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MEE1045-Mechatronics System Design

J-Component Project Report

by

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Acknowledgement

We the undersigned solemnly declare that the project report on the topic "MULTI-SEGMENT TRAJECTORY PLANNING" is based on our work carried out during the course of study under the supervision of Dr. Prof. Senthil Kumar S, Professor Grade 1, School of mechanical engineering, VIT. We assert the statements made and the conclusions that are drawn are outcomes of our research work. We further certify that the work contained in the report is original and has been done by us under the general supervision of our supervisor. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this university or any other University of India or abroad. We have followed the guidelines provided by the university in writing the report. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given due credit to them in the text of the report and given their details in the references.

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Abstract

Nowadays, Robotic arms are being used in industries to minimize the human errors and increase efficiency, productivity, precision of the operations taking place. One of the most important advantages of introducing Robotic arm in Industries is that it can work in crucial conditions like high temperatures, pressures where it's risky for humans to work. Since a manipulator comes under Flexible Automation, they can be updated and modified easily

A robot may appear like a human being or an animal or a simple electro-mechanical device. A robot may act under the direct control of a human (e.g., the robotic arm of the space shuttle) or autonomously under the control of a programmed computer. Robots may be used to perform tasks that are too dangerous or difficult for humans to implement directly (e.g., nuclear waste clean-up) or may be used to automate repetitive tasks that can be performed more cheaply by a robot than by the employment of a human (e.g., automobile production) or may be used to automate mindless repetitive tasks that should be performed with more precision by a robot than by a human (material handling, material transfer applications, machine loading and unloading, processing operations, assembly and inspection).The last two decades have witnessed a significant advance in the field of robots

A robot is a mechanical device that performs automated tasks and movements, according to either pre-defined program or a set of general guidelines and direct human supervision. These tasks either replace or enhance human work, such as in manufacturing, contraction, or manipulation of heavy or hazardous material. Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these days. Robots are now more than a machine, as robots have become the solution of the future as cost labour wages and customers' demand. Even though the cost of acquiring robotic system is quite expensive but as today's rapid development and a very high demand in quality with IS0 standards, humans are no longer capable of such demands. Research and development of future robots is moving at a very rapid pace due to the constantly improving and upgrading of the quality standards of products. In this project we are going to perform three main actions the robot is going to pick operation to place operation and to fill the quantity of liquid according to user.

Objective

In this project we are designing complete model of pick and place robotic arm. The process variables that are to be controlled in this project are movement of arm, position of arm, etc. The project includes creating a model. The complete process is controlled by using Arduino Microcontroller. In this model the object is picked by arm automatically from conveyor belt and place it to desired position.

Literature Review

Harish K, Megha D, Shuklambari M, Amit K, Chaitanya K Jambotkar, Presented Pick and Place Robotic Arm Using Arduino [1]. In this paper a system of pick and place robot is designed using Arduino which is implemented via RF signal. Here, the input signal or controlling signal is given from a wireless play station, which is interfaced with the microcontroller by a RF receiver module. When the signal is sent from the play station it is decoded in the controller and proper controlling signal is sent to actuators (dc motors or servo motor) in the system.

Dr.P. Gomathi, S. Baskar, presented Design and Implementation of Pick and Place Robot Using Arduino for Smart Grid Monitoring [2]. In this paper the system is developed using Arduino microcontroller to build up the equipment and programming for a Bluetooth controlled automated arm. This system is Bluetooth controlled having a mechanical arm for pick and place application.

N. U. Alka, A. A. Salihu, Y. S. Haruna and I. A. Dalyop, A Voice Controlled Pick and Place Robotic Arm Vehicle Using Android Application [3], In This paper the system of pick and place robotic arm vehicle is developed using an android application to control the robot through voice commands. The robotic vehicle is android voice application controlled for remote operation.

Mr. Vedant Chikhale, Mr. Raviraj Gharat, Ms. Shamika Gogate, Mr. Roshan Amireddy, Voice Controlled Robotic System using Arduino Microcontroller [4], In This paper the system of voice-controlled robot is developed using an Arduino microcontroller and Bluetooth module application to control the robot through voice commands. The robotic vehicle is android voice application controlled for remote operation. The wireless camera is interfaced with Arduino to record forward movement of the robotic system which also includes wireless night vision camera. Also, an obstacle detector is added to protect the system from obstacles.

Hardware Used

1) Arduino Nano: - Arduino Nano is a flexible, low cost and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.
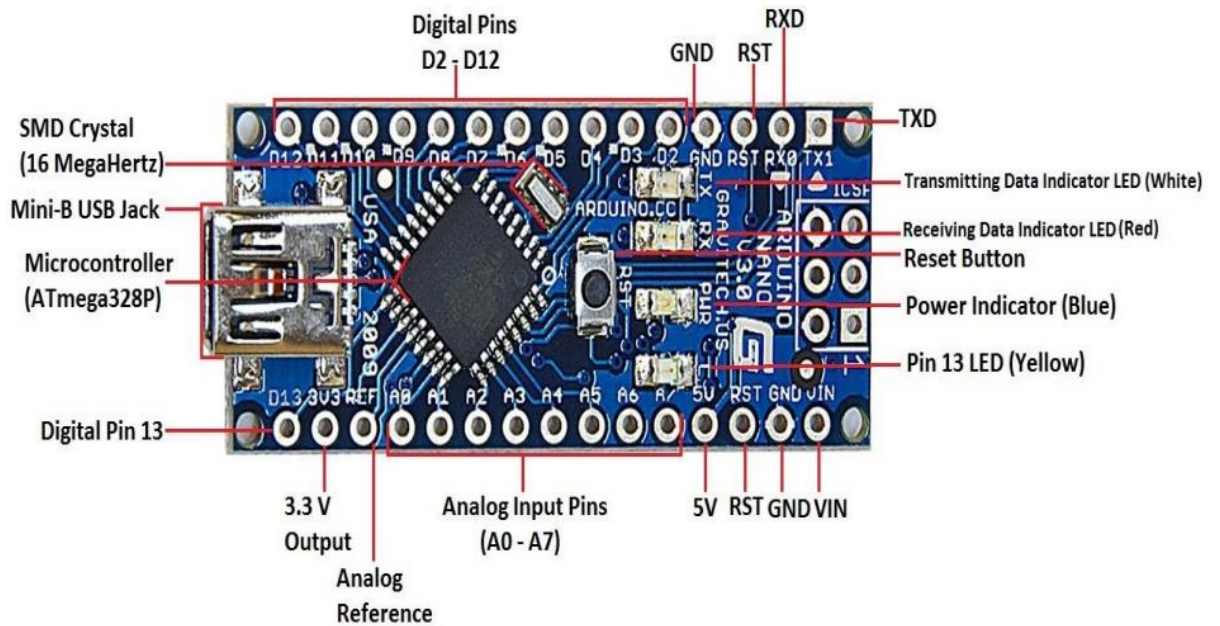
Figure Arduino Nano

2) Jumper wires: - Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.

3) Servo Motor: - The servo motor is specialized for high-response, high-precision positioning. As a motor capable of accurate rotation angle and speed control, it can be used for a variety of equipment. A rotation detector (encoder) is mounted on the motor and feeds the rotation position/speed of the motor shaft back to the driver

Figure Servo Motor

4) Power Supply: - The Arduino nano board can connect via USB Connection or with an external power supply through switch board. The main reason for power supply is to conversion AC to DC. The Arduino board connected a power supply to operate a robotic arm with help of connecting wires

5) 3D Printer: -FDM is the one of the most widely used additive manufacturing processes for fabricating a rapid prototyping technology and functional parts in common engineering plastics, after stereo lithography. FDM is made up of thermoplastic material, ABS and PLA. FDM is a material extrusion process. A plastic filament is unwound from a coil and supplies material to an extrusion nozzle. The nozzle is heated to melt the plastic and has a mechanism which allows the flow of the melted plastic to be turned on and off. The nozzle is mounted to an x-y plotter type mechanism which traces out the part contours, there is a second extrusion nozzle for the support material. As the nozzle is moved over the table in the required geometry, it deposits a thin bed of extruded plastic to form each layer. the plastic hardens immediately after being squirted from nozzle and bonds to the layer below. The object is built on a mechanical stage which moves vertically downward layer by layer as the part is formed. the entire system is contained within a chamber which is held at a temperature just below the melting point of the plastic.

Program


```
String readString;
#include <Servo.h>
Servo myservoa, myservob, myservoc;  // create servo object to control a servo

void setup() {
  Serial.begin(9600);

  //myservoa.writeMicroseconds(1500); //set initial servo position if desired

  myservoa.attach(9);  //the pin for the servoa control
  myservob.attach(12);
  myservoc.attach(10);
  Serial.println("arm control"); // so I can keep track of what is loaded
}

void loop() {

  //expect single strings like 700a, or 1500b, or 2000c,
  //or like 30b, or 90a, or 180c,
  //or combined like 30a,180b,70c,120a,

  if (Serial.available()) {
    char c = Serial.read();  //gets one byte from serial buffer
    if (c == ',') {
      if (readString.length() >1) {
        Serial.println(readString); //prints string to serial port out

        int n = readString.toInt();  //convert readString into a number

        // auto select appropriate value, copied from someone elses code.
        if(n >= 500)
        {
          Serial.print("writing Microseconds: ");
          Serial.println(n);
          if(readString.indexOf('a') >0) myservoa.writeMicroseconds(n);
```



```
//or combined like 30a,180b,70c,120a,

  if (Serial.available()) {
    char c = Serial.read();  //gets one byte from serial buffer
    if (c == ',') {
      if (readString.length() >1) {
        Serial.println(readString); //prints string to serial port out

        int n = readString.toInt();  //convert readString into a number

        // auto select appropriate value, copied from someone elses code.
        if(n >= 500)
        {
          Serial.print("writing Microseconds: ");
          Serial.println(n);
          if(readString.indexOf('a') >0) myservoa.writeMicroseconds(n);
          if(readString.indexOf('b') >0) myservob.writeMicroseconds(n);
          if(readString.indexOf('c') >0) myservoc.writeMicroseconds(n);
        }
        else
        {
          Serial.print("writing Angle: ");
          Serial.println(n);
          if(readString.indexOf('a') >0) myservoa.write(n);
          if(readString.indexOf('b') >0) myservob.write(n);
          if(readString.indexOf('c') >0) myservoc.write(n);
        }
        readString=""; //clears variable for new input
      }
    }
    else {
      readString += c; //makes the string readString
    }
  }
}
```
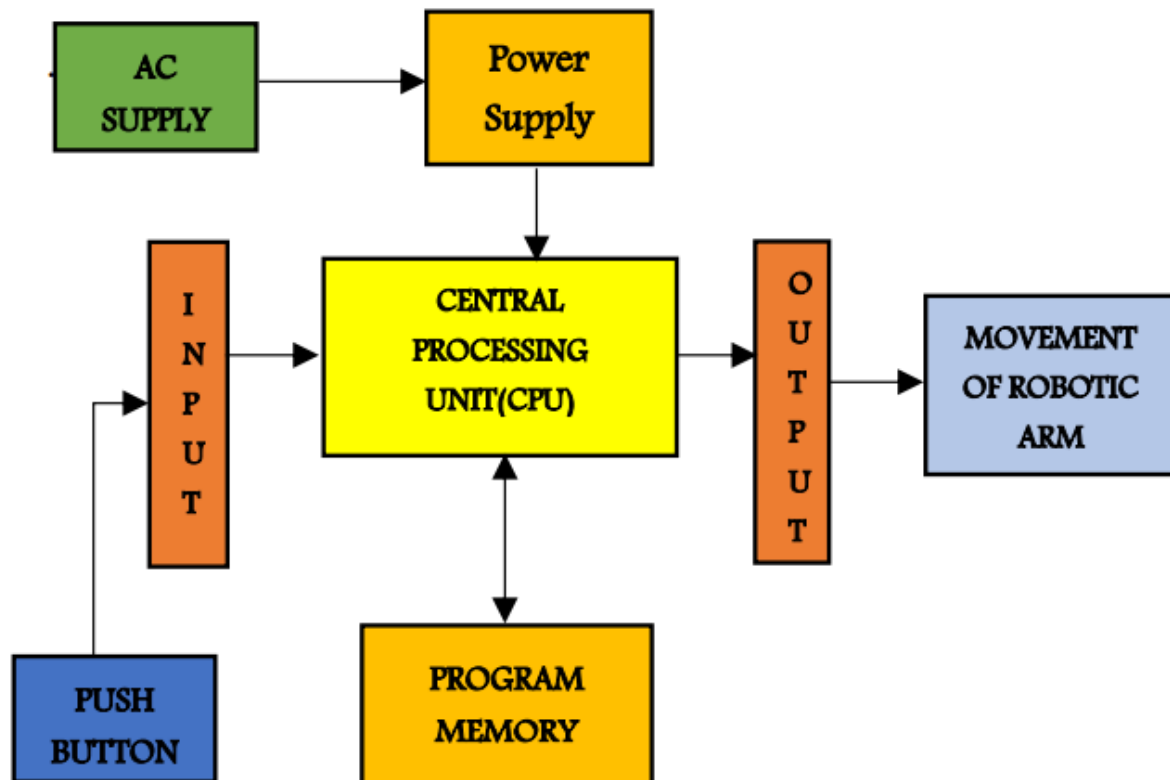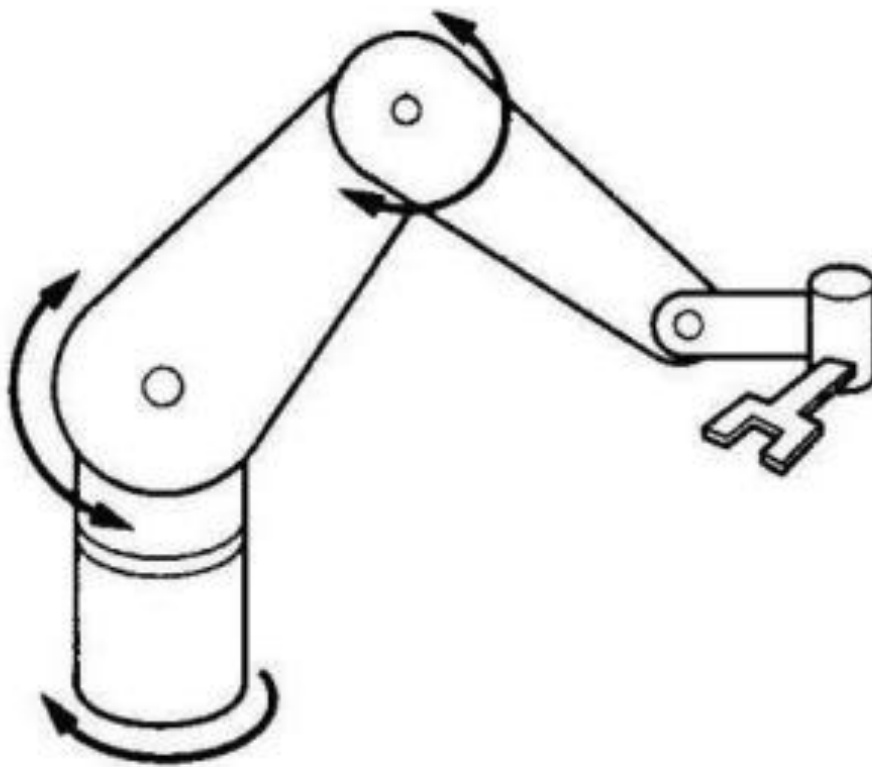
Figure Block Diagram
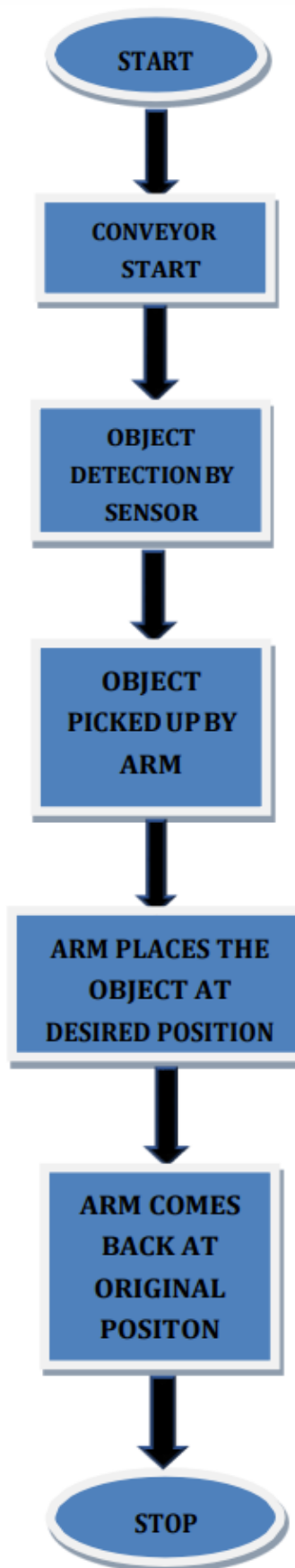

Figure Mechanical Design

```
        ┌─────────────┐
        │    START    │
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │  CONVEYOR   │
        │    START    │
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │   OBJECT    │
        │ DETECTION BY│
        │   SENSOR    │
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │   OBJECT    │
        │ PICKED UP BY│
        │     ARM     │
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │ ARM PLACES THE│
        │  OBJECT AT  │
        │DESIRED POSITION│
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │ ARM COMES   │
        │  BACK AT    │
        │  ORIGINAL   │
        │  POSITON    │
        └─────────────┘
               │
               ▼
        ┌─────────────┐
        │    STOP     │
        └─────────────┘
```

Figure Flow Chart

Assembled Model

Figure Assembled Robotic Arm

Conclusion

There are many designs for pick and place robot arm. Some designs involve grippers to pick and place. Some designs do not involve gripper, here we have designed a robot for pick and place with a gripper.

To make the link of the robot arm, various types of materials can be chosen according to the design. Some links are made with fibre, iron, acrylic or aluminium. In this pick and place robot arm design, ABS material is chosen to make the link of the robot. The properties of ABS are suitable for this desired robot arm. The properties of ABS High rigidity, good impact resistance, even at low temperatures, good insulating properties, good weldability, good abrasion and strain resistance and High dimensional stability.

Actuators to drive the robot arm are motors. Some robot uses servo motor to drive the robot arm. Some robot uses stepper motor or DC motor with encoder. In this design, stepper motors are chosen to drive the system because the control program is written with steps to reach desired position

Reference

[1] Harish K, Megha D, Shuklambari M, Amit K, Chaitanya K Jambotkar, "Pick and Place Robotic Arm Using Arduino" International Journal of Science, Engineering and Technology Research (IJSETR) Volume 6, Issue 12, December 2017, ISSN: 2278 - 7798 All Rights Reserved © 2017 IJSETR.

[2] Dr.P. Gomathi, S. Baskar, "Design and Implementation of Pick and Place Robot Using Arduino for Smart Grid Monitoring". International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682 Vol.6, No.9, September 2017 DOI:10.15693/ijaist/2017.v6i9.18-24

[3] N. U. Alka, A. A. Salihu, Y. S. Haruna and I. A. Dalyop, "A Voice Controlled Pick and Place Robotic Arm Vehicle Using Android Application". American Journal of Engineering Research (AJER) 2017 American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-6, Issue-7, pp-207-215 www.ajer.org Research Paper Open Access w w w . a j e r . o r g

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