RGB COLOR-SENSING ROBOT

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in Electronics and Communication Engineering

By

RUTH BALAJI (39130382)

SUBHARAJA CHELLAM.A (39130443)

SNEHA.S (39130343)

DEVADHARSHINI (39130108)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC I 12B Status by UGC I Approved by

AICTE JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119.

OCTOBER - 2022

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of RUTH BALAJI (39130382) SUBHARAJA CHELLAM. A (39130443), SNEHA.S (39130434) and DEVADHARSHINI (39130108), who has done the Project work as a team and who carried out the project entitled " **RGB Color sensing robot**" under my supervision from July 2022 to October 2022.

Internal Guide

Dr. G. D. ANBARASI JEBASELVI, M.E, Ph.D,

Head of the Department

Dr. T. RAVI M.E., Ph.D.,

Submitted for Viva voice held on: _____

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

we, Ruth Balaji (39130382), Subharaja Chellam.A (39130443), Sneha.S (39130434) and Devadharshini (39130108) hereby declare that the Project Report entitled **"RGB Color Sensing Robot"** done by us under the guidance of **"Dr. G. D. ANBARASI JEBASELVI"** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication.

DATE: **SIGNATURE OF THE CANDIDATES**

PLACE: Chennai

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ACKNOWLEDGEMENT

We are pleased to acknowledge my sincere thanks to the Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and successfully completing it. We are grateful to them.

We convey our thanks to **Dr. N. M. NANDHITHA., M.E., PH.D.** Dean, School of Electrical and Electronics Engineering, and **Dr.T. RAVI., M.E., PH.D.** Head of the department. Dept. of Electronics and Communication Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep gratitude to our project guide **Dr. G. D. ANBARASI JEBASELVI** for her valuable guidance, suggestions, and constant encouragement that paved the way for our project's successful completion work.

we wish to express our thanks to all Teaching and Non- teaching staff members of the Department of Electronics and Communication Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

Arduino RGB Color Detector using TCS3200 Color Sensor is a wonderful project for students who want to have fun with too many colors. In this project, we will be “Interfacing TCS3200 Color Sensor with Arduino” for designing a simple color detector. Experimental Set-Up has been designed specifically for detecting the frequency of RGB color. The LCD panel directly displays the frequency of RGB color. A combination of all these colors gives a different color. There is various software available that directly converts the combination of RGB frequency into the desired color. The setup is absolutely self-contained and requires no other apparatus. We make it a robot setup based on an RGB color-sensing robot.

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CHAPTER 1

INTRODUCTION

1.1. Introduction to Artificial Intelligence

Artificial intelligence (AI) is the ability of machines to replicate or enhance human intellect, such as reasoning and learning from experience. Artificial intelligence has been used in computer programs for years, but it is now applied to many other products and services. For example, some digital cameras can determine what objects are present in an image using an artificial intelligence software. In addition, experts predict many more innovative uses for artificial intelligence in the future, including smart electric grids. AI uses techniques from probability theory, economics, and algorithm design to solve practical problems. In addition, the AI field draws upon computer science, mathematics, psychology, and linguistics. Computer science provides tools for designing and building algorithms, while mathematics offers tools for modeling and solving the resulting optimization problems.

1.2. Advantages and Disadvantages of Artificial Intelligence

Advantages: -

- Reduction in Human Error
- Takes risks instead of Humans
- Helping in Repetitive jobs
- Faster Decisions

Disadvantages: -

- High costs of creation
- Making humans lazy
- Unemployment
- No emotions
- Lacking out-of-box thinking

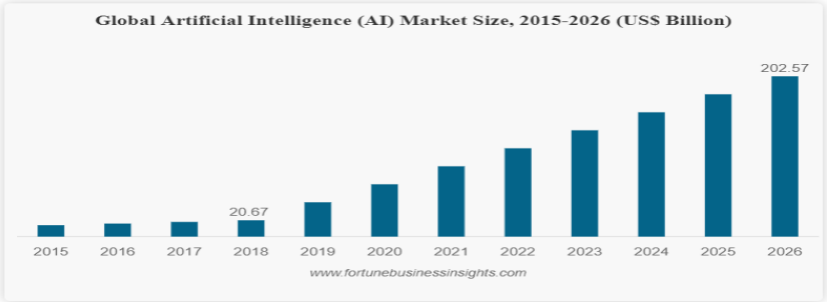

Figure 1.1. Global AI market size

1.3. Introduction to RGB

TCS3200 RGB Color Sensor For Arduino is a complete color detector, including a TAOS TCS3200 RGB sensor chip and 4 white LEDs. The TCS3200 can detect and measure a nearly limitless range of visible colors. Applications include test strip reading, sorting by color, ambient light sensing and calibration, and color matching. The TCS3200 RGB Color Sensor For Arduino has an array of photodetectors, each with either a red, green, or blue filter, or no filter (clear). The filters of each color are distributed evenly throughout the array to eliminate location bias among the colors. Internal to the device is an oscillator that produces a square-wave output whose frequency is proportional to the intensity of the chosen color. The TCS3200 color sensor can detect a wide variety of colors based on their wavelength. This sensor is especially useful for color recognition projects such as color matching, color sorting, test strip reading, and much more.

1.4. Advantages and Disadvantages of RGB

Advantages: -

- No transformations required to display data on the screen.
- It is considered as the base color space for various applications
- With the help of additive property, it is used in video displays
- It relates simply to CRT applications.

Disadvantages: -

- RGB values are commonly not transferable between devices
- Not perceptually uniform.
- Not perfect for identification of colors.

CHAPTER 2

LITERATURE SURVEY

This chapter provides a literature review on the innovation and challenges. A summary of the past and present research was provided for this reason in three sections: Early innovations, Modern trends, and Future challenges.

2.1. EARLY DEVELOPMENT

The period between 1940 and 1960 was strongly marked by the conjunction of technological developments (of which the Second World War was an accelerator) and the desire to understand how to bring together the functioning of machines and organic beings. For Norbert Wiener, a pioneer in cybernetics, the aim was to unify mathematical theory, electronics, and automation as "a whole theory of control and communication, both in animals and machines". Just before, the first mathematical and computer model of the biological neuron (formal neuron) had been developed by Warren McCulloch and Walter Pitts as early as 1943.

At the beginning of 1950, John Von Neumann and Alan Turing did not create the term AI but were the founding fathers of the technology behind it: they made the transition from computers to 19^{th}-century decimal logic (which thus dealt with values from 0 to 9) and machines to binary logic (which rely on Boolean algebra, dealing with more or less important chains of 0 or 1). The two researchers thus formalized the architecture of our contemporary computers and demonstrated that it was universal machine, capable of executing what is programmed. Turing, on the other hand, raised the question of the possible intelligence of a machine for the first time in his famous 1950 article "Computing Machinery and Intelligence" and described a "game of imitation", where a human should be able to distinguish in a teletype dialogue whether he is talking to a man or a machine. However controversial this article may be (this "Turing test" does not appear to qualify for many experts), it will often be cited as being the source of the questioning of the boundary between the human and the machine.

Two factors explain the new boom in the discipline around 2010.

- First of all, access to massive volumes of data. To be able to use algorithms for image classification and cat recognition, for example, it was previously necessary to carry out sampling yourself. Today, a simple search on Google can find millions.

- Then the discovery of the very high efficiency of computer graphics card processors to accelerate the calculation of learning algorithms. The process is very iterative, it could take weeks before 2010 to process the entire sample. The computing power of these cards (capable of more than a thousand billion transactions per second) has enabled considerable progress at a limited financial cost (less than 1000 euros per card).

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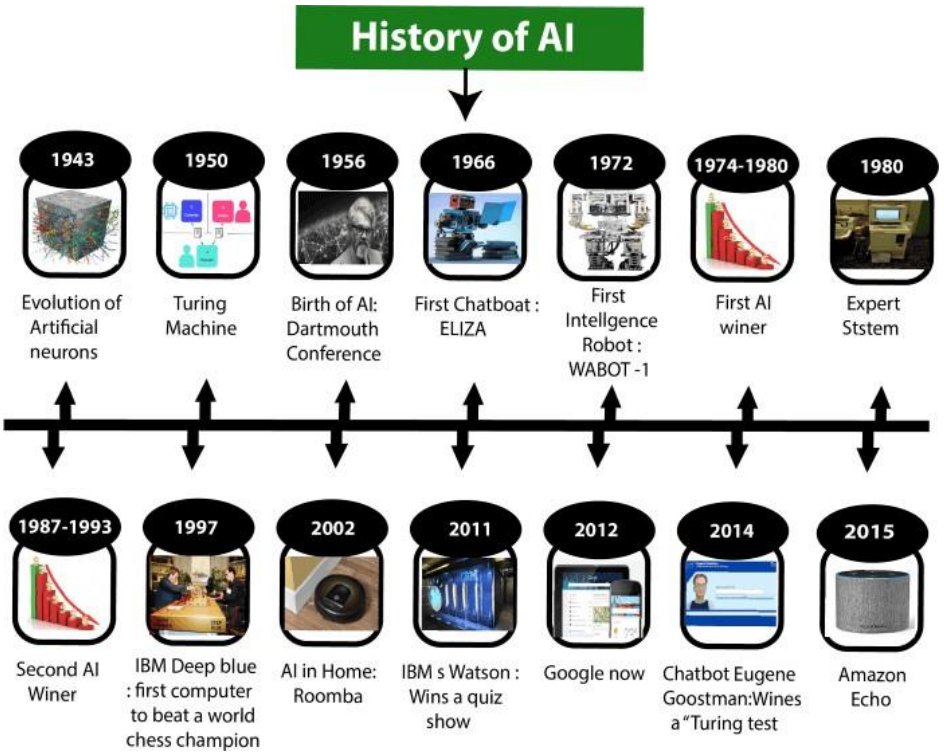

Figure 2.1 History of AI

2.2. MODERN TRENDS

1. AI for Cybersecurity

One of the biggest artificial intelligence trends we're seeing is the increased use of AI technology for cybersecurity and surveillance. With an increasing amount of business happening online, cybercrime is an increasingly pressing issue for organizations. This is especially true for those with extensive networks of connected devices.AI techniques are helping to produce more robust security measures in a number of ways. Firstly, AI can learn to recognize and flag criminal activity before it becomes a problem. Secondly, AI can be used to improve access security measures with features like:

- Face and voice recognition
- Video analysis
- Biometric authentication

These are ideal for improving security systems and getting ahead of suspicious activity.

Figure 2.2 AI in Cyber Security

2. AI for Communications

The next trend we're going to focus on is AI for communications. Next-generation AI tools use Natural Language Processing (or NLP for short) to generate visual, auditory, and text-based data automatically. What's more, these processes have become so good that AI outputs are virtually indistinguishable from real data. One of the biggest NLP trends to take root has been the development of AI chatbots. Chatbots can be used to automate business-customer interactions to provide clients with human-like interactions on-demand. This takes the pressure off customer support teams by automating repetitive tasks. And it improves overall access to customer services. For example, chatbots can easily replace humans to:

- Answer simple client questions
- Organize appointments
- Send out reminders or personalized offers

But as well as real-time communication, AI technology is also capable of creating content. Increasingly, AI tools are being used to generate creative outputs, such as writing headlines or designing logos.

Figure 2.3 Ai for Communication

3. Automated Business Processes

More and more organizations now use AI technologies to automate their business processes. That could involve automating your marketing efforts, appointments… the list goes on. AI tools are able to memorize and follow set protocols of tasks. And, as a result, they can help businesses streamline business processes and become more efficient. Increasingly, manual data procedures are being replaced by automation. Intelligent automation can:

- Solve common business challenges
- Reduce pressure on employees
- Eliminate manual error
- Increase productivity and efficiency

The key to achieving a successful digital transformation is scalability.

Marketing automation is taking the business world by storm. With so many business models to choose from in this space, you might be wondering which processes can be automated successfully.

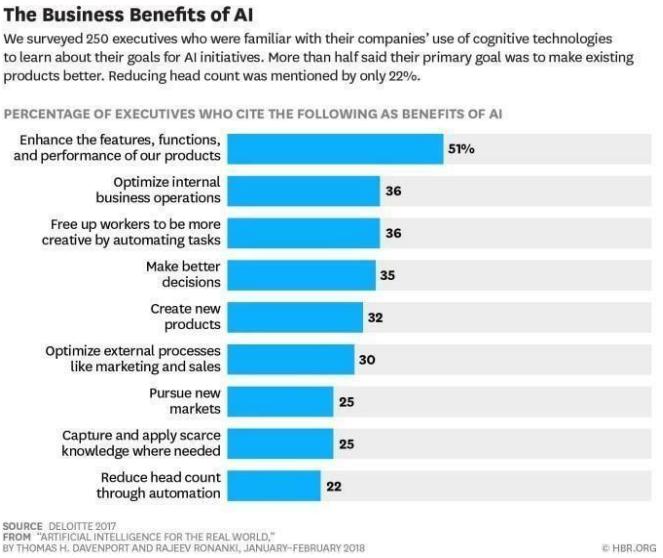

Figure 2.4 Ai in Business

4. Ethical AI

As well as focusing on what AI can do for businesses, there's a growing awareness surrounding the ethics of AI. And the topic is being discussed more and more at computer science conferences. Demand for ethical AI is rising. Today's consumers are increasingly value-driven. And more and more organizations are questioning how we can make use of these technologies in the most ethical way possible. It's critically important that we monitor the quality and use of big data because AI technologies use it. AI data compliance (AKA ensuring that all AI systems meet the prerequisite regulatory requirements) is essential to the distribution and use of responsible and ethical AI solutions. Platforms like Hadoop help organizations manage big data applications. You can learn more in the Hadoop blog post from Databricks.

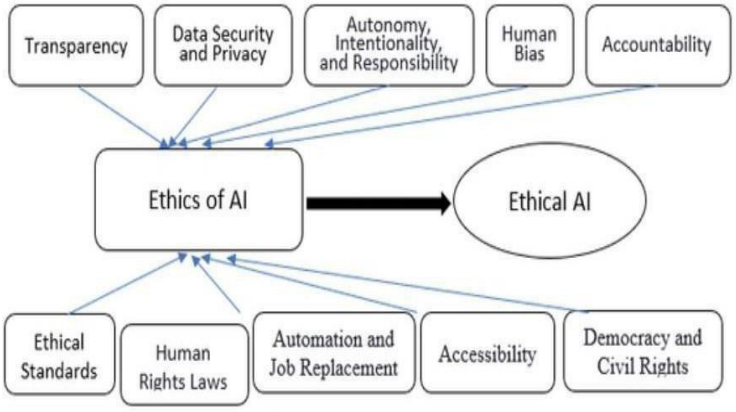

Figure 2.5 Ethical Ai

5. AI for Healthcare

We're set to see an increased uptake of AI technologies in the healthcare sector. AI has already proven to be a boon to healthcare providers, who can use the technology to facilitate care more efficiently and allow patients greater access to safe medical care. AI is making it easier to acquire real-time data from patient health records. This leads to faster diagnosis and care-enhancing processes. Furthermore, AI is effectively assisting hospital staff when it comes to monitoring and managing

patient records, hospital admissions, and more. New, AI-driven technologies like thermal cameras for detecting patient temperatures and contactless delivery tools proved invaluable during the COVID-19 outbreak, and innovations such as these are only set to continue in the sector.

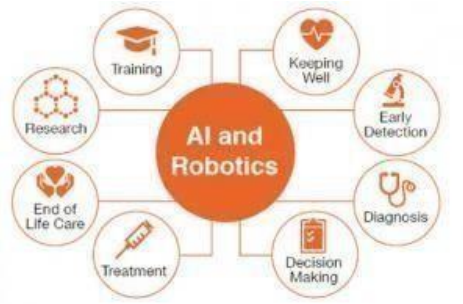

Figure 2.6 Ai for Healthcare

6. AI & IoT

The last artificial intelligence trend we're going to be discussing today is the relationship between AI and the Internet of Things (IoT). IoT is now commonplace within companies, but many businesses still struggle to use it effectively. The main problem has been how to garner actionable insights from IoT. By mobilizing IoT products in conjunction with AI, it becomes easy to translate and gather data. More and more industries are starting to combine AI and IoT for better results all around, resulting in what is becoming known as the AiIoT.

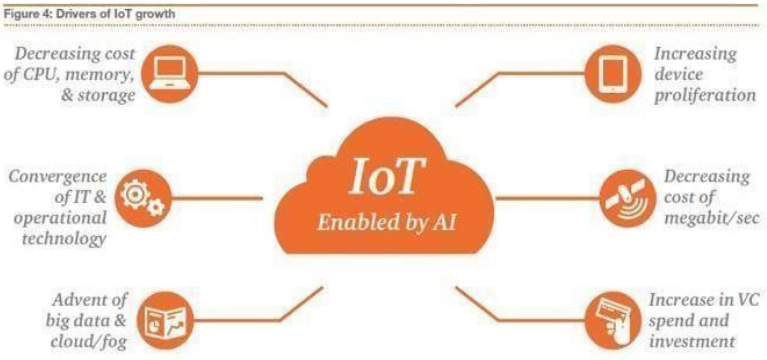

Figure 2.7 AiIoT

2.3. FUTURE CHALLENGES

1. Determining the right data set

Data quality and availability are necessities for AI capabilities. For a company to ensure the most efficient and timely AI capabilities, it should use the right data sets and have a trusted source of relevant data that is clean, accessible, well-governed, and secured. Unfortunately, it is impossible to configure AI algorithms to control the flow of low-quality and inaccurate data; but businesses can get in touch with AI experts and work with the owners of different data sources to overcome the challenges of implementing AI.

2. The bias problem

The quality of AI systems depends on the data they are trained on. Good data are key to good artificial intelligence development services. If good data are lacking, companies face numerous AI implementation challenges stemming from biases — anomalies in the output of ML algorithms when producing results based on discriminatory assumptions made during the machine learning process or prejudices in the training data. Low-quality data often go along with racial, gender, communal, and ethnic biases.

Such biases must be eliminated. Real change may come either from training the AI systems with unbiased data or from the development of easily-explained algorithms that can be easily read. Furthermore, many companies that develop artificial intelligence invest heavily in developing control frameworks and techniques to drive better trust and transparency and to identify bias in AI algorithms.

3. Data security and storage

Most artificial intelligence development services rely on the availability of large amounts of data to train the algorithms. Although generating large volumes of data provides better business opportunities, on the one hand, it simultaneously creates data storage and security issues on the other. The more data is generated and the more users have access, the higher the chances of data leakage into the hands of someone on the dark web. Data security and data storage issues have reached a global scale, as this data is generated from millions of users around the globe. This

is why businesses need to ensure that the best data management environment for sensitive data and training algorithms for AI applications are being used.

4. Infrastructure

Artificial intelligence-based solutions change our lives and provide daily utility through high internet speeds. AI systems achieve these speeds under the condition that a company has suitable infrastructure and premium processing capabilities. However, most organizations still rely on outdated infrastructures, applications, and devices to run their IT operations, as management often gets scared of the expenses needed to update the systems, choosing instead to reject implementing AI at all. Although companies that develop artificial intelligence or adopt it should beready to bring their IT services to a new level, replacing outdated infrastructure withtraditional legacy systems remains one of the biggest challenges for many IT companies.

5. AI integration

Challenges with implementing AI in business first arise from the necessity of integrating AI into existing systems. It requires the support of AI solutions providers with extensive experience and expertise. Transitioning to AI is more complicated than just adding new plugins to the current website. Infrastructure, data storage, and data input should be considered and secured from negative effects. Compatibility with all AI requirements, as well as smooth operation of the current systems, must be ensured. Additionally, once the transition is over, the employees must be given proper training on working with the new system.

6. Computation

The information technology industry encounters many challenges and constantly needs to keep updating. No other industry has developed as fast. But achieving the computing power to process the vast volumes of data necessary for building AI systems is the biggest challenge that the industry has ever faced. Reaching and financing that level of computation can be challenging, especially for startups and small-budget companies.

7. Expensive and rare

As mentioned above, AI integration, deployment, and implementation require a specialist like a data scientist or a data engineer with a certain level of skills and expertise. One of the major challenges with implementing AI in business is that these experts are expensive and are currently quite rare in the IT market. Companies with a small budget, then, face a challenge to bring in the suitable specialists that the project requires. Moreover, once you decide to implement or develop an AI-based system, you'll have to provide constant training, which may require rare high-end specialists.

8. Legal issues

There are a lot of legal concerns around artificial intelligence app development andimplementation that companies need to be concerned about. The data the algorithms collect from users are very sensitive. Erroneous algorithms and data governance systems installed in AI applications will always make incorrect predictions and bring losses to the company's profit. Moreover, it can violate laws or regulations, putting the organization in the trap of legal challenges.

9. Explainability

It's human nature to trust only things that are easily understood. One of the critical AI implementation challenges is the unknown nature of how deep learning models and a set of inputs can predict the output and formulate a solution for a problem. Explainability in AI is required to provide transparency in AI decisions, as well as thealgorithms that lead to them. This means that organizations must work on the policies that inspect the impact of artificial intelligence on decision making, provide frequent audits of their systems, and have regular training.

CHAPTER 3

AIM AND SCOPE

The aim of the project is to make the robot identify the RGB colors that are Red, green, and blue and display the frequency output on the LCD and the color name in the program.

PURPOSE

Arduino RGB Color Detector using TCS3200 Color Sensor is a wonderful project for students who want to have fun with too many colors. In this project, we will be “Interfacing TCS3200 Color Sensor with Arduino” for designing a simple color detector. Experimental Set-Up has been designed specifically for detecting the frequency of RGB color. The LCD panel directly displays the frequency of RGB color. A combination of all these colors gives a different color. There is various software available that directly converts the combination of RGB frequency into the desired color. The setup is absolutely self-contained and requires no other apparatus. We make it a robot setup based on an RGB color-sensing robot. So, this project will be very much useful in identifying colors and helpful also for children to learn colors and recognize them.

CHAPTER 4

EXPERIMENTAL OR MATERIALS AND METHODS

MATERIALS

The components used in this project are divided into two parts, they are hardware and software.

HARDWARE

Arduino UNO

Arduino UNO is a low-cost, flexible, 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, and Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs – light on a sensor, a finger on a button, or a Twitter message – and turn it into an output – activating a motor, turning on an LED, or publishing something online. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Figure 4.1 Arduino UNO

LIQUID CRYSTAL DISPLAY

A liquid-crystal display (LCD) is a flat-panel display or another electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. It has materials that combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates is coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

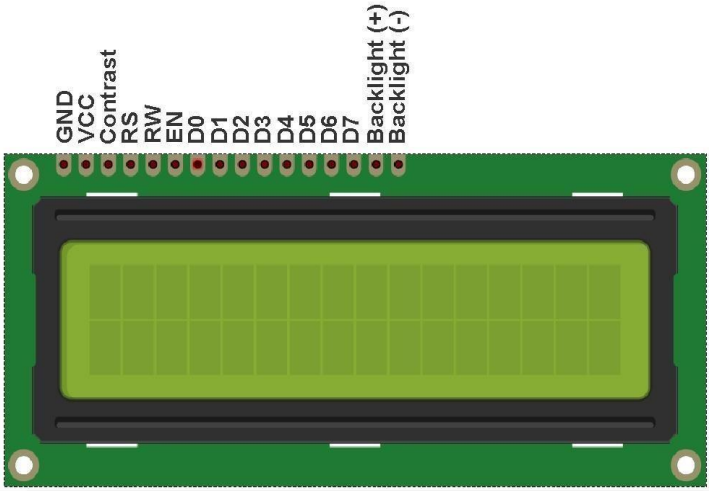

Figure 4.2 LCD

BATTERY

A battery can be defined as an electrochemical device (consisting of one or more electrochemical cells) that can be charged with an electric current and discharged whenever required.

Batteries are usually devices that are made up of multiple electrochemical cells that are connected to external inputs and outputs.

Batteries are widely employed in order to power small electric devices such as mobile phones, remotes, and flashlights.

Historically, the ‘term’ battery has always been used in order to refer to the combination of two or more electrochemical cells. However, the modern definition of the term ‘battery’ is believed to accommodate devices that only feature a single cell.

Figure 4.3 Battery

L293d

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC that can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*). The l293d can drive small and quite big motors as well, check the Voltage Specification at the end of this page for more info. It works on the concept of H-bridge. H-bridge is a circuit that allows the voltage to be flown in either direction. As you know voltage needs to change its direction for being able to rotate the motor in the clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuits inside the IC which can rotate two dc motors independently. Due to its size it is very much used in the robotic application for controlling DC motors. Given below is the pin diagram of an L293D motor controller. There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with the left H-bridge you need to enable pin 1 to be high. And for the right H-Bridge, you need to make pin 9 to high.

If anyone of either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It’s like a switch

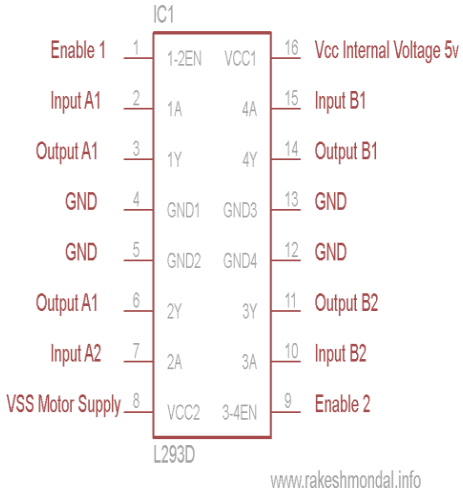

Figure 4.4 L293d pin diagram

ROBOT CHASSIS

The chassis is the structural component of the robot which contains the drivetrain and allows the robot to be mobile by using wheels, tank treads, or another method. A chassis is sometimes referred to as the robot's frame. The chassis also provides a structure to attach manipulators such as arms, claws, lifts, plows, conveyor systems, object intakes, and other design features used to manipulate objects.

Figure 4.5 Robot chassis

MOTOR

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy. Electric motors can be powered by direct current (DC) sources, such as from batteries, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters, or electrical generators. A DC motor is defined as a class of electrical motors that convert direct current electrical energy into mechanical energy.

Figure 4.6 Dc motor

SOFTWARE

ARDUINO IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension 'ino.' The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably

one of the main reason Arduino became so popular. We can certainly state that being compatible with the Arduino IDE is now one of the main requirements for a new microcontroller board. Over the years, many useful features have been added to the Arduino IDE and you can now manage third-party libraries and boards from the IDE, and still keep the simplicity of programming the board. The main window of the Arduino IDE is shown below, with the simple Blink example.

WORKING

In this project the Dc motor is connected to the front two wheels and the dc motor uses 100 RPM and the voltage supplied to the motor is 12V. A power supply board is used in order to supply the correct amount of voltage to other materials. In the power supply board 12volt, ground, and 5volt are connected. The 12-volt, ground, and 5volt are connected to the motor driver. The input pins in the motor driver are connected to the microcontroller pins 5,6 and 7. The color sensor is used to detect the RGB color and it is connected to the microcontroller. When the robot is on, the LCD displays “RGB robot”, after which when an object is placed in front of the color sensor, for example, Red color is brought in contact with the color sensor then it gets identified and the frequency of the red color object is determined and displayed on the LCD, depending on the frequency the color gets recognized and displayed as the output stating the color “RED” and it’s the same way for green and blue color. Each and every object for the RGB colors have a different frequency, on determining the frequency the program is run and the color is shown in the output stating the color.

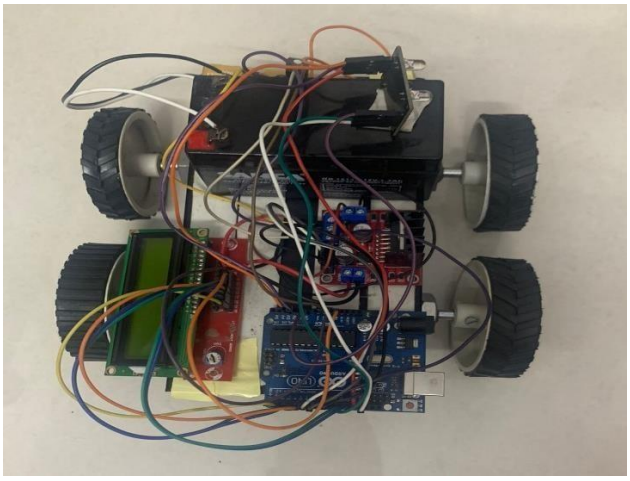

Figure 4.7 RGB robot

PROGRAM

```
#include <LiquidCrystal.h>
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
#define s0 A0
#define s1 10
#define s2 A1
#define s3 A2
#define out 13

int data=0;

void setup()
{
   pinMode(s0,OUTPUT);
   pinMode(s1,OUTPUT);
   pinMode(s2,OUTPUT);
   pinMode(s3,OUTPUT);
   pinMode(out,INPUT);

   Serial.begin(9600);
   lcd.begin(16, 2);
   lcd.setCursor(0,0);
   lcd.setCursor(0,0);
   lcd.print("RGB");
   lcd.setCursor(0,1);
   lcd.print("ROBOT");
   delay(2000);
   digitalWrite(s0,HIGH);
   digitalWrite(s1,HIGH);
}

void loop()
{

   digitalWrite(s2,LOW);
   digitalWrite(s3,LOW);
   Serial.print("Red value= ");
   GetData();

   digitalWrite(s2,LOW);
   digitalWrite(s3,HIGH);
   Serial.print("Blue value= ");
   GetData();

   digitalWrite(s2,HIGH);
   digitalWrite(s3,HIGH);
   Serial.print("Green value= ");
   GetData();

   Serial.println();

   delay(2000);
}


void GetData(){
   data=pulseIn(out,LOW);
   Serial.print(data);
   Serial.print("\t");
   delay(20);
 lcd.setCursor(0,0);
 lcd.print("RGB ROBOT");
 lcd.setCursor(0,1);
 lcd.print(data);
 delay(2000);
 lcd.clear();
      if(data>=10)
   {
    digitalWrite(6,HIGH);
    digitalWrite(7,LOW);
    digitalWrite(8,HIGH);
    digitalWrite(9,LOW);
   }
   else
      {

    digitalWrite(6,LOW);
    digitalWrite(7,LOW);
    digitalWrite(8,LOW);
    digitalWrite(9,LOW);
     lcd.setCursor(0,0);
     lcd.print("ROBOT");
     lcd.setCursor(0,1);
     lcd.print("STOPED");
      delay(3000);
      lcd.clear();
   }

}
```

CHAPTER 5

RESULT AND DISCUSSION

In this project, when the color is brought in contact with the color-detecting sensor then it recognizes the color and displays the frequency of the color on the LCD, once the frequency is read and the program is run, then the output displays the color that it has recognized. For example, when red color is shown to the sensor, it determines it frequency and displays it on the LCD and the program is run and an output is displayed stating the Color is “RED”.

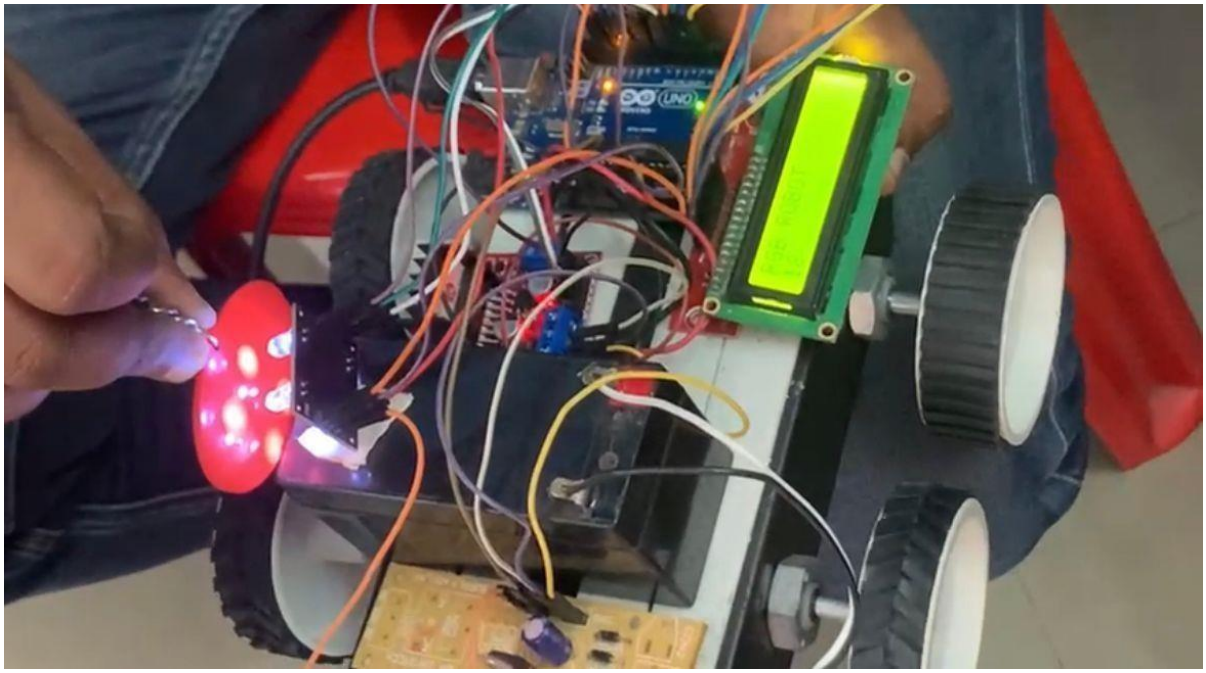

Figure 5.1 color detection

CHAPTER 6

SUMMARY AND CONCLUSION

In this project, we are able to make the robot identify the RGB colors that are red, green, and blue, and the frequency of the colors are displayed on the LCD in the form of numbers so that we get the output in the program stating the color. This Robot is very much helpful for identifying colors while moving around and any color that is read by the sensor gets identified by the robot and the output gets displayed. This project is very much useful for children to study the colors as well as identify them. The setup is absolutely self-contained and it is an easy-to-use project.

REFERENCE

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