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Gesture Controlled Prosthetic – Hand

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Abstract: *This project describes about design and fabrication of a gesture controlled robotic hand using computer vision, instead of button and joystick. The aim of the project is to create a gesture-control for hand to perform pick and place tasks. Gesture recognition consists of three stages: capturing of image, image processing and data extraction. The hand consists of servo motor, web camera ,arduino nano and braid wire ,which is used to control the finger's motion, capturing data ,commanding servo motor and to transfer the motion from servo motor to fingers. .This hand is constructed to reduce human difficulties and used for physically challenged people because of simple, flexible and easy control. In future it can be used to eliminate bombs, military purposes and hazardous operations. The hand operate in the way of opening and closing, up and down motion .From further research it can be used for the whole humanoid robot that will benefit in various areas applications and so on.*

Keywords: Gesture Recognition, Robotic Hand, Human Computer Interaction

I. INTRODUCTION

In today's age, the robotic industry has been developing many new trendsto increase the efficiency, accessibility and accuracy of the systems. Some of thetasks are harmful to the human. Though robots can be areplacement to humans, they still need to be controlled by humans itself. Robots can be wired or wireless, both having a controller device. Though it has pros and cons in controlling the robotic systemthrough physical devices, recent method of **gesture control** has become very popular. The main purpose of using gestures is that it provides a morenatural way of controlling and provides a rich and intuitive form of interaction with the robotic system. This mainly involves image processing and machine learning for the system or application development, it also requires some kind of hardware for interfacing with the system for gesture control. This system is made up of three parts: **a laptop (that's Machine vision), Arduino, a robotic hand, the robotic hand** is attachedto a platform that is controlled wired by Arduino nano. the robotic hand is synced with the user's and operator's hand motions and postures

1.1 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.

1.2 Anatomy of the Human Hand and Wrist

A. The Bones and Joints

Human hand consists of the carpus and five fingers, see figure 1.1

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 Multangular (LM), Capitate (C) and the Hamate (H)

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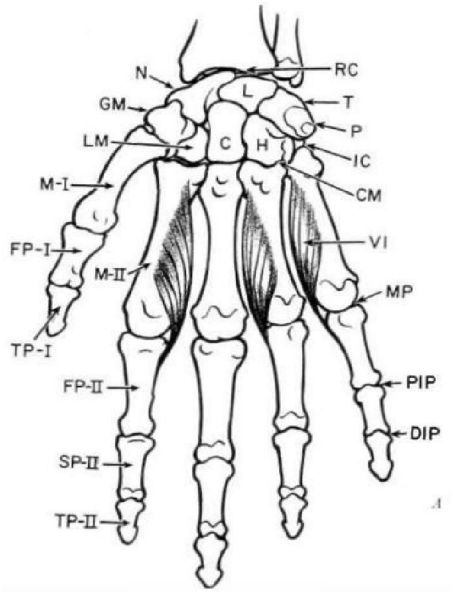

Fig 1.1 : Human Hand Antonomy

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 intercarpal (IC) joint. The thumb only has the third and fifirst phalanges and therefore only two joints between thephalanges, namely the MP and DIP joints.

B. The Tendons

In terms of finger movements in a hand there is flexion, extension, abduction and adduction. These movements are controlled and performed by various tendons, some of which can be seen in figure 1.1.2 and 1.1.3. 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 profundo's (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) thatis replicated.

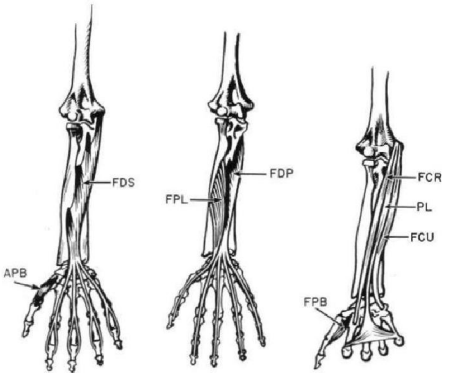

FIG 1.1.2: Human Hand Movement

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Different Types of Human Grips

There are several grip forms that a human hand can execute, 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 between the thumb and the side surface of the index finger, commonly used when unlocking a lock with a 16 key. The tripod pinch is when the object isheld 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 ofthe hand. If the axis of the object is transverse in reference of the axis of the handthen 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.

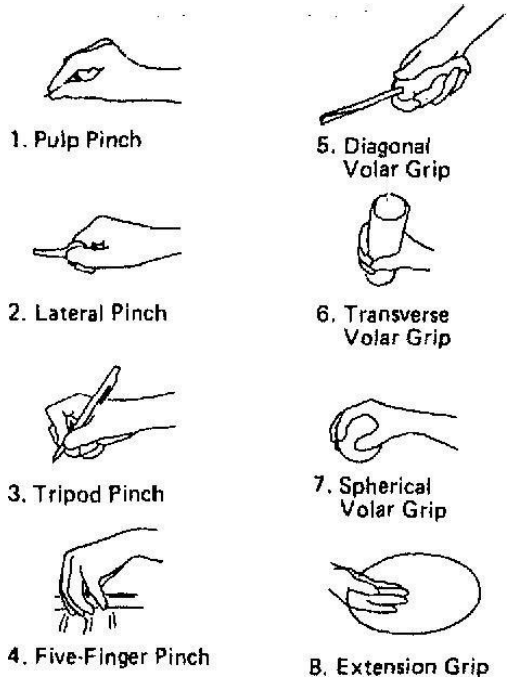

Figure 1.1.3: Human Hand Grips

II. LITERATURE REVIEW

Hand Gesture Recognition Algorithm Using SVM and HOG Model for Control of Robotic System(2021) By Phat Nguyen Huu and Tan Phung Ngoc

Review: This paper is about to hand gesture recognition algorithm based on HOG incorporating SVM that is able to apply to robotic systems

Hand gesture recognition on python and opencv (2020) By Ahmad Puad Ismail, Farah Athirah Abd Aziz , Nazirah Mohamat Kasim and Kamarulazhar Daud

Review : This project is about the hand gesture recognition using Python and OpenCV can be implemented by applying the theories of handsegmentation and the hand detection system which use the Haar-cascade classifier to manage

To establish a complete system for detecting, recognizing and interpretinghand gesture recognition through computer vision using Python and OpenCV

Gesture Controlled Robot using Image Processing(2013) by Harish Kumar Kaura, Vipul Honrao , Sayali Patil, Pravish Shetty

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Review : This paper is about without using any external hardware support for gesture input unlike specified existing system. After gesture recognition commandsignal is generated and passed to the robot and it moves in specified direction.

Hand Gesture Recognition Techniques For Human Computer Interaction Using OpenCv by Sajjad Ur Rahman, Zeenat Afroze, Mohammed Tareq

Review : This paper is about different effective techniques for man-machine interaction are observed. a few systems for preprocessing of input image are presented. this paper also introduced about fingertip and palm detection in the hand gesture which increases the freedom of usability.

Gesture Controlled Robot with Robotic Arm (2022) by Priyank Garg ,Mansi Patel , Harshit Verma

Review : This paper is based on a robotic arm to its movement is precise, accurate,easy to handle, and user pleasant. anticipated to solve problems such as putting or picking things

Implementation Of Gesture Control In Robotic Arm Using Kinect Module (2015) By Rajesh Kannan Megalingam, Deepansh Meno, Nitin Ajithkumar , Nihil Saboo

Review : This project was aimed at creating a robotic arm which is controlled by themovements of the user's (human) arm.

A Study on New Arduino NANO Board for WSN and IoT Applications (2020) By Hani Al-Mimi1, Ali Al-Dahoud , Mohamed Fezari, MohammadSh. Daoud

Review : For using the Arduino IDE for its simplicity and open source aspect, but just want a great value, small and powerful board they can trust for their compact projects

Design and Construction of the Robotic Hand Prosthesis UC-1 by C .Quinayas ,Doyra Mariela Muñoz-Añasco, Andres Vivas and CarlosAlberto Gaviria Lopez

Review : This article is about the design and construction of prosthesis consisting ofthree fingers (middle, index, and thumb), with three degrees of freedom oneach finger. For arrangement allows for complex pincer, lateral, hook, andball grips and cylindrical. The final construction allowed to validate thesemovements and observe

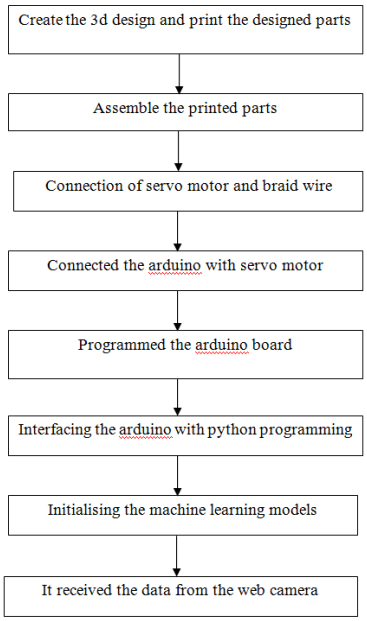
Fabrication of PLA Filaments and its Printable Performance (2013) byWenjie Liu, Jianping Zhou* , Yuming Ma, Jie Wang and Jie Xu

Review: For 3d printing and surface roughness and ultimate tensile stress of the obtained PLA filaments. The optimal process parameters for fabrication ofqualified filaments were determined

Robotic Hands: Design Review and Proposal of New Design Process (2007)By Jimmy W. Soto Martell, and Giuseppina Gini

Review : For the finger operating and actuating methods

III. METHODOLOGY



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3.1 Existing Methodology

- Analog flex sensors are used on the hand glove to measure the fingerbending this is not so accurate
- Gestures are recognized using Microsoft Xbox 360 Kinect(C) this Kinect sensor are gather the colour and depth information using an RGB and Infra-Red camera respectively so This system is not very cost effective.

3.2 Limitation

- loss of signal.
- Complicate to control.

3.3 Proposed Methodology

The wireless gesture control prosthetic hand is achieved by the five servo motors and computer vision is required. and microcontroller (arduino nano) are needed to execute the desired motion of the robotic hand and the computer vision & machine learning algorithm are used for the wireless communication for the robotic hand. components of the hand will be printed with a three-dimensional (3d) printer.

IV. HARDWARE COMPONENTS

4.1 Micro Processor (Arduino Nano)

The Arduino nano every variant is used here .The Nano every board is designed based on the old Arduino Nano with little difference. It is equipped with the ATMega4809 microcontroller and an energy efficient processor called Arm's Cortex M0+. It comes with doubled flash memorysize, higher clock speed and 3x the SRAM. It is suitable for everyday projects. The Arduino Nano Every features a powerful processor, the ATMega4809. It is the first AVR device that includes Microchip's Core Independent Peripherals (CIP).

Specifications

- Processor :Microcontroller ATmega328
- Operating Voltage : 5 V
- Input Voltage : 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins : 14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

Fig 4.1.1 NANO(Side view)

Fig 4.1.2 NANO(Top view)

4.2 Servo Motor

Servomotors are widely used for building up robotic systems with many degreesof freedom and varied morphologies the reduced size, movement accuracy and low cost. it has significant position adjustment errors and zero position variationscaused by changes in temperature and supply voltage. The features of a robotic manipulator are particularly determined by mechanical accuracy of its movementand the exercise capacities, the number of degrees of freedom, and sophisticationand reliability of the controller. Metal gear servo motor is used here,

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Specification

- Model : MG995
- Weight : 56 g
- Operating voltage : 4.8V to 6 V
- Recommended voltage : 5V
- Running current : 350 mA
- Control system : Analog
- Small torque : 14 kg cm
- Operating angle : 180 degree
- Motor type : carbon
- Gear type : Metal
- Required Pulse : 500us-2500us

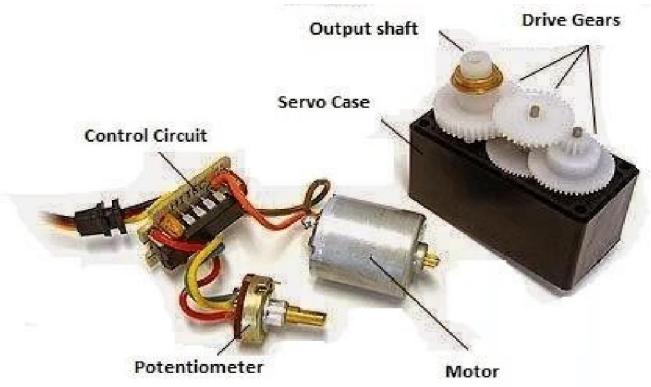

Fig 4.2.1 SERVO MOTOR (Internal construction)

Fig 4.2.2 SERVO MOTOR

3D DESIGNED PARTS

Robotic hand is created by 3D printing with PLA material .this Robotics handhas five finger each finger has 8 different part. In which it replicate the exact human finger movement.

FIG 4.3.1. HAND ASSEMBLY MODEL

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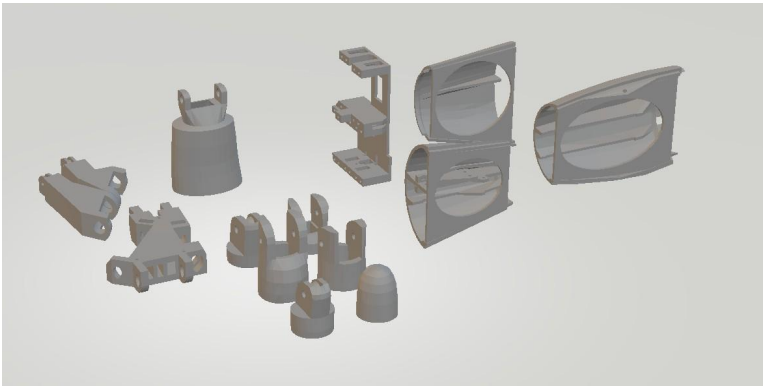

FIG 4.3.2 HAND PART DESIGN

4.3 Braid Wire

Body Style: A general rule of thumb is to string smaller-bodied acoustics withlighter gauges, larger bodied instruments with heavier gauges

Playing Style: Finger picking styles are much easier to play with lighter-gauge string. Here thisstring will connected with the hand and to the servo motor so that it can controlthe movement of the finger respectively

FIG 4.4 BRAID LINE WIRE

V. WORKING

We propose a system, the wireless prosthetic robotic hand using gestures. we operates the robot control using laptop or a pc with a good quality in-built webcam or external webcam. This webcam is used to capture real time video stream of hand gestures to generate commands for the robot. gesture commands are given using hand palm. This hand mimics human hand is moved in all possible directions in the commands hand fold open and closes. image frame is taken as an input and processed using image processing. processed image is then used to extract the gesture command. this gesture command can have one of the four possible commands as specified. Arduino nano – micro controller takes this signal as input from the laptop threw open cv and generates some output signals that are passed to the servo motor this output signal generation depends on the gesture input, for every four possible gesture input, different output signal is generated. it takes digital signals as the input from the Arduino and gives these signals as an output to the servo motors. once a command signal is given to the robot, it continues to move in that direction till the next command.

5.1 Circuit Diagram

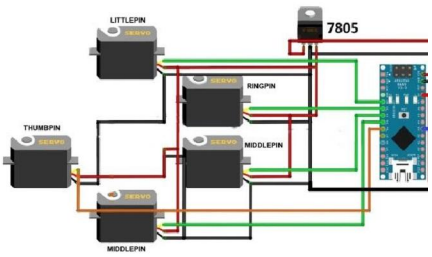

FIG 5.1 CIRCUIT DIAGRAM

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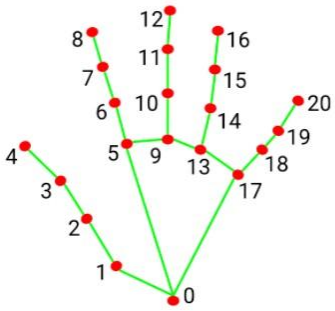
5.2 Hand Detection

Detection of Hand Key points

- MediaPipe works with RGB images but OpenCV reads images in BGR format. So, using cv2.cvtCOLOR () function we convert the frame to RGBformat.
- The process function takes an RGB frame and returns a result class.
- Then we check if any hand is detected or not, using result.multi_hand_landmarks method.
- After that, we loop through each detection and store the coordinate on a listcalled landmarks.
- Here image height (y) and image width(x) are multiplied with the result because the model returns a normalized result. This means each value in the result is between 0 and 1.
- And finally using mpDraw.draw_landmarks () function we draw all the landmarks in the frame.



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

FIG 5.2 KEY POINTS

5.3 Image Processing

- Capture the frames continuously from the camera using OpenCV.
- Convert the BGR image to an RGB image and make predictions using initialized holistic model.
- The predictions made by the holistic model are saved in the results variable from which we can access the landmarks using results.face_landmarks, results.right_hand_landmarks, results.left_hand_landmarks respectively.
- Draw the detected landmarks on the image using the draw_landmarks function from drawing utils.
- Display the resulting Image

5.4 Python Programming

Python is open source programming language its has rich librarires and function. Python is interpreted language, so with the use of command-line interpreter student can easily check how operators or functions work. It interpreter has built-in help module Python code is easy enough, it has tools such as ‘variables’ and ‘functions’ easy-to-use. The software may be rewrittenin lower language if needed.

Libaries used in this project are,

OpenCV library in python is a computer vision library that is widely used for image analysis, image processing, detection, recognition, etc.

mediapipe is a cross-platform library developed by Google that provides amazing ready-to-use ML solutions for computer vision tasks.

NumPy is a general-purpose array-processing package. It provides a high- performance multidimensional array object, and tools for working with thesearrays. It is the fundamental package for scientific computing with Python

VI. CALCULATION

6.1 Braid Wire:

Tensile Stress = force / area
Motor torque =10 kg/cm
Length of wire =30 cm
Force = (10*9.81)/30 =3.27 N

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Diameter of wire = 0.5 mm
Area = 3.14 * (D/2)^2
=1.96 *10^-8 M2
Stress = 3.27/(1.19*10^-8)
=1.6*10^8 pa

6.2 Design Calculation

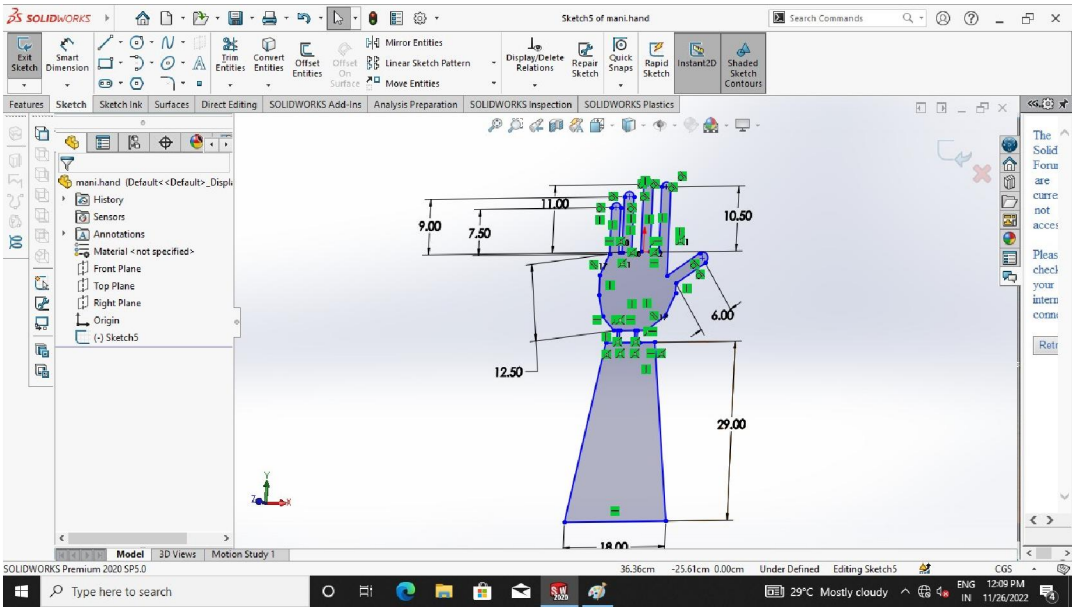

FIG 6.2 DIMENSION(CM)

6.3 Program Calculation

SERVO MOTOR

```
if (counter < stringLength){
    receivedString = String(receivedString+c);
    counter++;
    }
if (counter >=stringLength){
    //$00000
    for(int i = 0; i<numOfValsRec; i++)
    {
int num = (i*digitsPerValRec)+1;
valsRec[i] = receivedString.substring(num,num +
    digitsPerValRec).toInt()
```

OPEN CV

```
def write_read(x):
    arduino.write(bytes(x, 'utf-8'))
    time.sleep(0.05)
data = arduino.readline()
return data

def distancebetweenpoints(x1,y1,x2,y2):
```

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```
x3 = x2-x1
 y3 = y2-y1
  distanceofpoints = ((x3**2)+(y3**2))**(1/2)
   return distanceofpoints
```

VII. RESULTS

7.1 Design Result

7.1 Design Model

7.2 Program Result

SERVO

```
#include <Servo.h>
#define numOfValsRec 5
#define digitsPerValRec 1

Servo servoThumb;
Servo servoIndex;
Servo servoMiddle;
Servo servoRing;
Servo servoPinky;

int valsRec[numOfValsRec];
int stringLength = numOfValsRec * digitsPerValRec + 1; //$00000
int counter = 0;
bool counterStart = false;
String receivedString;
        void setup() {
  Serial.begin(9600);
  servoThumb.attach(7);
  servoIndex.attach(8);
  servoMiddle.attach(9);
  servoRing.attach(10);
  servoPinky.attach(11);
  }
void receiveData(){
  while(Serial.available())
  {
    char c = Serial.read();
     if (c=='$'){
    counterStart = true;
```

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```
  }
  if (counterStart){
   if (counter < stringLength){
    receivedString = String(receivedString+c);
    counter++;
   }
   if (counter >=stringLength){
    //$00000
    for(int i = 0; i<numOfValsRec; i++)
    {
     int num = (i*digitsPerValRec)+1;
    valsRec[i] = receivedString.substring(num,num + digitsPerValRec).toInt();
    }
    receivedString = "";
    counter = 0;
    counterStart = false;
  }
  }
  }
}
 void loop()  {
   receiveData();
   if (valsRec[0] == 1){servoThumb.write(180);}else{servoThumb.write(0);}
   if (valsRec[1] == 1){servoIndex.write(180);}else{servoIndex.write(0);}
   if (valsRec[2] == 1){servoMiddle.write(180);}else{servoMiddle.write(0);}
   if (valsRec[3] == 1){servoRing.write(180);}else{servoRing.write(0);}
   if (valsRec[4] == 1){servoPinky.write(180);}else{servoPinky.write(0);}
}
```

PYTHON OPEN CV

```
import cv2
import mediapipe as mp
import time
import math
import serial
import numpy as np
from pynput.mouse import Button, Controller
import mido
def make_720p():
cap.set(3, 1920)
cap.set(4, 1080)

mouse = Controller()
cap = cv2.VideoCapture(0)

#make_720p()

mpHands = mp.solutions.hands
hands = mpHands.Hands(False,1)
```

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```
mpDraw = mp.solutions.drawing_utils

pTime = 0
cTime = 0

arduino = serial.Serial(port='COM13', baudrate=115200, timeout=.1) #####arduino code#####

def write_read(x):
arduino.write(bytes(x, 'utf-8'))
time.sleep(0.05)
data = arduino.readline()
   return data

def distancebetweenpoints(x1,y1,x2,y2):
   x3 = x2-x1
   y3 = y2-y1
   distanceofpoints = ((x3**2)+(y3**2))**(1/2)
   return distanceofpoints
def findcentercorofsameaxis(x1,x2):
   x3=((x1+x2)/2)
   k=int(float(x3))
   return k
msg1 = mido.Message('note_on', note=60, velocity=112)
msg2 = mido.Message('note_off', note=60, velocity=112)
msg3 = mido.Message('note_on', note=61, velocity=112)
msg4 = mido.Message('note_off', note=61, velocity=112)
#port = mido.open_output('mymidiport 1')
counter=0
counter1=0
counter2=0
print("HAND GESTURE ROBOT INITIALISING.....")
while True:
   # Get image frame
   success, img = cap.read()
   imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
   results = hands.process(imgRGB)
   #print(results.multi_hand_landmarks)

   if results.multi_hand_landmarks:
      for handLms in results.multi_hand_landmarks:
         for id, lm in enumerate(handLms.landmark):
            #print(id,lm)
            h, w, c = img.shape
            cx, cy = int(lm.x*w), int(lm.y*h)
            #print(id, cx, cy)
            if id==4:# thumb finger
               cv2.circle(img, (cx, cy), 10, (0,255,0), cv2.FILLED)
               xcor1 = cx
               ycor1 = cy
```

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```
        thumbfingertracker = (xcor1, ycor1)
    if id==8:# index finger
        cv2.circle(img, (cx, cy), 10, (0,255,0), cv2.FILLED)
        xcor2 = cx
        ycor2 = cy
        point2indexfinger = (xcor2, ycor2)
        #print(point2indexfinger)
    if id==9:# centerline tracker
        cv2.circle(img, (cx, cy), 10, (255,0,255), cv2.FILLED)
        xcor3 = cx
        ycor3 = cy
        centerlinefingertracker = (xcor3, ycor3)
    if id==0:# hand bottom tracker
        cv2.circle(img, (cx, cy), 10, (255,0,255), cv2.FILLED)
        xcor4 = cx
        ycor4 = cy
        handbottomtracker = (xcor4, ycor4)
    if id==12:# middle finger tracker
        cv2.circle(img, (cx, cy), 10, (255,0,255), cv2.FILLED)
        xcor5 = cx
        ycor5 = cy
        middlefingertracker = (xcor5, ycor5)
    if id==16:# ring finger tracker
        cv2.circle(img, (cx, cy), 10, (255,0,255), cv2.FILLED)
        xcor6 = cx
        ycor6 = cy
        ringfingertracker = (xcor6, ycor6)
    if id==20:# little finger tracker
        cv2.circle(img, (cx, cy), 10, (255,0,255), cv2.FILLED)
        xcor7 = cx
        ycor7 = cy
        littlefingertracker = (xcor7, ycor7)
          mpDraw.draw_landmarks(img,handLms,mpHands.HAND_CONNECTIONS)
k1=findcentercorofsameaxis(xcor1, xcor2)
k2=findcentercorofsameaxis(ycor1, ycor2)
k3=findcentercorofsameaxis(xcor3, xcor4)
k4=findcentercorofsameaxis(ycor3, ycor4)
centerofmiddleline=(k3,k4)
 midpointbetween = (k1,k2)
########lines#######
cv2.line(img, centerlinefingertracker,handbottomtracker,(0,0,255),4)# angle of orientation line
cv2.line(img, handbottomtracker,point2indexfinger,(255,0,0),4)
cv2.line(img, handbottomtracker,middlefingertracker,(255,0,0),4)
cv2.line(img, handbottomtracker,ringfingertracker,(255,0,0),4)
cv2.line(img, handbottomtracker,littlefingertracker,(255,0,0),4)
cv2.line(img, centerlinefingertracker,thumbfingertracker,(255,0,0),4)
#cv2.line(img, handbottomtracker,(0,ycor4),(255,0,0),4)#blue
#cv2.line(img, centerlinefingertracker,(0,ycor4),(255,255,0),4)#cyan line
```

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```
distance1and2 = distancebetweenpoints(xcor4, ycor4, xcor2, ycor2)#####INDEX              FINGER####
distance1and3 = distancebetweenpoints(xcor4, ycor4, xcor5, ycor5)#####MIDDLE               FINGER###
distance1and4 = distancebetweenpoints(xcor4, ycor4, xcor6, ycor6)#####RING FINGER#####
distance1and5 = distancebetweenpoints(xcor4, ycor4, xcor7, ycor7)#####LITTLE FINGER###
distance1and6 = distancebetweenpoints(xcor3, ycor3, xcor1, ycor1)#####THUMB FINGER####
d1=distancebetweenpoints(xcor3, ycor3, 0,ycor4)
d2=distancebetweenpoints(xcor3, ycor3, xcor4,ycor4)
d3=distancebetweenpoints(xcor4, ycor4, 0,ycor4)
k=((d2**2)+(d3**2))
m=((d1**2)-k)
j=((-2)*d2*d3)
if j==0:
   j=0.1
h=(m/j)
g=math.acos(h)
f=math.degrees(g)
d5=distancebetweenpoints(xcor3, ycor3, xcor4, ycor4)
lenghtrange=range(60,401,1)
lengthlist=[*lenghtrange]
radiusrange=range(0,341,1)
scalelist=[*radiusrange]
#print(lengthlist)
#print(scalelist)
findvalue=int(d5)
findindex=0
if findvalue in lenghtrange:
   findindex=lenghtrange.index(findvalue)
   #print(findindex)
length_value=lenghtrange[findindex]
radius_value=radiusrange[findindex]
#print(length_value)
#print(radius_value)
angle1=int(f)
#print("Angle :",angle1," length of center line :",distance1and2)
######MOUSE CONTROLLER#######
xpos=k1
ypos=k2
xpos2=((xpos)*(1920/600))
ypos2=ypos*(1080/400)

#mouse.position = (1920-xpos2,ypos2)# mouse pointer activation
#print('The current pointer position is {0}'.format(mouse.position))
j1=0
j2=0
if(distance1and2<30):
   if (counter==0):
      #cv2.circle(img,(thumbfingertracker),radius_value, (255,0,0),2)
      #port.send(msg1)
      #mouse.press(Button.left)
```

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```
            counter=counter+1
            j1=xcor1
            j2=ycor1

    currentpos=(j1,j2)

    if(distance1and2>40):
        if(counter==1):
            #cv2.circle(img,currentpos,0, (255,0,0),2)
            #mouse.release(Button.left)
            counter=counter-1
            #port.send(msg2)

    #############2nd note########
    if(distance1and3<30):
        if (counter1==0):
            #cv2.circle(img,(thumbfingertracker),radius_value, (0,255,0),2)
            #port.send(msg3)
            #mouse.press(Button.right)
            counter1=counter1+1
            j1=xcor1
            j2=ycor1
    currentpos=(j1,j2)
    if(distance1and3>40):
        if(counter1==1):
            #cv2.circle(img,currentpos,0, (0,255,0),2)
            #mouse.release(Button.right)
            counter1=counter1-1
            #port.send(msg4)
    datastring="$"
    ############################## INDEX FINGER ##################
    if(distance1and2>170):
        lights="3"
        counter2=0
        datastring=datastring+"1"
        #right
        #write_read(lights)
        #cv2.putText(img,str("INDEX FINGER OPEN"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
        #print(distance1and2)
    elif(distance1and2<170):
        lights="3"
        counter2=0
        datastring=datastring+"0"
        #right
        #write_read(lights)
        #cv2.putText(img,str("INDEX FINGER CLOSED"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
        #print(distance1and2)
         ############################## MIDDLE FINGER ##################
```

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```
if(distance1and3>170):
    lights="3"
    counter2=0
    datastring=datastring+"1"
    #right
    #write_read(lights)
    #cv2.putText(img,str("MIDDLE FINGER OPEN"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
    #print(distance1and3)
elif(distance1and3<170):
    lights="3"
    counter2=0
    datastring=datastring+"0"
    #right
    #write_read(lights)
    #cv2.putText(img,str("MIDDLE FINGER CLOSED"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
    #print(distance1and3)
############################## RING FINGER ##################
if(distance1and4>170):
    lights="3"
    counter2=0
    datastring=datastring+"1"
    #right
    #write_read(lights)
    #cv2.putText(img,str("RING FINGER OPEN"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
    #print(distance1and4)
elif(distance1and4<170):
    lights="3"
    counter2=0
    datastring=datastring+"0"
    #right
    #write_read(lights)
    cv2.putText(img,str("RING FINGER CLOSED"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
    #print(distance1and4)

############################## LITTLE FINGER ##################
if(distance1and5>80):
    lights="3"
    counter2=0
    datastring=datastring+"1"
    #right
    #write_read(lights)
    cv2.putText(img,str("LITTLE FINGER OPEN"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
    #print(distance1and5)

elif(distance1and5<80):
    lights="3"
    counter2=0
    datastring=datastring+"0"
    #right
```

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```
            #write_read(lights)
            cv2.putText(img,str("LITTLE FINGER CLOSED"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
            #print(distance1and5)
        ############################## THUMB FINGER ##################
        if(distance1and6>70):
            lights="3"
            counter2=0
            datastring=datastring+"1"
            #right
            #write_read(lights)
            cv2.putText(img,str("LITTLE FINGER OPEN"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
            #print(distance1and5)
        elif(distance1and6<70):
            lights="3"
            counter2=0
            datastring=datastring+"0"
            #right
            #write_read(lights)
            cv2.putText(img,str("LITTLE FINGER CLOSED"),(0,450),cv2.FONT_HERSHEY_PLAIN,3,(0,255,0),3)
            #print(distance1and5)
        write_read(datastring)
        print(datastring)
    cTime = time.time()
    fps = 1/(cTime-pTime)
    pTime = cTime
    cv2.putText(img,str(int(fps)),(10,70),cv2.FONT_HERSHEY_PLAIN,3,(255,0,0),3)
 #video resolution
    width = cap.get(cv2.CAP_PROP_FRAME_WIDTH )
    #print("width = ",width)# the width value
    height = cap.get(cv2.CAP_PROP_FRAME_HEIGHT )
    #print("height = ",height)# the height value
    # Display
    cv2.imshow("Image", img)
    cv2.waitKey
```

VIII. APPLICATION

- Used as prosthetic arm for the physically challenged
- Used in robotic surgery
- Used in the handling the high temperature objects
- Used in military purpose

IX. FUTURE SCOPE

This machine vision method can be extended to the whole body of humanoid robot. Gesture Controlled Robotic arm can also help the astronauts to repair or pick up objects in zero gravity without going outside the space craft, and it also used in human being while handling hazardous and harmful task .

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X. CONCLUSION

The project presents the design and implementation of a low cost robotic hand .This robotic hand control approach is anticipated to solve problems such as picking and placing dangerous objects quickly and easily, and boosting our ability to accomplish such activities

XI. APPENDIX

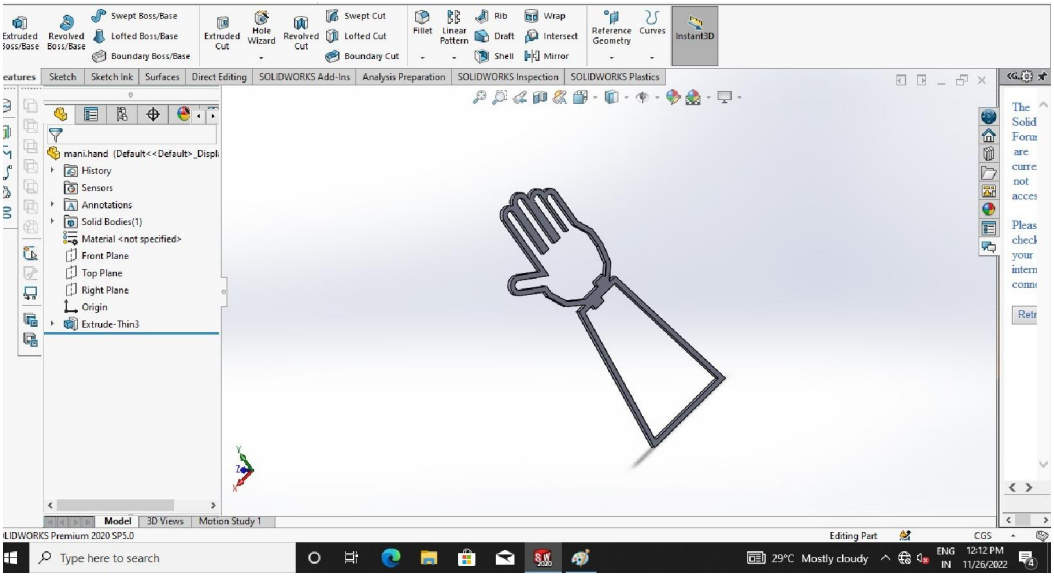

FIG 11.1 SYSTEM VIEW

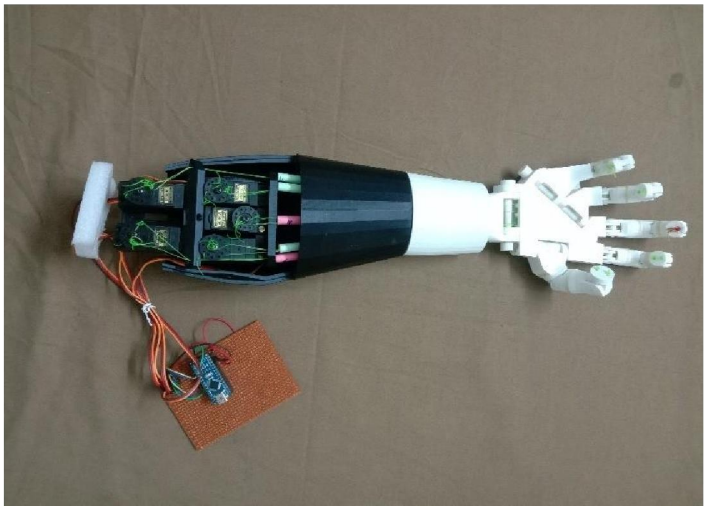

FIG 11.2 TOP VIEW

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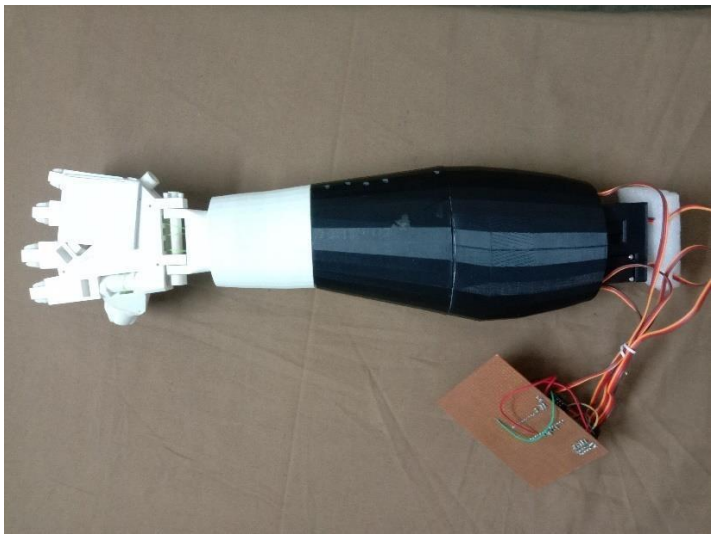

FIG 11.3 BACK VIEW

FIG 11.4 SIDE VIEW

FIG 11.5 WRIST (DOWN VIEW)

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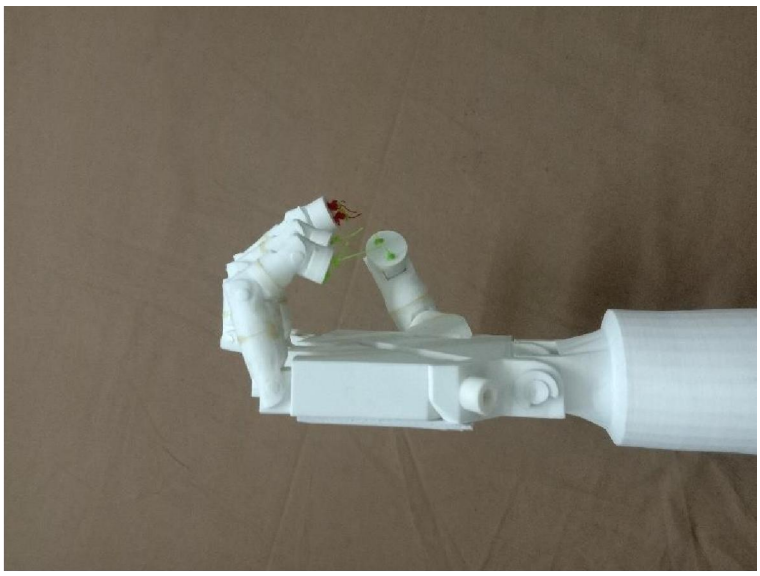

FIG 11.6 WRIST(UP VIEW)

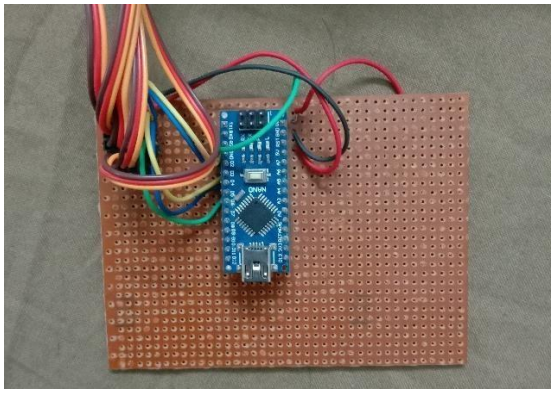

FIG 11.7ARDUINO CONNECTION

FIG 11.8 SERVO CONNECTION

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