitness. A wide range of smart monitoring systems have been built around the world to assist people in improving their lives. Enhancing one's quality of life by delivering a variety of services helping hand. Wearable smart technology has become the standard the century's main focus, especially in the medical sector, where breakthroughs range from pulse hearing aids to monitors the procedure for creating, developing and testing a small wearable interface uses a variety of sensors to keep track of a user's back posture in real-time and notify them when their posture is bad identified is described in this article.

CHAPTER 1

INTRODUCTION

INTRODUCTION:-

The way people hold themselves, in terms of how they stand, sit, move, and perform activities, is known as posture, and it has a significant impacton their health. Poor posture has been related to both poor health and poor performance.

A study found that slouching has an effect on the transverse's abdominis muscle. When an individual maintains a slouched pose, the breadth of the transverse abdominis muscle has shrunk substantially. Low back pain has been attributed to intransitive abdominis dysfunction. Low back pain is oneof the most common causes of disability worldwide, with an estimated 80% of people suffering from it. Also, because the neck supports the weight of the head, it can be at risk of injuries and conditions that cause pain and restrictmotion

It is projected that 80 percent of the population will experience it at some point. Back discomfort costs about $50 billion per year. In the United Arab Emirates, 62 percent of the young population reports suffering from back pain and neck pain. Back discomfort can be caused by ordinary actions such as hunching over in a chair. Neck pain often spreads from the neck towards the shoulders or upper back. It can often cause headaches. The painmay be worse when you hold your head in one position for a long time, such as at a computer. Furthermore, a study found that subjects who were asked to sit in a hunched position registered more stress and therefore lowerperformance. Even with good posture, staying in the same position for an extended period of time is a harmful postural habit because the muscles in the spine can stop producing substances required for appropriate biological function. As a result, maintaining good posture and changing positions on a regular basis is considered critical, if not essential, for maintaining good health.

1.1] Aim

- To detect the correct or incorrect posture by detecting the changes that occur in human posture using sensors i.e., accelerometer sensor and push buttons fixed on the belt vertically in direction of spinal cord.

1.2] Need of the project

- Posture is a way in which a human holds his body so that there is less strain on muscles during movement.
- Poor body posture leads to many health issues. Incorrect postureproblems, which range from back pain to fatigue may rise up and affect our daily activities. Nowadays maximum population suffers from backpain, injuries, neck pain and shoulder problems etc., hence a need to develop a device is increased.
- A wearable device has been designed in the form of belt. Also, a mechanism has been designed to detect the area of stress and time duration for which a person is sitting in the same posture

1.3] Proposed Work

- To detect the correct or incorrect posture by detecting the changes that occur in human posture using sensors i.e., accelerometer sensor and push buttons fixed on the belt vertically in direction of spinal cord.
- The changes occur in different directions (i.e., right, left, forward, backward) are detected using sensors, by calculating the angles according to the tiltation of a body and time for which stress applies on particular back area is detected using push buttons. Indication of the incorrect posture is provided by the buzzer to the user.
- The Device is designed for human comfort and good body posture, which is required to maintain body and mind healthy.

- The angle is the primary deterministic factor for the postures. We use the angle subtended by the neckline and the torso line to the y-axis. The neckline connects the shoulder and the eye. Here we take the shoulder as the pivotal point.
- Similarly, the torso line connects the hip and the shoulder, where the hip is considered a pivotal point.
-

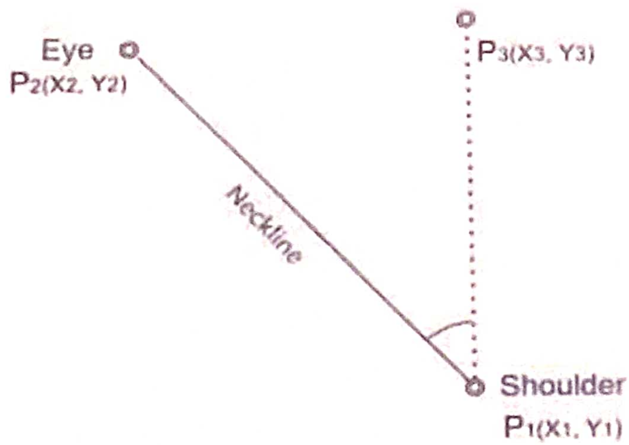


Fig 1. Neckline inclination measurement

- Taking neckline as an example, we have following points.

  - P1(x1, y1): Shoulder
  - P2(x2, y2): eye
  - P3(x3, y3): any point on the vertical axis passing through P1

- Apparently, for P3 x-coordinate is the same as that of P1. Since y3 is valid for all y, let's takey3 = 0 for our simplicity.

We take the vector approach to find the inner angle of three points. The angle between two vectors P_{12} and P_{13} is given by,

$$\theta = \arccos\left(\frac{\vec{P_{12}} \cdot \vec{P_{13}}}{|\vec{P_{12}}| \cdot |\vec{P_{13}}|}\right)$$

Solving for θ we get,

$$\theta = \arccos\left(\frac{y_1^2 - y_1 \cdot y_2}{y_1 \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}}\right)$$

1.4] Theory

The back pain relief systems and back posture corrective safety gadgets are readily available in bulk in the market as, but all are not supported for continued uses as well their dimensions are differently designed which may result in variable results which tries to fulfil the basic need of the person in curing him/her from back pain and get relief, but these designs may have magnetic strips for providing magnetic therapy is suggestible for using the limited electronics-based system can be implemented which can present the data as well as the alert via buzzer and physical signals too as an alert to the user, whereas in this user has the control of monitoring his posture during daily basis and correct it to the allowable and scientifically correct manner with the help of data time not on continues basis.

In that too, becomes difficult to correct the posture in many cases as these belts are having no smart functioning system which can give an alert when goes in the wrong posture for longer time, thus few of the researches goes into this direction and some of the belts were served as a result of this studies and they have electric vibration therapy and some physical alert mechanism involved into it which improves results, thus our interest goes into this field and we found a lack of accuracy into correction mechanism which delays the results and thus user needs to wear the belt for longer period thus we come up across a study in which the notified by the system on his mobile device. Here the making the improvement in older posture mechanism is taken place with use of belt design and its dimension points though the electronic system is involved inside the package which can drive entire mechanism. Thus, result can be achieved comparatively in shorter period.

Wrong Postures:

1. C Shape Sitting (Hunch Over Sitting Posture):

fig 2

This sitting position basically knows as Hunch Over Sitting Posture. In this position shoulders move forward; your pelvis normally tilts back to balance. In this sitting posture create C – Curve in spine. Due to C-Curve the pressure goes directly to downwards and creates pain and strain. This position is can cause severe back pain, tail bone pain, hip pain, muscle spasms etc. To avoid this position just takes shoulder up and little back so the Spine position can be straight. Take little break by standing or moving hands and shoulders in a short period of time.

2. Sitting on Easy going chair or on Pillow:

Fig 3

While working sitting on pillow or easy going chair can create wrong sitting posture. Due to softness of pillow the butt sink in and, pelvis move to back and change the position to keep body upright, Due to change in Pelvics natural position body works harder to balance body. Prolong sitting on pillow or cushy chair can cause severe pain in butt, back and shoulder. Choose a chair which has bit hard surface with proper back support and take regular breaks if you sitting for longer time.

03. Leaning back and working:

Many of us prefer to sit and leaning back and work on laptop or read on iPad or Kindle. Leaning back position seems to be comfortable but gives constant pressure to spine against gravity. The eyes position focuses in a wrong direction and hence it puts pressure on brain to think or analyze.

04. Sitting straight but eyes on lap:

Most of us love to sit in this position specifically School Kids or College going adults. They are so engage in checking WhatsApp, Playing Games or Checking Facebook Videos.

Unknowingly they sit straight but their eyes on lap to read phone or Tab. Sitting in this position head pulls at your spine and puts stress on upper back which may cause headaches and weakens the eyes.

05. Sitting Cross Leg:

Sitting Cross leg is an absolute wrong posture. In this position one hip moves upwards and changes its position. This can give lots of pressure on spine and knee. Avoid sitting cross leg for longer time on chair.

06. Sitting Too Low:

Sitting in low chairs can push back pelvis, curve the spine and tilt head forward. To correct this posture, pull the chair bit up and adjust to properly align your body.

07. Sitting on high chair and hanging feet:

Most of us prefer to sit on high level chairs and forget to support their legs. The leg keeps hanging and not resting on pad. Sitting on this posture pushes pelvis back and gravity constantly pulls your foot towards ground. Always use resting pad provided in high level chairs and sit straight in 90 degrees.

08. Sitting too close or back in Seat:

Sometimes we sit too close or back in the seat that disturbs correct sitting postural angle. Instead of sitting too back try to match your knee level with your hips.

09. Sitting on floor with support of hand:

Most of us love to sit on floor with support of the hand kept behind on the floor. But this sitting posture is not correct as this disturbs spines natural curve. Always avoid sitting like this. Instead of this sitting prefer to sit in Vajrasana Position or cross leg position while sitting on floor.

11. Sitting in same position for longer periods of time:

Most of us spend 8 hours in office and almost 5 hours on chair continuously. But sitting in one position without any movement can invite backpain, shoulder pain, neck pain, strain in eyes, headaches, and more muscle pains. It is suggested to take break in gap of 10 minutes or do some chair exercises to avoid muscle spasm.

Tips for maintaining correct posture when sitting:

Fig 4

If you need to sit for longer periods, make sure you have an ergonomically designed chair. Adjust your chair in such a way that the normal curves of the back are maintained.

1. Place your elbows at your sides

Your elbows should be placed on the armrests in such a way that your arms form an L-shape. Your wrists and forearms should be parallel to the floor. You may need to adjust your chair's height accordingly. This is to ensure minimum pressure on your wrists and prevent strain-related injuries.

2. Rest your feet on the floor

Adjust the chair's height so that your feet stay flat on the floor. Make sure your knees are slightly lower than your hips. You can use a footrest for this purpose. Avoid crossing your legs to prevent posture-related problems.

3. Adjust your screen to be eye level

The top part of your monitor should roughly be at eye level so that you do not have to bend your neck. Stay an arm's length away from the screen. You can use a monitor stand for this purpose.

4. Keep your mouse close

Place the mouse as close to you as possible. Using a mouse mat with a wrist pad is a better option to avoid strain-related injuries.

5. Keep objects in reach

Keep frequently used objects such as pens, notepads, or phones within easy reach. Position them in such a way that you do not need to repetitively twist or stretch your body.

CHAPTER 2

LITERATURE SURVEY

2.1 STUDY OF RESEARCH PAPER

1. Paper Name: Posture Detection and Correction System using IOT

Author: C. C. Lim et.al

Abstract :

The growing technology in the world is rapidly transforming the way people lead their lives. Industrialization and urbanization have brought an enormous increase in sedentary lifestyle to the modern world. Indulged in technology, people are often found abandoning their good posture and being hunched over for really long hours. Good posture is of utmost importance for leading a healthy lifestyle and it is said that back pain is the third most common reason for people to visit the doctor. Yet, knowingly or unknowingly, people compromise on one of the most essential traits of what makes them human; the ability to walk upright. The aim of this paper is to identify efficient techniques used in posture detection and correction.

In one embodiment is a method of providing postural feedback comprising: receiving by a microprocessor at repeated intervals data from a tri-axial accelerometer, the microprocessor and the tri-axial accelerometer comprising a sensor device attached to a user, the sensor device further comprising memory, an actuator, and a power Source; normalizing by the microprocessor the received accelerometer data; determining by the microprocessor a postural description of the user based on the normalized received accelerometer data; and triggering by the microprocessor the actuator to output sensory feedback based on the postural description of the user. In another embodiment is a postural feedback apparatus comprising: a sensor device configured to be attached on a user, the sensor device comprising: a tri-axial accelerometer; an actuator, and a microprocessor configured to receive data from the tri-axial accelerometer about movement of the user; normalize the received accelerometer data; determine a postural description of the user based on the normalized received accelerometer data; and trigger the actuator to output sensory feedback based on the postural description of the user. A non-transitory computer readable medium having stored thereupon computing instructions comprising: a code segment to receive by a microprocessor at repeated intervals data from a tri-axial accelerometer, the microprocessor and the tri-axial accelerometer comprising a sensor device attached to a user, the sensor device further comprising memory, an actuator, and a power Source: a code segment to normalize by the microprocessor the received accelerometer data; a code segment to determine by the microprocessor a postural description of the user based on the normalized received accelerometer data; and a code segment to trigger by the microprocessor the actuator to output sensory feedback based on the postural description of the user.[1]

2. Paper Name:- Human Posture Detection System Using real-time self-calibrating algorithm

Author: Davide Curoneetal

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 presents in the device alert the user to correct the posture. The bad posture data are sends to server through the Wi-Fi module present in the device. The data are stored in the database along with time, date and device id.

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.

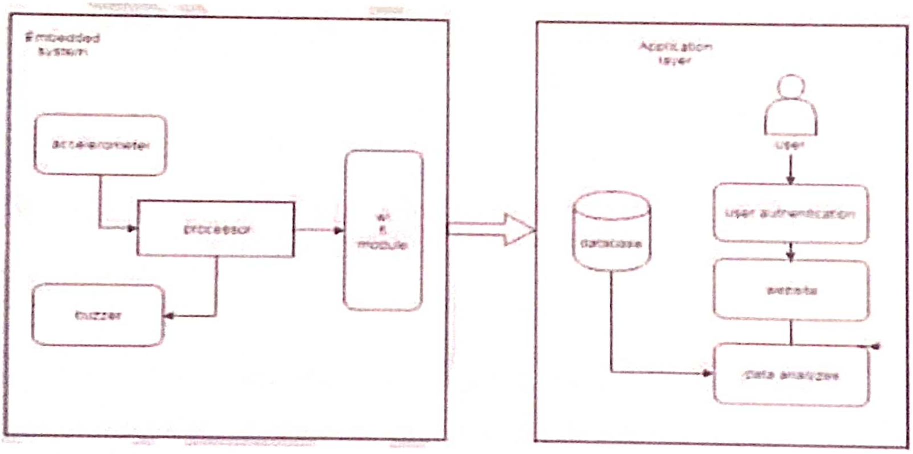


Fig 5.Posture Detection System Architecture

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.[2]

3. Paper Name: IOT-based Smart Posture Detector

Author name: Ricardo Barbaetal

Abstract: states that the current mechanisms to detect postural changes are usually expensive, greatly limiting their use in effective computing. The authors have ruled out commercial solutions for two basic reasons: the need to adjust the size of the sensors and their cost. They used the method of combining many basic sensors that could be used together to build a posture sensor cushion to address the a fore mentioned issues.

Another approach uses three main sensors: an accelerometer, a gyroscope, and a Bluetooth module. One of the implementations suggests the use of sensors (acceleration sensors) embedded in a smartphone, contrary to the ones that require separate hardware components for the same. However, attaching the sensor to the phone and the phone to a belt is not feasible as there is a risk of dropping the phone every time any rigorous activity is performed. Moreover, people use their phones extremely frequently, and for most of the day, they will have them on their hands and not their belt by combining several simple sensors so that they can be used together to form a posture sensor cushion.

Fig 4

In another approach, SPD is attached to the user's back. The region where the spine bends, just a few inches below the neck, is the best spot for the device to deliver accurate readings. Based on the user's posture, the IMU sends positional readings, according to the z-axis, to the Arduino. The accelerometer provides these values, which are then divided into three ranges, such as "excellent," "terrible," and "acceptable." The Arduino sets the LED lights on the SPD according to the values received. A white light indicates proper posture. A green light denotes good posture, and a red light denotes terrible posture. Also, using the Bluetooth module, the Arduino transmits data to the Android app that is deduced from the values it has received.[3]

4. Paper Name: Posturector – Posture Corrector

Author:- Santhana Lakshmi. et.al

Abstract: Posture Corrector" stated that advanced technology in wearable devices had contributed ways to correct the wrong posture to avoid severe consequences in the future. Smart electronic devices known as wearables can be used as implants or accessories by anyone. The main objective or aim of the paper is to design a product that is easy to use to correct posture while sitting or working on a computer. The main goal of this paper is to create a simple wearable device to correct or maintain correct posture while sitting or doing everyday activities without any physical issues like back or neck pain to improve lifestyle. The PIC microcontroller, flex sensor, buzzer, LCD, flexible belt, and DC gear motor components are used for designing this device. The user is wearing a compression shirt with a flex sensor and buzzer attached to the lower back. An output of sensors is given to the microcontroller, and then the microcontroller determines whether the user is in the proper posture or not. If a user is in bad posture, the microcontroller will sound like a buzzer. Information about the bad posture of a user will be displayed on the LCD. Threshold values are considered the initial stage values of flex sensors. The user is wearing a compression shirt with a buzzer and flex sensor attached to the lower back. If the user sits in the wrong posture for a long time, then the DC motor present on the flex sensor will lift the user back to the correct position based on set threshold values.

Fig 5. Posture Corrector

The whole arrangement must be worn by the user. At first, the user is in his or her typical position. As the user deviates from the regular position, the flex sensor value changes. The buzzer activates as feedback when the flex sensor value changes, alerting the user to return to the default position. This is done by programming. If the user doesn't return to his or her regular posture after a wait, the DC gear motors attached to the elastic belt are turned on. The way they are programmed pushes the user back to their default posture. Proteus software is used for simulation to check the program' functionality.[4]

CHAPTER 3

PROBLEM STATEMENT

3.1 PROBLEM STATEMENT

Due to people sitting for longer time causes various health related problems such as neck as neck pain, back pain so the objective of our project is to design a device so it will allow a person to correct their posture. Although there were many methods in existence, this method was designed to overcome the drawbacks of the previous methods.

3.2 OBJECTIVE

- To develop an IOT-based system to detect and indicate wrong postures.
- To detect back, neck, and hand postures while sitting.
- To provide health improvement solutions using the proposed system.

3.3 BACKGROUND

Due to sitting for a longer duration, the user tends to sit in the wrong posture.

- It is usual for people to use devices to correct their posture and to improve their health while sitting such as working on Laptop, watching television, reading books, etc.

- As the primary function is to keep the body in the correct posture with the help of the device that includes the functionality of informing a user of his/her wrong posture.

CHAPTER 4

PROJECT REQUIREMENT

4.1] Hardware Interfaces:

- RAM: 8 GB
- As we are using Machine Learning Algorithm and Various High-Level Libraries
- Laptop
- RAM minimum required is 8 GB.
- Hard Disk: 40 GB
- Application- Eagle 7.2.0, Arduino Bluetooth Text to Speech

4.2] Hardware Specifications:

1. HC-05 Bluetooth Module –

- Model: HC-05
- Input Voltage: DC 5V
- Communication Method: Serial Communication
- Master and slave mode can be switched

2. Atmega328p

Description: 8-bit Microcontroller

Feature:

- ATmega328P 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash
- High performance, low power AVR® 8-bit microcontroller
- Advanced RISC architecture
- 131 powerful instructions – most single clock cycle execution
- 32 □ 8 general purpose working registers
- Fully static operation
- Up to 16MIPS throughput at 16MHz
- On-chip 2-cycle multiplier
- High endurance non-volatile memory segments
- 32K bytes of in-system self-programmable flash program memory
- 1Kbytes EEPROM
- 2Kbytes internal SRAM

- Write/erase cycles: 10,000 flash/100,000 EEPROM
- Manufacture - ATMEL

3. MPU6050 Accelerometer and gyroscope sensor –
   - MPU6050 has a 3-axis gyroscope, 3- axis Accelerometer and a Digital motion processor integrated on a single chip.
   - It works on the power supply of 3V-5V.
   - MPU6050 uses the I2C protocol for communication and transfer of data.
   - This module has a built-in 16-bit ADC which provides great accuracy.
   - MPU6050 consists of three 16-bits ADC's for digitizing the gyroscope 0utputs and three 16-bits ADC's for digitizing the accelerometer outputs.
   - Gyroscope needs 3.6mA of current for operating.

4. Passive Active Buzzer –
   - VCCIO of 5.0V or 3.3V with 3.3V Operation being 5V Tolerant
   - 32 - 256 Macrocells with Enhanced Features
   - Pin-compatible with Industry Standard Devices
   - Speeds to 5 ns Maximum Pin-to-pin Delay
   - Registered Operation to 250 MHz

5. EMG Sensor –
   - Small Form Factor (1inch X 1inch)
   - Specially Designed for Microcontrollers
   - Adjustable Gain – Improved Ruggedness
   - New On-board 3.5mm Cable Port
   - Pins Fit Easily on Standard Breadboards

6. Buzzer -
   - Rated Voltage: 6V DC
   - Operating Voltage: 4-8V DC
   - Rated current: <30mA
   - Sound Type: Continuous Beep
   - Resonant Frequency: ~2300 Hz
   - Small and neat sealed packag

4.3] BILL OF MATERIAL:

Component Name	Cost Price (RS)
Atmega328p microcontroller	3,554
Buzzer	50
Bluetooth HC-05 module	240
MPU6050	115
EMG sensor	3,336
Total	7,295

CHAPTER 5

SYSTEM ANALYSIS

5.1] BLOCK DIAGRAM:

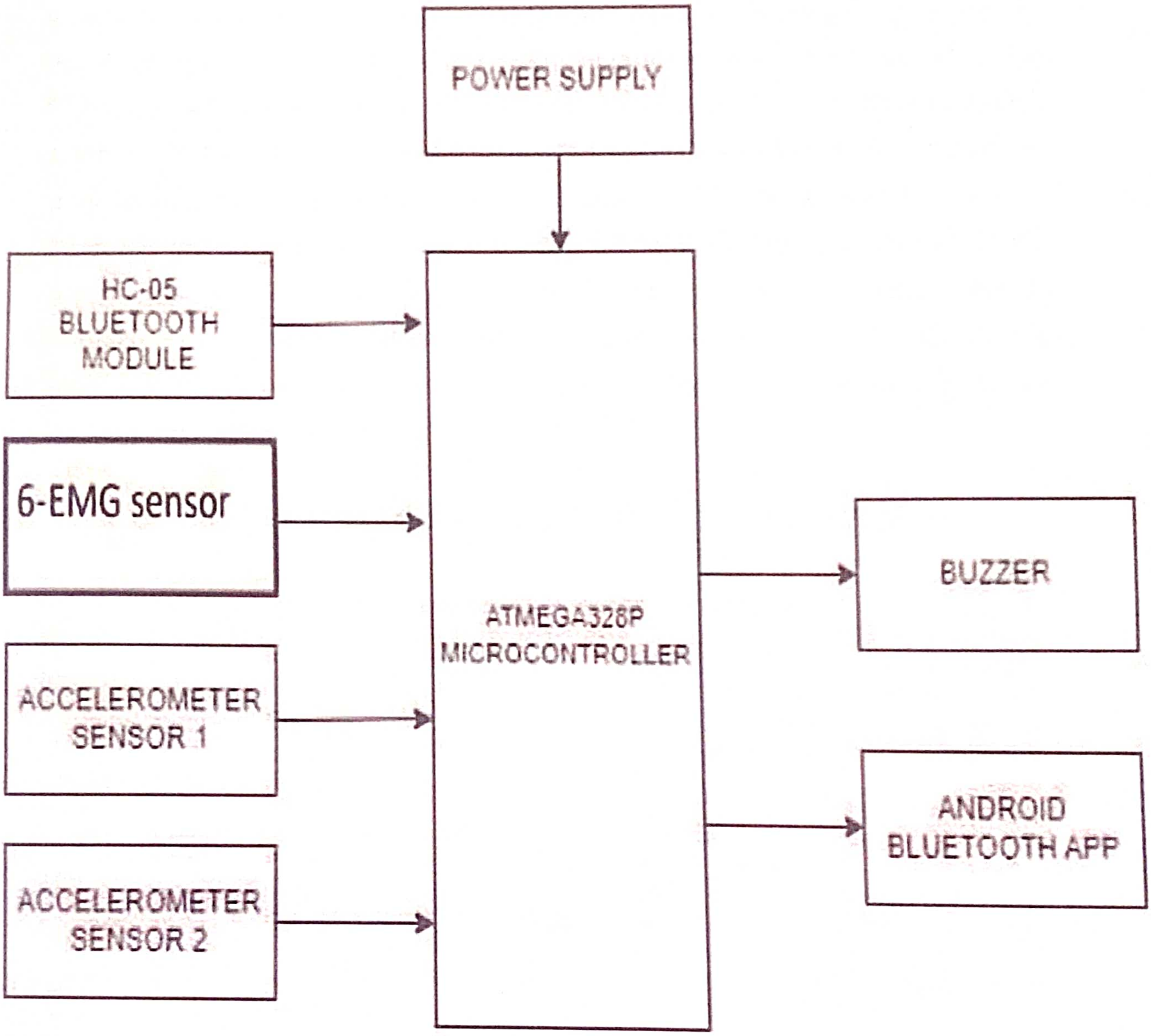


Fig 6. Block Diagram

5.2| ELEMENTS OF BLOCK DIAGRAM:

1. ATmega328p

The ATmega328p is a single-chip, high-performance, efficient microcontroller created by Atmel in the megaAVR family. It is an 8-bit AVR RISC-based microcontroller chip. In this post, we will learn about the ATmega328p pinout, its datasheet, specifications, and programming methods in detail. It consists of **32 KB ISP flash memory** with read-while-write capabilities, **2 KB SRAM**(Static RAM), **1 KB of EEPROM**, **23 general-purpose I/O pins**, a **16MHz clock**, 32 general-purpose working registers, three flexible timer/counters with compare modes (two 8 bits and one 16 bit), internal and external interrupts, serial programmable UART, a byte-oriented I2C (inter-integrated circuit) interface pins, SPI serial port, 6-channel 10-bit Analog to Digital converter, programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between a voltage range of 1.8-5.5 volts.

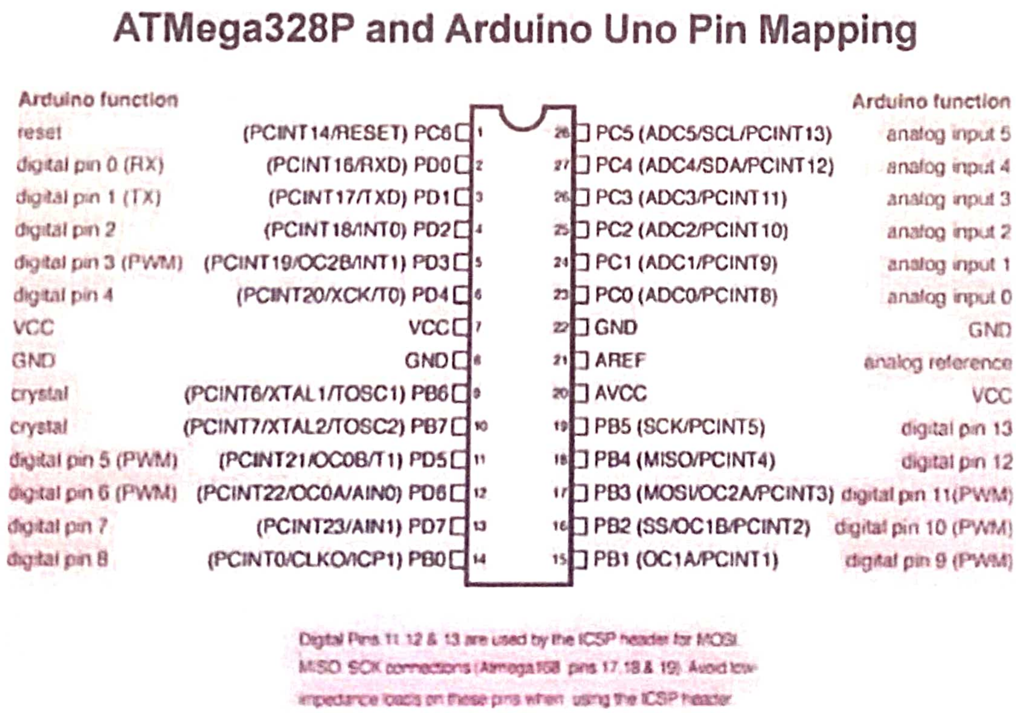


Fig 7

2. EMG Sensor -

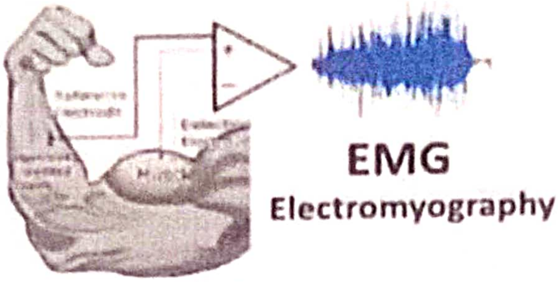


Fig 8

EMG Sensor, also known as an electromyography sensor is one that measures small electrical signals generated by your muscles when you move them!

This includes lifting your arm up, clenching your fist, or even the simplest of movements like moving a finger!

Technical details

- The whole process starts off in your brain
- Neural activity in the motor cortex (part of your brain) signals to the spinal cord
- The signal is then conveyed to the muscle part via motor neurons
- Motor neurons innervate the muscle directly, causing the release of Calcium ions within the muscle and ultimately creating a mechanical change
- This mechanical change involves depolarization (change in electromechanical gradient), which is then detected by EMG for measurement

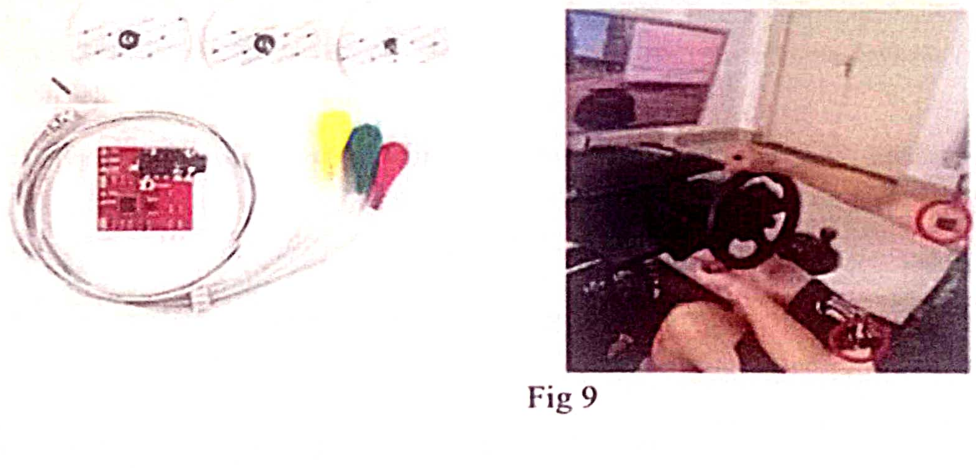


Fig 9

3. HC-05 Bluetooth Module

HC-05 is a Bluetooth module that is designed for wireless communication. Thismodule can be used in a master or slave configuration.

Pin Description

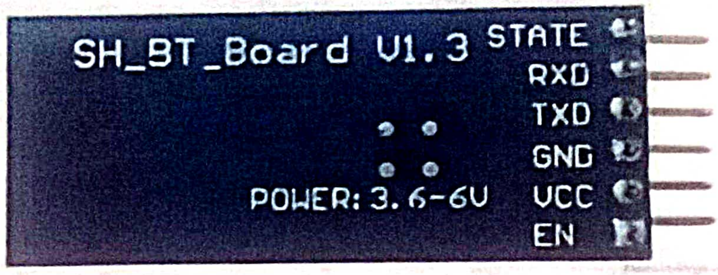


Fig 10

Bluetooth serial modules allow all serial-enabled devices to communicate with each other using Bluetooth.

It has 6 pins,

1. **Key/EN:** It is used to bring the Bluetooth module into AT commands mode. If the Key/ENpin is set to high, then this module will work in command mode. Otherwise, by default, it isin data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

1. Data mode: Exchange of data between devices.
2. Command mode: It uses AT commands which are used to change the settings of HC-05. To send these commands to the module serial (USART) port is used.

2. **VCC:** Connect 5 V or 3.3 V to this Pin.

3. **GND:** Ground Pin of the module.

4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. **State:** It tells whether the module is connected or not.

4. MPU6050 Accelerometer and Gyroscope Module

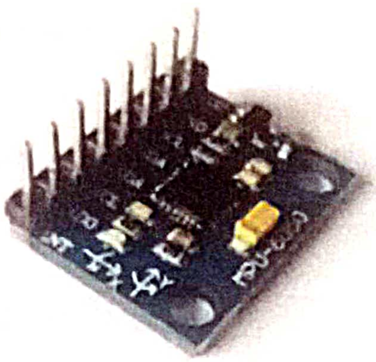


Fig 11

The **MPU6050 module** is a Micro Electro-Mechanical Systems (**MEMS**) which consists of a 3-axis Accelerometer and 3-axis Gyroscope inside it. This helps us to measure acceleration, velocity, orientation, displacement and many other motion-related parameter of a system or object.

MPU6050 Features

- MEMS 3-axis accelerometer and 3-axis gyroscope values combined Power
- Supply: 3-5V
- Communication: I2C protocol
- Built-in 16-bit ADC provides high accuracy
- Built-in DMP provides high computational power
- Can be used to interface with other IIC devices like magnetometer
- Configurable IIC Address
- In-built Temperature sensor

5. Active Passive Buzzer

A buzzer is a small yet efficient component to add sound features to our project/system. It is a very small and compact 2-pin structure hence can be easily used on Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

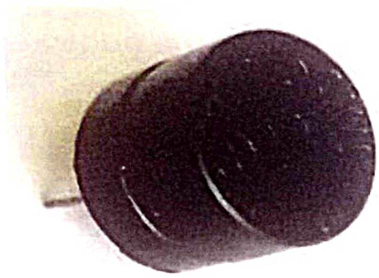


Fig 12

5.3] METHODOLOGY:

This work proposed a methodology to detect incorrect posture and muscle strain while sitting. Block diagram of the methodology and phases involved in the proposed method of the wrong posture and muscle strain detector. The device that we will create can be wear behind the user's upper back, around the neck, and on the user's arms. When the user sits in a bad posture, the buzzer in the device turns on and alerts the user that he or she is standing or sitting in a bad posture. The readings are sent via Bluetooth module to the user's Android app. The Android app will monitor the user's posture and provide feedback accordingly. A power source, memory, and an actuator are also included in the sensor device. For the accelerometer sense, the input readings are taken from an accelerometer and EMG sensors. The data received from the EMG and accelerometer sensors are passed to the ATmega328p microcontroller attached to the user. Accelerometers are used to measure the acceleration along the x, y, and z axes at the point where they are placed on the body.

An EMG sensor is also used to monitor the little electrical impulses produce when the user moves muscles. These values are then transmitted to the microcontroller through wires or a wireless medium for further processing and classification. The device is designed to consist of a sensor network comprising an accelerometer for measuring the tilt of the body and EMG sensors for measuring the movement of the body. Then the HC-05 Bluetooth module is used for connecting the device containing these sensors to the mobile application designed to display these readings. This application then alerts the user if he or she is exhibiting good or bad posture by buzzing the buzzer. Further, serial port programming has been done to get the particular output onthe atmega328p microcontroller. The Arduino has been programmed for various gestures and body postures that a person encounters in everyday life.

5.4] FLOWCHART:

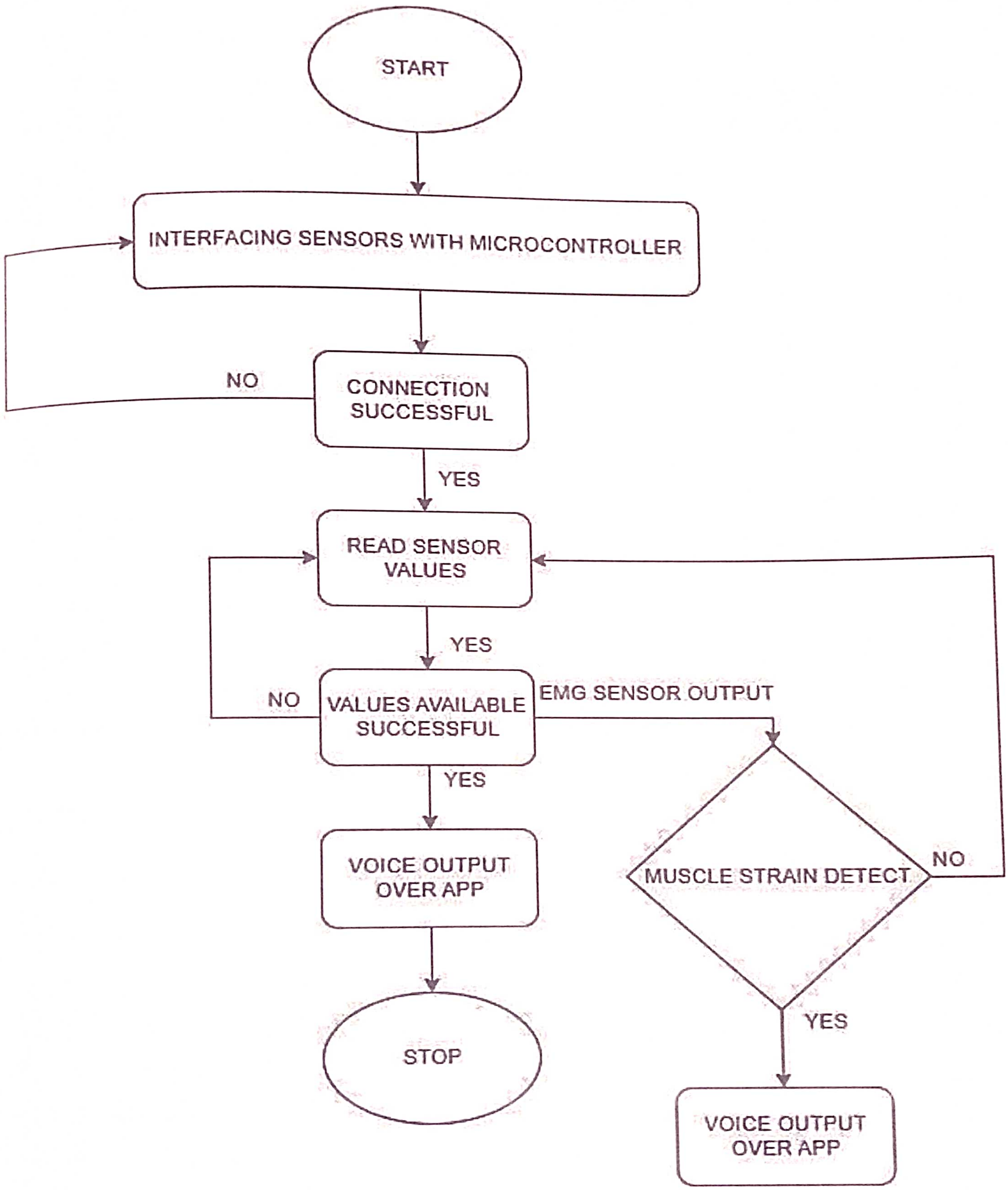
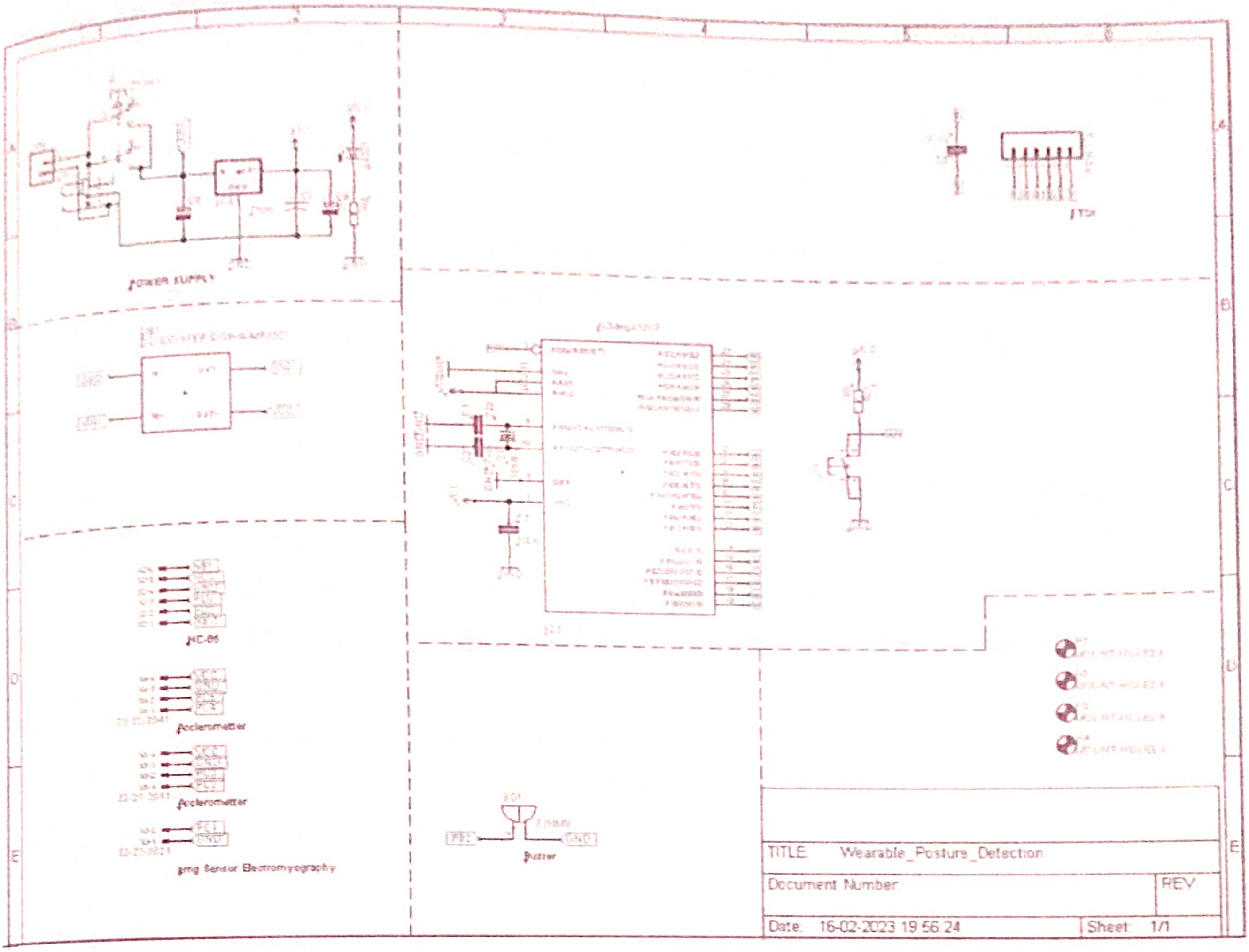


Fig 14

5.5] PCB LAYOUT:



5.6] DATASHEETS:

1. Atmega328p –

Feature:

- ATmega328P 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash
- High performance, low power AVR® 8-bit microcontroller
- Advanced RISC architecture
- 131 powerful instructions – most single clock cycle execution
- 32 ⊓ 8 general purpose working registers
- Fully static operation
- Up to 16MIPS throughput at 16MHz
- On-chip 2-cycle multiplier
- High endurance non-volatile memory segments
- 32K bytes of in-system self-programmable flash program memory
- 1Kbytes EEPROM
- 2Kbytes internal SRAM
- Write/erase cycles: 10,000 flash/100,000 EEPROM
- Manufacture – ATMEL

Speed (MHz)	Power Supply (V)	Ordering Code[2]	Package[1]	Operational Range
20[3]	1.8 - 5.5	ATmega328P-AU ATmega328P-AUR[4] ATmega328P-MU ATmega328P-MUR[4] ATmega328P-PU	32A 32A 32M1-A 32M1-A 28P3	Industrial (-40°C to 85°C)

Speed (MHz)[2]	Power Supply	Ordering Code	Package[1]	Operational Range
16	2.7 to 5.5V	ATmega328P-15AZ	MA	Automotive (–40°C to +125°C)
16	2.7 to 5.5V	ATmega328P-15MZ	PN	Automotive (–40°C to +125°C)

2. EMG Sensor –

Features:

- Small Form Factor (1inch X 1inch)
- Specially Designed for Microcontrollers
- Adjustable Gain – Improved Ruggedness
- New On-board 3.5mm Cable Port
- Pins Fit Easily on Standard Breadboards

Parameter	Min	TYP	Max
Power Supply Voltage (Vs)	±3V	±5V	±30V
Gain Setting, Gain = 207*(X /1 kΩ)	0.01 Ω (0.002x)	50 kΩ (10,350x)	100 kΩ (20,700x)
Output Signal Voltage (Rectified & Smoothed)	0V	--	+Vs
Differential Input Voltage	0 mV	2-5mV	+Vs/Gain

3. HC-05 Bluetooth module –

Features:

- Model: HC-05
- Input Voltage: DC 5V
- Communication Method: Serial Communication
- Master and slave mode can be switched

Configuration	Description
Bluetooth protocol	Bluetooth 2.0+ EDR standard
USB protocol	USB v1.1/2.0
Operating frequency	2.4GHz ISM frequency band
Modulation mode	Gauss frequency Shift Keying
Transmit power	≤4dBm, second stage
Sensitivity	≤-84dBm at 0.1 Bit Error Rate

4. MPU6050 Accelerometer and Gyroscope Module

Gyroscope module -

VDD = 2.375V-3.46V, VLOGIC (MPU-6050 only) = 1.8V±5% or VDD, T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
GYROSCOPE SENSITIVITY						
Full-Scale Range	FS_SEL=0		±250		°/s	
	FS_SEL=1		±500		°/s	
	FS_SEL=2		±1000		°/s	
	FS_SEL=3		±2000		°/s	
Gyroscope ADC Word Length			16		bits	
Sensitivity Scale Factor	FS_SEL=0		131		LSB/(°/s)	
	FS_SEL=1		65.5		LSB/(°/s)	
	FS_SEL=2		32.8		LSB/(°/s)	
	FS_SEL=3		16.4		LSB/(°/s)	
Sensitivity Scale Factor Tolerance	25°C	-3		+3	%	
Sensitivity Scale Factor Variation Over Temperature			±2		%	
Nonlinearity	Best fit straight line; 25°C		0.2		%	
Cross-Axis Sensitivity			±2		%	
GYROSCOPE ZERO-RATE OUTPUT (ZRO)						
Initial ZRO Tolerance	25°C		±20		°/s	
ZRO Variation Over Temperature	-40°C to +85°C		±20		°/s	
Power-Supply Sensitivity (1-10Hz)	Sine wave, 100mVpp; VDD=2.5V		0.2		°/s	
Power-Supply Sensitivity (10 - 250Hz)	Sine wave, 100mVpp; VDD=2.5V		0.2		°/s	
Power-Supply Sensitivity (250Hz - 100kHz)	Sine wave, 100mVpp; VDD=2.5V		4		°/s	
Linear Acceleration Sensitivity	Static		0.1		°/s/g	
SELF-TEST RESPONSE						
Relative	Change from factory trim	-14		14	%	1
GYROSCOPE NOISE PERFORMANCE	**FS_SEL=0**					
Total RMS Noise	DLPFCFG=2 (100Hz)		0.05		°/s-rms	
Low-frequency RMS noise	Bandwidth 1Hz to10Hz		0.033		°/s-rms	
Rate Noise Spectral Density	At 10Hz		0.005		°/s/ √Hz	
GYROSCOPE MECHANICAL FREQUENCIES						
X-Axis		30	33	36	kHz	
Y-Axis		27	30	33	kHz	
Z-Axis		24	27	30	kHz	
LOW PASS FILTER RESPONSE	Programmable Range	5		256	Hz	
OUTPUT DATA RATE	Programmable	4		8,000	Hz	
GYROSCOPE START-UP TIME	**DLPFCFG=0**					
ZRO Settling (from power-on)	to ±1°/s of Final		30		ms	

Accelerometer –

VDD = 2.375V-3.46V, VLOGIC (MPU-6050 only) = 1.8V±5% or VDD, T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
ACCELEROMETER SENSITIVITY						
Full-Scale Range	AFS_SEL=0		±2		g	
	AFS_SEL=1		±4		g	
	AFS_SEL=2		±8		g	
	AFS_SEL=3		±16		g	
ADC Word Length	Output in two's complement format		16		bits	
Sensitivity Scale Factor	AFS_SEL=0		16,384		LSB/g	
	AFS_SEL=1		8,192		LSB/g	
	AFS_SEL=2		4,096		LSB/g	
	AFS_SEL=3		2,048		LSB/g	
Initial Calibration Tolerance			±3		%	
Sensitivity Change vs. Temperature	AFS_SEL=0, -40°C to +85°C		±0.02		%/°C	
Nonlinearity	Best Fit Straight Line		0.5		%	
Cross-Axis Sensitivity			±2		%	
ZERO-G OUTPUT						
Initial Calibration Tolerance	X and Y axes		±50		mg	1
	Z axis		±80		mg	
Zero-G Level Change vs. Temperature	X and Y axes, 0°C to +70°C		±35			
	Z axis, 0°C to +70°C		±60		mg	
SELF TEST RESPONSE						
Relative	Change from factory trim	-14		14	%	2
NOISE PERFORMANCE						
Power Spectral Density	@10Hz, AFS_SEL=0 & ODR=1kHz		400		μg/ √Hz	
LOW PASS FILTER RESPONSE	Programmable Range	5		260	Hz	
OUTPUT DATA RATE	Programmable Range	4		1,000	Hz	
INTELLIGENCE FUNCTION INCREMENT			32		mg/LSB	

5. Buzzer -

Parameter	Active/Passive Buzzer
Operating Voltage	5V (typical)
Operating Current	10-30mA (typical)
Sound Output Level	85-95 dB
Frequency Range	2-4 kHz (typical)
Operating Temperature	-20°C to +60°C
Termination Type	Through-Hole (pins or leads)
Dimensions	12mm diameter (typical)
Housing Material	ABS plastic
Mounting Type	Panel mount or PCB mount
Control Method	Active: Input signal determines sound output Passive: External signal source required
Pin Configuration	2 or 3 pins (GND, VCC, Signal or NC)
Packaging	Bulk or reel packaging options available
Compliance	RoHS compliant
Additional Features	- Built-in oscillator circuit (active buzzer) - Requires external oscillator circuit (passive) - Different tone options available - Low power consumption

CHAPTER 6

ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES AND DISADVANTAGES:

Advantages:

- Interesting features extraction from images providing depth information from a stereo vision
- Conveniences to use with respect to a reference frame
- Direct Force measurements
- Muscle activation detection prior to muscle contraction

Disadvantages:

- Sensitivity to environments (e.g light) Occlusions Problems
- Time delay by frame rate
- Sensor (potentiometer, gyroscope, etc. attachments problem)
- Difficulties in measuring without contact
- Difference between the applied and measured force vector
- Electrode attachments problems
- Cross-talk effects

CHAPTER 7

APPLICATION WITH FUTURE SCOPE

1] Application:

- Posture detection with real time feedback
- Electrical muscle stimulation
- Automatic slouching detection and correction utilizing Emg
- Sensor technology for posture detection

2] Future scope:

Although limitations include placement of the sensors and electrodes, we plan to integrate them into wearable clothing and devising an auto-calibration system that can be customized to each individual's comfort. We plan to conduct a further study to balance the male to female ratio. Our future work includes testing the automatic detection and correction of slouching under different physical conditions such as standing, walking, and carrying different loads on users` backs.

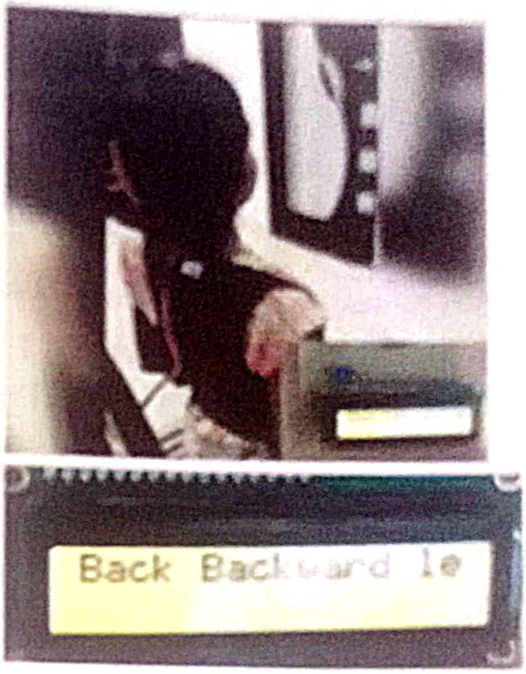
Lots of research work is also going on a posture detection systems like fall detection using computer vision instead of IoT. Computer vision uses images and video which can be proved very beneficial in a fall detection system. As the sensor takes time in measuring the person's positionand triggers an alarm after 15 seconds, and with the help of cameras and computer vision technology, the fall of a person can be detected in real and it reduces the false positive, so the alarm can be triggered.

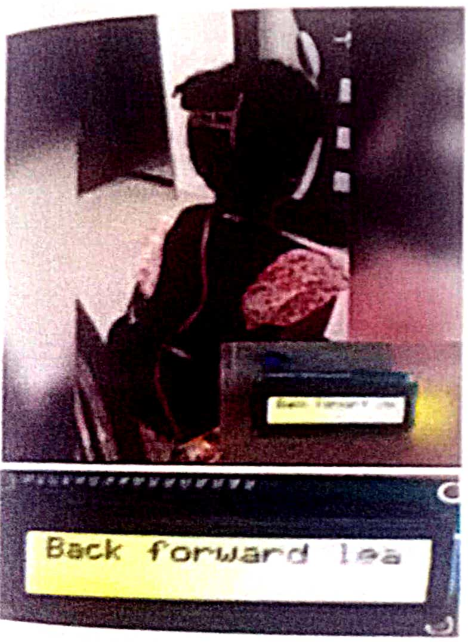
CHAPTER 8

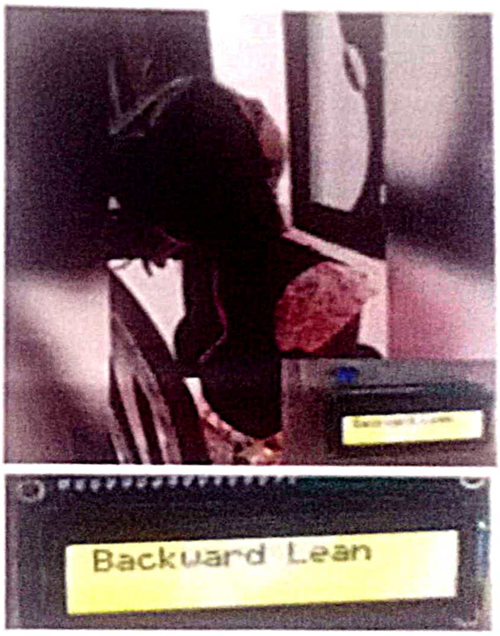
RESULT & CONCLUSION

5.1 RESULT

... neck posture, the correct angle has been measured between 80 and 105 degrees. For wrist, it ... recognizes correct arm position angles between 80 and 100 degrees. The neck position ... depends on the posture angle of the upper body. Therefore, the angular position of the torso is ... measured between 80 and 105 degrees.







[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

CHAPTER 9

REFERENCES

1. Alessandro Manzi, Filippo Cavallo, and Paolo Dario. A neural network approach to human posture classification and fall detection using rgb-d camera. In Italian Forum of Ambient Assisted Living, pages 127–139. Springer, 2016.
2. Paul Rosero-Montalvo, Daniel Jaramillo, Stefany Flores, Diego Peluffo, Vanessa Alvear, and Milton Lopez. Human sit-down position detection using data classification and dimensionality reduction. Advances in Science, Technology and Engineering Systems Journal, 2(3):749–754, 2017.
3. Khushi Arora, Parnika Gupta, Shefali Chopra, and Niharika Pathak. Posture monitoring belt. Int. J. Innov. Res. Stud, 4, 2015.
4. Qi Wang, Wei Chen, Annick AA Timmermans, Christoforos Karachristos, Jean-Bernard Martens, and Panos Markopoulos. Smart rehabilitation garment for posture monitoring. In 2015 37th Annual international conference of the IEEE Engineering in medicine and biology society (EMBC), pages 5736–5739. IEEE, 2015.
5. CC Lim, SN Basah, MA Ali, and CY Fook. A wearable posture identification system for good sitting position. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 10(1-16):135–140, 2018.
6. Elisabetta Farella, Augusto Pieracci, Luca Benini, and Andrea Acquaviva. A wireless body area sensor network for posture detection. In 11th IEEE Symposium on Computers and Communications (ISCC'06), pages 454–459. IEEE, 2006.
7. Elisabetta Farella, Augusto Pieracci, and A Acquaviva. Design and implementation of wimoca node for a body area wireless sensor network. In 2005 Systems Communications (ICW'05, ICHSN'05, ICMCS'05, SENET'05), pages 342–347. IEEE, 2005.
8. Reem Alattas and Khaled M Elleithy. Detecting bad posture using Arduino among engineering graduate students. 2015.
9. Jeremy A Walraven et al. Introduction to applications and industries for microelectromechanical systems (mems). In ITC, pages 674–680, 20

ISSN NO : 0363-8057

MODERNIZE POSTURE DETECTION SYSTEM TO AVOID LOWER BACK AND NECK PAIN

...akshada Kalokhe [1], Nikita Deshmukh[2], Sejal Mate[3], Gayatri S Ambadkar[4] and Bhagyashri Warhade[5]

Department of Electronics and Telecomunication Engineering
Nutan Maharashtra institute of engineering and Technology,Talegaon Dabhade,Pune

Abstract: *Low back and neck discomfort is the most frequent cause of medical visits. Lower back pain affects transverse abdominal muscles due to bad posture. Correct posture and excellent posture can help enhance and maintain one's fitness. Modern technology has been developed to help people live better lives. It delivers a variety of services to enhance one's quality of life. The primary focus of this century has been on wearing advanced devices, particularly in the medical field, where innovations range from pulse monitors to hearing aids to monitoring. The process for developing, building, and testing a tiny wearable electronic device that tracks a user's back posture in real time and alerts them when their posture is incorrectly diagnosed is described in this article.*

Keywords: **IoT, Posture Detection, Posture Correction, Arduino, Android, Circuit.**

1. INTRODUCTION

Posture refers to how a person holds themselves while standing, sitting, moving, and carrying out activities, and it greatly impacts their health. Both bad health and poor performance have been linked to poor posture. Slouching affects the transverse abdominal muscle, based on the study. The oblique abdominal muscle greatly decreases in width when a person maintains a slouched position. The low back strain has been linked to abdominal dysfunction caused by intransitive mobility. With 80% of the population affected, low back pain is one of the most common causes of disability worldwide. Also, because the neck bears the weight of the head, it is susceptible to illnesses and injuries that cause discomfort, limit mobility, and impair biological function; hence, maintaining proper posture and switching positions often are seen as crucial, if not necessary, for sustaining good health.

2. REVIEW OF LITERATURE

[1] C. C. Lim et.al., in their paper "Posture Detection and Correction System using IOT" described human body features and movements. The authors explained neck conditions around the cervical region. Taking all body back parts into consideration, the authors designed and developed their device, which detects the back posture of the human body. An accelerometer was used in this device. By leaning forward and backward, it detects bad posture when certain readings of the accelerometer have been met successfully. Then, the buzzer starts to go on, informing users about their bad posture.

Figure 1. Flowchart of Posture Detection and correction device

The gadget calculates the proper posture and alerts the user if they are hunched over. Instead of placing five flex sensors along the back, only one was utilized on the lower back to detect improper posture. Using basic DC motors, authors were also able to develop an automatic posture correction system in addition to the basic prototype for posture detection. By showing the results from the flex sensor and checking that the motor is turned on or off properly, the authors evaluated the accuracy of the flex sensor thresholds, which are established based on a particular percentage that the user deviates from the ideal posture. The PIC continuously reads information from the flex sensor, providing precision.

[2] Davide Curone et.al., in their paper "Human Posture Detection System Using real-time self-calibrating algorithm" described a posture detection system.

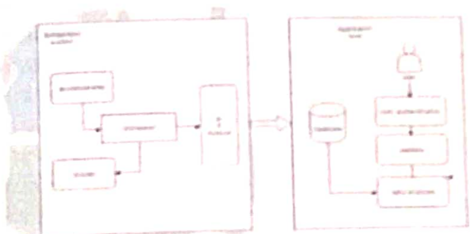


Figure 2. Human Posture Detection System

The device reminds the user to correct their posture. The accelerometer calculates the axis of the user's upper body. A self-calibrating real-time algorithm device that measures human posture and activity based on tri-axial accelerometer signals compares the posture value to a threshold value. The Intelligent Chair Sensor's classification and correction of sitting posture threshold value for a typical human posture was found by the author. The gadget relies on the user to alter their posture if the value goes beyond the threshold limit for a minute, using the buzzer or vibrator. Using the wi-fi on these gadgets, the device transmits a posture value to the server when the buzzer or vibrator is triggered. From the website, the user generates the monthly report. The report shows how many times the gadget prompts you to modify your posture. The equipment is wearable. This study describes a piece of equipment that detects and corrects the user's posture.

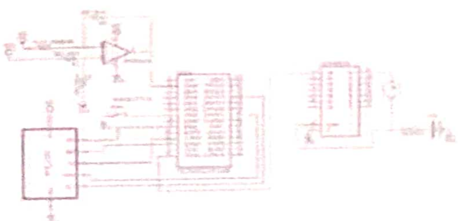
[3] Ricardo Barba et.al., in their paper "IOT-based Smart Posture Detector," states that the current mechanisms to detect postural changes are usually expensive, greatly limiting their use in effective computing. The authors have ruled out commercial solutions for two basic reasons: the need to adjust the size of the sensors and their cost. They used the method of combining

many basic sensors that could be used together to build a posture sensor cushion to address the aforementioned issues. Another approach uses three main sensors, an accelerometer, a gyroscope, and a Bluetooth module. One of the implementations suggests the use of sensors (acceleration sensors) embedded in a smartphone, contrary to the ones that require separate hardware components for the same. However, attaching the sensor to the phone and the phone to a belt is not feasible as there is a risk of dropping the phone every time any rigorous activity is performed. Moreover, people use their phones extremely frequently, and for most of the day, they will have them on their hands and not their belt.

Figure 3. The layout of Android App

by combining several simple sensors so that they can be used together to form a posture sensor cushion. In another approach, SPD is attached to the user's back. The region where the spine bends, just a few inches below the neck, is the best spot for the device to deliver accurate readings. Based on the user's posture, the IMU sends positional readings, according to the z-axis, to the Arduino. The accelerometer provides these values, which are then divided into three ranges, such as "excellent," "terrible," and "acceptable." The Arduino sets the LED lights on the SPD according to the values received. A white light indicates proper posture. A green light denotes good posture, and a red light denotes terrible posture. Also, using the Bluetooth module, the Arduino transmits data to the Android app that is deduced from the values it has received.

[4] Author Santhana Lakshmi. et.al., in their paper "Posturector – Posture Corrector" stated that advanced technology in wearable devices had contributed ways to correct the wrong posture to avoid severe consequences in the future. Smart electronic devices known as wearables can be used as implants or accessories by anyone. The main objective or aim of the paper is to design a product that is easy to use to correct posture while sitting or working on a computer. The main goal of this paper is to create a simple wearable device to correct or maintain correct posture while sitting or doing everyday activities without any physical issues like back or neck pain to improve lifestyle. The PIC microcontroller, flex sensor, buzzer, LCD, flexible belt, and DC gear motor components are used for designing this device. The user is wearing a compression shirt with a flex sensor and buzzer attached to the lower back. An output of sensors is given to the microcontroller, and then the microcontroller determines whether the user is in the proper posture or not. If a user is in bad posture, the microcontroller will sound like a buzzer. Information about the bad posture of a user will be displayed on the LCD. Threshold values are considered the initial stage values of flex sensors. The user is wearing a compression shirt with a buzzer and flex sensor attached to the lower back. If the user sits in the wrong posture for a long time, then the DC motor present on the flex sensor will lift the user back to the correct position based on set threshold values.



ISSN NO : 0363-8057

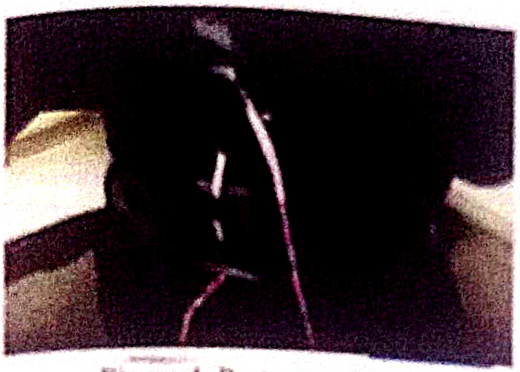


Figure 4. Posture corrector

The whole arrangement must be worn by the user. At first, the user is in his or her typical position. As the user deviates from the regular position, the flex sensor value changes. The buzzer activates as feedback when the flex sensor value changes, alerting the user to return to the default position. This is done by programming. If the user doesn't return to his or her regular posture after a wait, the DC gear motors attached to the elastic belt are turned on. The way they are programmed pushes the user back to their default posture. Proteus software is used for simulation to check the program's functionality.

3. PROPOSED METHODOLOGY

This work proposed a methodology to detect incorrect posture and muscle strain while sitting. Figure 5 shows the block diagram of the methodology and phases involved in the proposed method of the wrong posture and muscle strain detector. The device that we will create can be wear behind the user's upper back, around the neck, and on the user's arms. When the user sits in a bad posture, the buzzer in the device turns on and alerts the user that he or she is standing or sitting in a bad posture. The readings are sent via Bluetooth module to the user's Android app. The Android app will monitor the user's posture and provide feedback accordingly. A power source, memory, and an actuator are also included in the sensor device. For the accelerometer sense, the input readings are taken from an accelerometer and EMG sensors. The data received from the EMG and accelerometer sensors are passed to the ATmega328p microcontroller attached to the user. Accelerometers are used to measure the acceleration along the x, y, and z axes at the point where they are placed on the body. An EMG sensor is also used to monitor the little electrical impulses produce when the user moves muscles. These values are then transmitted to the microcontroller through wires or a wireless medium for further processing and classification. The device is designed to consist of a sensor network comprising an accelerometer for measuring the tilt of the body and EMG sensors for measuring the movement of the body. Then the HC-05 Bluetooth module is used for connecting the device containing these sensors to the mobile application designed to display these readings. This application then alerts the user if he or she is exhibiting good or bad posture by buzzing the buzzer. Further, serial port programming has been done to get the particular output on the atmega328p microcontroller. The Arduino has been programmed for various gestures and body postures that a person encounters in everyday life.

ISSN NO : 0363-8057

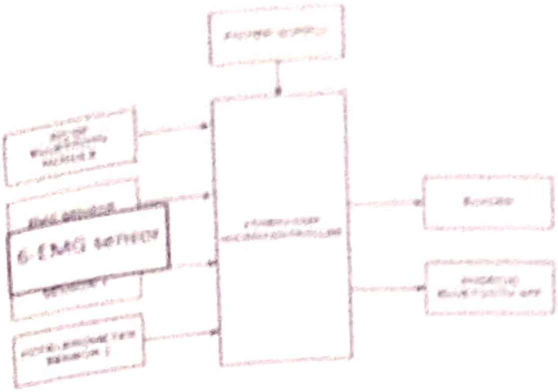


Figure 5. Block Diagram

5. COMPONENTS USED IN DESIGNING POSTURE DETECTION AND CORRECTION SYSTEM

I. Atmega328p microcontroller

A single-chip, high-performance, and effective microcontroller belonging to the mega AVR family, the ATmega328p was developed by Atmel. It is an AVR RISC-based 8-bit microcontroller chip.

It includes the following:

1. 32 KB ISP flash memory
2. 2 KB (Static RAM), EEPROM of 1 KB, general-purpose 23 I/O pins
3. a clock of 16MHz
4. general-purpose32 working registers
5. Three flexible timers/counters with compare modes (consists of one 16-bit and two 8 bits)
6. External and Internal Interrupts
7. Serial programmable UART
8. 6-channel 10-bit ADC (Analog to Digital Converter)
9. Internal oscillator having a Programmable watchdog timer. The voltage range lies between 1.8 to 5.5 Volts.

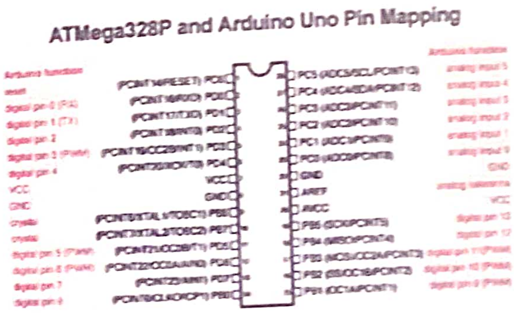


Figure 6. Pin Diagram of Atmega328p

ISSN NO : 0363-8057

Table-1: Comparison between Arduino Uno and Nano

Specifications	Arduino UNO	Arduino nano
Processor	ATmega328P	ATmega328P
Input Voltage	5V/7 to 12V	5V/7 to 12V
Speed of CPU	16MHz	16MHz
Analog I/O	6/0	8/0
Digital IO/PWM	14/6	14/6
EEPROM/SRAM [KB]	1//2	1/2
Flash	32	32
USB	Regular	Mini

2. Buzzer

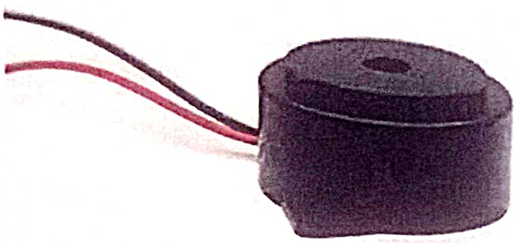


Figure. 7 Buzzer

A buzzer is a small, efficient component that adds sound to the system. It is a compact 2-pin structure and therefore can be easily used on a breadboard. This component is widely used in most electronic applications.

3. BluetoothHC-05

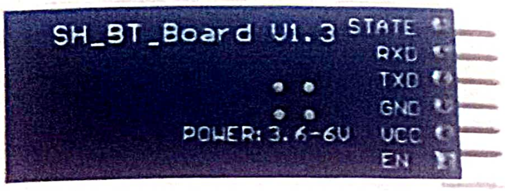


Figure. 8 BluetoothHC-05

The Bluetooth HC-05 module is an easy-to-use module. The Bluetooth SPP (Serial Port Protocol) module is designed for a transparent wireless serial connection setup. It can be used in a slave configuration or a master configuration, which makes it a great solution for wireless communication.

1. **Key/EN:** Key/EN brings the Bluetooth module into AT commands mode. If the Key/EN pin is set high, then this module works in command mode. Or else, it is in data mode by default.HC-05 has a default baud rate of 38400bps in data mode and 38400 bps in command mode.
   HC-05 module has two types of modes:

- Data mode: This mode exchanges data between devices.
- Command mode: This mode uses AT commands which change the settings of HC-05. The module serial port (USART) is used to send these commands.

ISSN NO : 0363-8057

2. **VCC:** This Pin is connected by 5 V or 3.3 V.
3. **GND:** GND is the ground pin of the module.
4. **TXD:** Transmit Serial data (It receives the data by Bluetooth module wirelessly which is transmitted out serially on TXD pin).
5. **RXD:** RXD receives data serially (the data received will be transmitted by Bluetooth module wirelessly).
6. **State:** The state tells whether the module is connected or not.

4. MPU6050

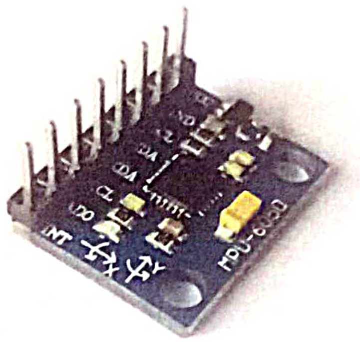


Figure.9 MPU6050

The module, such as MPU6050, is a micro-electro-Mechanical system (MEMS) consisting of a 3-axis accelerometer and a 3-axis gyroscope. This module helps with measurements such as displacement, acceleration, velocity, orientation, and many other motion-related parameters of a system or object.

MPU6050 Features:-

• In MEMS 3-axis accelerometer and 3-axis gyroscope values are combined.

•Power Supply: Power Supply varies from 3-5V

• Communication: I2C (Inter-Integrated Circuit) protocol

• 16-bit built-in ADC providing high accuracy

• Built-in DMP providing high computational power

• IIC devices like magnetometers can be interfaced with MPU6050

• IIC address is configurable

• Consists of an in-built temperature sensor

5.EMG Sensor -

ISSN NO : 0363-8057

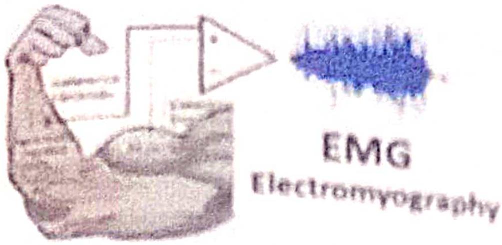


Figure. 10. EMG Sensor

EMG sensors are also known as electromyography sensors. When the movement of muscles happens, that is measured by the EMG sensor by measuring the generated electrical signals by your muscle movement, which includes lifting your arm, clenching your fist, or even the simplest movement like moving a finger.

6. RESULT

For back posture, the correct angle has been observed between 90 and 105 degrees. For arms, it also recognizes correct arm position angles between 90 and 100 degrees. The neck posture depends on the posture angle of the upper body. Therefore, the angular position of the torso is observed between 90 and 105 degrees.

7. CONCLUSION

There are various kinds of sensors used to collect data on human posture. This data is then used to classify a posture as healthy or unhealthy using IOT techniques. Once the model is trained, the data is classified in real-time after being sent to the model using Bluetooth. The prototype used gives 95 % accuracy while detecting the correct and wrong postures.

8. FUTURE SCOPE

Though limitations include placement of the sensors and electrodes, we can further plan to integrate them into wearable clothing and also devise an auto-calibration system that can be customized according to each individual's comfort.

9. REFERENCES

[1] Nitesh Sahani, Prafull Patil, Siddhesh Chikane, Prof. Deepti Vijay Chandran, "Posture Detection and Correction System using IOT : A Survey", 2020 International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 12 | p-ISSN: 2395-0072

[2] M. Suresh Anand, R.Kumar, K.Deepak Keshav, G.Karthikeyan, B.Vigneshwaran, "Human Posture Detection System Using real-time self-calibrating algorithm", 2019 Journal of Emerging Technologies and Innovative Research (JETIR) , Volume 6, Issue 6, ISSN-2349-5162

ISSN NO : 0363-8057

[3] Greeshma Karanth, Niharika Pentapati, Shivangi Gupta, and Roopa Ravish, "IoT based Smart Posture Detector", September 2019 Conference: Global AI Congress, [0000-0002-6348-3228].

[4] Santhana Lakshmi. P, Anupam Kumar, Mr.C. Aravindan Posturector – Posture Corrector, Volume 2, Issue 3, March – 2017, International Journal of Innovative Science and Research Technology. ISSN No: - 2456- 2165, IJERT 1724.

[5] CC Lim, SN Basah, MA Ali, and CY Fook. A wearable posture identification system for good sitting position. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 10(1-16):135–140, 2018

[6] Maniarasu, R. & Pk, Rajesh. (2018). Ergo-Human Optimum Sitting Position With Enhance the Biomechanics to Maintain the Natural Curvature of Spine Posture in Prominent Support and High Comfort of Backrest In Automobile Seating. International Journal of Scientific Research in Science and Technology. 4. 10.32628/IJSRST184839

GRADIVA REVIEW JOURNAL
An UGC-CARE Approved Group-II Journal
ISSN NO : 0363-8057 / Website : http://gradivareview.com/
Email : Submitgrjournal@gmail.Com

Paper ID : GRJ/4990

Certificate of Publication

This is to certify that the paper titled

Modernize Posture Detection System To Avoid Lower Back And Neck Pain

Authored by

Sejal Mate

From

Nutan Maharashtra institute of engineering and Technology,Talegaon Dabhade,Pune

Has been published in

GRADIVA REVIEW JOURNAL Volume 9, Issue 3, March 2023.

UGC APPROVED JOURNAL

Indexed by Scopus

DOI: 10.37897/GRJ

crossref member
CROSSREF.ORG
THE CITATION LINKING BACKBONE

Teresa Gallart
Editor-in-Chief
Gradiva Review Journal

6.1
IMPACT FACTOR

An UGC-CARE Approved Group-II Journal

ISSN NO : 0363-8057 / Website : http://gradivareview.com/
Email : Submitgrjournal@gmail.Com

Paper ID : GRJ/4990

Certificate of Publication

This is to certify that the paper titled

Modernize Posture Detection System To Avoid Lower Back And Neck Pain

Authored by

Nikita Deshmukh

From

Nutan Maharashtra institute of engineering and Technology,Talegaon Dabhade,Pune

Has been published in

GRADIVA REVIEW JOURNAL Volume 9, Issue 3, March 2023.

UGC APPROVED JOURNAL

Indexed by Scopus

DOI: 10.37897/GRJ

crossref member
CROSSREF.ORG THE CITATION LINKING BACKBONE

Teresa Gallart
Editor-In-Chief
Gradiva Review Journal

6.1 IMPACT FACTOR

GRADIVA REVIEW JOURNAL
An UGC-CARE Approved Group-II Journal
ISSN NO : 0363-8057 / Website : http://gradivareview.com/
Email : Submitgrjournal@gmail.Com

Paper ID : GRJ/4990

Certificate of Publication

This is to certify that the paper titled

Modernize Posture Detection System To Avoid Lower Back And Neck Pain

Authored by

Akshada Kalokhe

From

Nutan Maharashtra institute of engineering and Technology,Talegaon Dabhade,Pune

Has been published in

GRADIVA REVIEW JOURNAL Volume 9, Issue 3, March 2023.

UGC APPROVED JOURNAL

Indexed by Scopus

DOI: 10.37897/GRJ

Crossref member
CROSSREF.ORG THE CITATION LINKING BACKBONE

Teresa Gallart
Editor-In-Chief
Gradiva Review Journal

6.1 IMPACT FACTOR

CERTIFICATE

Of Appreciation

Department of Electronics Engineering

CONGRATULATIONS

This is to certify that Mr. /Miss. **Nikita Deshmukh** has participated in Project competition organised at AISSMS Polytechnic College held during May 2023

Shri. S. K. Giram
PRINCIPAL,AISSMS POLYTECHNIC

CERTIFICATE

Of Appreciation

Department of Electronics Engineering

CONGRATULATIONS

This is to certify that Mr. /Miss. Sejal Mate has participated in Project competition organised at AISSMS Polytechnic College held during May 2023

Shri. S. K. Giram

PRINCIPAL,AISSMS POLYTECHNIC

CERTIFICATE

Of Appreciation

Department of Electronics Engineering

CONGRATULATIONS

This is to certify that Mr. /Miss. Akshada Kalokhe has participated in Project competition organised at AISSMS Polytechnic College held during May 2023

Shri. S. K. Giram

PRINCIPAL, AISSMS POLYTECHNIC

Nutan Maharashtra Institute of Engineering & Technology (NMIET)

CERTIFICATE
OF APPRECIATION

this certificate is proudly presented to the

Miss Akshada Kolokhe

for active participation /~~winner~~ /~~runner up~~ in the event Poster Presentation at Tech-fiesta 2k23 organized by Nutan Maharashtra Institute of Engineering & Technology, Pune from 18th to 20th April 2023.

Mr. Rahul Patil	Mr. Prakash Kshirsagar	Mr. Kapil Wagh	Mr. Mahesh Chinchole
Coordinator Tech-Fiesta	Coordinator Tech-Fiesta	Coordinator Tech-Fiesta	Coordinator Tech-Fiesta

Mr. Spandan Waghmare
Coordinator Tech-Fiesta

Dr. Vilas Deotare
Principal, NMIET

TECH-FIESTA 2K23

All the best

Pimpri Chinchwad Education Trust's (PCET's)
Nutan Maharashtra Vidya Prasarak Mandal's (NMVPM's)

Nutan Maharashtra Institute of Engineering & Technology (NMIET)

CERTIFICATE

OF APPRECIATION

this certificate is proudly presented to the

Miss. Nikita Deshmukh

for active participation /~~winner~~ /~~runner up~~ in the event Poster Presentation at Tech-Fiesta 2k23 organized by Nutan Maharashtra Institute of Engineering & Technology, Pune from 18th to 20th April 2023.

Mr. Rahul Patil
Coordinator
Tech-Fiesta

Mr. Prakash Kshirsagar
Coordinator
Tech-Fiesta

Mr. Kapil Wagh
Coordinator
Tech-Fiesta

Mr. Mahesh Chinchole
Coordinator
Tech-Fiesta

Mr. Spandan Waghmare
Coordinator Tech-Fiesta

Dr. Vilas Deotare
Principal, NMIET

TECH-FIESTA 2K23

Pimpri Chinchwad Education Trust's (PCET's)
Nutan Maharashtra Vidya Prasarak Mandal's (NMVPM's)

Nutan Maharashtra Institute of Engineering & Technology (NMIET)

CERTIFICATE
OF APPRECIATION

this certificate is proudly presented to the

Miss. Sejal Mate

for active participation /~~winner~~ /~~runner up~~ in the event Poster Presentation at Tech-Fiesta 2k23 organized by Nutan Maharashtra Institute of Engineering & Technology, Pune from 18th to 20th April 2023.

Mr. Rahul Patil	Mr. Prakash Kshirsagar	Mr. Kapil Wagh	Mr. Mahesh Chincholе
Coordinator Tech-Fiesta	Coordinator Tech-Fiesta	Coordinator Tech-Fiesta	Coordinator Tech-Fiesta

Mr. Spandan Waghmare
Coordinator Tech-Fiesta

Dr. Vilas Deotare
Principal, NMIET

TECH-FIESTA 2K23

All the best

Date: 31-05-2023

Sponsorship Letter

To Whom It may concern:

Re: Official Sponsorship Approval Letter

It is with great delight that <u>**Atul Hampe & Associates**</u> have to extend an offer of sponsorship for

Students Below:

- Ms. Sejal Mate
- Ms. Akshada Kalokhe
- Ms. Nikita Deshmukh

Students studying in Final Year degree program of Electronics & Telecommunication Engineering at **"PCET's Nutan Maharashtra Institute of Engineering and Technology".** Official Recipient of Under the Academic Project At <u>**Atul Hampe & Associates**</u>

Project Name: **"Wrong Posture and Muscle Strain Detector"**

Here at <u>**Atul Hampe & Associates**</u> is a Construction-based company. We are directed to fostering new talent and we believe that students have what is takes to make a huge impact. In return, we ask that Students display promotional signs and literature throughout.

The approval consists of the total expenditure required For the Completion Of The Project. I look forward to hearing from you soon so that we can move forward with this wonderful opportunity for and students.

Yours sincerely,

ΣMERTXE
The future-ready IT Institute

Affiliated to
N·S·D·C National Skill Development Corporation
ESSCI

CERTIFICATE OF INTERNSHIP

PRESENTED TO

Akshada Kalokhe

For Successfully Completing Online Internship on

EMBEDDED SYSTEMS

This Internship Provided Hands-On Exposure on

- Foundational Programming Skills in C & Micro-Controllers
- SDLC Based Project Building in Embedded Systems

Internship Start Date : 8th Nov 2021 **Internship End Date :** 31 Dec 2021

Technology Head, Emertxe
(Mubeen Jukaku)

CERTIFICATE ID
EI21_003

Director, Emertxe
(Jayakumar Balasubramanian)

www.emertxe.com

ΣMERTXE
The future-ready IT Institute

Affiliated to
N·S·D·C National Skill Development Corporation
ESSCI

CERTIFICATE OF INTERNSHIP

PRESENTED TO

Nikita Deshmukh

For Successfully Completing Online Internship on

Internet of Things (IoT)

This Internship Provided Hands-On Exposure on

- **Foundational Programming Skills in C & Micro-Controllers**
- **SDLC Based Project Building in IoT**

Internship Start Date : 27th Jun 2022 **Internship End Date :** 25th Aug 2022

Technology Head, Emertxe
(Mubeen Jukaku)

CERTIFICATE ID
EI22_005

Director, Emertxe
(Jayakumar Balasubramanian)

www.emertxe.com

TATA

HR / 2022 / 99999519

28.04.2022

CERTIFICATE

This is to certify that **Ms. Sejal Chandrashekhar Mate** a student of **Nutan Maharashtra Institute of Engineering & Technology, Pune** has successfully completed her Project at TATA Motors Passenger Vehicles Ltd, Pune from **28.02.2022 to 28.04.2022.**

During the above period, she was placed in our **"EV Shop"** where she carried out a project titled as:

"Interfacing Scanner & Automation of Radiator Coolant Filling Machine"

The candidate was found to be enthusiastic and observant during her stint in TATA Motors Passenger Vehicles Ltd, Pune her performance has been assessed as **Very Good.**

For TATA Motors Passenger Vehicles Ltd.

Ghanwat Santosh Haribhau
HR - Skill Development

LEARNING & DEVELOPMENT TATA MOTORS CAR PLANT HUMAN RESOURCE