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IOT-BASED COLOR PRODUCT SORTING SYSTEM

Prof. Savita More[1], Aishwarya[2], Bhagyashree[2], Deepti[2], Nandini[2]

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[1] Research Professor, Department of Electronics and Communication Engineering, Guru Nanak Dev Engineering College, Bidar, Karnataka, India
[2] UG Student, Department of Electronics and Communication Engineering, Guru Nanak Dev Engineering College, Bidar, Karnataka, India

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ABSTRACT

In industrial automation, manual sorting remains labor-intensive, error-prone, and inconsistent, limiting productivity and quality assurance. This project introduces an IoT-enabled Color Product Sorting Machine designed to automate classification and distribution of items based on color attributes. The system integrates a TCS3200 color sensor with a microcontroller such as Arduino Nano or NodeMCU ESP8266 to detect and categorize objects moving along a conveyor belt. By analyzing RGB frequency values, the sensor identifies the color of each product, while a servo motor-driven arm diverts it into the appropriate bin.

Beyond basic automation, the system incorporates IoT connectivity for real-time monitoring and data logging. Using platforms like Blynk or ThingSpeak, managers can remotely track item counts, operational status, and production metrics. Notifications are pushed to mobile applications or dashboards when bins reach capacity or mechanical faults occur, enabling predictive maintenance and minimizing downtime. This integration of sensing, actuation, and cloud intelligence enhances sorting accuracy, increases throughput, and reduces reliance on human intervention.

The framework is cost-effective and adaptable across industries such as food, pharmaceuticals, and packaging. By transforming a conventional sorting machine into a smart factory asset, the project demonstrates how IoT can drive efficiency, sustainability, and resilience in modern manufacturing environments.

KEYWORDS: IoT, Color Sorting, TCS3200 Sensor, Arduino Nano, Industrial Automation, Smart Manufacturing, Real-time Monitoring

INTRODUCTION:

Industrial automation increasingly demands precision and efficiency, yet manual sorting remains labor-intensive, error-prone, and inconsistent. To overcome these limitations, this project introduces an IoT-based Color Product Sorting Machine that automates classification of items by color. Using a TCS3200 sensor and microcontrollers such as Arduino Nano or NodeMCU ESP8266, the system detects RGB values and directs products into designated bins via servo actuation. IoT connectivity enables real-time monitoring, data logging, and predictive maintenance, transforming conventional sorting into a smart, cost-effective solution for modern manufacturing industries.

MATERIALS AND METHODS:

Hardware:

- TCS3200 Color Sensor – detects RGB frequency values of objects.
- Microcontroller (Arduino Nano / NodeMCU ESP8266) – processes sensor data and controls actuators.
- Conveyor Belt System – transports products for sorting.
- Servo Motor – drives the mechanical

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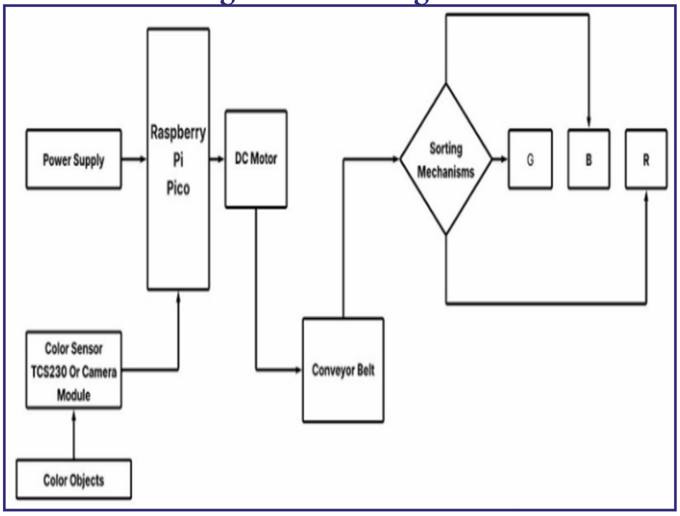
arm to divert items into bins.
- IoT Module (ESP8266 Wi-Fi) – enables cloud connectivity and real-time monitoring.
- Power Supply Unit – provides stable voltage and current for all components.

Software and Cloud:
- Arduino IDE (for programming microcontroller)
- IoT Cloud Platforms (Blynk / ThingSpeak)
- Mobile App / Web Dashboard (for monitoring & notifications)

Deployment approach:
- Installed along conveyor belt with sensor + microcontroller + servo.
- Detects RGB values, sorts products into bins automatically.
- IoT cloud integration for monitoring, alerts, and predictive maintenance.

Data handling:
- RGB values are captured from the TCS3200 sensor in real time.
- Microcontrollers process sensor inputs and control servo motors for sorting.
- IoT connectivity logs sorting data and system status for monitoring and predictive maintenance.
- Cloud storage enables analytics, performance tracking, and fault prediction.

Fig. 1: Block Diagram



RESULTS

The prototype of the IoT-based Color Product Sorting Machine successfully demonstrated a low-cost automated solution for classifying and sorting objects by color. Using a Raspberry Pi Pico with a TCS3200 sensor, the system accurately detected RGB values and directed items into bins via a servo motor. Real-time monitoring through IoT integration enhanced transparency and efficiency. Results showed consistent accuracy under controlled lighting, though calibration was required for optimal performance. The project highlights scalability for industrial automation and suggests future improvements with AI-based vision systems for irregular shapes.

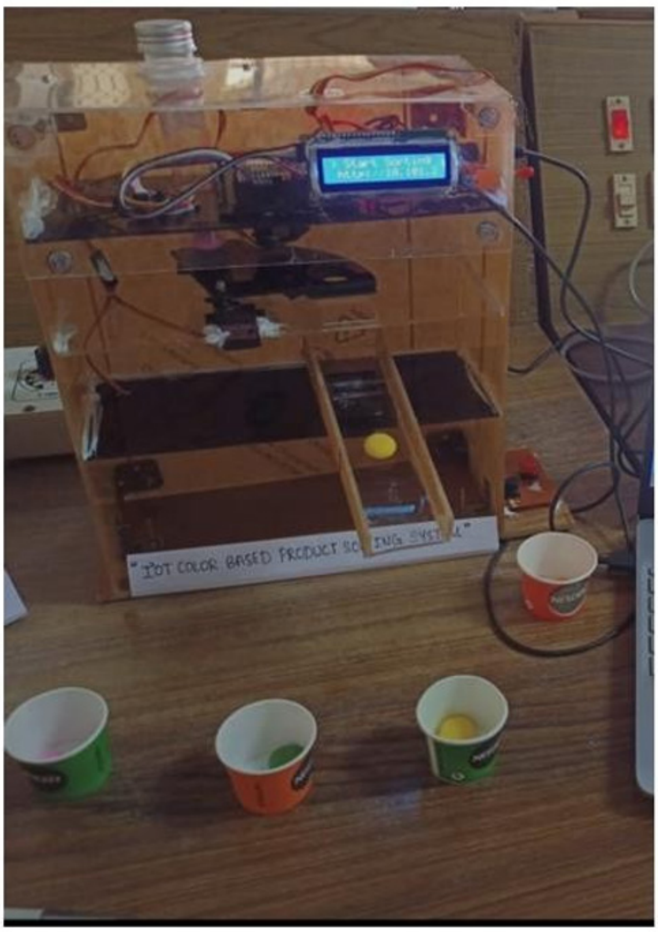
DISCUSSION

The IoT-based Color Product Sorting Machine demonstrates how low-cost embedded systems can be effectively applied to industrial automation. By integrating a Raspberry Pi Pico with a TCS3200 color sensor and servo motor, the prototype successfully classified and sorted objects into bins based on their detected RGB values. The inclusion of IoT connectivity provided real-time monitoring, enabling transparency and data collection that aligns with Industry 4.0 practices. The results confirmed that the system achieved consistent accuracy under controlled lighting conditions, though calibration was necessary to maintain precision. This highlights the importance of environmental factors in sensor-based automation. The project also showcased scalability, as the same framework could be extended to larger industrial applications such as packaging, pharmaceuticals, and food processing. However, limitations were observed in sensitivity to ambient lighting and the inability to handle irregularly shaped or multi-colored items. Future improvements could involve integrating camera-based vision systems, machine learning algorithms, or advanced sensors to enhance adaptability and accuracy. Overall, the project validates the feasibility of combining IoT with automation for smart manufacturing, offering a cost-effective solution that reduces human intervention, improves efficiency, and sets the foundation for more sophisticated industrial sorting systems.

CONCLUSIONS

Here is the IoT-based Color Product Sorting Machine successfully achieved its objective of providing a low-cost, automated solution for sorting objects by color. By integrating a Raspberry Pi Pico with a TCS3200 sensor and servo motor, the system demonstrated reliable classification and sorting under controlled conditions. The addition of IoT connectivity enabled real-time monitoring, making the prototype more aligned with Industry 4.0 standards. While the system performed accurately, it required calibration to maintain precision and was sensitive to ambient lighting. Despite these limitations, the project highlights the potential of combining embedded systems with IoT to create scalable, efficient, and smart automation solutions. Future enhancements such as AI-based vision systems and advanced sensors could further improve adaptability, accuracy, and industrial applicability. Overall, the project validates the feasibility of IoT-enabled automation in manufacturing and sets a foundation for more sophisticated smart factory innovations.

Fig. 2: Working Model



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