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DESIGN & DEVELOPMENT OF A PROTOTYPE OF VOICE CONTROLLED MOBILE ROBOT FOR PICK & PLACE OPERATION INTEGRATED WITH MACHINE VISION SYSTEM

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ABSTRACT

Within the field of Robotics & Automation, human-machine interaction integration has been a central focus of research with the goal of improving productivity and usability. The Voice-Controlled Pick and Place Robot is a revolutionary system that uses robotic control and natural language processing to enable intuitive communication between people and robots. This paper describes the concept, development, and implementation of this system. To build a seamless platform for interaction, the proposed system combines robotic manipulation capabilities with sophisticated speech recognition algorithms. Because it has sensors to sense its surroundings, the robot can operate in a variety of environments. Artificial intelligence has been integrated into the system to enable humans to intuitively control the robot's motions and behaviors. The system is capable of understanding and executing sophisticated spoken instructions. Among the system's essential elements is a powerful voice robust speech recognition, an advanced control algorithm, and an effective pick and place mechanism are some of the system's key components. Modern methods are used by the voice recognition module to precisely understand spoken commands, and the control algorithm converts these commands into exact robotic movements. The robot is appropriate for a range of commercial and residential applications because of its pick and place mechanism, which guarantees accurate and dependable object manipulation. The study investigates the accuracy, responsiveness, and adaptability of the system in various settings. The study also explores the Voice-Controlled Pick and Place Robot's possible uses in sectors including manufacturing, logistics, and healthcare, where human-robot cooperation is becoming more and more important.

Keywords- Bluetooth module, L293D motor driver, microcontroller, regulator IC.

I. INTRODUCTION

This project will teach us how to use Arduino to create a voice-activated robotic car. Voice instructions can be used to drive the robotic car remotely from this user. The robot has four directions of motion: left, right, forward, and stop. The HC-05 Bluetooth module is used to interface with the Arduino voice-controlled robot automobile. Via an Android software that is loaded on the phone, we are able to provide the robot with precise speech commands.

The commands are received by a Bluetooth transceiver module at the receiving end, which then transmits them to the Arduino to drive the robotic automobile. In this approach, the necessary task is performed by an Android application using a microcontroller. Bluetooth technology facilitates the connection between the robot and the application.

The module will receive the commands that are delivered when they are transmitted across the channel. A voice-controlled robotic vehicle's (VCRV) main job is to listen to user commands and respond accordingly. Here, the system needs to be trained on accents before it can begin to comprehend the orders that are given; codes have been appended to the commands.

The Voice Controlled Robotic Vehicle project facilitates the use of voice commands obtained through an Android application to drive robots. To record and interpret spoken orders, a control unit and Bluetooth device are integrated.

After then, the robotic car responds to commands given by an Android application. Because an ATmega-16 microcontroller is built into the system, driving the car with an Android application is feasible. Creating a VCRV with the primary objective of analyzing human speech and responding to pre-programmed .

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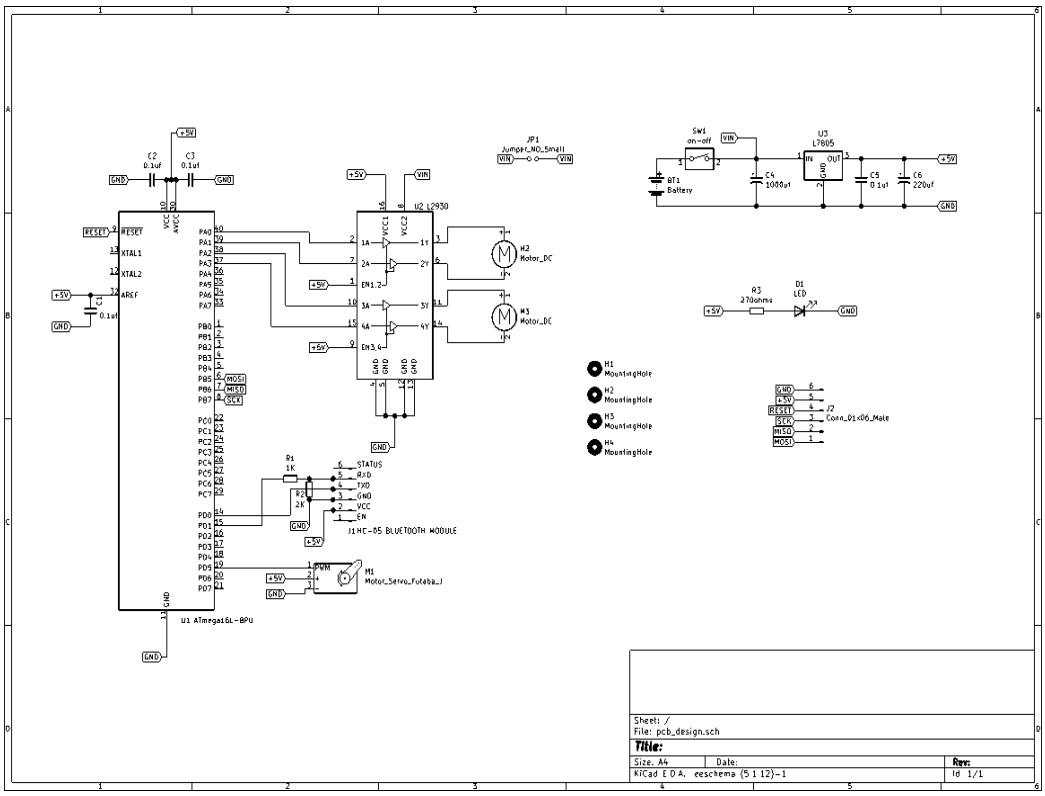
II. DESIGNING OF THE BOARD

The 9V battery is coupled to the 7805 regulator integrated circuit, which converts the 9V current to 5V. The ATmega 16 microcontroller, Bluetooth module, L293D motor driver IC, and servo motor are then all receiving this current. The (U)3 7805 regulator IC pin that is connected to GND is connected to another IC pin that is for input and output. Additionally, there are connections to capacitors C6, C5, and C4, with values of 220 uf, 1000 uf, and 0.1 uf respectively. An on/off switch (SW1) is available. The feedback servo motor was connected to the ATmega 16 microcontroller via four connections, and the 7805 regulator IC provided the current. The ATmega 16 microcontroller has Bluetooth linked to it, so we can use an Android device to give the robot particular orders.



FUGURE 1 : CIRCUIT BOARD DESIGN

III. CALCULATION

MECHANICAL PROPERTIES

- Yield Tensile Strength: - 66 mpa
- Ultimate Tensile Strength: - 52 mpa
- Tensile Modulus: - 3 gpa
- Shear Strength: - 100 mpa
- Shear Modulus: - 3 gpa
- Fatigue Strength: - 48 mpa
- Elongation At Break: - 10 %
- Poisson's Ratio: - 0.37
- Hardness: -M95
- Density: - 1.1 g/cm^3
- Impact Strength (ASTM): - 21 J/m

Electrical/Magnetic Properties

- Surface Resistance (ANSI): - 1240000 GΩ
- Magnetism: - 1240000 GΩ

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Thermal Properties

- Heat Deflection Temperature: -94 °C
- Thermal Expansion Coefficient: -75.5 µm/(m·°C
- Specific Heat Capacity: -1.480 J/g°C
- Thermal Conductivity:- 0.193 W/(m·°C)
- Melting Point:-218 °C

GRIPPER CALCULATION:-

- The degree of Freedom (DOF): 2
- Claw material: aluminium alloy
- Claw weight: about 68g (without motor)
- Claws overall length: 108mm (overall maximum length when closed claw)
- Claws overall width: 98mm (maximum overall width of the claw when open)
- Claw maximum opening angle: 55mm

BLUETOOTH CALCULATION:-

- Bluetooth protocal: Bluetooth Specification v2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK(Gaussian Frequency Shift Keying)
- Emission power: =4dBm, Class 2
- Sensitivity: =-84dBm at 0.1% BER
- Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps
- Synchronous: 1Mbps/1Mbps
- Security: Authentication and encryption
- Profiles: Bluetooth serial port
- Power supply: +3.3VDC 50mA
- Working temperature: -20 ~ +75 Centigrade
- Dimension: 26.9mm x 13mm x 2.2 mm
- Range: 100m

IV. HARDWARE

BLUETOOTH MODULE (HC-05) :-

- The standard HC-05 Bluetooth module has six pins. However. we will only be using 4 of the pins in this project. The pins we will be using are the VCC pin, the GND pin, the TXD pin, and the RXD pin.
- The HC05 Bluetooth module is used as UART serial converter module and can easily transfer the UART data through the wireless Bluetooth.
- HC05 module is a simple Bluetooth module is a simple Bluetooth serial port protocol module designed for wireless serial connection setup. It has a footprint assmall as 12.7mm X 27mm. It will simplify the overall design cycle.

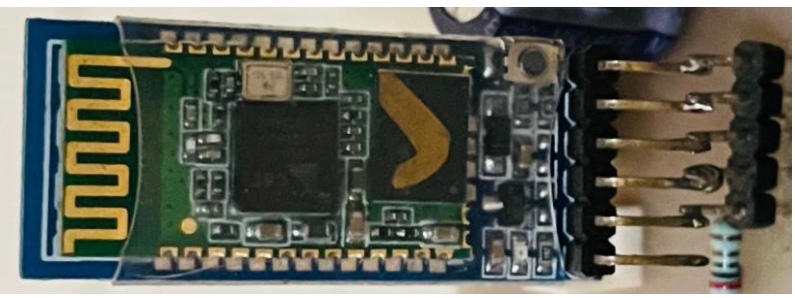

FIGURE 2 :-BLUETOOTH MODULE HC-05

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L293D MOTOR DRIVER :-

- L293D has output current of 600mA and peak output current of 1.2A per channel [6]. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.
- The L293D will send power to the motors depending on the voltage applied to theenable pins. The higher the voltage applied to the enable pin, the more power will be supplied to the motor, and the faster it will spin.
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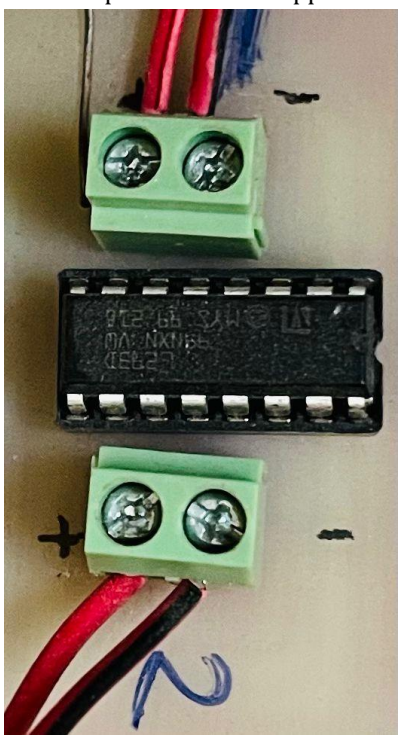

FIGURE 3 :-L293D MOTOR DRIVER

ATMEGA 16 MICROCONTROLLER :-

- ATmega16 is an 8-bit high performance microcontroller from the Atmel's Mega AVRfamily.
- Atmega16 is a 40 pin microcontroller based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. It has a 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes.
- The ATmega series features microcontrollers that provide an extended instruction set (multiply instructions and instructions for handling larger program memories), an extensive peripheral set, a solid amount of program memory, as well as a wide range of pins available.

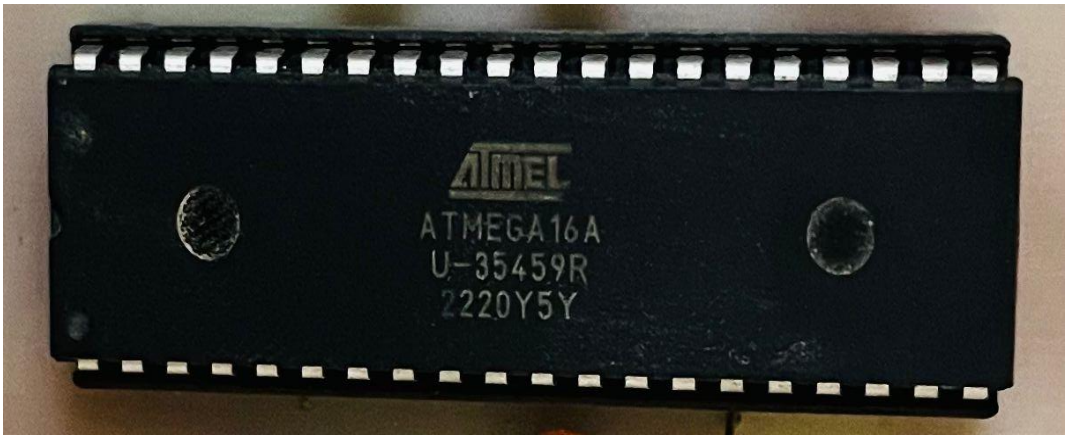

FIGURE 4 :- ATmega 16 MICROCONTROLLER

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ESP 32 CAM MODULE :

- The ESP32-CAM is a low-cost development board with an onboard camera that's popular for IoT applications and machine vision. It has a camera module, MicroSD card support, and 4MB PSRAM.
- The ESP32-CAM can capture uncompressed images at a resolution of 1600 x 1200 and can do on-device machine learning tasks like image classification and person detection.

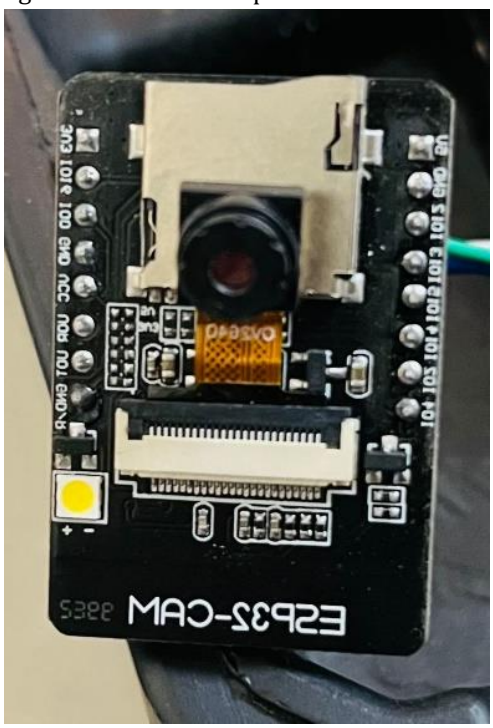

FIGURE 5 :- ESP 32 CAM MODULE

PERFORMANCE & ANALYSIS

Right Command Movement :

TABLE 1 : RIGHT COMMAND MOVEMENT

RIGHT COMMAND MOVEMENT	
COMMAND	DEGREE OF ROTATION (IN DEGREE)
1 COMMAND	85
2 COMMAND	90
3 COMMAND	90
4 COMMAND	92
5 COMMAND	90

Left Command Movement :

TA BLE 2 : LEFT COMMAND MOVEMENT

LEFT COMMAND MOVEMENT	
COMMAND	DEGREE OF ROTATION (IN DEGREE)
1 COMMAND	90
2 COMMAND	91
3 COMMAND	90
4 COMMAND	90
5 COMMAND	90

Command Response Time :

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TABLE 3 : COMMAND RESPONSE TIME

COMMAND RESPONSE TIME	
COMMAND	RESPONSE TIME
1 COMMAND	1
2 COMMAND	1.25
3 COMMAND	1
4 COMMAND	1.05
5 COMMAND	1

Continuous Working Mode :

TABLE 4 : CONTINUOUS WORKING MODE

CONTINOUS WORKING MODE	
Time In Hours	State Of Charge (Battery level In Percentage)
0 Hour	100.00
1 Hour	91.67
2 Hour	83.34
3 Hour	75.01
4 Hour	66.68
5 Hour	58.35
6 Hour	50.02
7 Hour	41.69
8 Hour	33.36
9 Hour	25.03
10 Hour	16.7
11 Hour	8.37
12 Hour	0.04

Right Command Movement Graph :

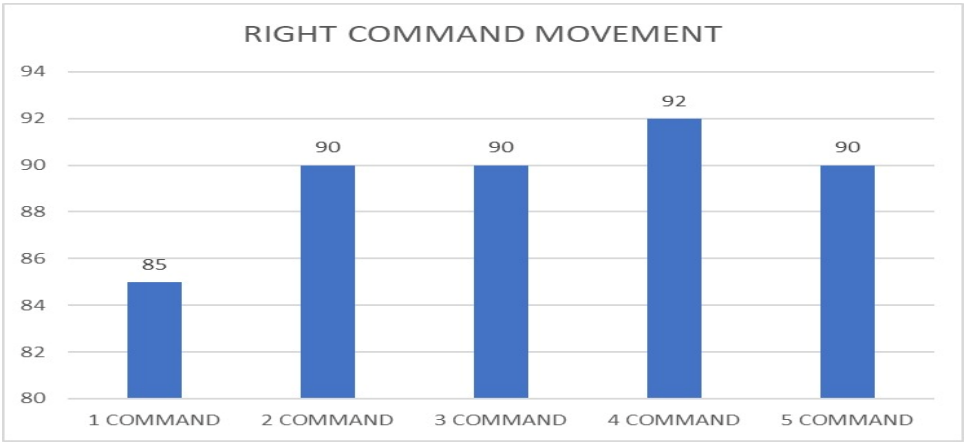

FIGURE 6 : RIGHT CAMMAND MOVEMENT GRAPH

Left Command Movement Graph :

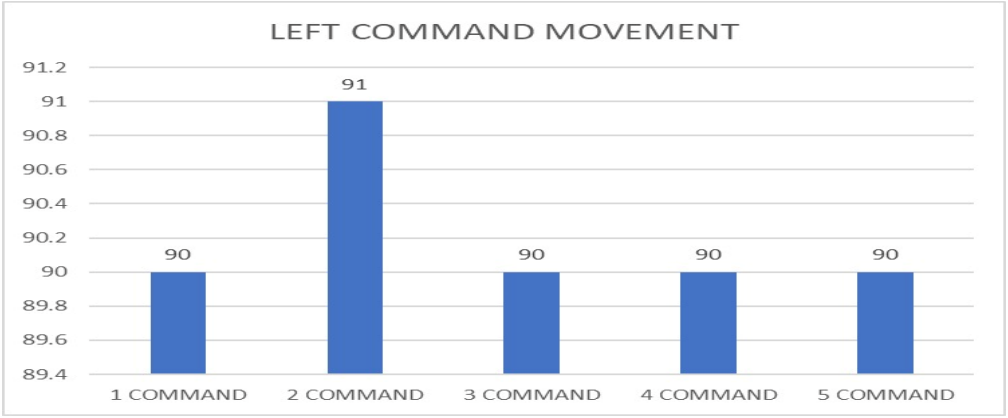

FIGURE 7 : LEFT COMMAND MOVEMENT GRAPH

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Response Time Graph :

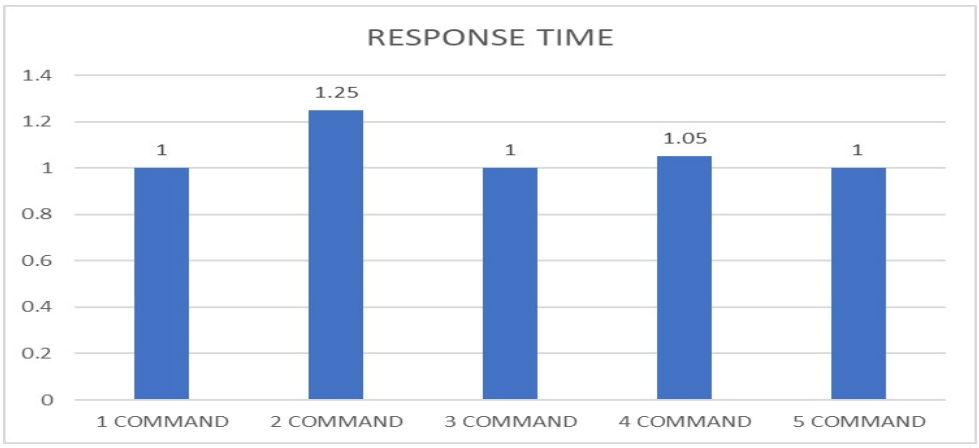

FIGURE 8 : RESPONSE TIME GRAPH

State Of Charge :

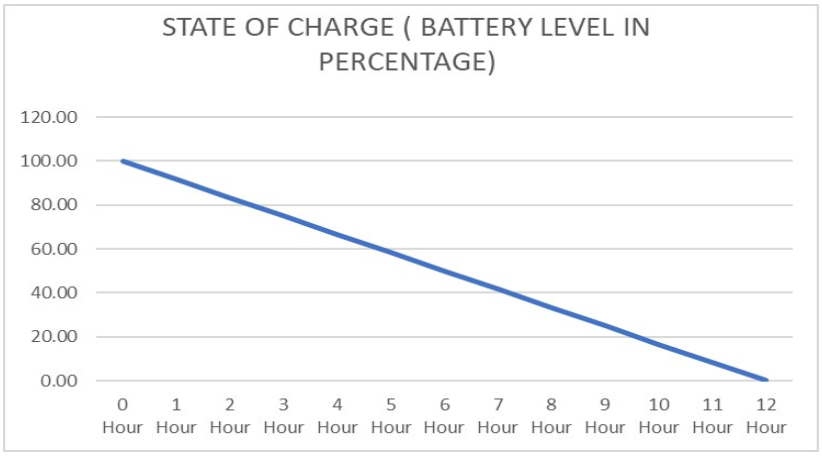

FIGURE 9 : STATE OF CHARGE

V. CONCLUSION

To sum up, the design & development of a prototype of voice controlled mobile robot for pick & place operation integrated with machine vision system which integrates the ESP32 CAM module with the HC-05 Bluetooth module, is a revolutionary development in the field of automated systems. Modern technologies are seamlessly combined in this project to provide a sophisticated yet approachable solution for a range of applications. The project provides a hands-free operation experience by incorporating voice control capabilities, improving convenience and safety in a variety of contexts. Simple voice commands make it easy for users to operate the car, doing away with the need for physical controls and reducing the possibility of mistakes. In addition, the integration of the ESP32 CAM module gives the car access to a powerful visual system that lets it recognize and classify objects with remarkably high precision. This talent is essential for jobs like picking up objects, where accurate interaction and navigation are necessary for best results. The project's adaptability and connectivity are further increased with the installation of the Bluetooth module HC-05, which permits smooth communication between the car and external devices like laptops or cellphones. This feature makes remote control and monitoring easier, increasing the project's usefulness and adaptability to a wider range of situations. All things considered, the Voice Controlled Pick and Place Vehicle with Vision System, ESP32 CAM module, and Bluetooth module HC-05 is a prime example of how cutting-edge technology may be used to produce creative solutions. Its voice control, vision system, and wireless communication features bring up new opportunities for automation, productivity, and efficiency in a variety of industries, from home automation to manufacturing and logistics. As technology advances, initiatives such as these demonstrate the ability of innovation to influence the direction that automation and intelligent systems will take in the future. There is an infinite potential for revolutionary influence in both ordinary and industrial settings with more developments and refinements.

VI. REFERENCES

[1] M. Meghana et al,2020, Hand gesture recognition and voice controlled robot,Materials Today: Proceedings, 2214-7853.

[2] M. Bhanu chandu, Kirupa Ganapathy,2020, Voice Controlled Human Assistence Robot, International Conference on Advanced Computing & Communication Systems(ICACCS), 978-1-7281-5197-7/20.

[3] P. Mahesh Reddy, Suram Pavan Kalyan Reddy, G R Sai Karthik, Priya B.K,2020,Intuitive Voice Controlled Robot for Obstacle, Smoke and Fire Detection for Physically ChallengedPeople, International Conference on Trends in Electronics and Informatics (ICOEI), ISBN: 978-1-7281-5518-0.

[4] Ms. M. Ramjan Begum, Mr. S. Chandramouli, Mr. T. Gowtham,2020, Design AndDevelopment Of Dual Axis Control Robot For Writing Robot Through Speech Recognition, International Research Journal of Modernization in Engineering Technology and Science, e- ISSN:2582-5208.

[5] Linda John et al,2020, Voice Control Human Assistance Robot, National Conference on Technical Advancements for Social Upliftment, Proceedings of the 2 nd VNC; VNC-2020;

[6] Muneera Altayeb & Amani Al-Ghraibah, Voice Controlled Camera Assisted Pick & Place Robot Using Raspberry Pi, 2022. Indonesian Journal of Electrical Engineering and Informatics (IJEEI) Vol. 10, No. 1, March 2022, pp. 51~59 ISSN: 2089-3272, DOI: 10.52549/ijeei.v10i1.3636

[7] Ghante Shweta & S.V.Sagavkar, Review on Wireless Voice Controlled Robot, 2022. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

[8] Dipesh Diwakar, Ashok Choudhary, Ashu Singhj & Prof. Nazish Fatima, Voice Controlled Robotic Vehicle, 2019. Design and Implementation of Voice Controlled Robotic ARM June 2021 DOI:10.1109/ICICT52195.2021.9568446Conference: 2021 International Conference on Communication & Information Technology (ICICT)

[9] Eshwar Pawar, AReview Article on Acrylic PMMA, 2019. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 13, Issue 2 Ver. I (Mar. - Apr. 2016), PP 01-04 www.iosrjournals.org

[10] P. Mahesh Reddy, Suram Pavan Kalyan Reddy, G R Sai Karthik, Priya B.K, Intuitive Voice Controlled Robot for Obstacle, Smoke and Fire Detection for Physically ChallengedPeople, 2020