MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Gov. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)
NAAC Accredited with A++ Grade

PROJECT REPORT
ON

COLOUR DETECTION USING ROBOTIC ARM

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CERTIFICATE

This is certified that **Suryadev Singh Raghuwanshi(090AI223D05) and Anuj Kumar Soni(0901AI223D01)** has submitted the project report title **COLOUR DETECTION USING ROBOTIC ARM under the mentorship of Dr. Anshika** Srivastava

In partial fulfilment of the requirement for the award of degree of Bachlor of technology in Artificial Intelligence from Madhav Institute of technology of Science , Gwalior.

Anshika 23/11/2023

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DECLARATION

We hereby declare that the work which has been carried out in the minor project in B.Tech. III-Year (V-Semester) in partial fulfillment for the award of the degree of Bachelor of Technology in Information technology from Madhav Institute of Technology & Science, Gwalior is an authenticated record of our work carried under the supervision /mentorship of (Assistant Professor Dr. Anshika Srivastava, MITS, Gwalior).The matter embodied in this minor project report is not submitted for the award of any degree or diploma anywhere else.

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ABSTRACT

Robotic arms have emerged as fundamental components in various fields, revolutionizing manufacturing, healthcare, space exploration, and beyond. This paper presents an extensive review of the latest advancements in robotic arm technology. It covers a spectrum of topics, including design principles, control systems, sensing mechanisms, and applications across industries. The discussion delves into the evolution of robotic arm architectures, highlighting the shift from rigid structures to more adaptable and versatile designs inspired by biological systems. Additionally, emphasis is placed on the integration of artificial intelligence and machine learning algorithms for enhanced autonomy and adaptability in diverse environments. Furthermore, this review outlines the significance of robust sensing technologies, exploring the role of vision systems, tactile sensors, and proprioceptive feedback in enabling precise manipulation and interaction with the environment. The paper also investigates the ongoing research in haptic feedback to improve human-robot interaction and collaboration. The applications of robotic arms across industries are examined, showcasing their pivotal role in automated manufacturing, minimally invasive surgeries, space exploration missions, and rehabilitation therapies. Challenges and future directions in the field are also discussed, focusing on scalability, cost-effectiveness, safety, and the ethical implications of widespread robotic arm deployment. In summary, this review provides a comprehensive analysis of the state-of-the-art in robotic arm technology, offering insights into its current capabilities, challenges, and the promising future avenues for research and development.

सार

रोबोटिक हथियार विभिन्न क्षेत्रों में बुनियादी घटकों के रूप में उभरे हैं, जिन्होंने विनिर्माण, स्वास्थ्य सेवा, अंतरिक्ष अन्वेषण और उससे आगे क्रांति ला दी है। यह पेपर रोबोटिक आर्म प्रौद्योगिकी में नवीनतम प्रगति की व्यापक समीक्षा प्रस्तुत करता है। इसमें डिज़ाइन सिद्धांतों, नियंत्रण प्रणालियों, सेंसिंग तंत्र और उद्योगों में अनुप्रयोगों सहित कई विषयों को शामिल किया गया है। चर्चा रोबोटिक आर्म आर्किटेक्चर के विकास पर प्रकाश डालती है, जो कठोर संरचनाओं से जैविक प्रणालियों से प्रेरित अधिक अनुकूलनीय और बहुमुखी डिजाइनों में बदलाव पर प्रकाश डालती है। इसके अतिरिक्त, विविध वातावरणों में बेहतर स्वायत्तता और अनुकूलनशीलता के लिए कृत्रिम बुद्धिमत्ता और मशीन लर्निंग एल्गोरिदम के एकीकरण पर जोर दिया गया है। इसके अलावा, यह समीक्षा सटीक हेरफेर और पर्यावरण के साथ बातचीत को सक्षम करने में दृष्टि प्रणालियों, स्पर्श सेंसर और प्रोप्रियोसेप्टिव फीडबैक की भूमिका की खोज करते हुए मजबूत सेंसिंग प्रौद्योगिकियों के महत्व को रेखांकित करती है। पेपर मानव-रोबोट संपर्क और सहयोग को बेहतर बनाने के लिए हैप्टिक फीडबैक में चल रहे शोध की भी जांच करता है। उद्योगों में रोबोटिक हथियारों के अनुप्रयोगों की जांच की जाती है, जो स्वचालित विनिर्माण, न्यूनतम इनवेसिव सर्जरी, अंतरिक्ष अन्वेषण मिशन और पुनर्वास उपचारों में उनकी महत्वपूर्ण भूमिका को प्रदर्शित करते हैं। क्षेत्र में चुनौतियों और भविष्य की दिशाओं पर भी चर्चा की जाती है, जिसमें स्केलेबिलिटी, लागत-प्रभावशीलता, सुरक्षा और व्यापक रोबोटिक आर्म तैनाती के नैतिक निहितार्थ पर ध्यान केंद्रित किया जाता है। संक्षेप में, यह समीक्षा रोबोटिक आर्म प्रौद्योगिकी में अत्याधुनिक का एक व्यापक विश्लेषण प्रदान करती है, जो इसकी वर्तमान क्षमताओं, चुनौतियों और अनुसंधान और विकास के लिए भविष्य के आशाजनक अवसरों की अंतर्दृष्टि प्रदान करती है

CONTENTS

CHAPTER-1 :

INTRODUCTION

In this experiment, the student was explained by the technician on robotic system. The robot part introduced to the student with basic layout of the robotic where consist robot arm, robot arm link and robot arm joint. We practice the robot with basic movement that have been shown by the lab assistant and recorded all the data of the robot arm movement. The basic movement of the robot arm depend on the joint types where our robot has revolute joints for rotary joint and prismatic joint for the linear movement of the robot arm.

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. Robotic system has been widely used in manufacturing, military and surgery since the robot can perform much advantages and used as the countermeasure for some job that cannot be conduct by the human excellently. These robotic arms have been used to perform a variety of tasks such as inspection of the Space Shuttle using a specially deployed boom with cameras and sensors attached at the end effector, and also satellite deployment and retrieval manoeuvres from the cargo bay of the Space Shuttle.

Figure 1: Robot Arm

In this practice, two work station involve to complete the practice which are work station 1 is the initial position of load and work station 2 is the target moved position for the load and the arm robot.

CHAPTER : 2

AIM AND OBJECTIBVE

The primary objective of this project is to develop an integrated robotic system that utilizes color detection technology to enable a robotic arm to accurately identify, locate, and sort objects based on their color attributes. This system aims to demonstrate the feasibility and practicality of employing robotics in automated sorting processes, particularly emphasizing the efficient handling of diverse objects through color-based identification.

1. Functionality: Create a robotic arm capable of performing a range of motions (eg, pick-and-place, manipulation, assembly) with precision and accuracy.

2. Adaptability: Design the arm to adapt to different environments and tasks, possibly through Al-driven decision-making or adaptable end-effectors.

3. Sensing and Perception: Integrate sensors (such as vision systems, tactile sensors, or proximity sensors) to enable the arm to perceive its surroundings and interact intelligently with objects.

4. Control and Actuation: Develop robust control systems to maneuver the arm efficiently, ensuring smooth and coordinated movements.

5. Safety: Implement safety measures to prevent accidents or collisions, potentially incorporating features like obstacle detection and emergency shutdown protocols.

6. Scalability and Cost-efficiency: Strive for a design that is scalable for various sizes or functionalities while considering cost-effective manufacturing and maintenance

7. Application Specific Objectives: Tailor the arm's capabilities to suit the intended application,

8. whether it's in manufacturing, healthcare, space exploration, or other industries

9. Human-Robot Interaction: Explore methods for intuitive human-robot interaction,

10. potentially incorporating haptic feedback or user-friendly interfaces.

11. Testing and Validation: Conduct rigorous testing and validation procedures to ensure the arm's functionality, reliability, and safety in real-world scenarios.

CHAPTER-3:

CIRCUIT DESIGN

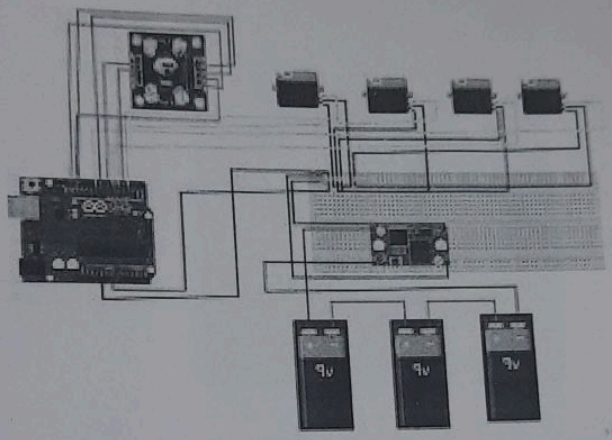


Fig1: Circuit diagram of colour sensing using robotic arm

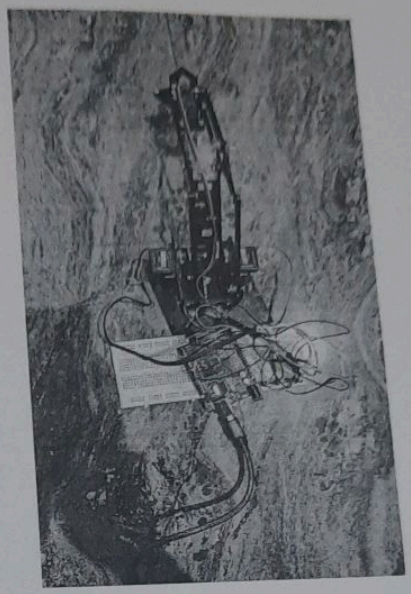


Fig2: connections of colour sensing using robotic arm

CHAPTER – 4 :

PROGRAM CODE

```
#include <Servo.h>
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
int servoPos = 0; // Initialize the servoPos variable
int ferquency = 0;
void setup() {
  servo1.attach(3);
  servo2.attach(5);
  servo3.attach(6);
  servo4.attach(9);
  delay(30);
}
void loop() {
  for (servoPos = 60; servoPos < 150; servoPos++) {
    servo1.write(servoPos);
   delay(30);
  }
  for (servoPos = 60; servoPos < 165; servoPos++) {
     servo2.write(servoPos);
 delay(30);
 }
 for (servoPos = 110; servoPos < 180 ; servoPos--){
 servo3.write(servoPos);
```

```
delay(30);
}
 for (servoPos = 180; servoPos <= 110 ; servoPos++){
servo3.write(servoPos);
delay(30);
 }
delay(1000);
  for (servoPos = 150; servoPos > 60; servoPos--) {
   servo1.write(servoPos);
   delay(30);
  }
  for (servoPos = 165; servoPos > 60; servoPos--){
    servo2.write(servoPos);
  delay(30);
   }
  for (servoPos = 0; servoPos > 150; servoPos++){
     servo4.write(servoPos);
  delay(30);
  }
  for (servoPos = 0; servoPos > 150; servoPos--){
  servo4.write(servoPos);
   delay(30);
   }
   }
```

CHAPTER – 5 :

METALLURGY

Sensing the Color: The robotic arm needs a sensor to detect colors. It can be done using a color sensor, a camera, or other similar devices. These sensors perceive the colors by analyzing the light reflected from an object.

Processing the Data: The sensor captures the color information and converts it into digital data. This data usually contains values representing the intensity of Red, Green, and Blue (RGB) colors or sometimes Hue, Saturation, and Value (HSV) values.

Decision Making: Once the color data is obtained, the robotic arm's programming interprets this information. It might have a pre-defined set of colors it can recognize or be programmed to distinguish between different colors based on their RGB or HSV values.

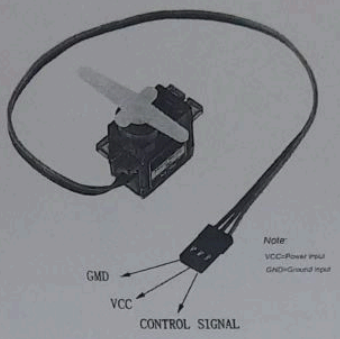
Control Actions: Depending on the detected color and the programmed instructions, the robotic arm performs specific actions. For example, it can pick an object of a certain color, sort items based on their colors, or execute different tasks in response to different detected colors.

Overall, color detection in robotic arms involves integrating sensors, data processing, decision-making algorithms, and action execution mechanisms to respond to the identified colors effectively.

CHAPTER – 6:

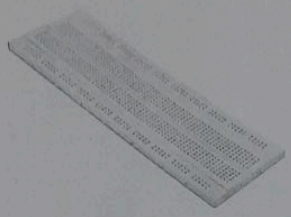
COMPONENT DESCRIPTION

1. Servo motor



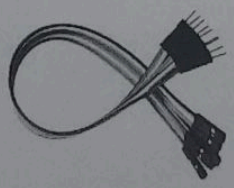
The SG90 servo motor is a small, lightweight, and commonly used servo motor in hobbyist and DIY projects. It's known for its compact size, affordability, and ease of use. The SG90 operates based on the principle of pulse-width modulation (PWM) signals, allowing precise control over its angular position. It's often used in model airplanes, cars, robotics, and various other applications that require precise control of movement within a limited range.

2.Breadboard



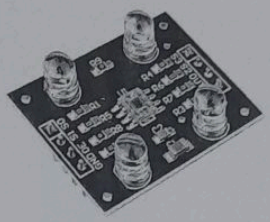
A breadboard is a prototyping tool used in electronics to build and test circuits without soldering. It has a grid of holes that allow components like resistors, LEDs, and wires to be inserted and connected, facilitating rapid circuit assembly and modification. The rows and columns of holes are typically connected in specific patterns, enabling easy experimentation and quick adjustments in circuit design

3.Jumper wire



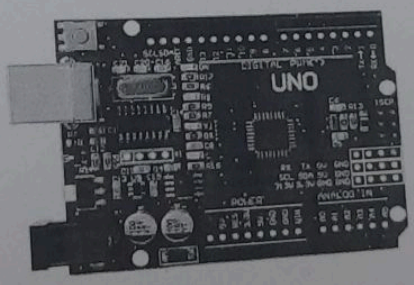
Jumper wires are essential components in electronics and prototyping. They're small, flexible wires with pins or connectors at each end, used to create electrical connections between different components on a breadboard, Arduino, Raspberry Pi, or other electronic platforms. These wires come in various lengths, colors, and types (like male-to-male, male-to-female, and female-to-female) to assist in building circuits and connecting various electronic components together easily and temporarily

4. Color Sensor



Color sensors work by detecting light reflected off an object and then analyzing the wavelengths of this light to determine its color. They typically use photodiodes or phototransistors to measure the intensity of red, green, and blue light. These sensors convert the detected light into electrical signals, which are then processed to determine the color based on the levels of red, green, and blue detected. Some sensors may use additional methods or filters to enhance accuracy in color detection.

5. Arduino Uno



In this proposed system, Arduino Uno is used as the controller. Arduino is a well-featured Open-Source prototyping platform that is based on easy-to-use hardware and software. It is very easy to program. Arduino boards are able to read inputs - light sensor and can read any physical environment changes with appropriate sensors and activate another module (motor, publish anything, any electrical part) online or offline. Arduino software is suitable for beginners due to its easy interface. It will provide a standard and flexible board, disconnect the process of creating a control environment. This can be programmed and connected to the system without any PCB design requirements. This software is low-cost, cross-platform, simple programming environment, open source extensible software and extensible hardware. It is flexible enough for advanced users. It works on platforms like Mac, Windows and Linux on any other type of operating system. It is the main tool for learning new things and the basis of automation.

CHAPTER : 7

CONCLUSION

The Color Detection using Robotic Arm project aimed to implement a system where a robotic arm could identify different colors of objects and perform specific actions based on the color detected. Throughout the project, we successfully designed and integrated sensors and software algorithms capable of recognizing various colors accurately. This system opens doors to numerous applications in industries requiring automated sorting, picking, and assembly tasks.

During the project, we encountered challenges related to sensor accuracy, lighting conditions affecting color detection, and response time of the robotic arm. Addressing these challenges involved fine-tuning the sensor calibration, optimizing the software algorithms for better accuracy, and improving the arm's response time for quicker actions.

Overall, the project demonstrates a proof-of-concept for color detection integrated with a robotic arm, highlighting its potential in streamlining industrial processes. Further refinements in sensor technology, software algorithms, and robotic arm capabilities could enhance the system's reliability and expand its applications in diverse fields.

9.REFERENCES :

- https://www.google.com/imgres?imgurl=https%3A%2F%2Fai.thestempedia.com%2Fwp-content%2Fuploads%2F2023%2F05%2FColor-Sorter-Robotic-Arm-Connection.jpg&tbnid=f-DnX9OOePYyxM&vet=1&imgrefurl=https%3A%2F%2Fai.thestempedia.com%2Fproject%2Fdiy-color-sorting-robotic-arm%2F&docid=-3W8NfHtYnzV0M&w=600&h=311&hl=en-IN&source=sh%2Fx%2Fim%2Fm1%2F4
- https://www.google.com/imgres?imgurl=http%3A%2F%2F4.imimg.com%2Fdata4%2FST%2FDA%2FMY-3287828%2Farduino-uno-compatible-board-500x500.jpg&tbnid=uQkEb88McLgD0M&vet=1&imgrefurl=https%3A%2F%2Fwww.indiamart.com%2Fproddetail%2Farduino-uno-compatible-board-13117901288.html&docid=cVqw4l1nCFKVjM&w=500&h=345&itg=1&hl=en-IN&source=sh%2Fx%2Fim%2Fm1%2F4
- https://images.app.goo.gl/ZiHbeMbv6Xc7Pm6k8
- https://images.app.goo.gl/LSz3aHvg3jvb1GDz9
- https://images.app.goo.gl/Enywawb8zLoaeope6