
**PROJECT REPORT**

**ON**

# COLOR SENSING ROBOT USING MATLAB & P89V51RD2

Submitted By:
Jitendra Dubey
National Institute of Technology, Meghalaya
Electronics and Communication Engineering

# ABSTRACT

This project presents a color-sensing robot using MATLAB and the P89V51RD2 microcontroller, designed for real-time object detection and movement control. The system integrates a color sensor and a camera to identify objects based on their color and process the acquired data for automated motion control. The microcontroller receives color information from the sensor, processes it, and communicates with MATLAB via serial communication to ensure precise and responsive movements. The robot's ability to distinguish different colors allows it to be implemented in various applications such as industrial automation, smart sorting systems, object tracking, and autonomous navigation. This system enhances efficiency by reducing human intervention in classification and transportation tasks, making it an ideal solution for modern automated industri

# Introduction

A **Colour Sensing Robot** is an autonomous system designed to detect and respond to different colours in its environment. This project utilizes a **P89V51RD2 microcontroller**, a **TCS3200 colour sensor**, and **MATLAB** to process and visualize colour data. The robot identifies colours and moves accordingly, making it suitable for applications like **industrial sorting, object classification, and automation**.

The project integrates **image processing** techniques within MATLAB, where the detected colour information is analysed and visualized. By implementing **serial communication**, the microcontroller transmits real-time data to MATLAB, enabling precise robot control. The system's ability to recognize and react to different colours demonstrates its potential for **intelligent automation** in various fields.

# OBJECTIVE

The objective of this project is to develop a colour sensing robot that detects and processes colour information to execute predefined actions. The key goals are:

- Accurate Colour Detection: Use the TCS3200 sensor to identify colours with high accuracy.
- Microcontroller Processing: Implement the P89V51RD2 to process colour data and make real-time decisions.
- MATLAB Integration: Visualize and analyze colour data in MATLAB.
- Autonomous Navigation: Move the robot based on detected colours.
- Reliable Communication: Establish UART serial communication between the microcontroller and MATLAB.
- Practical Applications: Apply the system in industrial sorting, waste segregation, and education.
- Future Enhancements: Enable machine learning, wireless communication, and camera-based vision.

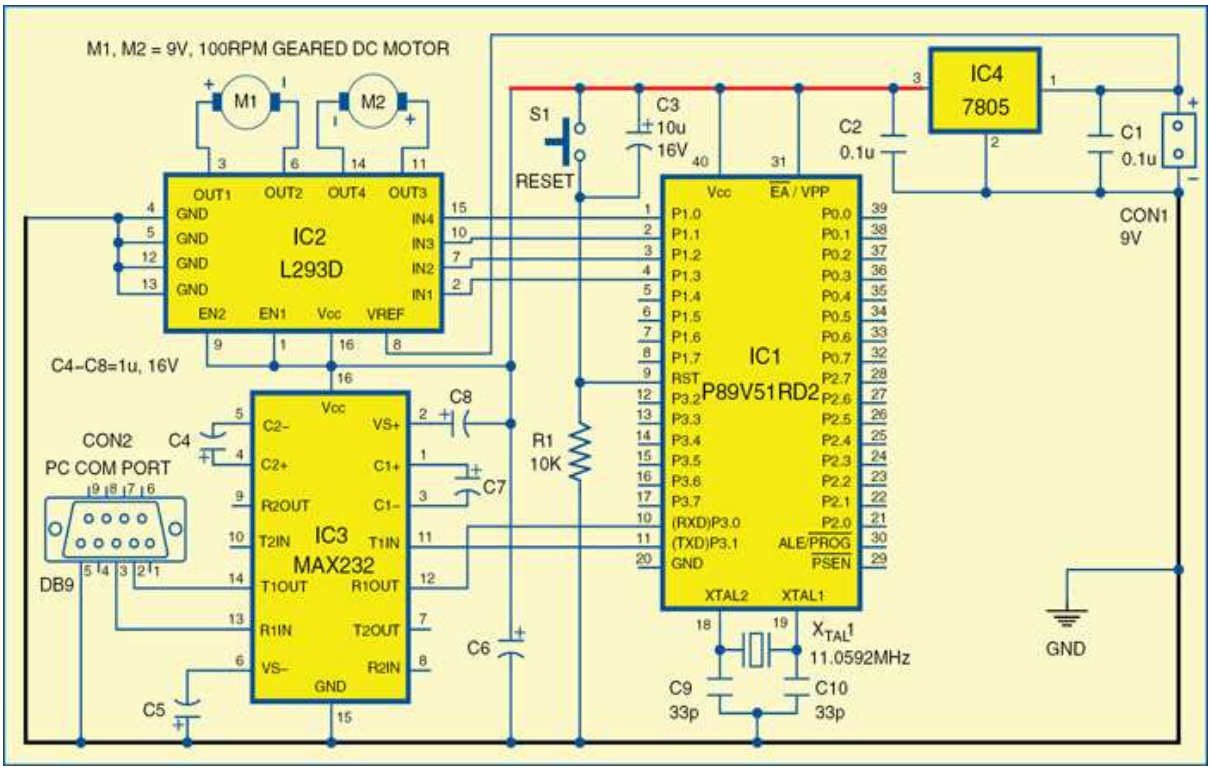
# COMPONENTS REQUIRED

- **Microcontroller**: P89V51RD2 (8051-based MCU)
- **Colour Sensor**: TCS3200
- **Motor Driver**: L293D
- **Motors**: 2 DC Motors (9V, 100 RPM)
- **Chassis**: Robot body
- **Power Supply**: 9V battery with 7805 voltage regulator
- **Serial Communication**: MAX232 for UART communication with PC
- **Software**: Keil (Embedded C programming), MATLAB (Data Processing & Visualization)

# WORKING PRINCIPLE

1. The **TCS3200** colour sensor detects the colour of an object by measuring the frequency output of red, green, and blue components.
2. The **P89V51RD2** microcontroller processes this frequency data and determines the dominant colour.
3. The microcontroller sends the RGB values to **MATLAB** via **UART serial communication** through **MAX232**.
4. MATLAB receives the colour data, processes it, and visualizes the detected colour.
5. Based on the detected colour, the robot performs specific movements using **DC motors controlled via the L293D motor driver**.

# CIRCUIT DIAGRAM & CONNECTIONS




**Different Pins Connections**

| TCS3200 Sensor | P89V51RD2 Microcontroller |
|---|---|
| VCC | 5V |
| GND | GND |
| S0 | P2.0 |
| S1 | P2.1 |
| S2 | P2.2 |
| S3 | P2.3 |
| OUT | P3.2 (INT0) |
| **L293D Motor Driver** | **P89V51RD2 Microcontroller** |
| IN1 | P1.0 |
| IN2 | P1.1 |
| IN3 | P1.2 |
| IN4 | P1.3 |
| Enable1 | 5V |
| Enable2 | 5V |
| Motor Power (VCC) | 9V Battery |

| MAX232 (UART Interface) | P89V51RD2 Microcontroller |
|---|---|
| T1IN | TXD (P3.1) |
| R1OUT | RXD (P3.0) |
| VCC | 5V |
| GND | GND |

**1.Power Supply**

- A **9V battery** provides power to the entire circuit.
- The **7805 voltage regulator (IC4)** converts 9V to a stable **5V** supply, which powers the **P89V51RD2 microcontroller (IC1), MAX232 (IC3), and TCS3200 sensor**.
- The **L293D motor driver (IC2)** is directly powered by the **9V battery** to drive the DC motors.

**2. Microcontroller (P89V51RD2) Connections**

- The **P89V51RD2 (IC1)** processes data from the **colour sensor (TCS3200)** and controls motor movement.
- The **UART TXD (P3.1) and RXD (P3.0)** are connected to the **MAX232 (IC3)** for serial communication with MATLAB on the PC.
- The **TCS3200 colour sensor** is connected to **Port 2 (P2.0 - P2.3) and INT0 (P3.2)** to read colour frequencies.
- The **motor control signals (P1.0 - P1.3)** are connected to **IN1 - IN4 of the L293D motor driver (IC2)**.

**3. Motor Driver (L293D) Connections**

- **IN1 - IN4** of **L293D (IC2)** are connected to **P1.0 - P1.3** of **P89V51RD2** to control motor direction.
- **EN1 and EN2** are connected to **5V** to keep the motor driver always enabled.
- The **output terminals (OUT1 - OUT4)** are connected to **two DC motors (M1 and M2)**.
- **Pin 8 (VCC2) of L293D** is directly connected to **9V** to drive motors efficiently.

**4. UART Communication with MAX232**

- **TXD (P3.1) of IC1** is connected to **T1IN of MAX232 (IC3)**, and **R1OUT of MAX232** is connected to **RXD (P3.0) of IC1**.
- This allows proper voltage-level conversion for serial communication between MATLAB and the microcontroller.

**5.TCS3200 Colour Sensor**

- **S0, S1, S2, S3** control the frequency scaling and colour filtering, connected to **P2.0 - P2.3**.
- **OUT pin of TCS3200** is connected to **P3.2 (INT0)** to read the pulse frequency corresponding to the detected colour.

# ALGORITHM & SOFTWARE IMPLEMENTATION

## Microcontroller Programming (Keil C)

1. Initialize **P89V51RD2** and configure UART for serial communication using MAX232.
2. Read frequency values from **TCS3200 sensor** for Red, Green, and Blue components.
3. Determine the dominant colour based on frequency values.
4. Send colour data to MATLAB via **serial communication**.
5. Control the motors based on the detected colour.

## MATLAB Processing

1. Read the serial data from the microcontroller.
2. Extract and display the **RGB values**.
3. Determine the dominant colour and visualize it using a **GUI (Graphical User Interface)**.
4. (Optional) Implement machine learning for improved colour recognition.

# RESULTS & OBSERVATIONS

- The robot successfully detected and classified colours into **Red, Green, and Blue**.
- The **MATLAB GUI** displayed the detected colours accurately.
- The robot responded correctly to different colours by moving **forward, stopping, or turning**.
- The UART communication between **P89V51RD2 and MATLAB** was stable and reliable.

# APPLICATIONS

- **Industrial Sorting**: Automating object sorting based on colour.
- **Waste Segregation**: Sorting recyclable materials by colour.
- **Line-Following Robots**: Following coloured paths for navigation.
- **Educational Projects**: Learning microcontroller programming and image processing.

# CONCLUSION

This project successfully demonstrates the integration of **P89V51RD2, TCS3200, and MATLAB** for colour detection and robotic movement. The system efficiently detects and processes colour information, providing real-time feedback. Future improvements could include **wireless communication**, **AI-based colour classification**, and **enhanced mobility** using advanced motor control techniques.

# FUTURE SCOPE

- Integrate **Wi-Fi or Bluetooth** for remote colour detection.
- Use **Machine Learning** for accurate colour classification in different lighting conditions.
- Expand to **multi-colour sorting** for complex applications.
- Implement **camera-based vision** for high-precision colour detection.

# REFERENCES


1. Datasheet of **P89V51RD2** Microcontroller.
2. Datasheet of **TCS3200** Colour Sensor.
3. Datasheet of **MAX232** Serial Interface IC.
4. Datasheet of **L293D** Motor Driver.
5. MATLAB Serial Communication Documentation.
6. Embedded C Programming for **8051 Microcontrollers**.