IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 2, Issue 8, May 2022

Gesture Controlled Robotics Hand

Dr. Katherasan Duraisamy, Lenin. S. A, Rahul. S, Reshma. R, Sanjay. C
Department of Robotics and Automation
Dhanalakshmi Srinivasan Engineering College (Autonomous), Permabalur

Abstract: *In this new era robotic hands is used in various areas such as military, defense, Medical Surgeries, pick and place function in industrial automation applications. Based on the gesture of human hands the robotic hand moves and performs the task and this system replicates the actions of human hand. The hand is very flexible and can be made suitable in places where the environment is not safe for humans like firework manufacturing industry, bomb diffusing etc. There are various techniques for controlling the robotic hand. This paper deals with the gesture recognition for controlling the movements of the robotic hand through wireless control using servo control, flex sensor, arduino nano, (receive rand transmitter)transceiver.*

Keywords: Robotic

I. INTRODUCTION

In this project we are going to simple gesture control robot hand. The aim is to build a robotic hand or which a high level of dexterity for the hand is desired. The goal is to be able to grip lightweight objects using the robotic hand. The control of the robotic hand will be carried out through wireless communication with a separate controller glove. To replicate the mechanical movements of fingers a combination of wires, rotary servomotors and sensors are applied. The concept of a robotic hand has several applications. It is therefore thought that the project has potential usage in diverse industries such as the medical industry, in laboratory settings and the defense industry, if it were to be developed. In particular for the medical industry, a well designed robotic hand with appropriate degrees of freedom would be suitable for use as a prosthetic. Similarly a well functioning robotic arm or hand could be used in environments dangerous to humans such as the handling of toxic substances and dismantling of bombs. Here we are going to mobilized robotic hand and main motive of this project to make a gesture control robotic hand for physically disabled person.

II. LITERATURE SURVEY

1. Cruciani, Silvia et al.In-Hand Manipulation Using Three-Stages Open Loop Pivoting 2017

Review:

In this paper we propose a method for pivotingan object held by a parallel gripper.
Without requiring accurate dynamical models or advanced hardware.
Our solution uses the motion of the robot arm for generating inertial forces to move the object

2. Engström, Jesper et al.Modeling of Robotic Hand for Dynamic Simulation 2010

Review:

KTHand is a robot hand designed within a doctoral thesis by Johan Tegin.
KTHand is meant to be a simple construction, able to be produced for a low cost but still be functional thanks to feedback from tactile and position sensors.
The mechanical construction of KTHand is based on three identical fingers, corresponding index finger, middle finger, and a thumb

3. Ramachandra A C, Karunakar Rai B, Suruchi Poddar-Hand Gesture Controlled Robot- 2020

Review:

Gesturing is so deeply involved in our communication system. Gesture recognition from hand motions or postures may be a lively area in gesture recognition research for Human Computer Interaction (HCI).

4. Kathiravan Sekar, Ramarajan Thileeban, Vishnuram Rajkumar, Sri Sudharshan Bedhu Sembian-2020
Review:
In this paper, we introduce a hand-gesture based control interface for navigating a robot.
A 3-axis accelerometer is used to record a user's hand gestures. The data is transmitted wirelessly via an RF module to a microcontroller

5. Tandrima Goswami, Divyanshi Sharma, Rahul Pratyush -Dynamic Gesture Robot hand -2020
Review:
What has made it more important is the fact that integrating it with control electronics could be result in various interesting results. Some of these are IOT based, Wi-Fi based, Bluetooth based, Gesture based, etc.

6. Parin Somaiya, Vipul Panchal, Divesh Mehta, Prof. Rupali Advirkar- GESTURE CONTROLLED ROBOT-2020
Review:
This paper discusses a proposed hand gesture-based control design for mobile robots.
Mobile robots can move in response to hand gestures that convey control signals

7. Gesture Controlled Robot- Shaunak Chokshi, Shashank Sharma, Hardik Joshi- 2016
Review:
The project is an application for live motion gesture recognition using Raspi camera module and performs the action corresponding to it. In our case we have controlled the motion of a mobile robot according to the gesture of the user

8. The Gesture Controlled robot-Dr. C.K Gomathy, G. Nitheesh, Sai krishna-2021
Review:
Gesture provide an intuitive interface to both human ans computrer.
Thus such gesture based intreface can not only substitute the common interface device, but can also be explotied to extend their functionally.

9. Gesture Recognition Robotic Hand-Niharika Gupta, Ruchi Varshney,Neeraj Sharma ,Manish Sharma, Kalika Sharma,Mahak Chaudhary-2014
Review:
The main purpose of gesture recognition research is to identify a particular human gesture and convey information to the user pertaining to individual gesture.
Overall aim is to make the computer understand human body language, thereby bridging the gap between machine and human.

10. Karthik Bankapur,Himmat Singh,Akshit Gupta, Hritik Mathur, Harikrishnan R, Shivali Amit Wagle
Review:
This paper discusses about the survey and Bibliometric analysis of hand gesture-controlled robot using Scopus database in analyzing the research by area, influential authors, countries, institutions, and funding agencies.

11. Sakshi Sharma, Shubhank Sharma, Piyush Yadav-2017
Review:
This paper deals with the Design and Implementation of a Wireless Gesture Controlled Robotic Hand with Vision.
The Robotic Hand is mounted over a movable platform which is also controlled wirelessly by another accelerometer.

12. Hand Gesture Control Robot Benjula Anbu Malar M B, Praveen R, Kavi Priya K P-2019
Review:
The robots travel by motion made by the user hand tilting.

The device receives the input from the user and work out according to the received input.

13. Hand gesture controlled robotic arm for industrial-D P Karthik,Diganth Bhargava, Dr. Abhay A Deshpande -2020
Review:
This Technique involves glove to control the robot, sensor are placed on the glove.

14. Nathan David, Chinedu Udengwu, Obiayor Onyia- A gesture Controlled system-2015
Review:
Here gesture originate from any bodily motion or state but commonly orginate from hand
This has minimized the need for the text interface.

15. Gesture based wireless control of robotic hand using image processing-Satyam M Achari,Shashwat G Mirji, Chetan P Desai, Mailari S Hulasogi, Sateesh PAwari-2018
Review:
The main motive of hand gesture is to recognize a specific Gesture and gives particular information depending on the type of gesture that has been provided.

16. Gesture controlled robotic hand using flex sensor-Sandeep Kumar Maurya R, Prasad-2015
Review:
To capture the motion of human limbs this flex sensor are used
Its aim to develope robotic hand that copy human hand movement

17. Design and implementation of a wireless gesture controlled robotic arm-Aggarwal Varnika Gaur Puneet-2013
Review:
Its is operated through simple coding and able to design in easy way

18. R Deepan, Santhaha Vikrama Rajavarman and K Narasimhan- Hand gesture based control of robotic hand using Raspberry pi-2015
Review:
This project show the flexibility and accuracy of the robotic hand movement depend up on the selection of sensing mechanism actuator and communication

19. Joystick controlled industrial robotic system with robotic arm-Reduanur Rahman, Sajid Rahman,Rahman Bhuiyan-2019
Review:
In this project it was developed an joystick controlled robot that pick and move object to the required place

20. Gesture control Robot using Arduino -Deepanshu Kiran, Himanshu Singh, Kushal Kant Singh Saxeriya-2019
Review:
The digital standards are processed by the arduino and transmit to the RF and reviced and robot will move in particular direction.

III. EXISTING AND PROPOSED WORK

3.1 Existing Work

Hand gesture based systems had been existing since early times. Even though all of the systems had the same goal of moving the robot, difference was in the different technologies used for hand gesture recognition. One of the approaches used is Accelerometer Based Hand Gesture Controlled Wheelchair refers to the use of an accelerometer for the hand gesture recognition.

Accelerometer is a device used for sensing the acceleration.The paper proposed the use of MEMS accelerometer. MEMS refer to Micro Electro Mechanical Systems which means sensors, actuators and other devices confined onto a single silicon substrate. The problem associated with this technique is the special training required for the user on the use of this system,as accelerometer is a sensitive device. Another technique which was specified in a Simple Shape-Based Approach to Hand Gesture Recognition suggests the use of three shape based features: segmentation, feature calculation and classification. Segmentation refers to the process of converting an image to black and white image. In feature calculation different features of the hand are used in combination. From this the compactness and the radial distance is calculated. The problem with this technique is that it can only be applied to stationary than varying objects. Another method specified in MultiCamera Hand Pose Recognition System Using Skeleton Image recognizes the hand gesture by using a multi camera. But the use of multi camera causes the variation in the centre of gravity of the hand which leads to instability in hand gesture recognition. Another method was proposed by Visual gesture recognition
Where in markers are placed on finger tips. The inconvenience of placing markers on the user's hand makes this an infeasible approach. Curvature Scale Space Gesture Controlled Robot using Image Processing hand gesture recognition technique involves finding the boundary contours of the hand.Even though it's a robust technique it is computationally more difficult.

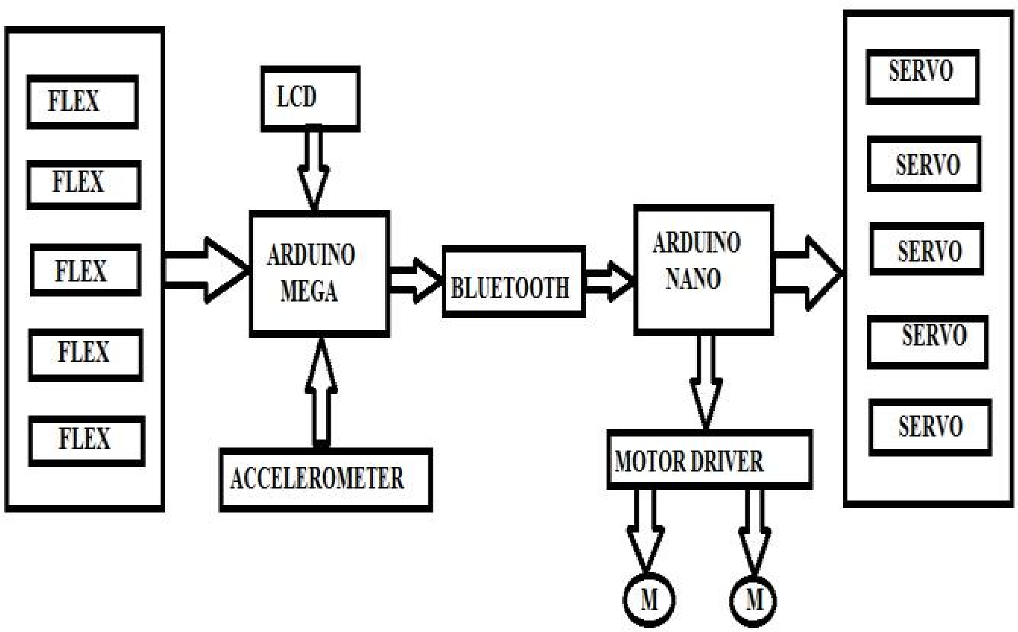

Fig 3.1 Existing work

3.1.1 Limitation

- There where loss of signal.
- Complicate to control.
- Can't control with vision system for long time.
- Battery Drain is fast due to vision system.
- Long distance of control cant be made.

3.2 Proposed Work

In order to achieve the set goal of the construction, five servo motors and five flex sensors are required. Two microcontrollers are needed to execute the desired motion of the robotic hand and two wireless transceivers are needed for the wireless communication between the glove and the robotic hand. Components of the hand will be printed with a three-dimensional (3D) printer. If there is a margin in time the thesis can be broadened by implementing a wrist motion of the robotic hand from the rotation of the glove. This would be done with the help of an inertial measurement unit (IMU).

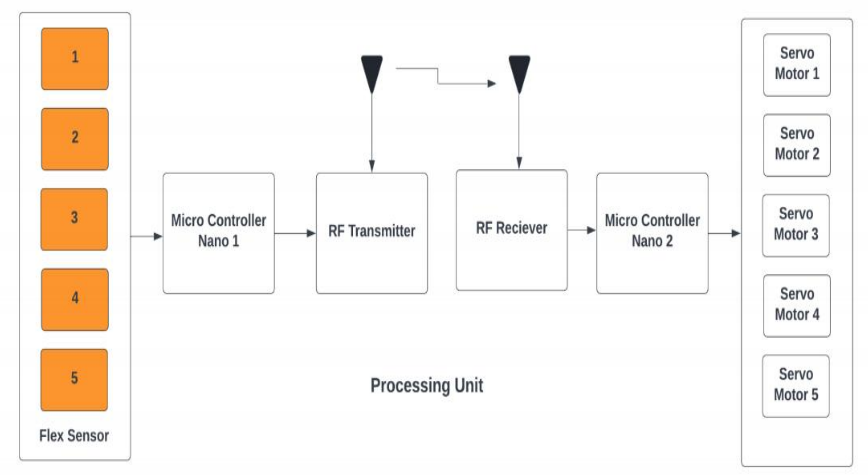

Fig 3.2 Proposed work

IV. METHODOLOGY

4.1 Theory

Once the subject was chosen for the bachelor's thesis project the initial research was made. Previous bachelor's theses regarding a wireless robotic arm controller, motorized tensioner system for prosthetic hands and hand gesture controlled wheelchair were used to grasp a basic understanding on solutions and what components were needed for the project.

4.2 Anatomy of the Human Hand and Wrist

4.2.1 The Bones and Joints

The human hand consists of the carpus and five fingers, see figure 2.1. The carpus is the collection of eight small bones between the wrist and the beginning of the fingers. These bones are the Navicular (N), Lunate (L), Triquetrum (T), Pisiform (P), Greater Multangular (GM), Lesser Multanguler (LM), Capitate (C) and the Hamate (H)

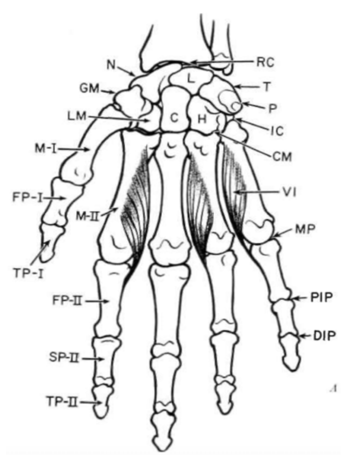

FIG 4.1. Human Hand Autonomy

. The hand is connected to the writs with the help of the Radiocarpal (RC) joint. Each finger, except for the thumb, is built by a metacarpal bone (M), three phalanges and four joints. The three phalanges are the fifirst phalanx (FP), the second phalanx (SP) and the third phalanx (TP). The four joints are the distal interphalangeal (DIP), proximal interphalangeal (PIP), metacarpophalangeal (MP) and either the carpometacarpal (CM) or intercapal (IC) joint. The thumb only has the third and fifirst phalanges and therefore only two joints between the phalanges, namely the MP and DIP joints.

4.2.2 The Tendons

In terms of finger movements in a hand there is flexion, extension, abduction and aduction. These movements are controlled and performed by various tendons, some of which can be seen in figure 2.2 and 2.3. In this project the fingers will only be able to execute flexion and extension. In general the flexor tendons run on the anterior surface of the forearm and the extensors run on the posterior surface of the forearm. The thumb follows the general scheme of flexor-extensor origin, but the extensors run on the radial surface. There are multiple layers to the extensor and flexor tendons that together actuate the finger movements as we know it. As stated above only the flexion and extension movements will be achieved in this project and therefore only flexor and extensor tendons will be replicated. Specifically for flexion in this project the flexor pollicis longus (FPL) and flexor digitorum profundus (FDP) is replicated to achieve contraction. In terms of extensors replicated in this project there is a combination of extensor digitorum communis (EDC)and extensor digiti quinti proprius (EDQP) for all fifingers bar the thumb. For the thumb it is the extensor pollicis longus (EPL) that is replicated.

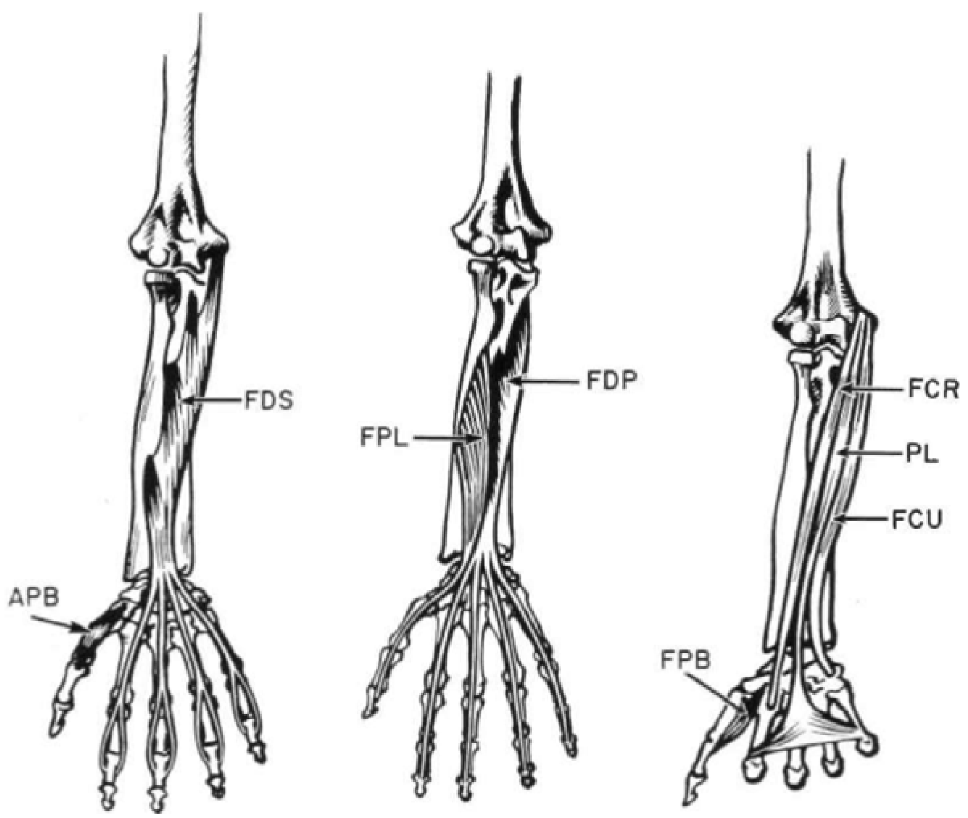

Fig 4.2 Human hand movement

4.2.3 Different Types of Human Grips

There are several grip forms that a human hand can execute, see figure 2.4. The human hand is a complex structure where several essential components are involved to perform an action. In order to execute a grip these components will not only have to be active but also collaborate with each other. The pinch grip consist of holding the object between the index or middle finger with the thumb, a common grip used when sewing by hand. The lateral pinch is when the object is held

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 8, May 2022
Impact Factor: 6.252

between the thumb and the side surface of the index finger, commonly used when unlocking a lock with a key. The tripod pinch is when the object is held between the thumb, index and middle finger, often used when writing with a pen. The five-finger pinch is when the object is held between the tips of the five fingers on the hand, with no contact to the palm. The diagonal volar grip consists of holding the object with the thumb and fingers while having contact with the surface of the palm, the object also has a diagonal axis in reference of the axis of the hand. If the axis of the object is transverse in reference of the axis of the hand then it is known as transverse volar grip. The spherical volar grip mimics the five-finger pinch, but the object has contact with the surface of the palm. The extension grip consist of holding the object between the thumb and the extended fingers, the object has no contact with the surface of the palm.

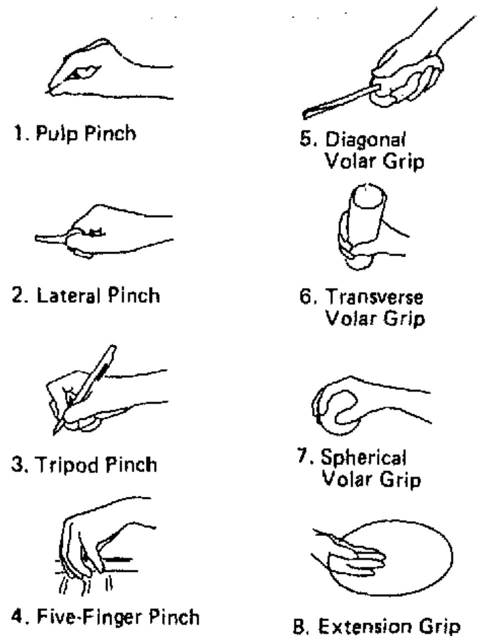

Figure: Human hand grips

V. IMPLEMENTATION

5.1 Overall Working

When a person move there finger while wearing the glove automatically the robotic hand will also move.In detail, consider a single finger where that finger is attach with the flex sensor.

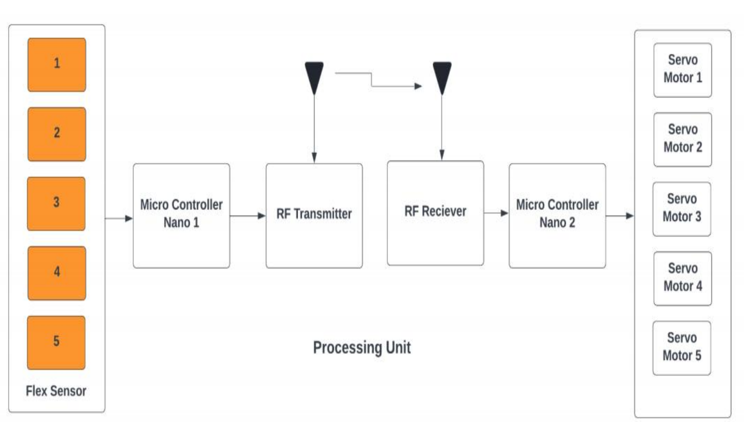

FIG 5.1 OVER ALL WORK DIAGRAM

The flex sensors were calibrated first by using the analogRead() function from which the values for a fully relaxed and fully bent flex sensor were observed. Using the observed values from the flflex sensors, the math function map() was used to re-map the recorded values to a range of 0-180◦ . The correct addresses for the IMU were opened and set according to the data sheet [18]. For calculating the orientation of the wrist ±2*g* was selected for the IMU. The angle of rotation of the wrist was calculated according to equation 2.2 in section 2.7 and was packaged with the flex sensor data in a message package. The package was then transmitted through the opened set address for the transceiver modules.

And in the robotic hand the six servo motors that were connected to the hand were programmed by first importing the Servo library. For the transceiver modules the RF24 library was also imported, allowing for the address of both transceiver modules to be set. After setting the address and opening the communication between the two RF modules the data received was used with the write() function to rotate the servo motors. The servo motors were calibrated using a code where the position of each servo motor was hard coded, . The servo motors were set to 90◦ , with the write() function, to thread the fishing lines in. After threading the fishing lines, the servo motors were rotated to 0◦ which is the fully extended state of the fingers. One of the fishing lines was tightened to keep tension throughout the arm. The servo motors were then rotated to 180◦ , the fully flexed state, and the second fishing line was tightened to the pulley.

VI. COMPONENT REQUIRED

6.1 ARDUINO NANO

The Arduino Nano is equipped with 30 male I/O headers, in a DIP30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.Micro-controller: Microchip ATmega328P.

Specification:

- Operating voltage: 5 volts
- Input voltage: 6 to 20 volts
- Digital I/O pins: 14 (6 optional PWM outputs)
- Analog input pins: 8
- DC per I/O pin: 40 mA
- DC for 3.3 V pin: 50 mA
- Flash memory: 32 KB, of which 0.5 KB is used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock speed: 16 MHz
- Length: 45 mm
- Width: 18 mm
- Mass: 7 g
- USB: Mini-USB Type-B [5]
- ICSP Header: Yes
- DC Power Jack: No

Fig 6.1ARDUINO NANO

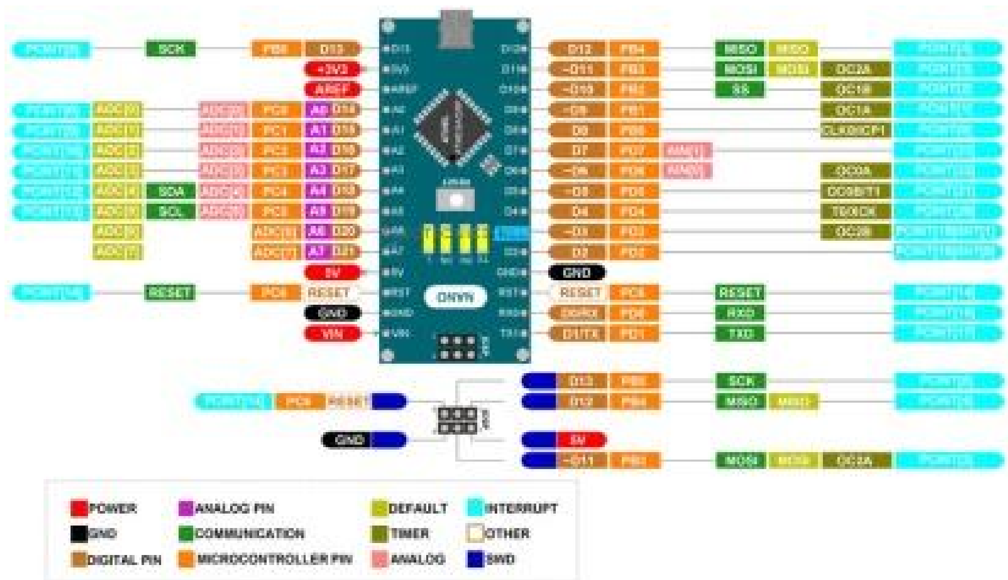

Fig.6.2 ARDUINO NANO PIN OUT DIAGRAM

6.2 TRANSCEIVER MODULE (nrf24l01)

The nRF24L01 is a single chip RF Transceiver IC developed by Nordic Semiconductor. It operates in the license-free 2.4GHz ISM band (ISM – Industrial, Scientific and Medical) with support for data rates of 250kbps, 1Mbps and 2Mbps. For data rates of 250kbps and 1Mbps, the channel bandwidth is approximately 1MHz. So, taking the minimum and maximum operating frequencies of 2400MHz and 2525MHz, you can implement a maximum of 126 RF Channels if your data rate is limited to 250kbps or 1Mbps.The module can use 125 different channels which gives a possibility to have a network of 125 independently working modems in one place. Each channel can have up to 6 addresses, or each unit can communicate with up to 6 other units at the same time.

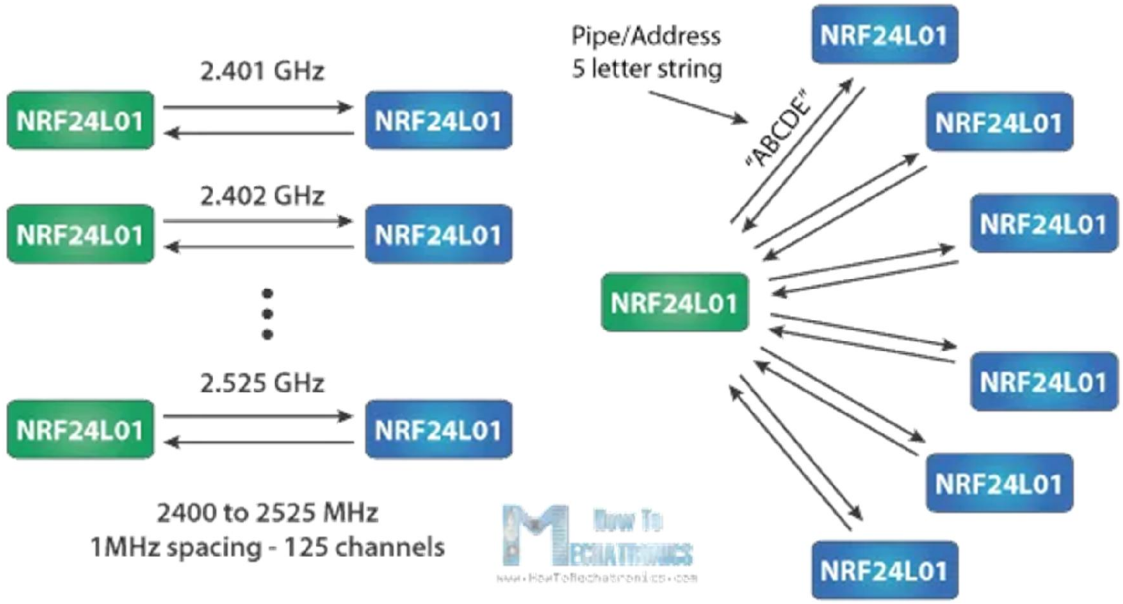

Fig 6.3 Transceiver Working

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 2, Issue 8, May 2022

The power consumption of this module is just around 12mA during transmission, which is even lower than a single LED. The operating voltage of the module is from 1.9 to 3.6V, but the good thing is that the other pins tolerate 5V logic, so we can easily connect it to an Arduino without using any logic level converters.Three of these pins are for the SPI communication and they need to be connected to the SPI pins of the Arduino, but note that each Arduino board has different SPI pins. The pins CSN and CE can be connected to any digital pin of the Arduino board and they are used for setting the module in standby or active mode, as well as for switching between transmit or command mode. The last pin is an interrupt pin which doesn't have to be used.

SPECIFICATION:

- Ultra-low power operation (26μA Standby-I mode, 900nA power down mode)
- SPI Interface with Micro-controller
- Integrated RF Transmitter, Receiver and Synthesizer
- Operating voltage is 1.9V – 3.6V
- Input pins can tolerate 5V

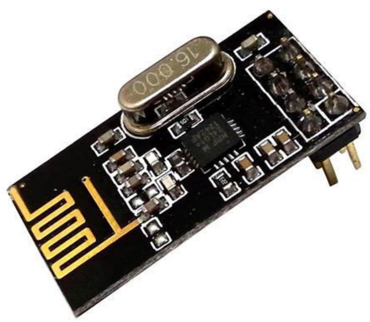

Fig 6.4 TRANSCEIVER MODUILE

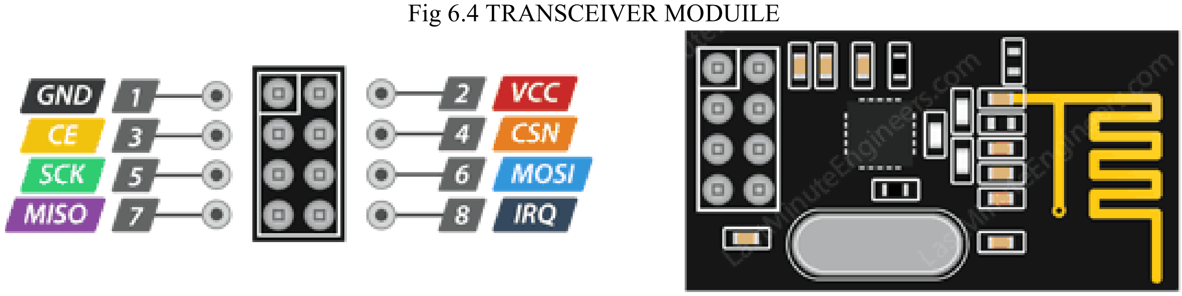

Fig 6.5 TRANSCEIVER MODULE PIN OUT DIAGRAM

6.3 FLEX SENSOR

A flex sensor is a kind of sensor which is used to measure the amount of defection otherwise bending. The designing of this sensor can be done by using materials like plastic and carbon. The carbon surface is arranged on a plastic strip as this strip is turned aside then the sensor's resistance will be changed. Thus, it is also named a bend sensor. As its varying resistance can be directly proportional to the quantity of turn thus it can also be employed like a goniometer.The easiest way to read the flex sensor is to connect it with a fixed value resistor (usually 47kΩ) to create a voltage divider. To do this you connect one end of the sensor to Power and the other to a pull-down resistor. Then the point between the fixed value pull-down resistor and the flex sensor is connected to the ADC input of an Arduino.

This way you can create a variable voltage output, which can be read by a Arduino's ADC input.

Note that the output voltage you measure is the voltage drop across the pull-down resistor, not across the flex sensor.The output of the voltage divider configuration is described by the equation

In the shown configuration, the output voltage decreases with increasing bend radius.For example, with 5V supply and 47K pull-down resistor, when the sensor is flat (0°), the resistance is relatively low (around 25kΩ). This results in the

$$V_O = V_{CC}\frac{R}{R + R_{Flex}}$$

following output voltage:

$$V_O = 5V\frac{47k\Omega}{47k\Omega + 25K\Omega}$$

$$= 3.26V$$

When flexed all the way (90°), the resistance rises to 100KΩ. This results in the following output voltage:

$$V_O = 5V\frac{47k\Omega}{47k\Omega + 100K\Omega}$$

$$= 1.59V$$

SPECIFICATION:

- Operating voltage of this sensor ranges from 0V to 5V
- It can function on low-voltages.Length 2.2 inch.
- Power rating is 1 Watt for peak & 0.5Watt for continuous.
- Operating temperature ranges from -45ºC to +80ºC
- Flat resistance is 25K Ω
- The tolerance of resistance will be ±30%
- The range of bend resistance will range from45K -125K Ohms.

Fig 6.6 FLEX SENSOR

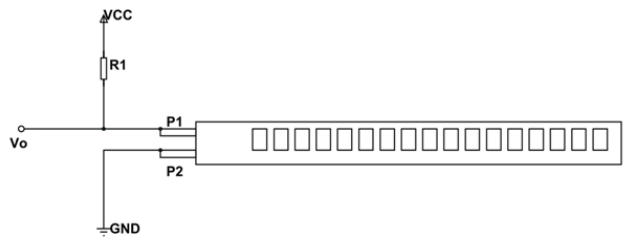

Fig 6.7 FLEX SENSOR PIN CONFIGURATION

6.4 SERVO MOTOR

A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

SPECIFICATION:

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation : 0°-180°
- Weight of motor : 9gm
- Package includes gear horns and screws

Fig6.8 SERVO MOTOR

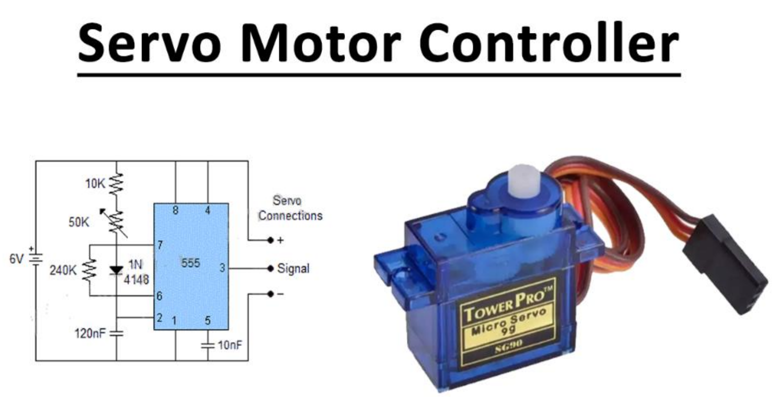

Fig 6.9 SERVO MOTOR PIN CONNECTION

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 2, Issue 8, May 2022

6.5 BATTERY

Battery1 is lithium ion battery basically rechargeable. A **lithium-ion battery** or **Li-ion battery** is a type of rechargeable battery composed of cells in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge and back when charging. Li-ion cells use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. Li-ion batteries have a high energy density, no memory effect (other than LFP cells)[9] and low self-discharge. Cells can be manufactured to prioritize either energy or power density.Here it is used in the robotics hand part.

Fig 6.10 BATTERY 1

SPECIFICAION

Battery Type : Lithium-Ion

Battery Capacity : 1200 mA

Model Number : XTT 18650

Is It Rechargeable : Rechargeable

Type : Cylinder

Battery 2 is 9V. The 9V battery is an extremely common battery that was first used in transistor radios. It features a rectangular prism shape that utilizes a pair of snap connectors which are located at the top of the battery. A wide array of both large and small battery manufacturers produce versions of the 9V battery. Possible chemistries of primary (non-rechargeable) 9V batteries include Alkaline, Carbon-Zinc (Heavy Duty), Lithium. Possible chemistries of secondary (rechargeable) 9V batteries include nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and lithium ion. The performance and application of the battery can vary greatly between different chemistries, meaning that some chemistiries are better suited for some applications over others.

Fig 6.11BATTERY 2

SPECIFICATION

- 9V Battery Nominal Voltage: 9 Volts
- Capacity (Alkaline) ≈ 550 mAh
- Capacity (Carbon-Zinc) ≈ 400 mAh
- Capacity (Lithium Primary) ≈ 1200 mAh
- Capacity (NiMH) ≈ 175-300mAh
- Operating Temperature: 0°C – 60°C

6.6 BRAID LINE WIRE:

Fig6.12 BRAID LINE WIRE

Body Style: A general rule of thumb is to string smaller-bodied acoustics with lighter gauges, larger bodied instruments with heavier gauges. Playing Style: Finger picking styles are much easier to play with lighter-gauge string. Here this string will connected with the hand and to the servo motor so that it can control the movement of the finger respectively.

6.7 ROBOTIC HAND

Robotic hand is created by 3D printing with PLA material which.Robotics hand has five finger each finger has 4 different part.In which it replicate the exact human finger movement.

Fig 6.13 3D PRINTED HAND

VII. WORKING

There are two categories in this thesis ,number one the glove (in which it is the controller part for the hand),second part is robot hand (which is made by 3D printing).This glove is to be wear in his/her hand.When someone where the glove and moves the hand,with respect to that robot hand will move.

7.1 GLOVE

In Glove area we need,Arduino NANO, Transceiver Module (nRF24L01)Flex sensor(5) ,Resistor (5) 10kBattery. When the flex senor is bend which means an human who wears the glove will fold his/her finger or move the finger the signal from the flex sensor will send to the nano and the nano will compile and send data to the transceiver.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 2, Issue 8, May 2022

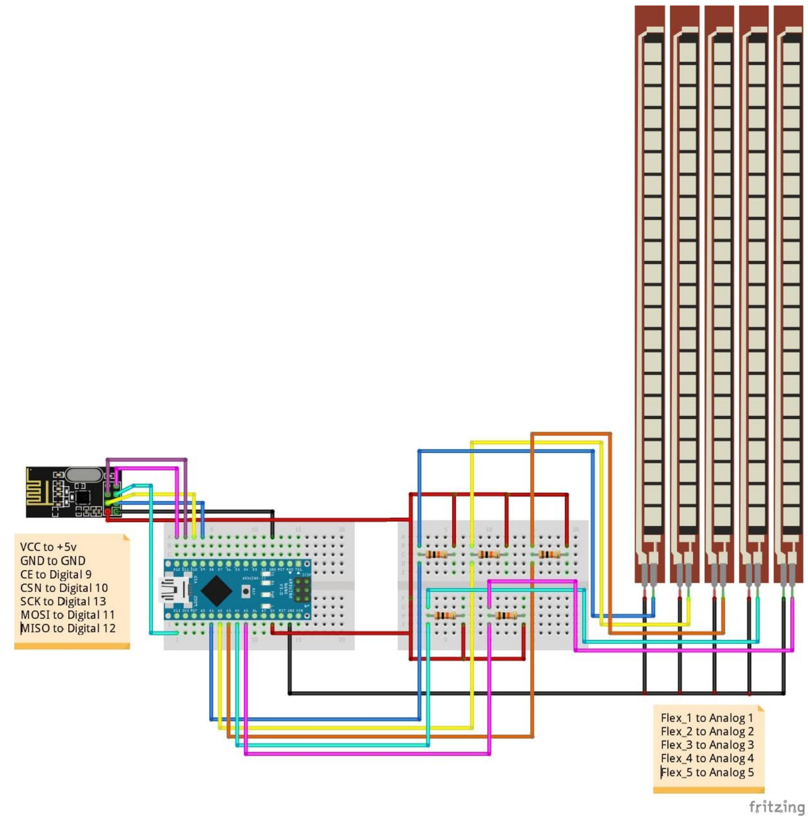

Fig 7.1 SCHEMATIC FOR GLOVE

7.1.1 ROBOTIC HAND

For the 3D printed robot hand the component needed,Arduino NO,Servo motors 5,Steel String, Battery,Transceiver Module(nRF24L01).For the each movement that made in the glove the signal will be gathered,and transferred by the transceiver module(in glove part) .And the transceiver module in the root hand will get the signal for each signal each servo motor will move respectively. And finger along with string which is connected to the servo will move

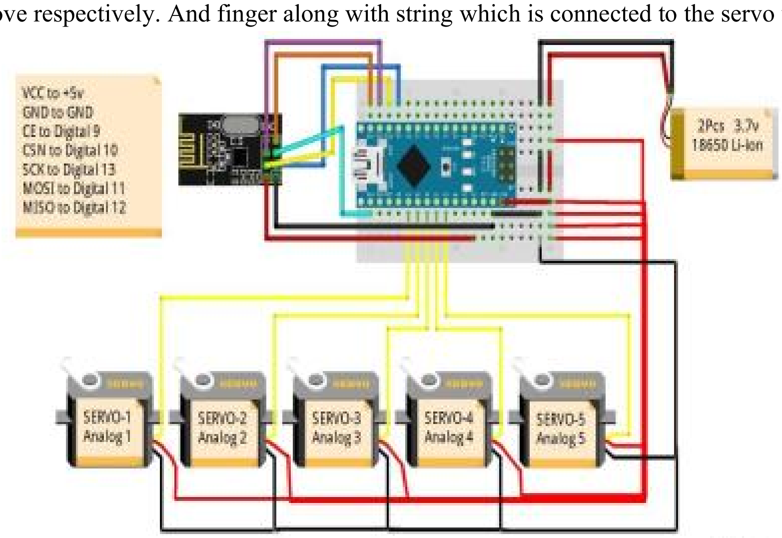

FIG 7.2 SECHMATICS FOR ROBOTIC HAND

When the finger is closed then then flex sensor also bend, then the it reading is recorded and transfer to the arduino nano and then it will send the data to the transceiver (nrf24l01)(glove is known as transmitter), and the transceiver send the radio frequency to the receiver which is also a transceiver(nrf24lo1) which is placed in the robotics hand (made by 3D printing) and the received data will send to the arduino nano and to the servo motor the servo motor then rotate in specific degree, and the braid line is connected to the each finger to the servo motor. With respect to that the fingers will move.

VIII. RESULT AND DISCUSSION

8.1 RESULT

Each finger managed to contract individually, however some fingers performed better than others. An example of a digit with worse performance was the thumb on the robotic hand. As for the hand signs the robotic hand was able to replicate the hand signs carried out by the operator with the glove The performed hand motions were also successfully imitated by the robotic hand, with little to no significant delays being observed.

8.2 DISCUSSION

The flex sensors on the controller glove had to be adjusted several times so that they fit snugly on the glove which allowed for the full angle range set for the servo motors to be achieved. The use of the flex sensors were after adjustment good but not perfect. The glove is not considered perfect owing to the fact that it was limited by a fixed size as well as the fit of the glove, when worn, affecting the bend of the flex sensors. The size of the glove for this project was fixed, this was done since the flex sensors were directly sewn onto the glove. If the glove was to be stretchable, then the flex sensors would have trouble staying in place. For example the tips of the sensors could jump out of the stitches on the glove and the imitation would therefore not be as good in the finger tips of the robotic hand. A possible solution to this problem, if a flexible glove was desired, could be to create pockets at the top part of the glove fingers where the tips of the sensors could be inserted in. This would prevent them from moving when the glove is stretched.Even with the limitations imposed by the controller glove the robotic hand was able to imitate the hand movements of the controller fairly well without any significant delay. The range of movement in the robotic hand was limited from the construction of the hand. This was due to the fact that the mechanical structure of the robotic hand is a simplified model of a human hand, which in this case resulted in it not being able to perform auction or abduction.

REFERENCES

[1]. Arduino Nano, https://store.arduino.cc/arduino-nano.

[2]. Semiconductor,nRF24series,https://www.nordicsemi.com/Products/ Low- power- short- range-wireless/nRF24- series,

[3]. R. J. Schwarz and C. Taylor, "The anatomy and mechanics of the human hand", Artifificial limbs, vol. 2, no. 2, pp. 22–35, 1955.

[4]. Iyer, nRF24L01+ RF Module Tutorial, https://www.deviceplus.com/how- tos/arduino- guide/nrf24l01- rf-module- tutorial/

[5]. How- tos/arduino- guide/nrf24l01- rf- module- tutorial/ 2017.maniacbug, RF LIBRARY, https://github.com/maniacbug/RF24.

[6]. Cruciani, Silvia et al.In-Hand Manipulation Using three-Stages Open Loop Pivoting 2017.

[7]. Engström, Jesper et al.Modeling of Robotic Hand for Dynamic simulation 2010.

[8]. Ramachandra A C, Karunakar Rai B, Suruchi Poddar-Hand Gesture Controlled Robot- 2020.

[9]. Kathiravan Sekar , Ramarajan Thileeban , Vishnuram Rajkumar , Sri Sudharshan Bedhu Sembian-2020 .

[10]. Tandrima Goswami, Divyanshi Sharma, Rahul Pratyush -Dynamic Gesture Robot hand -2020.

[11]. Parin Somaiya1, Vipul Panchal, Divesh Mehta, Prof. Rupali Advirkar- GESTURE CONTROLLED ROBOT-2020.

[12]. Gesture Controlled Robot- Shaunak Chokshi, Shashank Sharma, Hardik Joshi- 2016.

[13]. The Gesture Controlled robot-Dr. C.K Gomathy, G.Nitheesh, Sai krishna-2021 .

[14]. Gesture Recognition Robotic Hand-Niharika Gupta, Ruchi Varshney,Neeraj Sharma ,Manish Sharma, Kalika Sharma,Mahak Chaudhary-2014 .

[15]. Karthik Bankapur,Himmat Singh,Akshit Gupta, Hritik Mathur, Harikrishnan R, Shivali Amit Wagle.
[16]. Hand Gesture Control Robot Benjula Anbu Malar M B, Praveen R, Kavi Priya K P-2019.
[17]. Hand gesture controlled robotic arm for industrial-D P Karthik,Diganth Bhargava, Dr. Abhay A Deshpande -2020.
[18]. Nathan David, Chinedu Udengwu, Obiayor Onyia- A gesture Controlled system-2015.
[19]. Gesture controlled robotic hand using flex sensor-Sandeep Kumar Maurya R, Prasad-2015.
[20]. .Design and implementation of a wireless gesture controlled robotic arm-Aggarwal Varnika Gaur Puneet-2013