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EXPLORING THE LANDSCAPE OF COLOR-BASED OBJECT SORTING SYSTEMS: A SURVEY

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ABSTRACT

A comprehensive review of automated sorting systems that categorize objects based on colour. The systems discussed utilize key technologies such as the Arduino Nano microcontroller, TCS3200 colour sensor, servo motors, and conveyor belts. The paper explores various methodologies including robotics, computer vision, and inverse kinematics in object sorting. It also dives deeper into the integration of Internet of Things (IoT) for enhancing connectivity and functionality. Additionally, the paper discusses the challenges faced by these systems, such as complex calculations, precise calibration, varying lighting conditions, and network security. The review underscores the potential of these systems in various industries and provides valuable insights for future research and development.

Keywords: Color Based Sorting, Servo Motors, Arduino Nano, TCS3200 Color Sensor, Conveyor Belt, Machine Learning.

I. INTRODUCTION

The automation of object sorting based on color has become a significant area of interest in various industries, including manufacturing, agriculture, and recycling. The need for such systems arises from the requirement to sort a multitude of objects based on their color for assembly, packaging, or processing. Traditionally, this sorting process has been conducted manually, which can be labor-intensive, time-consuming, and prone to errors.

The advent of technologies such as robotics, computer vision, Arduino, and the Internet of Things (IoT) has opened up new possibilities for automating this process. These technologies have the potential to increase the accuracy and efficiency of color-based object sorting, while also reducing the cost and labor required.

This survey paper aims to provide a comprehensive review of the current state of the art in color-based object sorting. It will explore various solutions that have been proposed, examining their strengths and weaknesses, and discussing their applicability in different settings. The paper will also identify areas where further research and development are needed, highlighting the opportunities for innovation in this field.

The rest of the paper is organized as follows: Section 2 provides a detailed review of the existing literature on color-based object sorting. Section 3 discusses the methodology. Section 4 identifies the advantages and limitations of the current solutions, and Section 5 provides a conclusion and summary of the paper's findings.

II. LITERATURE REVIEW

Magadum RA, Bombale UL in [1], presents a novel approach to object sorting using a color-based robotic system. The authors propose a system that uses a color sensor to detect the color of an object and a robotic arm to sort the object into the appropriate bin. The system is designed to automate the process of sorting objects based on color, which can be a time-consuming and error-prone task when done manually. The authors demonstrate the effectiveness of their system through a series of experiments, showing that it can accurately sort objects based on color. This work contributes to the field by demonstrating the potential of robotics in automating tasks that require color recognition.

Fadhil AT, Abbar KA, Qusay AM propose a computer vision-based system for classifying and sorting colored objects in [2]. Their system uses a camera to capture images of the objects, and then applies image processing techniques to identify the color of each object. Once the color of an object is identified, the system sorts the objects based on their color. The authors demonstrate the effectiveness of their system through a series of

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experiments, showing that it can accurately classify and sort objects based on color. This work contributes to the field by showing how computer vision techniques can be used to automate the process of sorting colored objects.

A system for sorting goods based on color in [3] is proposed by Sawant A, Rane D, Shaikh G, Sethi M, Jayawant. Their system uses a color sensor to detect the color of a good, and then a conveyor belt to sort the good into the appropriate bin. The authors demonstrate the effectiveness of their system through a series of experiments, showing that it can accurately sort goods based on color. This work contributes to the field by demonstrating the potential of color-based sorting systems in automating the process of sorting goods.

Babu KM, Vardhini PH have discussed the design and development of a cost-effective object sorting system in [4] that uses an Arduino microcontroller. The system uses a color sensor to detect the color of an object, and then a servo motor to sort the object into the appropriate bin. The authors demonstrate the effectiveness of their system through a series of experiments, showing that it can accurately sort objects based on color. This work contributes to the field by showing how an Arduino can be used to create a cost-effective object sorting system.

Febriramadhan L, Triwiyatno presented a system in [5], that sort the objects based on their color using an arm manipulator. The system uses a color sensor to detect the color of an object, and then an arm manipulator to sort the object into the appropriate bin. The arm manipulator uses the inverse kinematics method to determine the appropriate movements. The authors demonstrate the effectiveness of their system through a series of experiments, showing that it can accurately sort objects based on color. This work contributes to the field by demonstrating how an arm manipulator can be used to sort objects based on color.

Jakkan DA, Sudhakar CB, Vilas JS, Aslam KU have discussed a product sorting machine in [6], that uses the Internet of Things (IoT) to sort products based on color. The machine uses a color sensor to detect the color of a product, and then a conveyor belt to sort the product into the appropriate bin. The machine is connected to the internet, allowing it to be controlled remotely. The authors demonstrate the effectiveness of their machine through a series of experiments, showing that it can accurately sort products based on color. This work contributes to the field by showing how IoT can be used to create a product sorting machine.

III. METHODOLOGY

The methodology for developing a color-based object sorting system begins with a thorough requirement analysis. This initial stage involves understanding the specific requirements of the system, including the types of objects to be sorted, the range of colors to be recognized, and the environmental conditions under which the system will operate. It also includes identifying the throughput requirements, cost constraints, and any safety considerations.

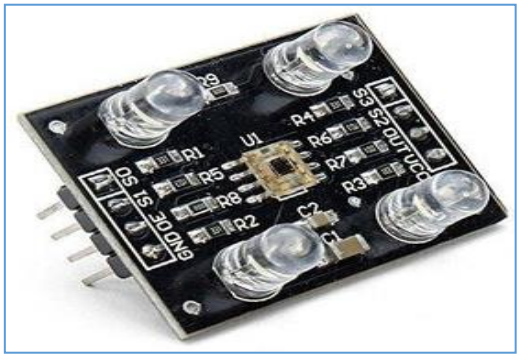

Figure 1: Color Sensor

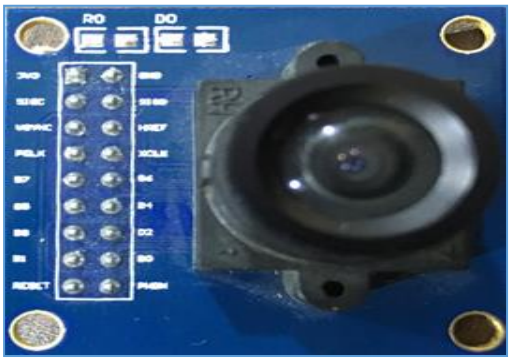

Figure 2: Camera Module

Based on the requirements, a system design is developed, which includes selecting the appropriate technologies for color detection, object manipulation, and system control. The design also considers the physical layout of the system, including the arrangement of bins or locations for sorted objects. Following the design stage, specific components to be used in the system are selected. This could include color sensors, cameras, robotic arms, conveyor belts, and control units such as Arduino or other microcontrollers.

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The selection of components takes into account factors such as cost, performance, reliability, and ease of integration. Once the components are selected, the system is implemented according to the design. This includes the physical assembly of the system, as well as the development of the software for controlling the system and processing the color data.

After implementation, the system is tested to verify that it meets the requirements. This includes testing the accuracy of the color detection, the reliability of the object sorting, and the overall performance of the system. Any issues identified during testing are addressed through iterative improvements to the system. Upon successful testing, the system is deployed in the intended environment, which includes any necessary calibration or adjustment to account for specific environmental conditions.

Once deployed, the system requires ongoing maintenance to ensure continued performance. This includes regular checks of the system components, as well as periodic updates to the software as needed.

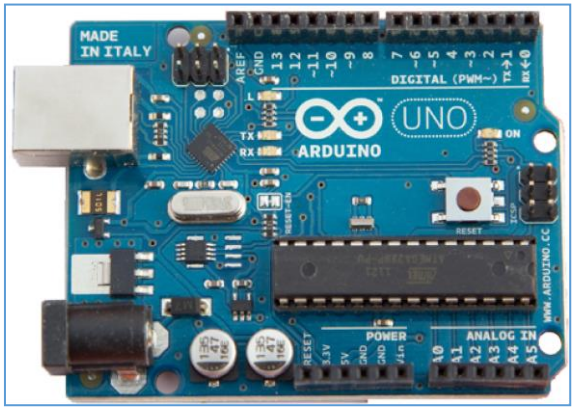

Figure 3: Arduino Microcontroller

IV. PROPOSED WORK

As an instance of the implementation, a comprehensive solution for sorting medicinal tablets can be developed. This solution can be designed to handle a wide range of tablets varying in color, size, and shape.

Advanced technologies such as robotics and computer vision can be incorporated to ensure high accuracy and efficiency in the sorting process. Robotics can enable precise handling of the tablets, reducing the risk of damage or contamination. Computer vision can be employed for the accurate classification and sorting of tablets based on their distinct features.

Furthermore, the system can be designed with cost-effectiveness in mind, ensuring that it is accessible and affordable. It can also incorporate the principles of the Internet of Things (IoT), allowing for real-time monitoring and control of the sorting process. This can enhance the overall efficiency of the system and allow for remote operation and troubleshooting.

Figure 3: Medicinal tablets

This possible solution can contribute to the advancement of this field by providing a single, integrated solution for medicinal tablet sorting. It can address the limitations identified in the referenced works and aim to set a new standard in this domain. The end goal is to create a system that is not only efficient and accurate but also

user-friendly and cost-effective. This can have significant implications for the pharmaceutical industry, potentially improving the speed and accuracy of medication dispensing.

V. ADVANTAGES

- **Efficiency:** Automated systems can sort objects faster than manual sorting, increasing productivity.
- **Accuracy:** These systems can accurately detect and sort objects based on color, reducing errors.
- **Cost-effective:** Over time, automated systems can be more cost-effective than manual labour.
- **Scalability:** These systems can handle a large number of objects, making them suitable for industrial applications.

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VI. CONCLUSION

In summary, these papers collectively demonstrate the various ways in which color-based object sorting can be achieved, from using robotics and computer vision to leveraging the capabilities of Arduino and IoT. They highlight the importance of this technology in various industries for automating the sorting process, improving efficiency and accuracy. These works also show the potential for future research in this area, particularly in terms of improving the accuracy and efficiency of these systems.

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