GESTURE CONTROL ROBOTIC ARM

Project report submitted in partial completion of the constraint for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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UNDER THE GUIDANCE OF

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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

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DECLARATION

I hereby declare that the work reported in the B.Tech Project Report entitled submitted at **"Jaypee University of Information Technology, Waknaghat, India"** is an authentic record of our work carried out under the supervision of **Dr. VIKAS BAGHEL.** I have not submitted this work elsewhere for any other degree or diploma.

HARDIK SHARMA
(161110)

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

.

Dr. VIKAS BAGHEL
Date:

ACKNOWLEDGEMENT

It is our privilege to express my sincerest regards to my project coordinator, Dr. VIKAS BAGHEL, for their valuable inputs, valuable guidance, encouragement, whole-hearted cooperation and constructive criticism throughout the duration of my project. I deeply express our sincere thanks to our Head of Department Dr. M.J Nigam for encouraging and allowing me to present the project on the topic "GESTURE CONTROL ROBOTIC ARM " at my department premises for the partial fulfillment of the requirements leading to the award of B-Tech degree.

LIST OF ACRONYMS AND ABBREVIATIONS

- AD0: I2C Slave Address LSB pin
- MCU: Microcontroller unit
- MPU: Microprocessing Unit
- INT: Interrupt digital output pin
- XCL: Auxiliary Serial Clock
- XDA: Auxiliary Serial Data
- SCL: Serial Clock
- SDA: Serial Data
- GND: Ground
- VCC: Power supply

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ABSTRACT

Most of robots are controlled by wireless connection (like control remote or smartphones) or by direct (wired) reference to pre-defined commands. During this project work we are designing a robot which is to be controlled by hand gesture of human and an accelerometer and Gyroscope is employed to maneuver robot consist with hand movement. During this work the hardware requirements and complexity has been removed due to not using remote NODMCU microcontroller makes it a self-activated robot, which drives itself consist with hand gesture of its controller.

CHAPTER 1

Introduction

1.1 Backgrounds of robotics

Robotics arm may be a programmable manipulator, it comprises of linear and rotary joints to permit for controlled movements (Robots.com, 2017). It's largely utilized in different field like smart industries, health care and defense forces for several years thanks to its high repeatability, accuracy and efficiency. The pliability or dexterity of an articulated robotic arm is proportional to the amount of axes of it. For the economic articulated robotic arm, it starting from different sizes counting on different application, as an example, the large heavy duty articulated arm perform automotive assembly while application like electronics assembly is performed by smaller articulated arm.

In military, articulated robotic arm is employed in bomb disposal unit. The bomb disposal robot is employed to disable explosive ordnance over years and saved countless lives. The robot is remotely controlled by bomb expert at a secure distance to look at explosive devices closely without putting themselves endanger. Thus, the robot usually equipped with cameras because the "eyes" of the robot to supply the vision of the encompassing situation in order that the operator can control the robotic arm through cameras to look at and dispose explosive devices.

The robot also equipped with pairs of caterpillar tracks or wheels to permit it to traverse rough terrain like climbing stairs and tools are often attached on the robotic arm like wire cutter so as to bypass fences. The body itself also armed with explosive detectors and X-ray devices for the detection of explosives, not only bomb but unexploded munitions and landmines also. Bomb disposal robot technically isn't a “robot", more accurately as a drone, as human control still needed since bomb experts' experience and decision is crucial in explosive disposal operation

Figure 1.1: Industrial articulated robotic arm

Figure 1.2: Bomb disposal robot (iRobot 510 PackBot) I

1.2 Goal and intention

The objectives of this project are shown as following:

- Building a 6-axis robotic arm.
- To place into practice gesture control on the robotic arm.
- To urge conversant in MPU 6050 sensor technology.
- To urge conversant in flex sensor

Gesture control method is going to be adopted during this development. With this gesture controlled robotic arm, the bomb disposal operation are going to be higher efficiency because the robot are often operate in faster and more intuitive way and no training is required.

When we use remote control with buttons or a joystick to control a robot the actions we create are not that precise or smooth. Using hand gestures we can give exact commands and replicate our hand movement into robotic actions.

CHAPTER 2

LITERATURE SURVEY

2.1 Backgrounds of study

2.1.1 Gesture control

The control is that the ability to acknowledge and understand movements of the human bodying order to interrelate with and control a computing system without direct physical contact". The interface of this procedure is comprehended as common interface, by and large, absence of moderate gadgets between the framework and subsequently the client. Signal control is undeniably increasingly easy and natural analyzed topdressing switches, tweaking handles, controlling mouse and contacting screens. It particularly adds to facilitate the association among client and gadgets, substituting or decreasing the need for console, mouse or fastens.

Human language will be progressively reasonable by the PCs which will make a far superior client experience through signals when face acknowledgment and voice orders such propelled interface innovations joined together. Signal control is getting utilized in clinical applications, elective PC interfaces, amusement applications and mechanization frameworks. In clinical applications, perilous conditions are regularly perceived with cutting edge signal acknowledgment mechanical frameworks.

For the amusement applications, motion control can give progressively natural control condition which will drench the player inside the game more than ever while inside the robotization frameworks in vehicles, homes and workplaces, signal control are regularly consolidated to downsize the need of essential and auxiliary information frameworks like fastens inside the vehicle theater setups as which will occupy the main thrust s when the driver needs to direct it while driving. Gesture control are frequently isolated into two classifications by the handling strategies:

2.2 Literature review

It is extremely hard and once in a while even perilous for laborers to head out to each plant and pluck organic products. Mechanical frameworks are progressively joined with new advances to computerize or semi-mechanize work serious work, for example, for example grape collecting. During this work they propose a self-loader strategy for help in gathering foods grown from the ground increment profitability per individual hour.

An automated arm is associated with a wanderer meander inside the in plantation and thusly the client can control it remotely utilizing the hand glove fixed with different sensors. In paper [] they talk about the arranging of hand glove fixed with different sensors, structure of 4 DoF mechanical arm and in this way the remote control interface. Moreover, the arrangement of the framework and thusly the testing and assessment under lab conditions additionally are introduced during this paper.

Framework Architecture:
In the Figure 2.1, the shaper activity is imitated by utilizing the thumb and file. The test arrangement comprised of a 4 DoF mechanical arm worked with lightweight aluminum channels one among which acts on the grounds that the fixed connection and staying three, versatile connections. The top impact or that is the shaper is connected at the last connection. This shaper cuts the dainty twigs that are held inside its ambit for this test arrangement. The client wears the glove with the sensors and MCU arrangement as appeared as disappointment tests and reaction time tests.

They finished up as farming mechanical technology is acquiring transformation rural area through and through the created nations, the creating countries like India shouldn't pass up a great opportunity the opportunity to shape utilization of such advancements and stay on point with developments in agrarian segment. During this setting they introduced the arranging and execution of a mechanical arm which might be remotely controlled utilizing a hand glove fixed with different sensors. The craving empowers the client to be inside the room rather than inside the field and control the arm. Some of the tests managed inside the lab including the achievement/disappointment tests and reaction time estimation tests and their outcomes are empowering

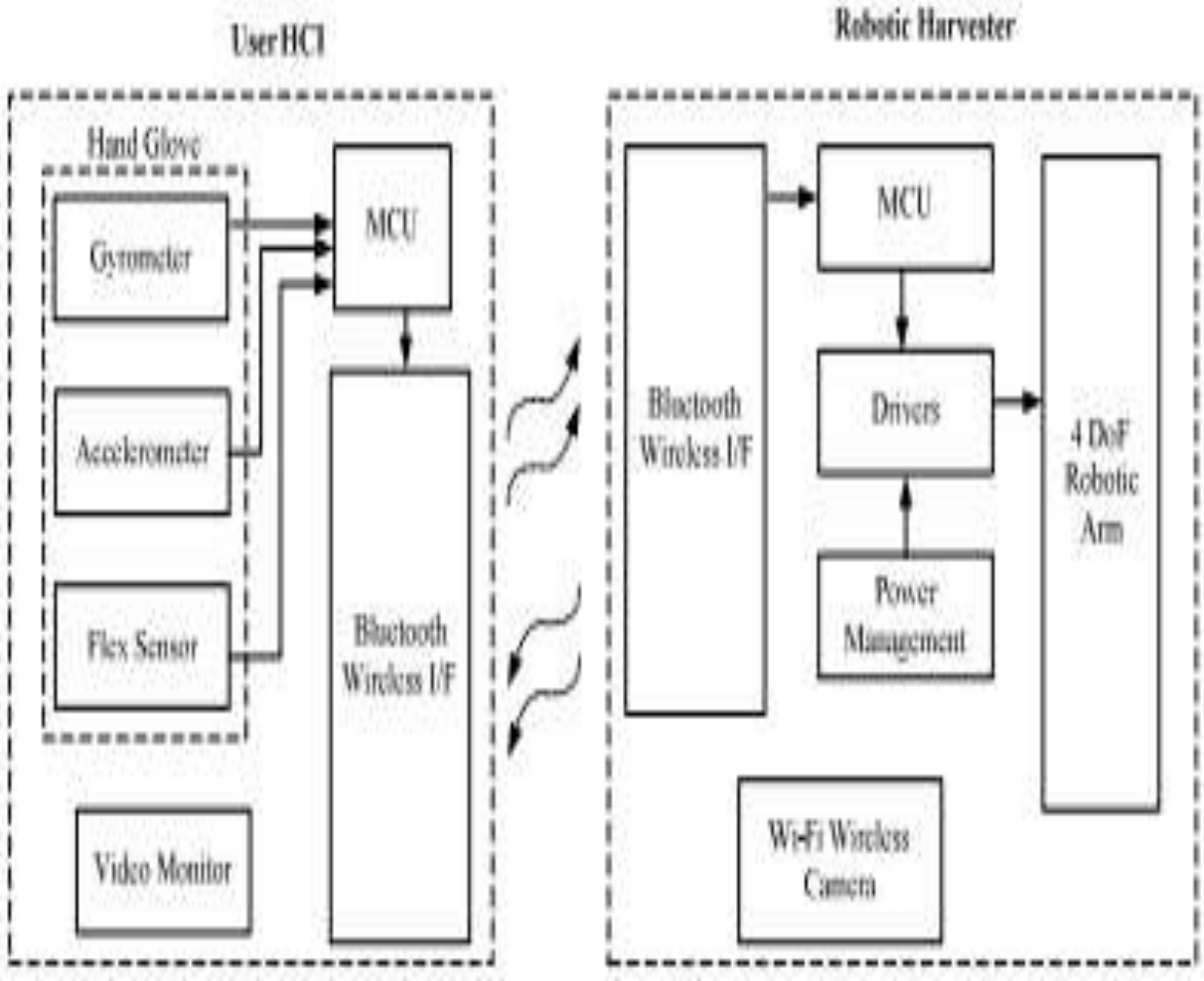


Figure 2.1 SYSTEM ARCHITECTURE

In paper [], the target of this examination is to perform different complex medical procedures easily, least attack and high exactness because of their exact controlled component and innovation. In any case, these robots are incredibly exorbitant because of their modern programming and hardware. This makes it excessively expensive for different specialists and clear medical procedures.

This task manages the arranging and improvement of an automated hand with constant control, which is exact and savvy. These five fingered automated arms copy a little level of smoothness and will be utilized for different applications like prosthesis for disease patients. This may permit them to encourage a superior level of opportunity and can help in their everyday life

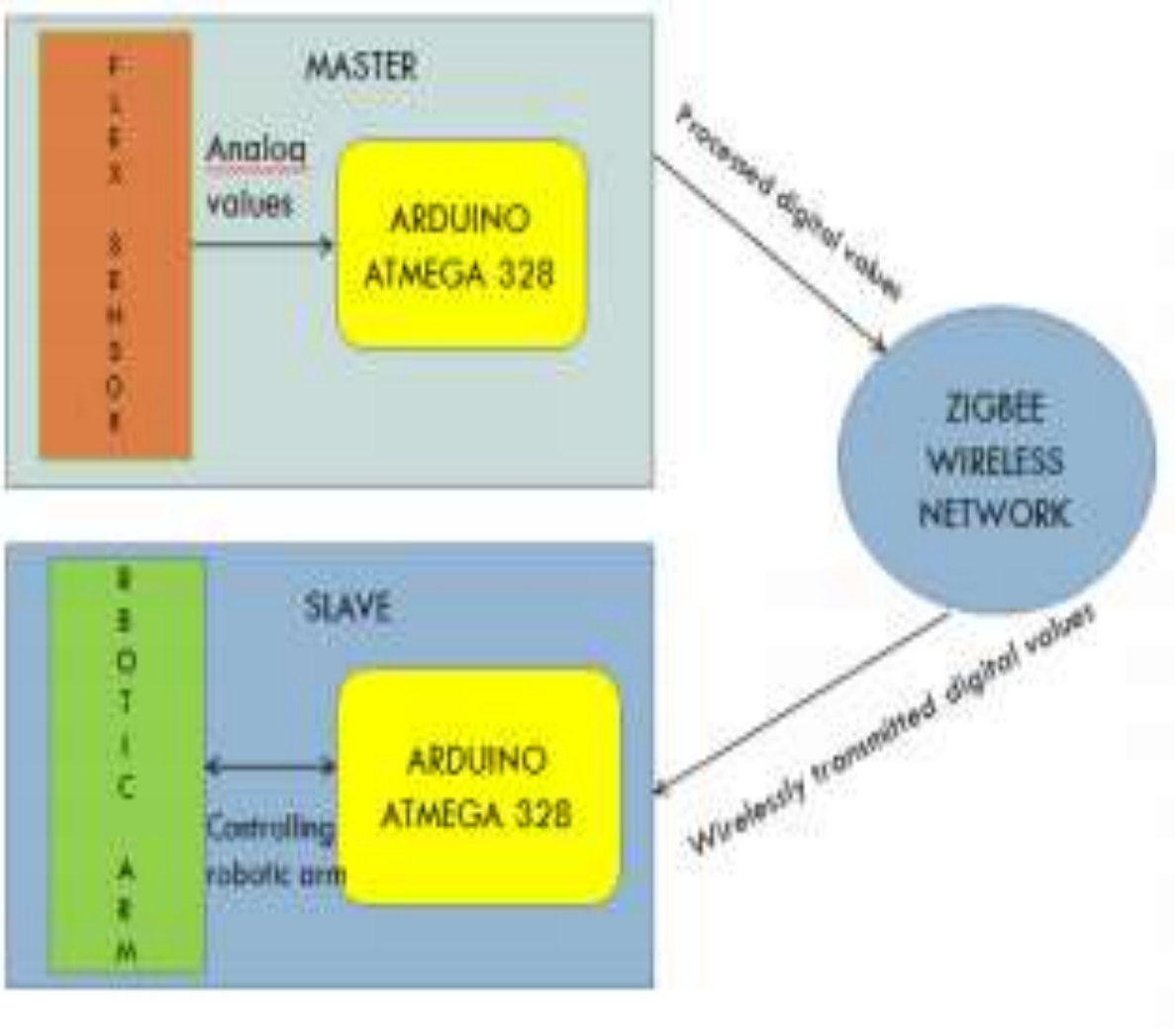


Figure 2.2: Block Diagram of a wireless robotic arm

In paper [], a model of automated hand for tele-surgery utilizing haptic innovation was actualized. The Arduino sheets were arranged to talk which encouraged the information move remotely. The outcomes appeared beneath show changes inside the flex sensor voltages, its simple qualities at the transmitting Arduino board and its relating an incentive at the getting Arduino board which might be mapped utilizing 'Guide" work. The 'simple Read' on an Arduino is basically a voltage meter. At 5V (maximum) it may peruse 1023, and at 0V it understands 0. In this way, the curve is regularly estimated utilizing the change inside the voltage esteems utilizing simple Read(). A potential divider circuit is created utilizing a 22kOhm resistor with the flex sensor.

The voltage esteems for the five flex sensors. In this manner, we will see the fingers inside the mechanical arm moving as we flex the differed flex sensors inside the glove.

Subsequently, by mounting five flex sensors on the individual fingers of the glove, each finger of the automated arm are regularly controlled independently giving more noteworthy level of movement and progressively number of mixes with the fingers, this finished up in model may be utilized for little scope surgeries just in the event of a crisis yet as of now, the fundamental restricting variable that was hindering the occasion of our model was "idleness" which is that the time delay between the guidelines gave by the specialist and in this manner the development of the robot which reacts to the directions. With the current degree of innovation, the specialist must be in closeness.

The goal of this investigation is to create model to direct automated arm through human signals utilizing accelerometer. A human hand with mounted three-hub accelerometer helps to play out the activity of mechanical arm steady with the activity of hand. Accelerometer is associated with the Atmega 16Microcontroller.

Model

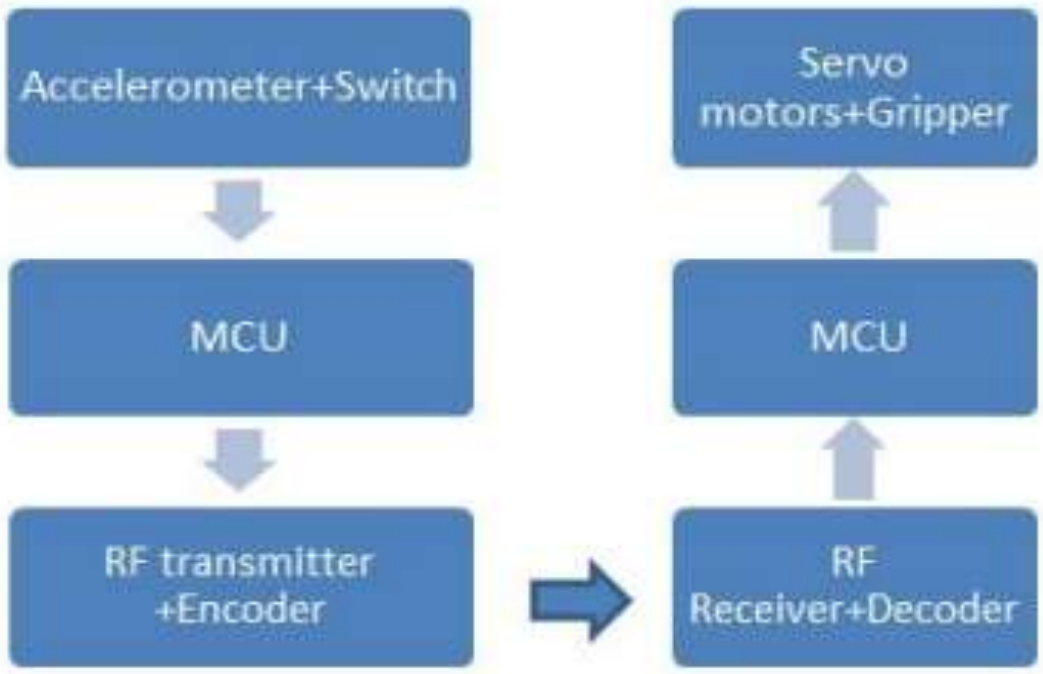


Figure2.3: Flow Chart of Process

The versatile stage is frequently controlled utilizing a remote. The model comprises of the transmitting and getting units. The framework is frequently comprehended with the help

of stream graph as appeared in figure-2.3. The qualities are being transmitted remotely at accepting end, which comprises of a RF recipient, and a microcontroller (ATmega16) for controlling servo engines.

The aftereffect of the trial is that this control instrument gives a basic movement& control of arm yet doesn't encourage the educating and learning. Therefore, a reasonable and direct method of control utilizing well known AVR microcontrollers and RF gadgets is executed. The structure of arm and portable stage works effectively recreating the motions of human arm. What's more, this finished up it gives an obviously better gratitude to control a mechanical arm utilizing accelerometer which is progressively natural and simpler to figure, other than offering the probability to direct a robot by different remote methods. Utilizing this procedure non-Experience mechanical arm controller can without much of a stretch control automated arm rapidly and during a characteristic way. Additionally, numerous applications which require exact control and work like populace are frequently handily actualized utilizing this methodology.

What's more, it gives increasingly adaptable control instrument. Accelerometer outfitted with gyro sensors can assist with framing development smoother. Despite the fact that the signal control is accomplished however issue of clamor and snaps are regularly there which might be additionally evacuated by aligning and taking more perceptions and utilizing a much exact smoothing calculation.

CHAPTER 3

EQUIPMENTS

3.1Flex sensor

Purpose: Measuring the value of deflection or twisting.

Types:

2.2 inches

4.5 inches

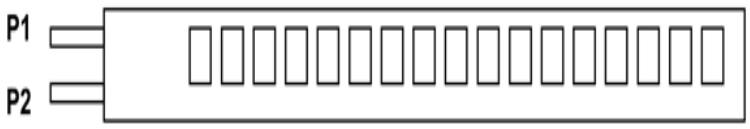


FIGURE 3.1 flex sensor

Flex Sensor Pin Configuration:

P1: Connecting to positive pin of power source.

P2: Connecting to the ground.

As mentioned above, flex sensor is essentially a rheostat whose terminal resistance increases when the sensor is bent. So, this detector resistance will increase depending on the one-dimensionality of the surface.

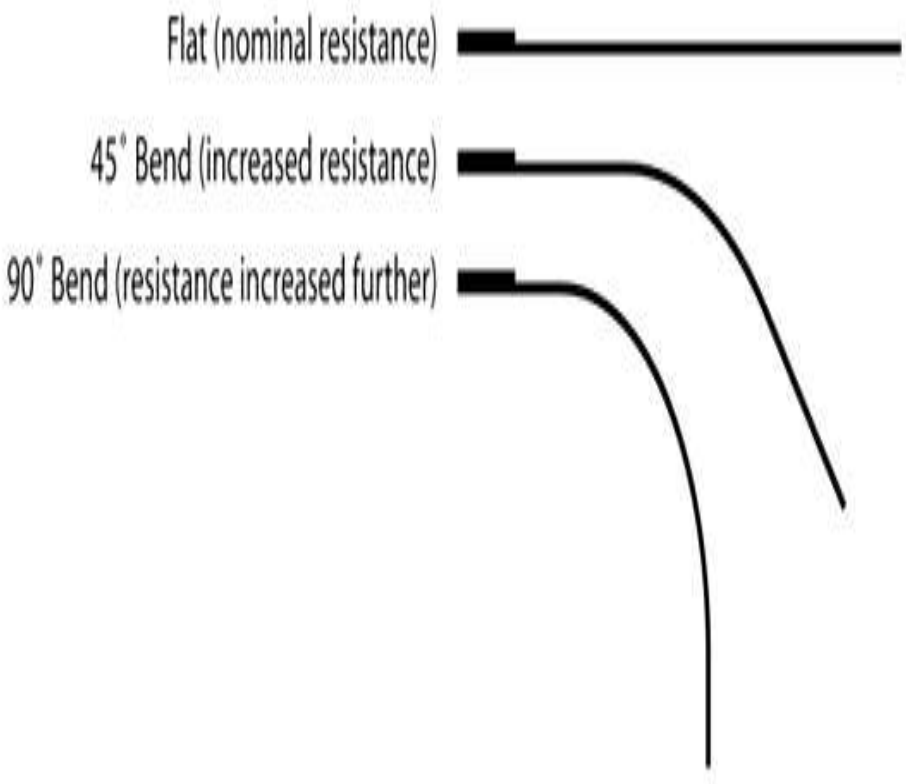


FIGURE 3.2 working of flex sensor

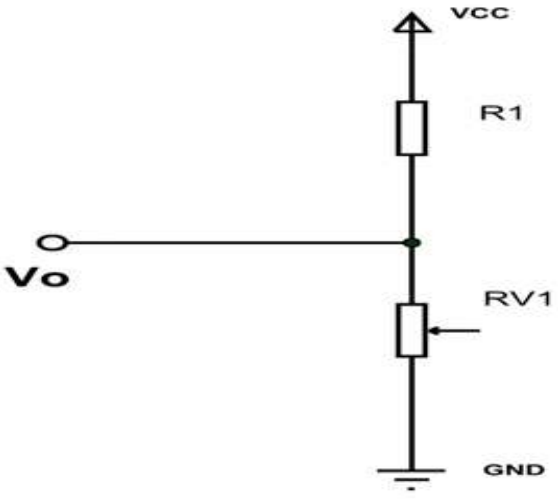


FIGURE 3.3 voltage divider

During this resistive system we've two protections. One is steady opposition (R1) and distinctive is variable obstruction (RV1). Vo is that the voltage at purpose of voltage divider circuit and is furthermore the yield voltage. Vo is moreover the voltage over

the variable obstruction (RV1). So once the obstruction worth of RV1 is adjusted the yield voltage Vo moreover changes. Thus, we are getting the chance to have obstruction change in voltage alteration with voltage divider circuit. Here we are getting the opportunity to supplant the variable opposition (RV1) with FLEX locator. The circuit will be as underneath

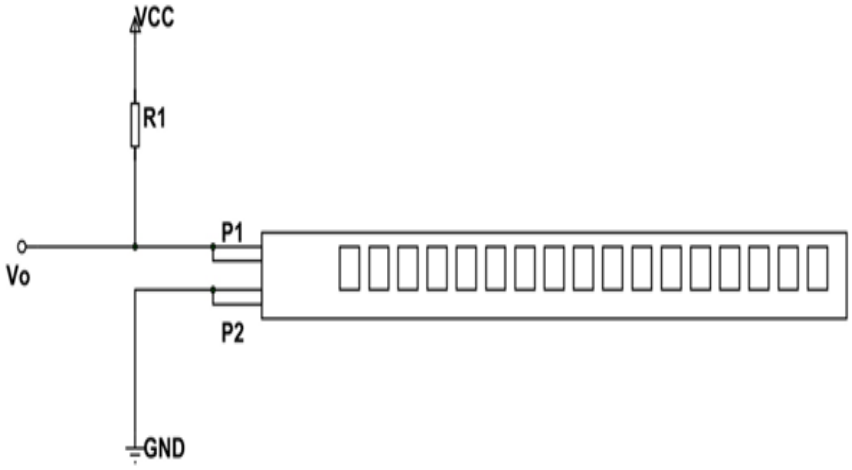


FIGURE 3.4 voltage divider with flex

3.2 MPU6050 (Gyroscope + Accelerometer + Temperature) Sensor

Module:

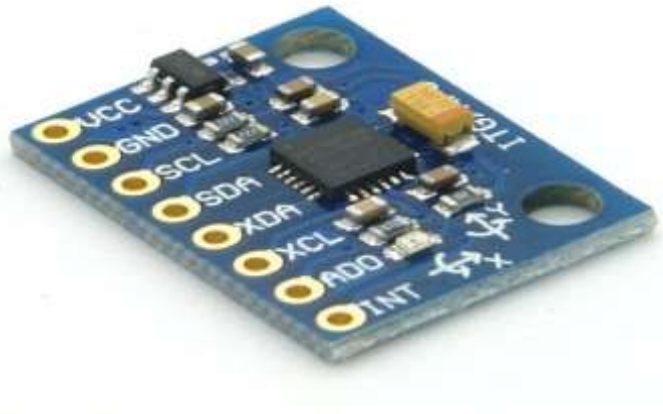


FIGURE 3.5 MPU6050 Module

MPU6050 identifier module is finished 6-pivot Motion interest Device. It consolidates 3-pivot component , 3-hub estimating instrument and Digital Motion

Processor dead little bundle .Also, it's further element of on-chip Temperature indicator. It has I2C transport interface to talk with the microcontrollers. It has Auxiliary I2C transport to chat with various indicator gadgets like 3-hub meter, Pressure sensor and so forth. In the event that 3-hub meter is associated with helper I2C transport, at that point MPU6050 can give total 9-axisMotion Fusion yield.

3-Axis Gyroscope:

The MPU6050 contains 3-pivot Gyroscope with Micro Electro framework (MEMS; innovation. it's wont to distinguish rotational speed along the X, Y, Z tomahawks as appeared in beneath figure.

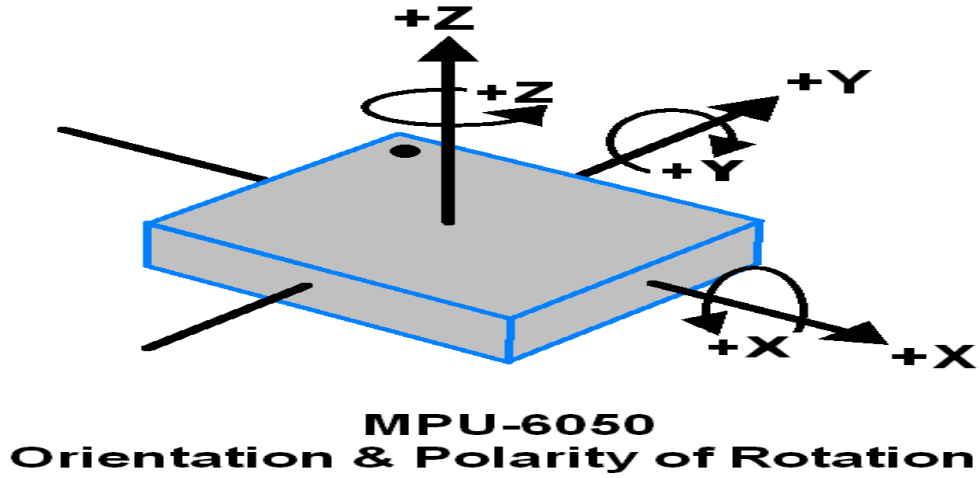


FIGURE 3.6 gyroscope

- when the gyros square measure turned concerning any of the sense tomahawks, the Coriolis impact causes a vibration that is recognized by a MEM inside MPU6050.
- The subsequent sign is intensified, demodulated, and separated to flexibly a voltage that is corresponding to the rakish rate.
- This voltage is digitized exploitation 16-piece ADC to test each hub.
- The full-scale scope of yield are 250, 500, 1000, 2000.
- It gauges the precise speed along every hub in degree every subsequent unit.

3-Axis Accelerometer:

The MPU6050 comprise 3-pivot Accelerometer with Micro Electro Mechanical (MEMs) innovation. It wont to distinguish point of tilt or tendency along the X, Y and Z tomahawks as appeared in beneath figure.

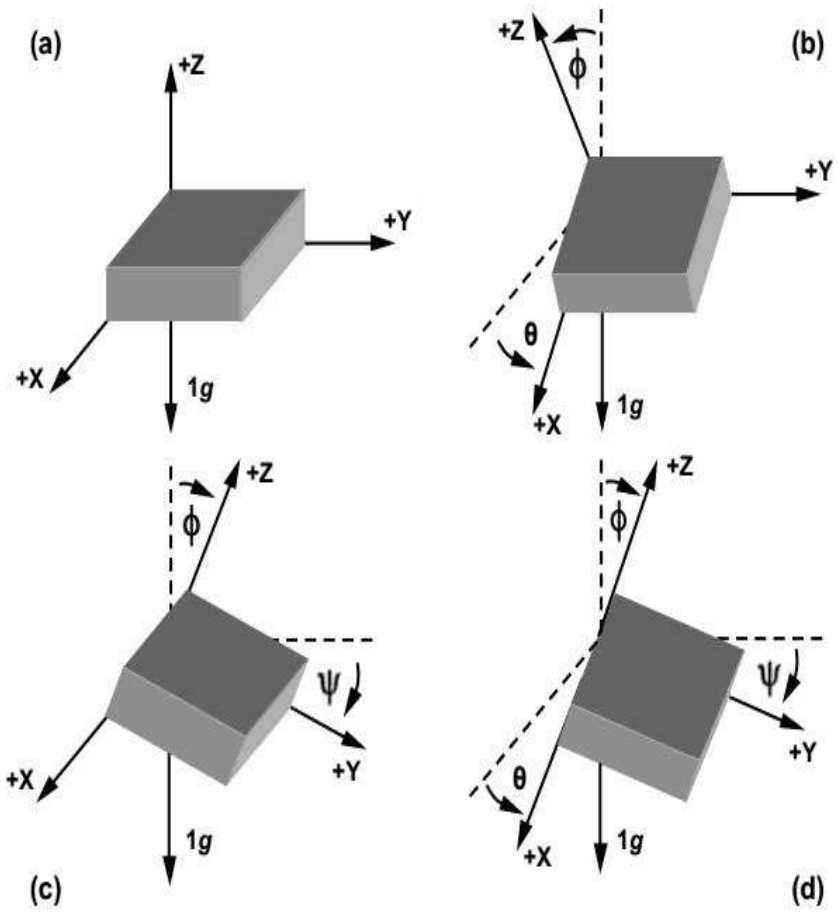


FIGURE 3.7 accelerometer

DMP (Digital Motion Processor)

The installed Digital Motion Processor (DMP) is utilized to make sense of movement process calculations. It takes information from instrument, accelerometer and extra outsider sensor like magnetometer and procedures the data. It gives movement information like move, pitch, yaw edges, scene and representation sense and so on. It limits the procedures of host in figuring movement information. The subsequent information are regularly perused from DMP registers

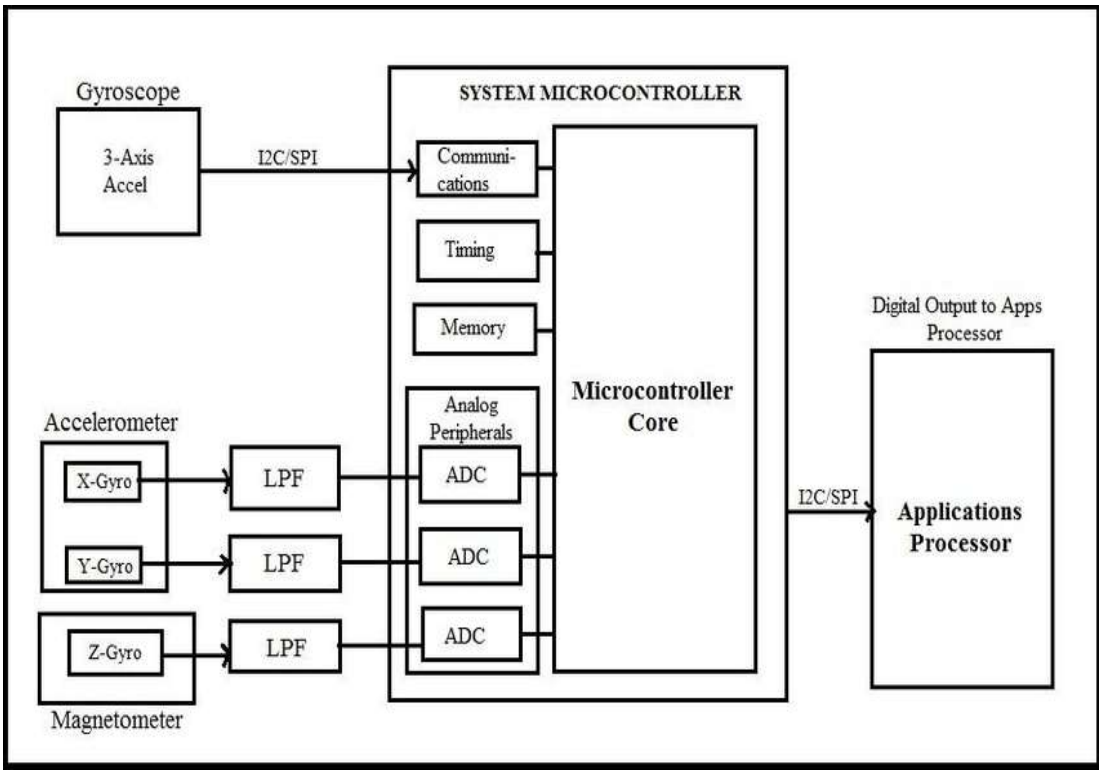


Fig. 3.8 On-chip Temperature Sensor

3.3 MPU-6050 Module

The MPU-6050 module has 8 pin .

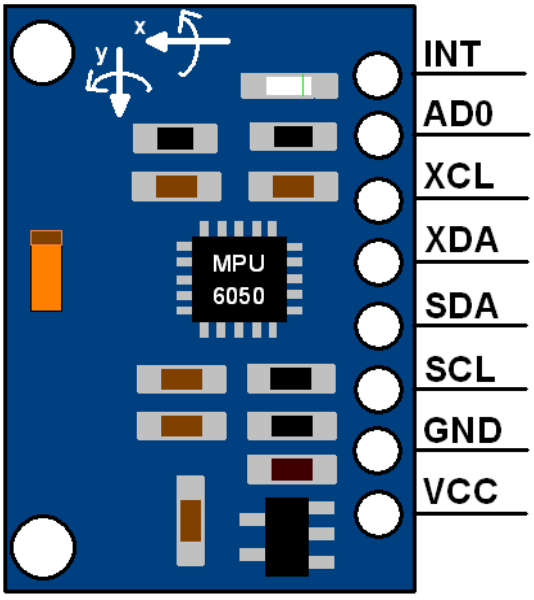


FIGURE 3.9 MPU-6050 Module

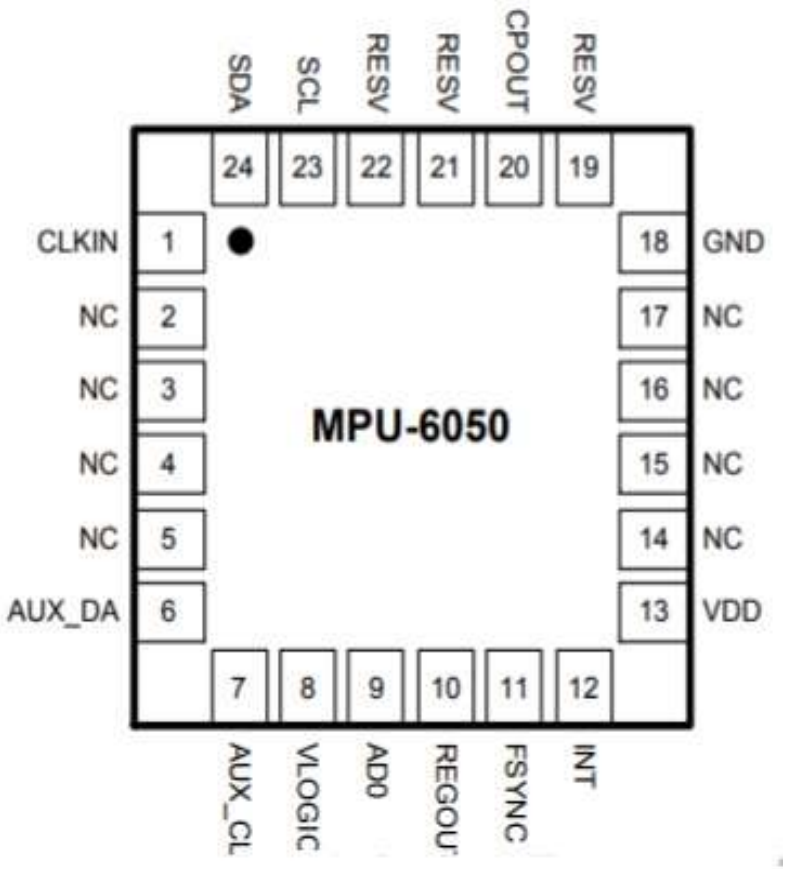


Fig 3.10 pin diagram of MPU

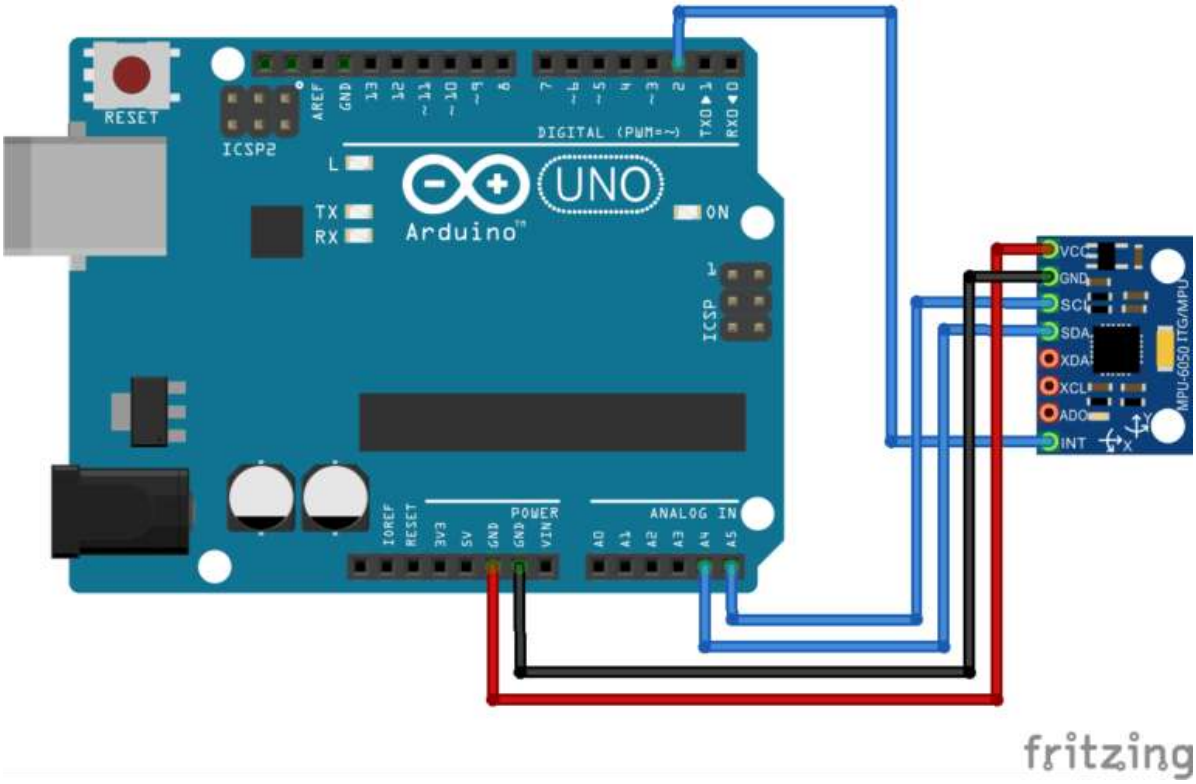


Fig 3.11 MPU with arduino

3.4 NODMCU

NODMCU partner open gracefully LUA base for the most part code produced for ESP8266 WLAN chip.

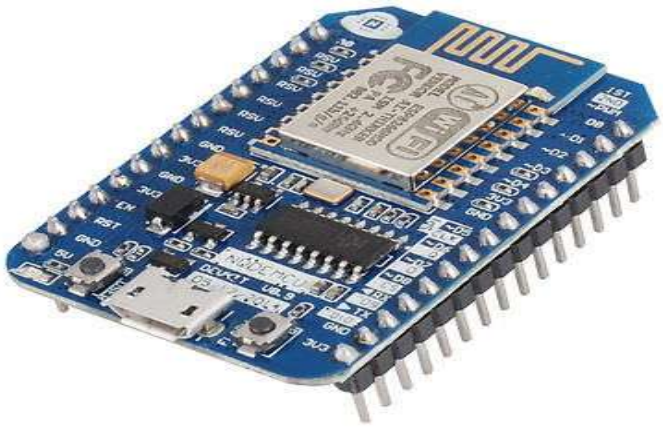


FIGURE 3.12 NODMCU

FIGURE 3.13 NODMCU Development Board/kit v1.0

Beginning with NODMCU

NODMCU Development board is included with LAN capacity, simple pin, advanced pins and sequential correspondence conventions. to encourage start with abuse NODMCU for IoT applications first we'd wish to comprehend concerning how to compose/download NODMCU microcode in NODMCU Development Boards. What's more, before that any place this NODMCU microcode can get according to our interest.

There is online NODMCU custom forms accessible utilizing which we will effortlessly get our custom NODMCU firmware according to our prerequisite. to comprehend huge amounts of concerning how to make custom NODMCU microcode on the web and move it alludes acquiring began with NODMCU

Composing codes for NODMCU

In the wake of setting up ESP8266 with Node-MCU firmware, how about we see the IDE (Integrated Development Environment) required for improvement of NODMCU.

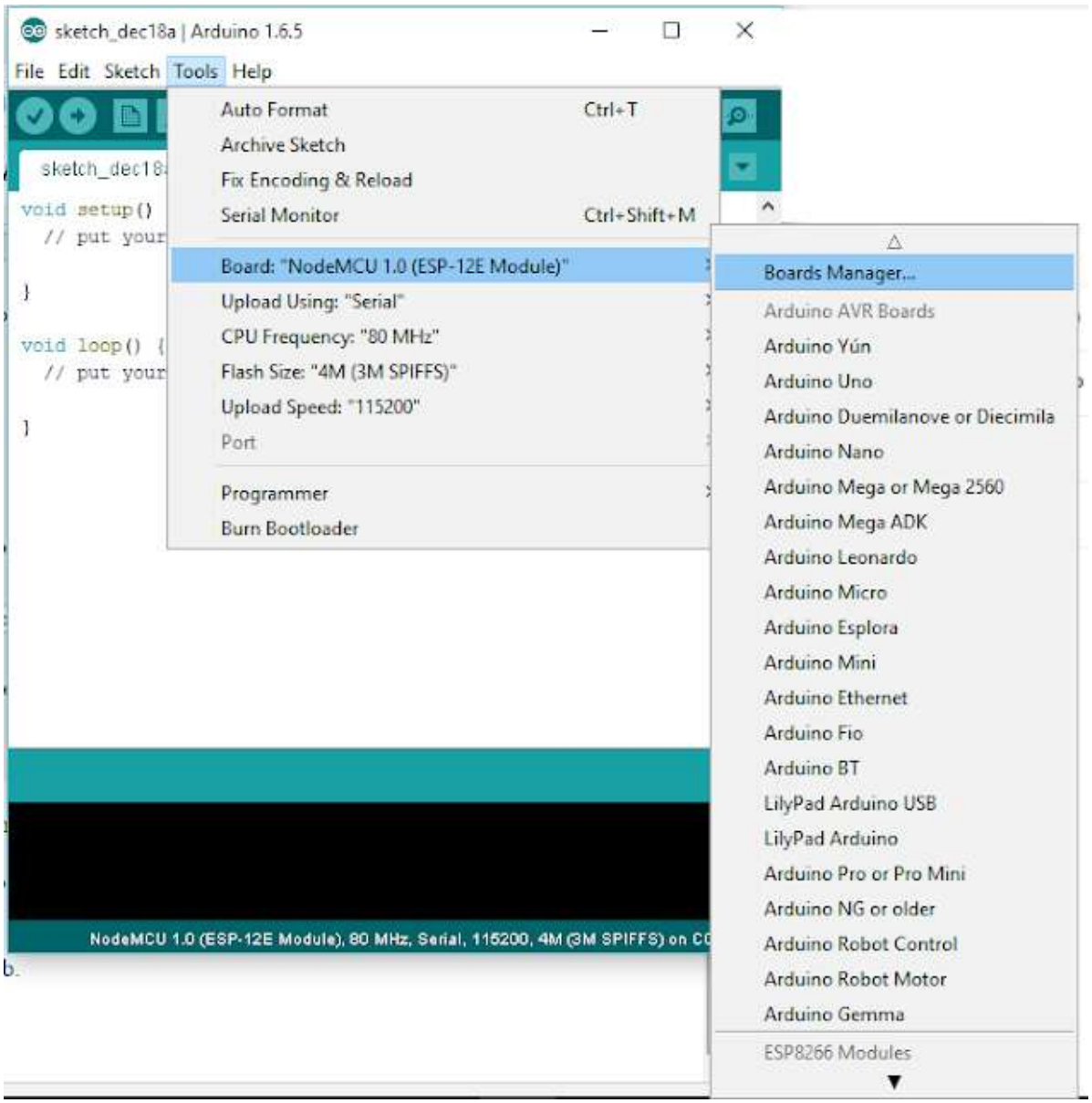
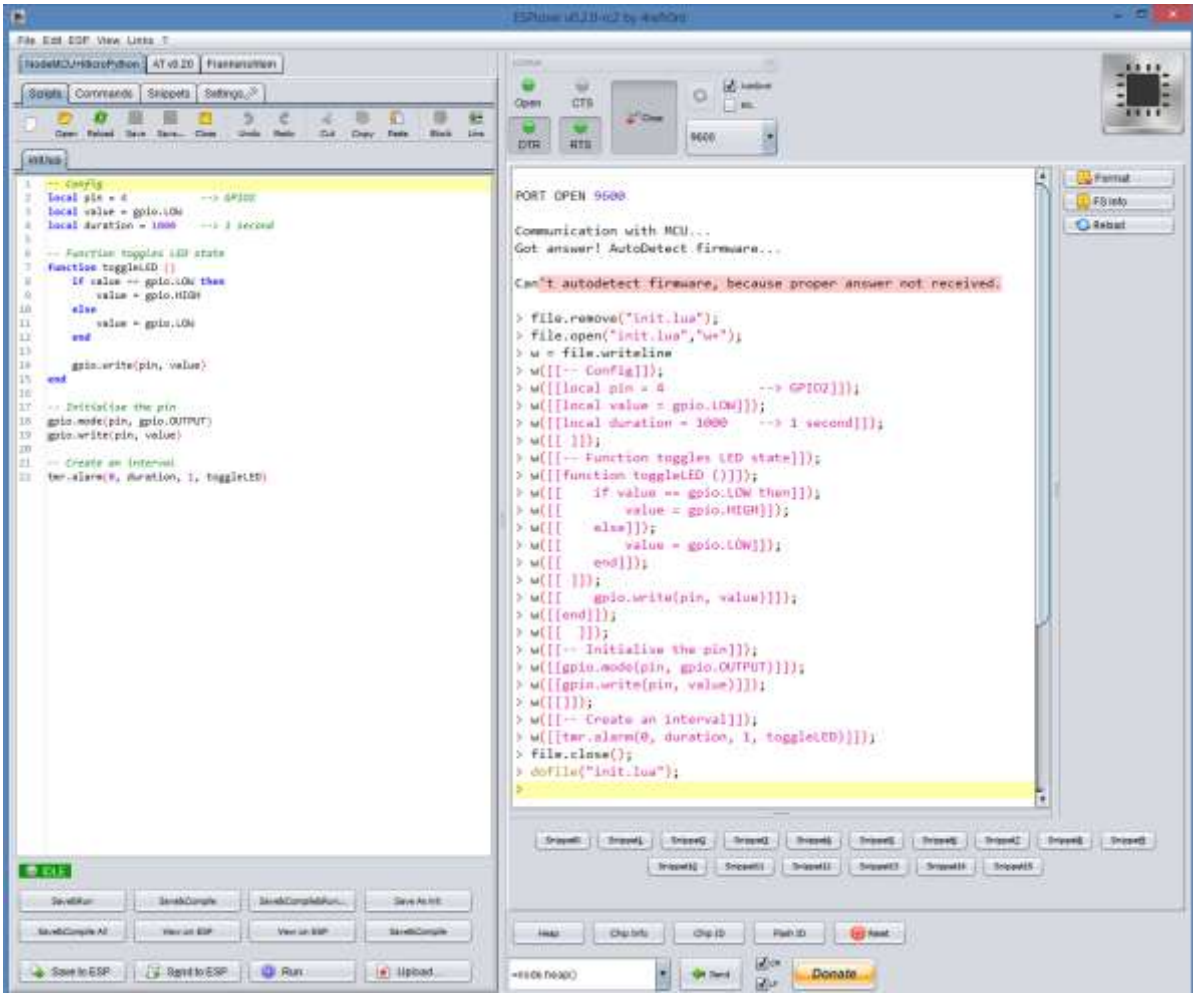


Fig 3.14 imorting liberary for NODMCU

NODMCU with ESPlorer IDE:

Lua contents are generally acclimated code the NODMCU. Lua is AN open gracefully, lightweight, embeddable scripting language based on C programing language .For huge amounts of information concerning how to record Lua content allude getting started with NODMCU abuse ESPlorerIDE.



3.5 MPU6050 Interfacing with NODMCU

NODMCU with Arduino UNO

Here is during an alternate method of creating NODMCU a broadly known IDE for example ArduinoIDE. we will conjointly create applicationson NODMCU abuse Arduino improvement environmental factors. This makes basic for Arduino engineers than learning new dialect and IDE for NODMCU. For huge amounts of information

concerning how to record Arduino sketch for NODMCU allude acquiring began with NODMCU abuse ArduinoIDE.

Distinction in utilizing ESPlorer and Arduino UNO:

All things considered, there's a man-made language differentiation we are prepared to state while creating application for NODMCU abuse ESPlorer IDE and Arduino IDE.We need to code in C\C++ language in the event that we tend to are abuse Arduino IDE for creating NODMCU applications and Lua language on the off chance that we tend to are abuse ESPlorer IDE. Essentially, NODMCU is Lua Interpreter, so it can comprehend Lua content without any problem. when we compose Lua contents for NODMCU and send/transfer it to NODMCU, at that point they'll get executes back to back.

It won't construct paired microcode record of code for NODMCU to write . it'll send Lua contents since it is to NODMCU to encourage execute. In Arduino IDE after we compose and order code, ESP8266 instrument chain in foundation makes paired firmware record of code we composed. Furthermore, after we move it to NODMCU then it'll streak all NODMCU microcode with new produced double microcode code. Indeed, it composes the whole firmware. That is the motivation behind why NODMCU not acknowledge extra Lua contents/code when it's acquiring flashed by Arduino IDE. In the wake of acquiring flashed by Arduino sketch/code it'll be no huge amounts of Lua translator {and we tend to\and that we} got blunder on the off chance that we endeavor to move Lua contents. To some other time start with Lua content, we'd prefer to streak it with NODMCU firmware. Since Arduino IDE accumulates and transfer/composes total firmware, it takes longer than ESPlorer IDE.

MPU6050 gadget module is AN integrated6-axisMotion pursue gadget.

• it's a 3-pivot Gyroscope, 3-hub Accelerometer, Digital Motion Processor and a Temperature sensor, beat one IC.

• It can acknowledge contributions from different sensors like 3-pivot magnetometer or weight sensor utilizing its Auxiliary I2C transport.

• If outside 3-hub magnetometer is associated, it can give total 9-hub Motion Fusion yield. Whirligig and estimating instrument perusing on X, Y and Z tomahawks are accessible in 2's supplement structure.

Temperature perusing is out there in marked whole number structure (not in 2's supplement structure). Gyrator readings are in degrees every subsequent unit;

FIGURE 3.15 MPU6050 Module

estimating instrument readings are in g unit; and Temperature perusing is in degrees Celsius.

For huge amounts of information concerning MPU6050 gadget Module and along these lines the gratitude to utilize it, allude the subject MPU6050 Sensor Module inside the sensors and modules segment .A NODMCU will speak with this module abuse I2C correspondence convention. to comprehend huge amounts of concerning I2C works in NODMCU allude NODMCU I2C with ESPlorer IDE or NODMCU I2C with Arduino UNO.

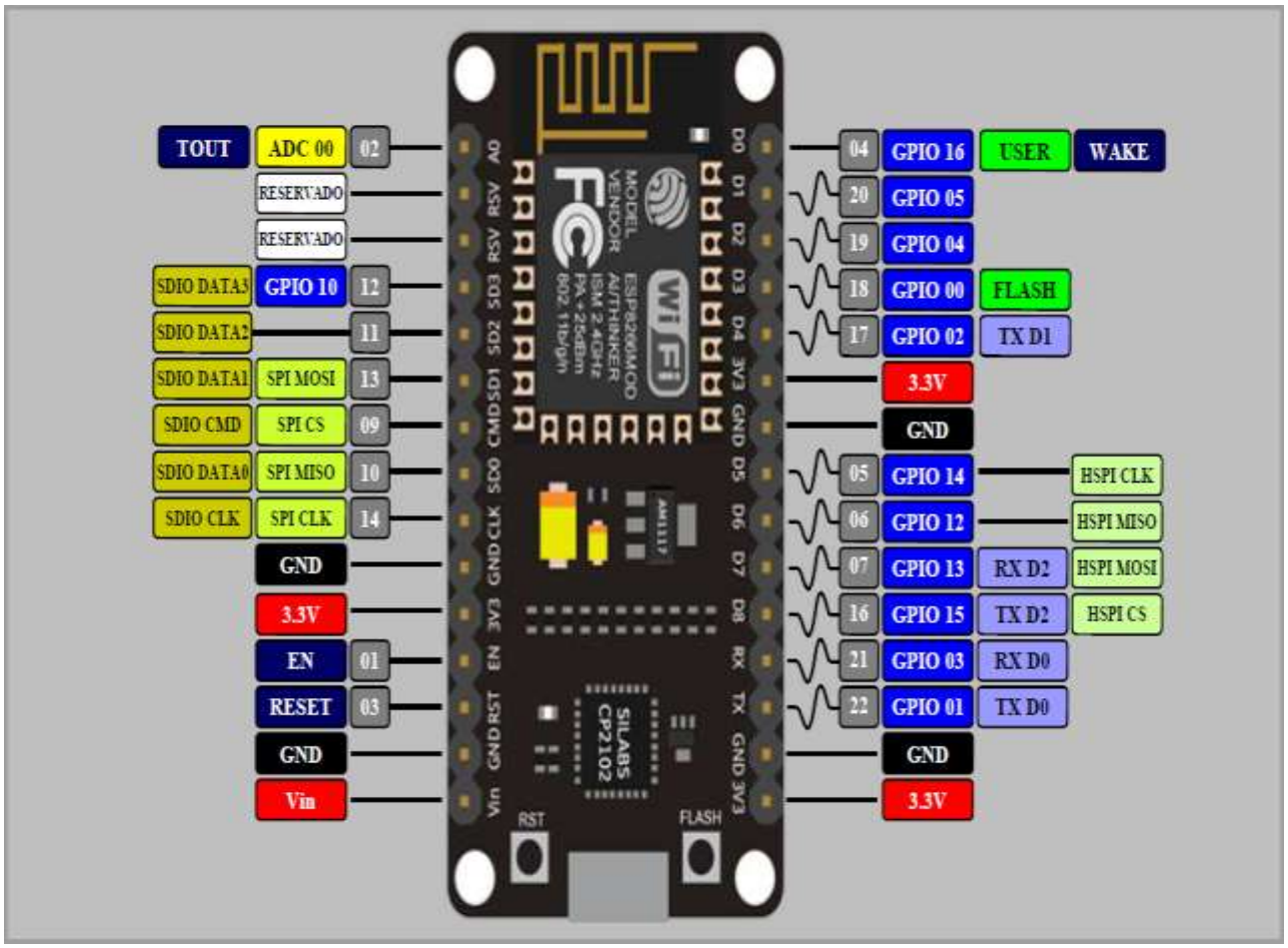


FIG. 3.16 MPU6050 Sensor Module

3.6 Servo Motor

A servo engine is an item that pushes or pivots with extraordinary precision. In the event that you need to turn and item at some point or separation, you utilize the servo engine. It is comprised of straightforward engines driven by a servo framework. On the off chance that the engine is controlled by DC power it is called DC servo engine, and on the off chance that it is AC fueled engine it is called AC servo engine. We get a truly elevated torque servo engine in a little and light bundle. Doe for toy offices, RC helicopters and highlights utilized in numerous applications, for example, airplane, mechanical technology machine and so forth.

Servo System:

It comprises of three sections:

1. Controlling hardware
2. Yield Sensor
3. Criticism framework

It is a shut circle framework where the regenerative framework utilizes the pole to control the speed and end position. Here the gadget is constrained by the criticism signal produced by looking at the yield and reference inputs.

Here the reference input is contrasted with the reference yield and along these lines the third sign is produced by the criticism framework. What's more, this third sign goes about as a contribution to control the gadget. This sign exists until the reaction signal is created or there is a contrast between the reference input and the reference yield. Along these lines, a great part of crafted by servomania is to deal with the yield of the framework at the ideal incentive within the sight of clamor.

Useful • It is a 3-pivot spinner, 3-hub accelerometer, advanced movement processor and temperature sensor that crushes the IC.

• It can acknowledge contribution from different sensors, for example, 3-pivot magnetometers or weight sensors utilizing its helper I2C transport.

3 If the outside 3-hub magnetometer is associated, it gives full 9-hub movement combination yield. The gyrators and estimating instruments on the X, Y and Z tomahawks are accessible as an enhancement to Reading 2.

The temperature perusing is as a marked whole number (not a supplement of 2). Spinner readings are in units every second; Measuring gadget readings is in the G unit; And the temperature perusing is in degrees Celsius.

Because of huge amounts of information about the MPU6050 Device Module and in this manner its utilization, see the MPU6050 Sensor Module in the Sensors and Modules segment. NODMCU This module speaks with the I2C correspondence convention. See

NODMCU I2C with ESPlorer IDE or NODMCU I2C with ESPlorer IDE to comprehend huge amounts of related I2C works in NODMCU.

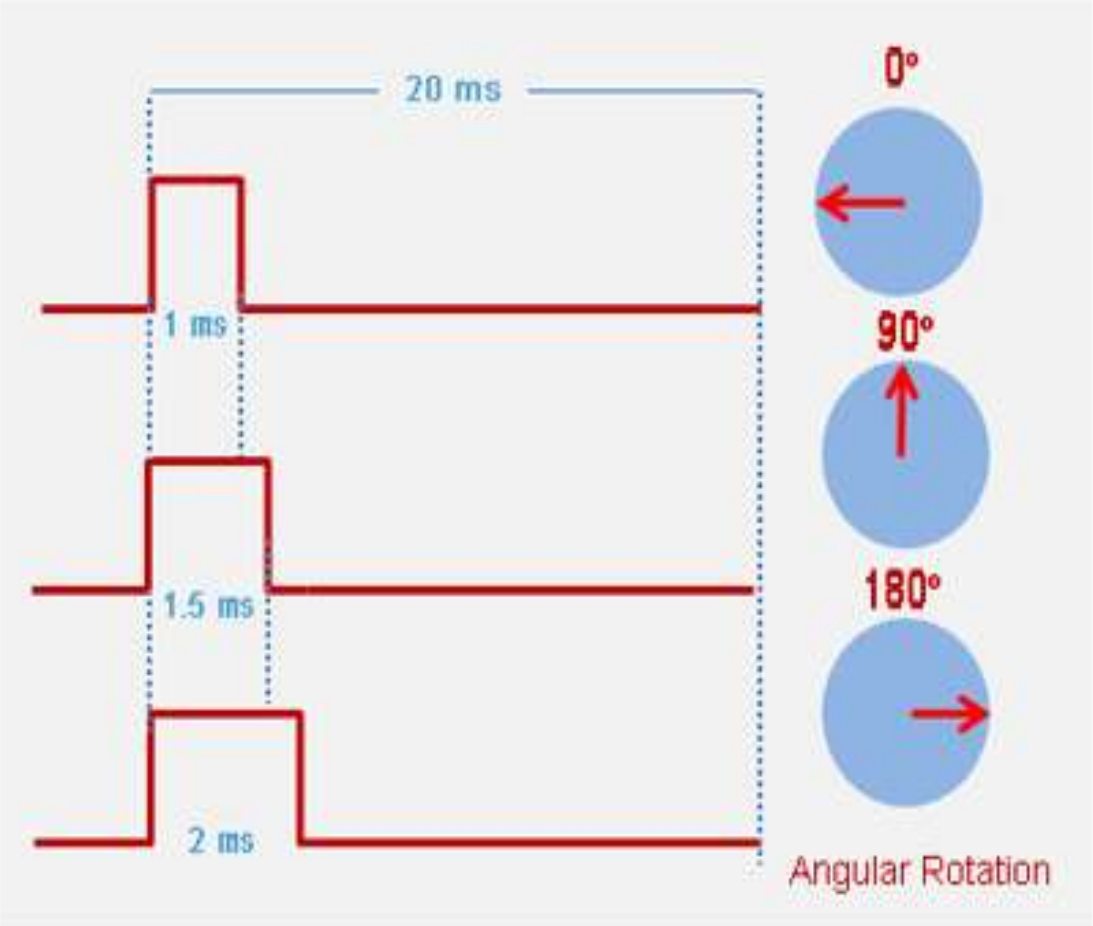


Figure 3.17 working of servo

CHAPTER 4

METHODOLOGY

4.1 System working principle

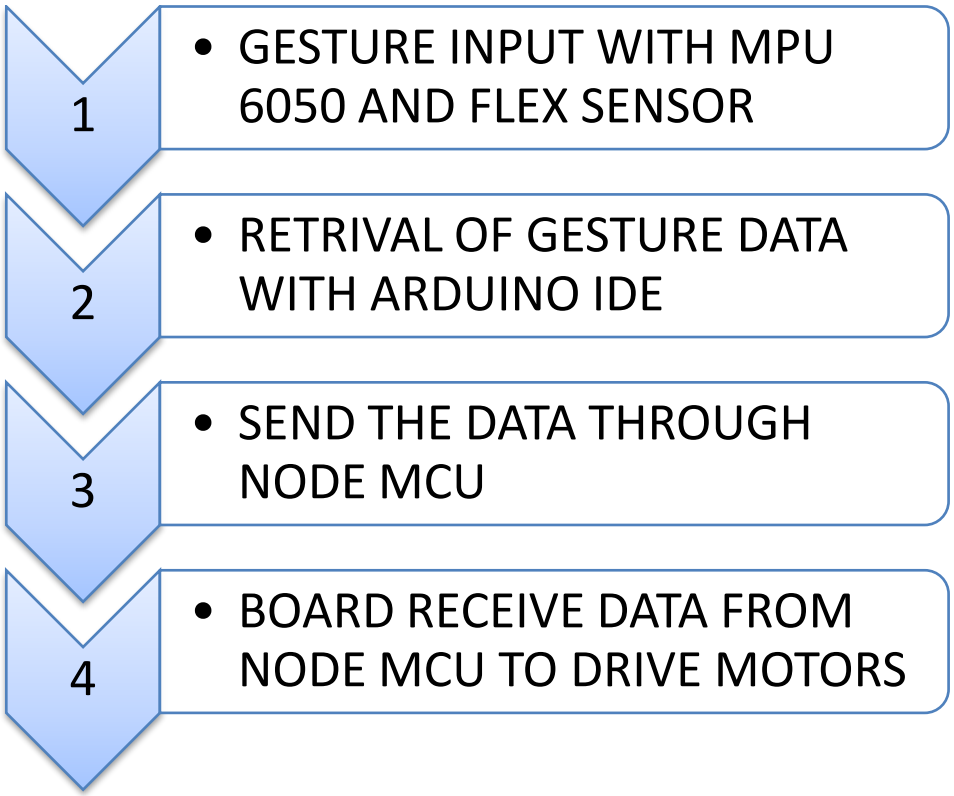


Fig 4.1: Flow chart of the hardware

The given Fig 4 .1 shows the working of the system. First, the gesture is captured by the mpu6050 sensor as the gesture input data, this gesture is then simulated by the Arduino IDE. Next, data processing such as inverse kinematics calculation and data conversion is done in the Processing software by coding in c language so the angle or position of the servo motors is determined. After data processing is done, the processed data is then sent to node mcu to drive the servo motors so that the desired movement of the robotic arm can be rendered out.

4.2 Project management

The schedule of the project is shown in the chart below:

Activity/week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Title selection																	
Idea discussion																	
Literature review																	
Methodology research																	
Component selection and procurement																	

4.3 Circuit Diagram:

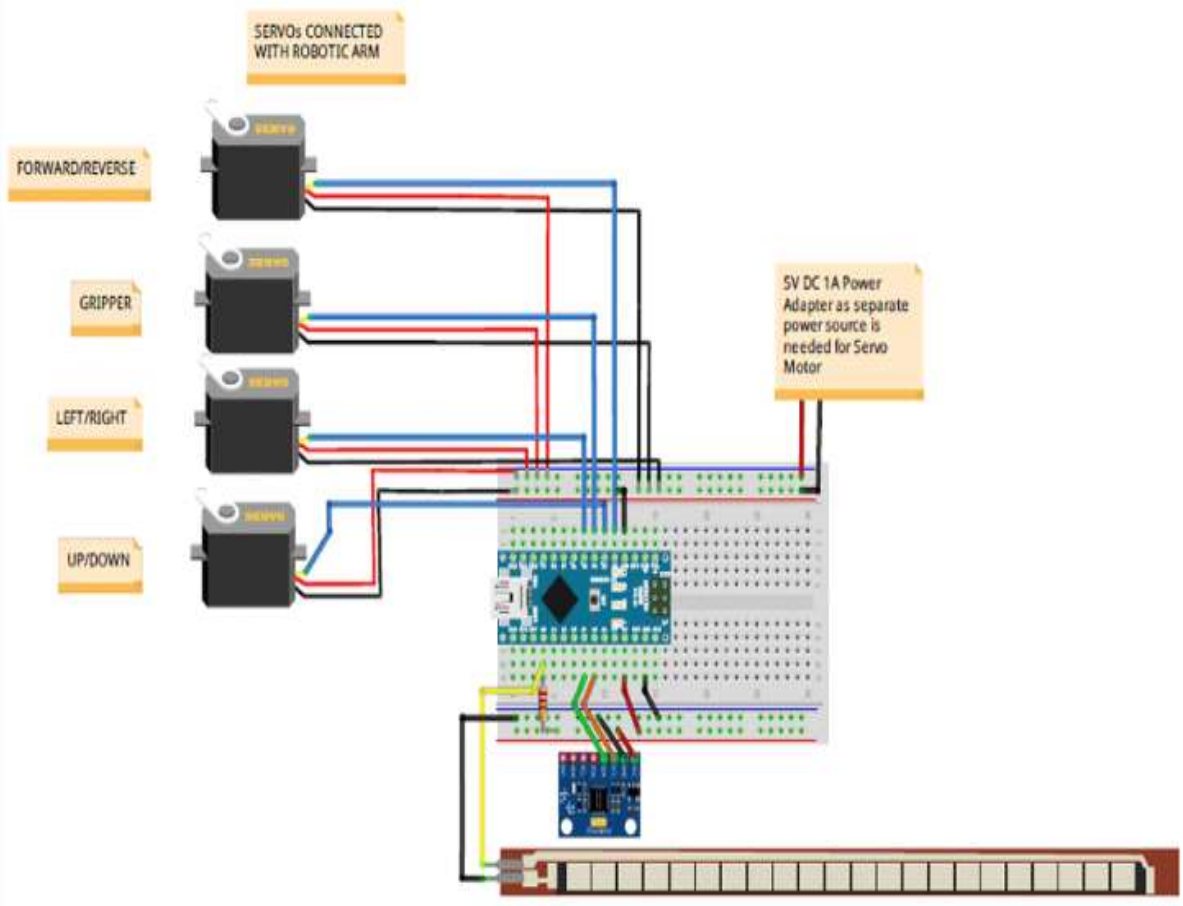


Fig 4.2 Circuit Diagram

4.3 Leap motion visualize

Motion tracking data generated by the sensor can be displayed in the Leap motion visualize in the form of model 3D hand. Various fps (frame per second) like render fps, data fps and device fps were shown at the highest right corner of the window. By pertaining to the specification of the Leap motion sensor, which claimed the tracking can have an fps of up to 120, which is extremely accurate. The basic three axes coordinate of the hand also been tracked and displayed here as well because the speed. Thus, the Leap motion visualizer was wont to make sure the hand or gesture is being well tracked by the sensor and also visualization are often done to urge a far better understanding of how the gesture looks like**.**

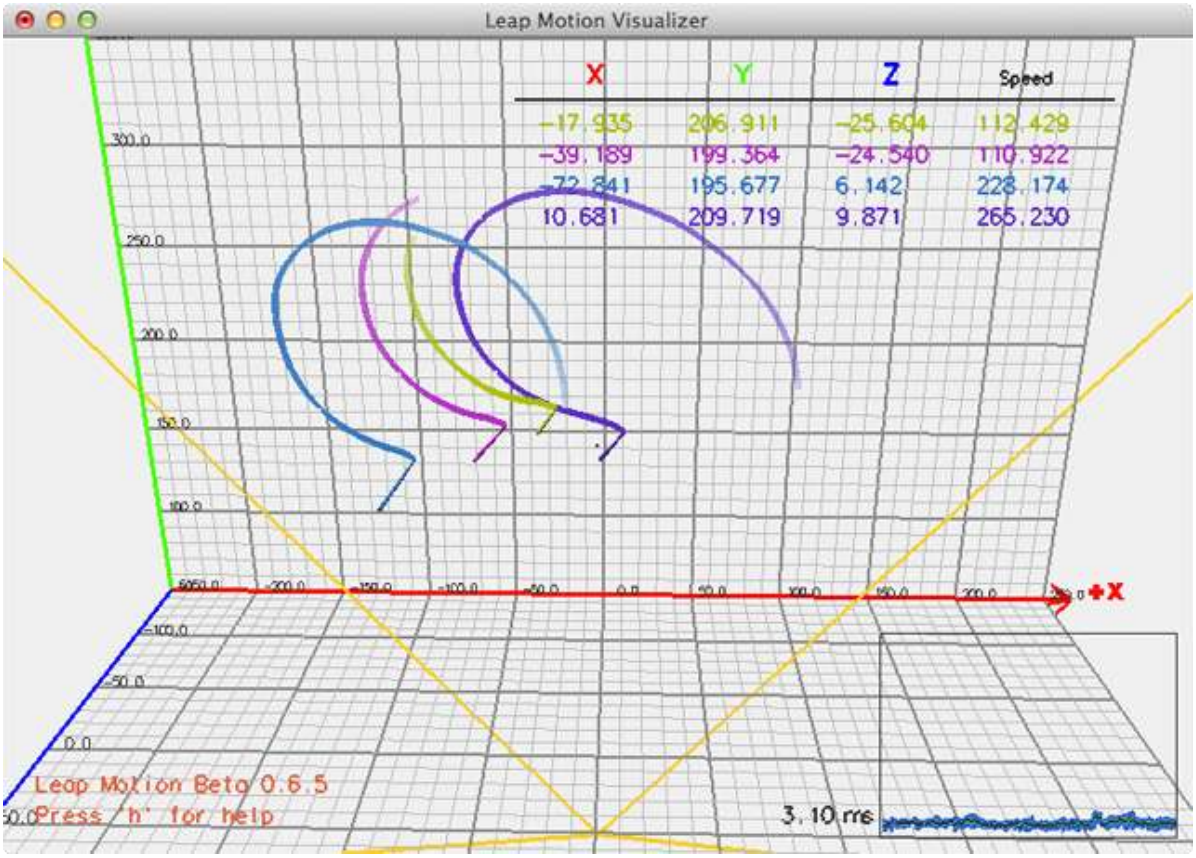


Fig 4.3 leap visualization window

4.4 Coding in processing software

4.4.1 Importing the libraries

Importing libraries is a very crucial step in code writing, since there are some important data such as configuration data, classes and parameter types that were predefined inside,

those data need to be imported when the programmer needs it for program development. There are few libraries were imported in the code by writing "import" in front of the library name as shown in Figure 4.2 below, those libraries are: "de. void plus. leap motion.*" for extracting the motion tracking data for the gesture captured by the Leap motion sensor, "controlP5.*" and "g4p_controls.*" for creating the GUI (graphic user interface) and the last one is "processing .serial.*" to enable the serial communication function of Processing software in order to send data between Processing software and Link it smar t 7688 duo board.

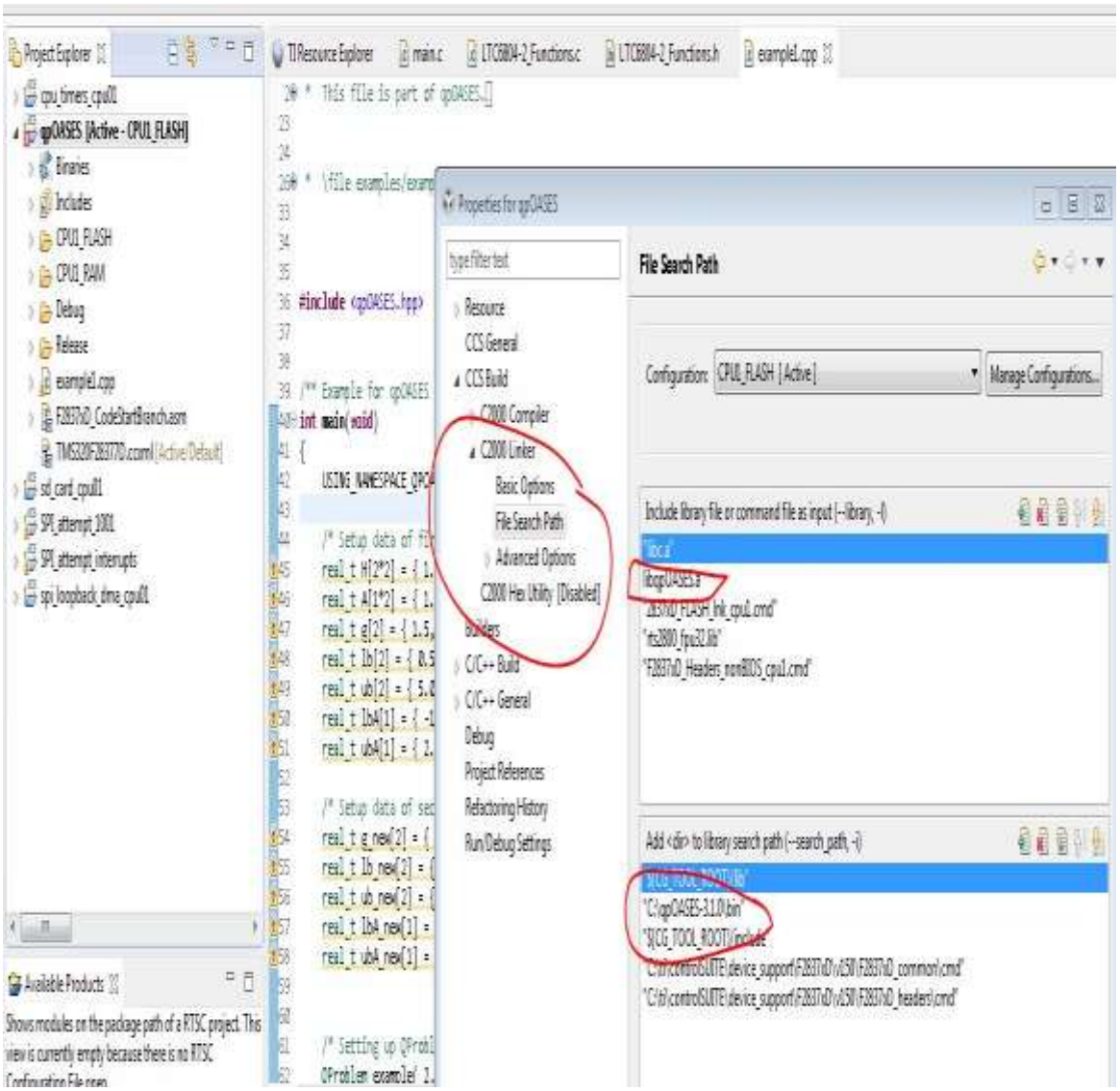


Fig 4.4 Importing libarary

4.4.2 Creation of knobs for indication

As shown in Figure 4.5, To monitoring the gesture parameters, knobs were created and thus the palm size for gripping during the control of the robotic arm. In figure 4.5 below, knobs were created by first declaring the name in "Knob" type, this "Knob" type are often created because the graphic interface library of the Processing software was imported within the previous step.

Next, the knob parameters were set as shown in Figure 4.5 below, by "myKnobA = cp5.addknob("X")" at the first line, which means the knob named "X" was created. Second line " .setRange(0, 180)" meaning that set the range of the knob set to from 0 to 180. Third line " .setValue(50)" is setting the initial value of the knob. Fourth line " .setPosition(50, 50)" is setting the position of the knob within the knob window which the primary value is that the horizontal coordinate and second value is that the vertical coordinate. Fifth line " .setRadius(50)" was setting the radius of the knob and therefore the last line " .setDragDirection(Knob.VERTICAL)" was allowed the knob to be scrolled in vertical direction for changing the value .

This section is that the main a part of the whole system that shows how the tracked gesture data being extracted and processed by the codes. The main 6 data of the hand to control the robotic arm were extracted by accessing the "hand1" class that created earlier. The statements were extracting the position of the hand, stabilized position of the hand which incorporates the x, y and z coordinates that require to be access later, roll of the palm in degree that wont to control the wrist of the robotic arm, the time for the hand visible on the sensor that wont to confirm whether the hand is appeared on the sensor, the pitch of the palm in degree that wont to control the wrist of the robotic arm too and lastly, the sphere radius of the palm or palm size that wont to control the gripper of the robotic arm.

For the data conversion as before sending the data out to the board, some process or conversion must be done first. For using the info to drive the servo motor, those data must be mapped, the range of the extracted data must be converted to match the operating range of the servo motor is 0 to 180 degree. The operating range of the servo motor not necessary to be fully utilized to render the movement of the hand. The "map(hand1_stabilized.x, 570, 30, 40, 180)" is the mapping statement, this mapped the

hand stabilized position of x coordinate from the range of 30 – 570 to 40 – 180. After that, this mapped value was sent to the respective knob that created earlier to indicate this mapped data during the control of the robotic arm, in this case is the myKnobA for x coordinate. This value is then converted to integer type first from float type since the servo motor only accept integer value to drive. "PosX(X)" is that the function header that wont to send this processed data to the Linkit board through serial communication. The serial communication function will be explained later. The last statement "delay(1)" was added within the code to offer a while to the Linkit board to reply for the signal that send from the Processing software, the control of the robotic arm will be crashed without this delay function.

For the gripper, a further step was finished better control and smoother by making the gripper to shut only the palm size bigger smaller than a particular value. Figure 3.5.3.3 shows that the gripper closes only when the palm size is bigger than 120, it is inverted because the configuration of the motor on the robotic arm structure was inverted. At the start , the gripper opens when the palm closes, with it invert mapping, now the gripper closes when the palm closes. Why the worth was set to 120 because it's the foremost suitable value that match various palm size when different users take hold .

4.4.3 Serial communication to Linkit board

For sending data between Processing software and Linkit board, serial communication was established by the first declaring interface named "myPort" as shown below. The data was sent with the serial function as shown in

X-axis coordinate sending function was the instance during this explanation. The serial port must be cleared before sending data through, writing data after clearing that ensures the data send out was not mixed with other data. The first number within the bracket is that the servo motor number assigned within the program within the Linkit board. The value is that the servo motor angle that processed out from the info conversion. The "\n" is the "next line" command which used to indicate the serial data was ended here. These three things were concatenated together for faster serial transfer.

4.5 Arduino IDE (Integrated Development Environment)

4.5.1 Setting up servo motors

The task of the Link it boards is interfacing servo motors and gesture data from Processing software. Certain pins must be reserved for the servo motors in order for sending PWM (pulse width modulation) signal from the Link it boards to servo motors. Figure 3.6.1.1 shows how the pins were assigned for the servo motors. For instance, pin 3 was assigned to servo 0 which is for the x coordinate, meaning that this servo 0 is responsible to show left and right for the robotic arm. For the, which is the pre-setting the angle for the servo motors, this pre-setting is for the robotic arm starting pose.

4.5.2 Receive data from processing software

When the info sent out from the Processing software through serial communication, it's to be read and decoded within the Linkit board. In Fig and Fig show the code that how to read the string from serial and how the string data parsing. The "serialEvent()" containing a quick time loop that keeps checking the serial is it available, meaning that as long because the signal sending in from the serial, the loop will keep looping for reading data. Since the serial is transferring the signal byte by byte, therefore the new byte must keep concatenating with the previous byte to make the entire signal. How to know whether the signal is completed was by checking whether the "\n" or "next line" is read from the serial. When this "next line" is read, the flag "string complete" are going to be raised, become true and this flag signal are going to be sent to subsequent function "parse command()" to undertake to to the parsing task as shown in

The "parse command()" function will first check whether the "string complete" flag is true, if yes, this function only starts to undertake to the task. It will start to trim the leading and trailing whitespaces in the string to remove the unnecessary signals. Next, the servo number was extracted from the string by taking the worth before the comma (,). With using the command of "indexOf(',')", the comma (,) position was found, this position was used because the separator index to separate the servo number and thus the servo angle. Thus the servo angle was retrieved by watching the worth after the separator index. Recap that the signal was sent out by this format from the Processing software as shown

in Fig , so the signal has to be parsed in this way to retrieve back the actual signal. Lastly, all the strings buffer, and therefore the flag must be cleared for subsequent pattern.

CHAPTER 5

RESULTS

5.1 Robotics arm outlook

The robotics arm was built with six servo motors, servo motor bracket holders and a gripper. It powered up by power bank with 5 Volts and 2.1 Ampere output. There are 3 pins in the cable of servo motor which positive, negative and signal pin. The positive and negative pin of the servo motor connected to the positive and negative wire that separated out from the USB to micro USB cable of power bank. The servo motor signal pin connected to the assigned pin on the Linkit board for receiving signal.

5.2 Testing of Arm

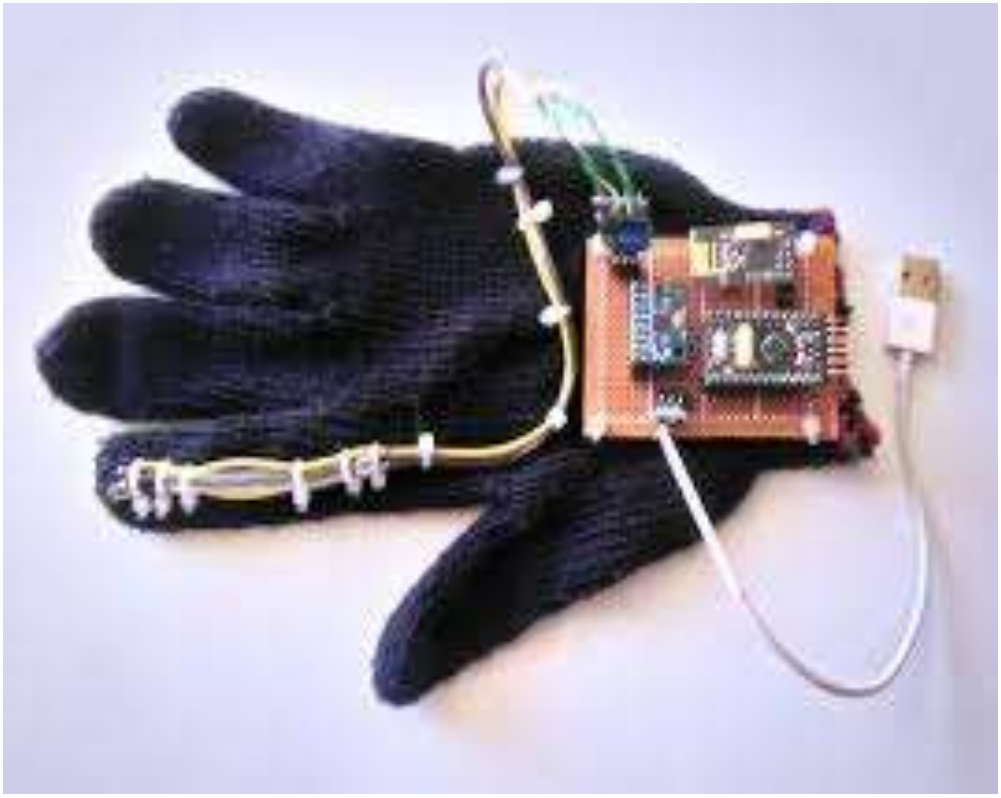


Fig.5.1 gesture control glove

Fig.5.2 Gesture control hand

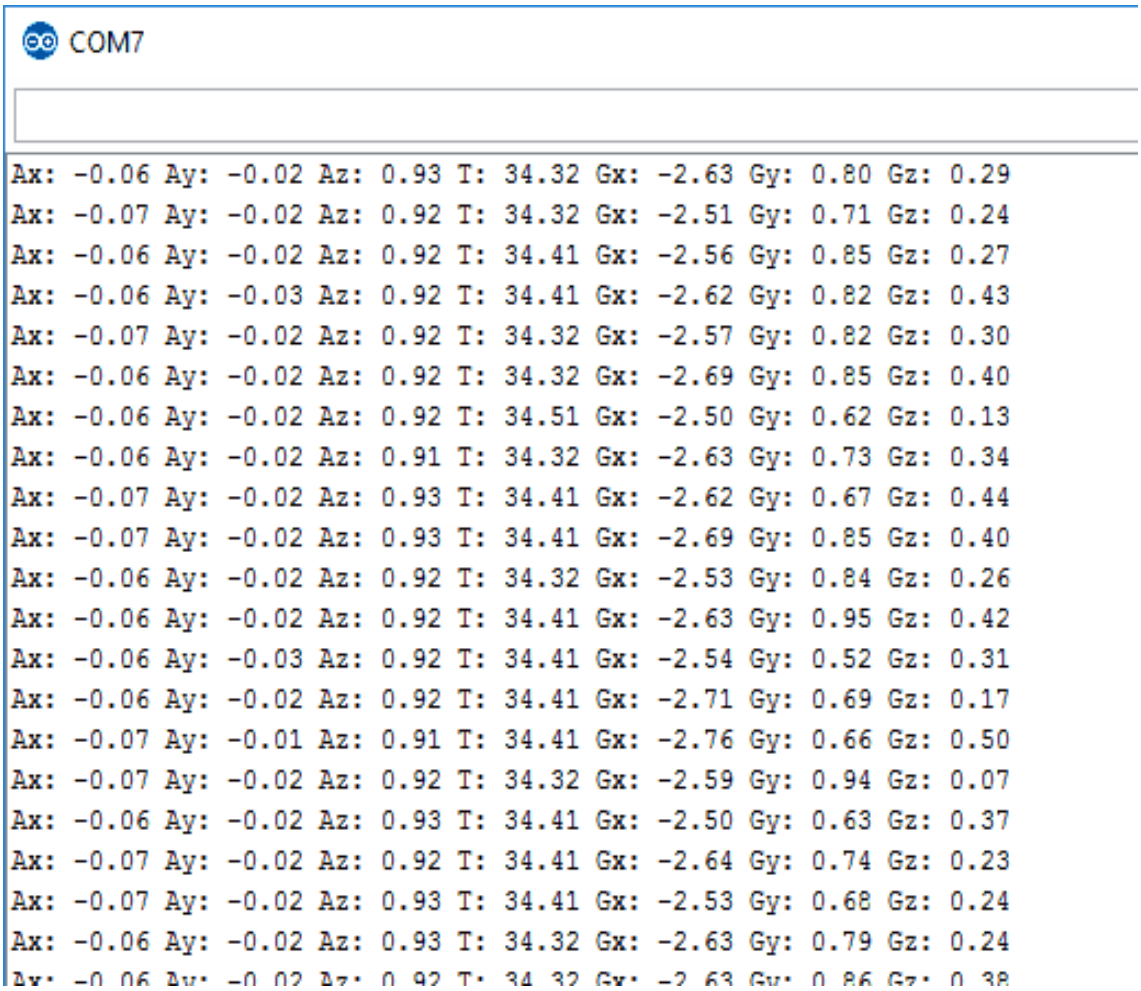


Fig. 5.3 Output window of mpu6050

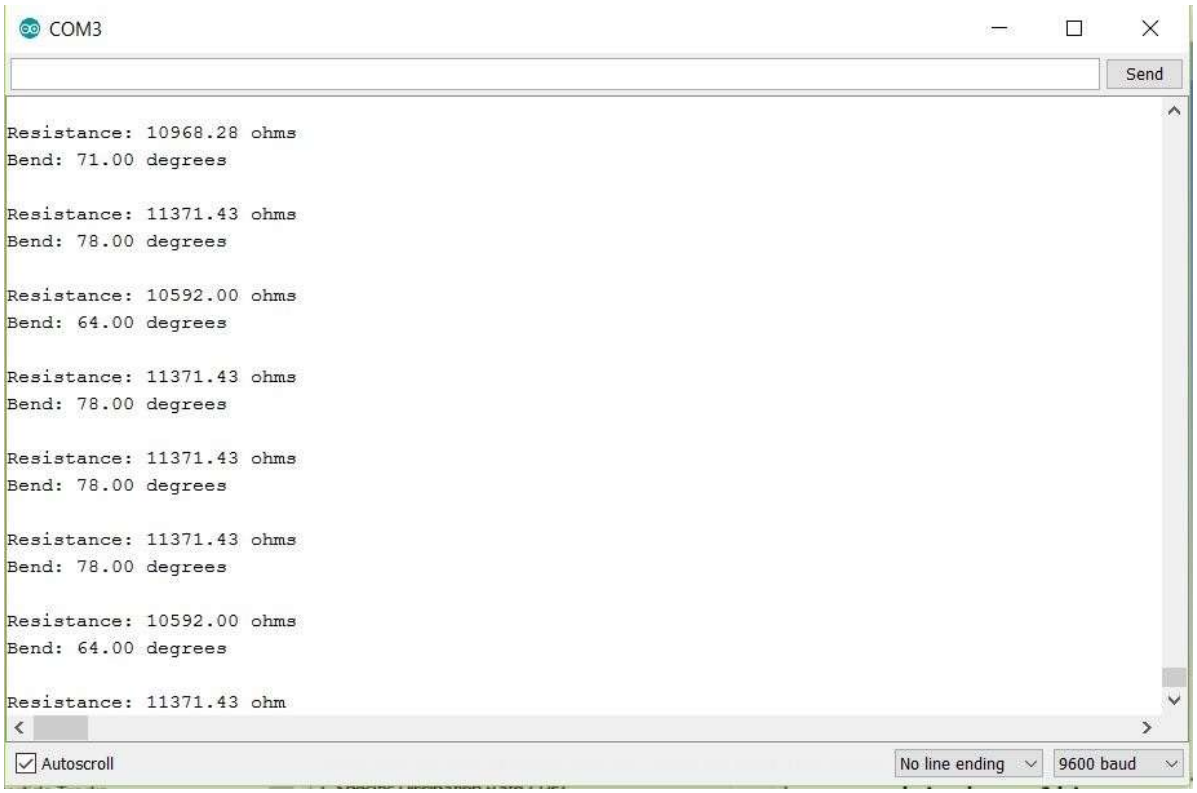


Fig. 5.4 Output window of flex sensor

CHAPTER 6

FUTURE SCOP AND CONCLUSION

6.1 Future scope

Despite the fact that a decent scope of human-innovation interfaces are proposed today, a specialty stays to be filled to ensure better solace and basic use to debilitated individuals utilizing assistive gadgets in their way of life exercises. Like another controllers, the quality of the proposed controller lies on offering non-obtrusive, natural, remote and wearable interfaces upheld patients' RFCs. The utilized control system accepts that the objective clients have leftover control of their neck and bears, and a shortage of mastery in their fingers which keeps them from appropriately collaborating with basic interfaces like joysticks. The proposed controller gives a legitimate exchange off among execution and in this way the quantity of fundamental information signals. In future work, clinical tests will help evaluating the additional estimation of such an assistive interface into the network of debilitated individuals.

6.2 Conclusion

We have learnt about many aspects of IOT and Robotics working on this project. We have learnt about how to interface sensors and microcontroller, And about some functioning of robots like motors and movements.

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