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Design and Fabrication of 5 Degree of Freedom Robotic Arm

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Abstract: Robotic arm is defined as study, design, fabrication and use of robotic arm for manufacturing and other such work. With rise in manufacturing activities a robotic arm is developed to help various industry in performing work without use of manpower. Robotic arm are used to perform unsafe, hazardous, repetitive and unpleasant work. Robotic arm can perform material handling, assembly, arc welding, machine load and unload function, drilling, painting and thermal spraying. . etc. It is very useful as it posses high precisions, intelligence and very high energy as compared to any human being.

Keywords: Arduino uno, Node-MCU, Dc Servo Motors, plastic 3D parts, screw, Blynk app.

I. INTRODUCTION

Robotic arm is a type of a mechanical robots that are usually programmable with similar function to that of human arm. The arm may be sum total of a mechanism or may be part of more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in articulated robot) or transnational (linear) displacement.

The link of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of manipulator is called as end effector and is analog to a human hand. There are so many robots have been invented by different scientists for different purpose. Some of them are as follows:-

Such as:-Scara robot, Cartesian robot, parallel robot, spherical/polar robot, cylindrical robot, articulated robot.. etc.

These robots perform different function and are used for different purposes. In this we are making a robotic arm with using Node-MCU(i.e. Wi-Fi module)which can be wirelessly controlled and programmed using custom build Android application. Using slider in app we can manually move robotic arm. By using save button we can record each position and steps. Then robots can perform same operation by their own. We can use same button to pause, resume and delete some operational steps.

II. LITERATURE REVIEW

A. "Design analysis of a remote controlled 'pick and drop' robotic arm", B. O. Omjeh (may 2014) international journal of engineering research and development.[1]

This paper tells us about the various design processes and steps involved in making of 5 degree of freedom robotic arm. After reading this paper, we have design our own robotic arm that can help human to avoid working at the places of high risk.

B. "Design of robotic arm for picking and placing an object, controlled by using lab view", Shyam. R. Nair(may 2012) international journal of scientific and research publication.[2]

This paper tells us about the design process involved in making robotic arm by using LAB VIEW. LAB VIEW was developed to provide inputs regarding the position of robotic arm. For every position, a coordinate is given. Once, any specific coordinates are given, it uses the inverse kinematics method for the calculation of position.

C. "Design of robotic arm with grippers and end effector for spot welding", puran singh(2013) universal journal of mechanical engineering.

This paper tells us about the various processes and design method to design a robotic arm similar to that of human hands. Efforts are being given to give realistic view to robotic arm with that of human hand, with having grippers like that of human fingers and end effector like that of human whole plam.

D. "Design and development of search and rescue robots", khalil Azha mohd Annur, Mohammad Haikalmdzi international journal of mechanical and Mechatronics engineering.

This paper tells us about design and development process of search and rescue robotic vehicle, controlled via mobile having a robotic arm with 4 degree of freedom. To ease the operations or functions, it has discussed the use of graphical user interface (GUI).

E. "Survey of robotic arm and parameters", Ritu tiwari (jan 2016) international Conference on computer communication and informatics.

This paper tells us about the parameters or factors that affects the performance of any robotic arm. By having knowledge of these parameters, have helped us in avoiding errors. It has discussed about robotic arm via diagram help.came to know degree of freedom can be increased by simply increasing number of joints and one should take care of speed, accuracy and axis of movement for a best robotic arm design.

III. OBJECTIVE

With increase in the industry and it's hazardous manufacturing units. The use of robots in place of human being has increased manifold. So, here comes need of cost affordable and effective working robots is needed. We are making a Node-MCU Wi-Fi module based robotic arm with the use of custom based Android application named "Blynk" App. This type of robotic arm can move and act stationary on demand of work scenario.

Not only industry, but this type of robot can be used in household, medicine purpose.. Etc.

IV. MAIN COMPONENTS AND TOOLS USED

Following are the main components used and their specific work:

1) *Node MCU*: MCU stands for a microcontroller unit, which really means a computer on single chip. A microcontroller contains one or more CPU (process core)along with memory and programmable input/output peripheral. It is basically a Wi-Fi module which connects through Wifi using a Android app which runs through internet.

They are used to automate automobile engine control, implantable medical devices, offline machine application.. Etc.

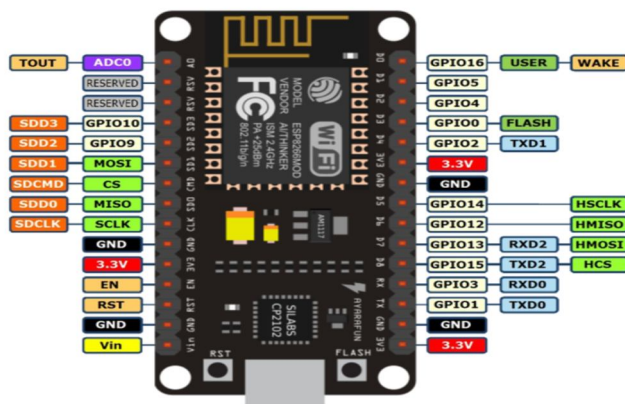


Figure 1 : Node-MCU

2) *Solidworks Software*: SolidWorks is very productive 3d computer aided software and computer aided engineering computer program that primarily on Microsoft Windows. It is used to design 3d model of any physical object and help to stimulate physical behavior such as kinematics, dynamics, stress, deflection, vibration, strain temperature and fluid flow to suit all type of design.

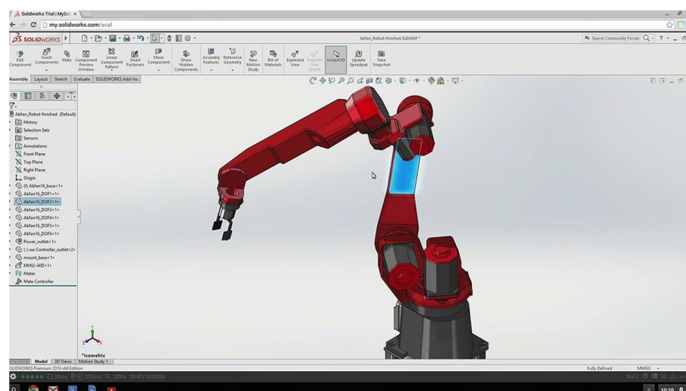


Figure 2 : CAD Design

- 3) **3D Printer:** It is a computer aided manufacturing (CAM) that creates three dimensional physical object. Like traditional printers 3d printers, receive data through computer as input (3d model that was designed in solidworks software). However instead of printing object on paper, it builds three dimensional model of an object out of custom material.

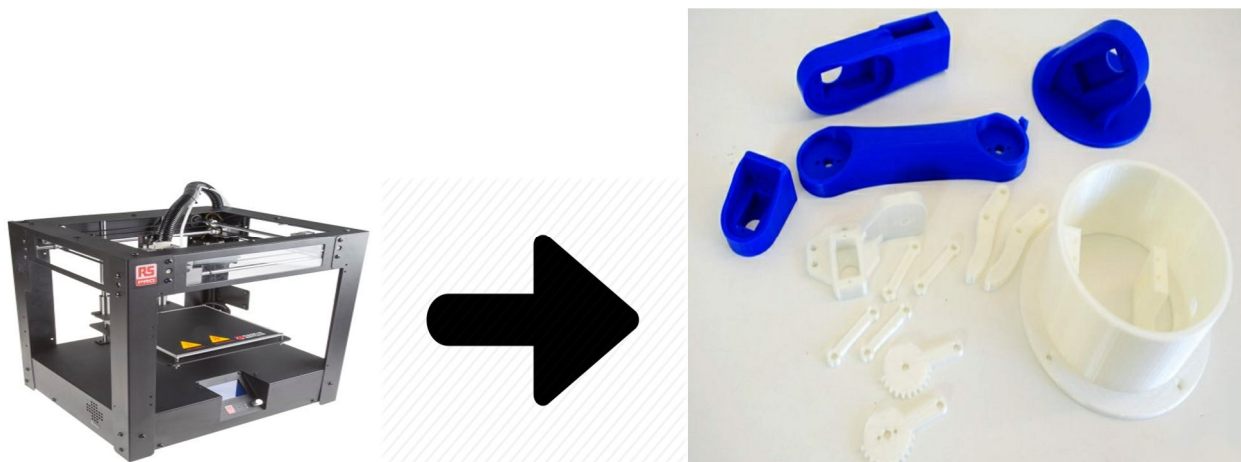


Figure 3 : 3D-Printer & Printed Parts

- 4) **Screwdriver:** It is a tool, manual or powered, used for screwing (installing) and Unscrewing(removing) screw. A typical screw driver has a handle and a shaft , ending in a tip the user puts into the screw head before turning the handle. The shaft usually made of tough steel to resist bending and Twisting. The tip may be Hardened to resist wear .



Figure 4: Screw driver and Arm

- 5) **Servo Motor:** A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of suitable motor coupled to sensors for position feedback.

Two types of servo motors are being used here :- MG996R DC SERVO MOTOR and SG90 DC SERVO MOTOR.



Figure 5 : Servo Motor

6) *Blynk App*: It is basically an Android app. It only runs on Android phone. It is used to control Arduino, Node MCU, particle photon Resberry pi, ESP8266, ESP32 and other microcomputer with the help of Android phone over internet.



Figure 6: Blynk App Logo.

7) *TIDBITS*: Soldering iron, 4 wheels, 1 rechargeable battery (6-12 volts). Wires for 3d printings, some different sensors.

V. PROCESS AND WORKINGS

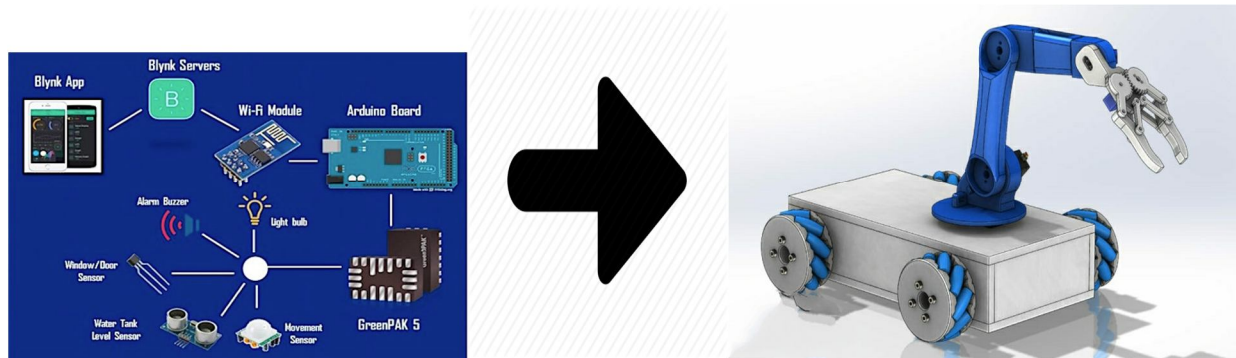


Figure 7: Working Diagram and complete CAD model.

First of all the needs of the robotic arm is analyzed. Then according to need 3d designing is done on solidwork software for analysis of different physical standards. According to analysis and design of 3d model, materials are selected (here we have taken fiber) . 3d printers command are given to 3d printers and physical model of design of parts are being printed. After then with the help of various tools (screw driver, servo motor, wires. etc.) fabrication is being done. After fabricating all parts including servo motors, Node-MCU, every parts. Programming is being done in blynk App. Giving command to Node MCU and other sensors. By using different button in App. We can run robotic arm. By using save button, we can save the steps and positions, later that data is being used by robots automatically, by using delete , one can remove some steps too.

VI. CONCLUSION

This robotic arm is cost effective and easy to operate, since it's a Wi-Fi based system. It can be deployed to some of hazardous places, like medical, household, places where human can afford to go.

It can be made stationary as well as movable, depending upon the need. Blynk programming can be changed to change commands to Node MCU and other sensors.

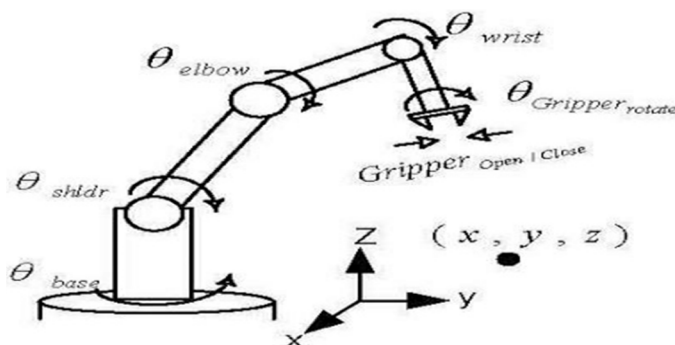


Figure 8: Degree of Freedom (DoF).

Five degree of freedom are being illustrated in the above figure8. It's only a prototype robotic arm. Though depending upon use, it's material Upgrade can be done from time to time.



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