COLOUR SORTING ROBOT WITH AURDINO AND COLOR SENSOR

[1]*Yadavalli Shravani, M.Tech Scholar, Embedded systems, Jayamukhi Institutions of Technology and Science, Narsampet, Warangal, Telangana, India*
[2]*Hameed Pasha, Professor, Deen Academics, Jayamukhi Institutions of Technology and Science, Narsampet, Warangal, Telangana, India*

Abstract

The colour sorting robot using Arduino Uno and TCS3200 colour sensor is designed to automate the process of identifying and categorizing objects based on their colour, offering a practical solution to challenges faced in manual sorting systems. Manual sorting is often time-consuming, labor-intensive, and prone to errors, especially when large volumes of objects need to be processed continuously. In industrial environments such as packaging, food processing, pharmaceuticals, and recycling, maintaining accuracy and efficiency in sorting is critical, and human operators may struggle to meet these demands consistently. This project integrates the TCS3200 colour sensor with an Arduino Uno microcontroller, enabling real-time detection of colours of objects placed on a conveyor mechanism. Upon detecting the colour, the system sends signals to a servo or DC motor, which directs the object into its corresponding bin. The automated mechanism ensures high-speed, precise, and consistent sorting, significantly improving productivity while minimizing human intervention. Beyond its immediate practical application, the system is cost-effective, compact, and modular, making it suitable for small-scale industries, educational laboratories, and research projects. Its design allows for future enhancements, such as integration with IoT systems for remote monitoring, wireless data logging, and machine learning algorithms for advanced object classification. The project also demonstrates the effective use of embedded systems, sensors, and actuators in solving real-world industrial problems, highlighting how simple microcontroller-based solutions can achieve automation comparable to expensive industrial machines. Furthermore, this work provides a platform for exploring automation, robotics, and smart system design in educational and research contexts. By bridging the gap between manual labour and industrial automation, the colour sorting robot not only improves operational efficiency but also serves as a valuable learning model for students and professionals interested in embedded systems, robotics, and intelligent automation. Overall, this project illustrates how modern technology can create reliable, scalable, and innovative solutions for tasks requiring precision, consistency, and efficiency.

Introduction

In today's industrial and manufacturing sectors, automation plays a crucial role in enhancing productivity, reducing operational costs, and maintaining high levels of accuracy. Among the numerous processes that benefit from automation, sorting is one of the most fundamental, particularly in industries such as packaging, food processing, pharmaceuticals, recycling, and material handling. Sorting objects based on their physical attributes, such as shape, size, weight, or colour, is essential for quality control and process optimization. Colour, in particular, is a critical parameter widely used for classification, identification, and grading of products. Manual sorting, however, remains a common practice in many small-scale operations, but it is often slow, labour-intensive, and prone to errors due to operator fatigue, human inconsistency, and the inability to maintain precision over extended periods. These limitations directly impact productivity, increase labour costs, and reduce overall operational efficiency.

The advent of affordable microcontrollers, sensors, and actuator technologies has opened new possibilities for the development of low-cost, efficient, and reliable automated sorting systems. Arduino Uno, a popular open-source microcontroller, provides a versatile platform

for building embedded systems capable of real-time interaction with sensors and mechanical components. When paired with a TCS3200 colour sensor, the Arduino Uno can detect and differentiate colours accurately by analyzing the intensity of reflected light from objects. Integrating these technologies into a robotic sorting mechanism allows objects to be detected, classified, and directed to designated bins automatically, reducing the need for human intervention while improving speed and accuracy. The Colour Sorting Robot project demonstrates a practical application of embedded systems in automating repetitive and critical tasks. The system processes colour data from the sensor, interprets it using the Arduino Uno, and then actuates servo or DC motors to sort objects into the correct categories. This automation not only enhances efficiency and reliability but also ensures consistency in operations, which is often unattainable with manual sorting methods. Moreover, the modular and programmable nature of the Arduino platform allows for system flexibility, enabling upgrades such as the integration of Internet of Things (IoT) capabilities, wireless monitoring, and advanced machine learning algorithms for enhanced sorting and classification performance. Beyond industrial applications, the Colour Sorting Robot serves as an educational and research-oriented tool. It provides a hands-on learning experience in the areas of robotics, embedded electronics, microcontroller programming, sensor integration, and automation system design. The project highlights the transformative role of intelligent systems in everyday applications, demonstrating how technology can bridge the gap between manual processes and fully automated solutions. By combining mechanical design, sensor technology, and control logic, this project provides a scalable, cost-effective, and practical solution for colour-based sorting while offering insights into the broader applications of robotics and automation in industry and education.

Existing System

In the existing system, sorting of objects based on colour is primarily performed through either manual methods or advanced automated machines in large-scale industries. Manual sorting involves human operators visually inspecting objects and categorizing them into designated bins based on colour. While this method is simple and does not require any complex equipment, it comes with significant drawbacks. The process is inherently time-consuming and requires continuous human effort, which can lead to fatigue and decreased concentration over extended periods. These factors contribute to inconsistent results, reduced efficiency, and a higher likelihood of human errors, especially when sorting large volumes of items in industries such as food processing, packaging, recycling, or pharmaceuticals. Additionally, relying on manual labour increases operational costs, as multiple operators may be required to handle the workload, and training is often necessary to ensure basic accuracy in sorting tasks. On the other hand, fully automated industrial sorting machines provide a more efficient alternative. These systems typically employ sophisticated image processing techniques, optical sensors, high-speed conveyors, and robotic actuators to detect and sort objects with high precision. They offer the advantages of speed, repeatability, and consistent performance, reducing reliance on human intervention. However, these industrial-grade solutions have their own limitations. They are often extremely expensive, making them inaccessible to small-scale industries, educational laboratories, and research projects. Installation and operation require specialized knowledge and trained personnel, and ongoing maintenance costs are high due to the complexity of sensors, actuators, and software systems involved. Moreover, these machines are typically large and less flexible, making it difficult to modify or adapt them for different sorting applications or smaller setups. Overall, the existing systems, whether manual or

industrial, present a clear trade-off between cost, efficiency, and scalability. Manual systems are low-cost but inefficient, prone to errors, and unsuitable for handling large quantities of objects, while industrial systems, although highly efficient and accurate, are prohibitively expensive and complex. This highlights a critical need for a low-cost, reliable, and flexible colour sorting solution that can combine the benefits of automation with accessibility for small-scale operations, educational purposes, and experimental research. Such a system would need to balance affordability, precision, and ease of implementation, providing a practical alternative to the limitations of both traditional manual sorting and high-end industrial machines.

Disadvantages of Existing System

The existing colour sorting systems face several drawbacks that limit their efficiency and usability. Manual sorting, which is still widely used in small-scale industries, is slow, labour-intensive, and prone to human error due to operator fatigue and inconsistency. This reduces productivity and makes the process unreliable for large-scale operations. On the other hand, fully automated industrial machines, though highly accurate and fast, are very costly and require skilled operators as well as regular maintenance. Their large size and high installation costs make them unsuitable for small businesses, laboratories, or educational projects. Thus, the current systems either suffer from inefficiency and inaccuracy in manual methods or become unaffordable and complex when relying on advanced industrial solutions, leaving a gap for a low-cost, reliable, and flexible alternative.

Proposed System

The proposed system aims to overcome the limitations of existing colour sorting methods by implementing an Arduino Uno-based Colour Sorting Robot using a TCS3200 colour sensor. This system automates the process of detecting and categorizing objects based on their colour, eliminating the need for manual inspection. The Arduino Uno microcontroller processes signals from the colour sensor and controls servo or DC motors to direct objects into their respective bins, ensuring accurate and consistent sorting. Unlike costly industrial machines, this system is low-cost, compact, and easy to implement, making it suitable for small-scale industries, laboratories, and educational purposes. Additionally, the modular design allows for easy upgrades and modifications, such as integrating IoT-based monitoring or advanced classification algorithms in the future. Overall, the proposed system provides a reliable, efficient, and cost-effective solution for automating colour-based sorting tasks while maintaining high accuracy and productivity.

Advantages of Proposed System

The proposed Arduino Uno-based Colour Sorting Robot offers several advantages over existing manual and industrial systems. Firstly, it automates the sorting process, reducing human effort and eliminating errors caused by fatigue or inconsistency. Secondly, it is cost-effective and compact, making it accessible for small-scale industries, educational purposes, and laboratory experiments. The system is also highly accurate and reliable, as the colour sensor ensures precise detection and classification of objects. Furthermore, the design is modular and flexible, allowing easy upgrades or integration with additional features such as IoT monitoring, data logging, or advanced sorting algorithms. Overall, the proposed system improves efficiency, saves time, and provides a practical solution for tasks that require colour-based sorting, bridging the gap between low-cost manual methods and expensive industrial machines.

Literature Review

Several studies have explored the development of colour sorting robots using sensors and microcontrollers, laying the foundation for low-cost automation systems. Lim Jie Shen and Irda Hassan (2015) designed a colour sorting robot that emphasized sensor-based detection and automated sorting to enhance

industrial efficiency. This work provided insights into sensor integration, which is directly applicable to our project's use of the TCS3200 colour sensor for accurate object identification.

Snehal Shirgave et al. (2017) demonstrated a colour sorting robot capable of classifying objects based on basic sensor inputs. While their system achieved reasonable accuracy, it was limited by the mechanical design and scalability. In our project, we improve upon this by implementing a servo/DC motor-based actuation system, which provides faster and more precise sorting.

Rudresh H.G. and Prof. Shubha P. (2017) focused on a sensor-based sorting robot, highlighting reliability and accuracy. Their work guided the development of our Arduino Uno microcontroller program, which processes colour sensor data efficiently to reduce errors in classification. Similarly, Shweta Suryawanshi et al. (2017) integrated robotic arms with microcontroller systems for sorting tasks. Our project adopts a simpler yet effective mechanical design to reduce costs while maintaining functional accuracy.

Recent studies have also explored IoT integration in sorting systems. D A Jakkan et al. (2019) implemented an IoT-based product sorting machine, enabling real-time monitoring and control. While IoT adds remote capabilities, our project focuses on creating a low-cost, standalone system suitable for laboratories and small-scale applications without requiring an internet connection.

Ch. Shravani et al. (2019) and Uzma Amin et al. (2019) demonstrated Arduino-based sorting machines using TCS3200 sensors and pick-and-place mechanisms, proving the feasibility of low-cost automated systems. Our project builds upon these approaches by optimizing the sensor calibration and motor control, ensuring smoother and faster sorting of multiple objects. Pratik Bapuso Patil et al. (2019) reviewed Arduino-based sorting systems, emphasizing their adaptability and educational value. In line with this, our project is designed to be modular, scalable, and easy to replicate, making it suitable for academic projects as well as small industrial use.

LIM JIE SHEN[1] In this method ,first step starts with background study on material,after the background study is finished ,next very important classification-colour sensing connection,colour recognising connection,fabricating of Robot body,after following operations are done building of assembly parts are very important and troubleshooting analysis is done at the last part. In programming section,background study on programming language is done by comparing various other methods,in this work it generally focus on TCS3200D Colour sensor for sorting of various colours,Arduino UNO board is used for controlling operations and GS90 Tower Pro servo motor used in conveyor for sorting of various colour.In this work robotic system will have huge potential for proper implementation.

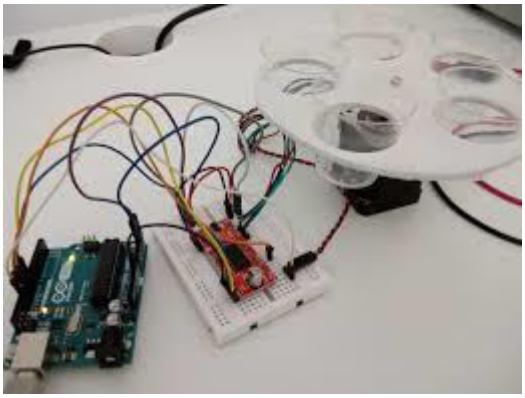
Snehal Shirgave[2] In the Zigbee based Colour Sorting mechanism,The input unit consist of Power supply unit,Rectifier unit is used for converting ac into dc,regulator used for regulation of supply,Display unit consist of LCD,it is generally used for displaying various colours,sorter mechanism consist of different colour balls used to sort and sensing of different colour is done by Wifi based module.With help of raspberry pi based method the entire color sorting system is automated. Rudresh.H.G[3] In this work colour sensor based object sorting robot generally uses the robotic arm for sorting of various colours,this robotic arm is generally placed near the conveyor belt.This robotic arm will generally pick and place the object in the desired location,with the help of robotic arm the manwork is reduced in rapid rate,accuracy and speed of classification of is done at the rapid rate.colour sensor will detect the colour,and send the signals to the microcontroller unit ,this microcontroller unit drives the motor in the conveyor belt. Shweta[4] In this work smart approach for implementing the robotic arm is introduced for

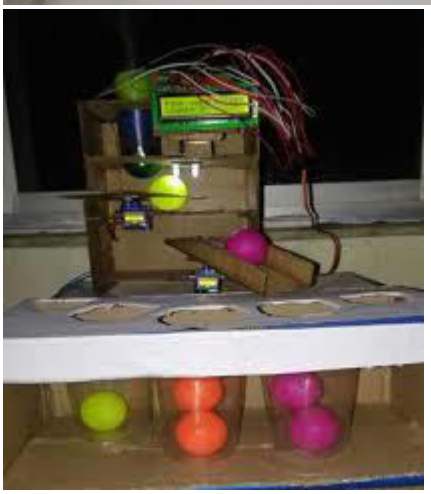
sorting of objects on the basics of color.In the this method they have used TCS34725 color sensor it is interfaced with the controller unit,sensor unit sends the signal to the microcontroller unit,it senses the signal and it generally send the data to the motor driver unit L293D.It generally drives the motor unit.The main application of this project is pick and place using the product like grains,apples,grapes and other fruits.It is generally used for industry sorting.

D A Jakkan[5] In this work the first stage of the operation is power supply unit ,this unit is generally used for supplying the power to the system ,the next stage of operation is rectification stage,during this stage it is generally used for converting ac into dc ,in the regulator stage it is generally used for regulation of the things.display unit is used for displaying the various parametric values.With help of IOT ,sorting is done generally with help of sorting mechanisms. Himanshu Patel[6] In this work various color objects are generally segregated with the help of the color sensor .color sensor will senses the incoming object and and sends the signal to the controller.the controller analysis the signal send the output for servomotor used for easy classification of the data.it is generally used in food industry for identifying the various rotted fruits and vegetables and it generally used for identify the defects in the raw materials and it is used in used small scale and large scale industries.

Ch.Shravani[7] Color based product sorting machine using IOT is very low cost method with which it is very much suited for small scale industry can able to get updated with the automated system for easy way of sorting .With the help of sequence of objects that can sorted based on colour which can reduce the man power and time consumption in industries,the output is displayed in the LCD Display. Uzma Amin[8] In this work they used PIC microcontroller(18F452) it 8-bit controller and it has 40 pins ,the main operating voltage of this system is 2-5,5V ,it generally contains number of 34 input and output ,it also contains timer modules,comparator modules ,it generally contains commication peripherals like SPI,I2C and UART,and it generally has 1536 byte of RAM and 256 bytes of data eeprom memory.

Result:





Conclusion

The Colour Sorting Robot using Arduino Uno and TCS3200 colour sensor successfully demonstrates an efficient and low-cost solution for automating the sorting of objects based on colour. By integrating the Arduino Uno microcontroller with a colour sensor and motor-driven mechanism, the system can detect and classify objects accurately, reducing

human effort and eliminating errors caused by fatigue or inconsistency. Compared to manual sorting methods, the proposed system is faster, more reliable, and provides consistent performance. It is also more affordable and compact than industrial sorting machines, making it suitable for small-scale industries, laboratories, and educational purposes. The modular design allows for easy modifications and future enhancements, such as IoT integration, data monitoring, or advanced automation algorithms.

References:

[1] Lim Jie Shen, Irda Hassan "Design And Development Of Colour Sorting Robot" Journal of Engineering Science and Technology EURECA 2014 Special Issue pp.71 – 81, January 2015

[2]Snehal Shirgave1, Aishwrya Salunkhe, Khadija Shirgave, S. Y. Upadhye," Color Sorting Robot" International Journal of Advanced Research in Computer and Communication Engineering Vol. 6, Issue 3, March 2017

[3]Rudresh.H.G, Prof. SHUBHA.P" Colour Sensor Based Object Sorting Robot" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 08 , Aug -2017

[4]Shweta Suryawanshi, Shrunali Sonone, Pooja Patil, Pooja Parbhane," Color Sorting Robotic Arm" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 10 ,Oct -2017

[5]D A Jakkan, Chaugule Bharat Sudhakar, Jagtap Sanket Vilas, Khan Umar Aslam "Color Based Product Sorting Machine using IOT" Journal of Embedded Systems and Processing, Volume 4, Issue 3,2019

[6]Alagu, M, Ponnusamy, P, Pandarinathan, S, Mohamed Ali, JS. Performance improvement of solar PV power conversion system through low duty cycle DC-DC converter. Int J Circ Theor Appl. 2020;

[7]] Ch.Shravani, G. Indira, V. Appalaraju,"Arduino Based Color Sorting Machine using TCS3200 Color Sensor", International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume.8, Issue.6, April 2019

[8] Uzma Amin, Ghulam Ahmad, Nudrat Liaqat, Manzar Ahmed4 , Sumbal Zahoor," Detection & Distinction of Colors using Color Sorting Robotic Arm in a Pick & Place Mechanism" International Journal of Science and Research (IJSR) Volume 3 Issue 6, June 2019

[9] Pratik Bapuso Patil, Mr. S.S.Patil, Mr. M.L.Harugade" Review on Colored Object Sorting System Using Arduino UNO" International Research Journal of Engineering and Technology (IRJET) Volume 06, Issue 05, May 2019

Student Details:

Yadavalli Shravani
M.Tech Scholar, Embedded systems,
Jayamukhi Institutions of Technology and Science, Narsampet, Warangal, Telangana, India

Guide Details:

Hameed Pasha
Professor, Deen Academics, Jayamukhi Institutions of Technology and Science, Narsampet, Warangal, Telangana, India