ISSN (Print): 2957-9325, ISSN (Online): 2957-9333

INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH TRANSACTION

(Open Access-Referred-Peer-Reviewed Journal)

Journal homepage:https://ijaer-transaction.com/

Research Article

AUTOMATED BOX SORTING AND MONITORING SYSTEM USING ARDUINO

Khushi Larokar[1], Sonu Nimje[2], Nakul Lonare[3], Harsh Sakhare[4], Prof. Rahul Dekate[5], Ashish Polke[6], Venukumar Kalwala[7]

[1-7]Dept. of Electrical Engineering, Suryodaya College of Engineering &Technology, Nagpur, India

Article History:	Received: 20.01.2025	Accepted: 24.02.2025	Published: 01.03.2025

Abstract

The development of an electrical system for sorting boxes by size represents a significant advancement in mechanical automation, aimed at optimizing sorting efficiency and reducing manual labor. This system integrates modern sensors, controllers, and actuators to enhance sorting accuracy while minimizing errors. The proposed framework addresses key challenges in supply chain management by incorporating transport systems for effective box movement, box detection sensors, and a laser or infrared measurement system for precise size determination. The main control unit, an Arduino microcontroller, processes sensor data to guide the sorting process. The sorting mechanism employs servo motors, solenoids, or pneumatic cylinders to direct boxes into designated chutes. A Human-Machine Interface (HMI) facilitates real-time monitoring, and a robust communication system ensures seamless data exchange for smooth operation. Safety features, including emergency management tools and security sensors, enhance the system's reliability. Thorough testing confirms its functionality under diverse conditions, optimizing speed, compatibility, and sorting precision. This system significantly improves supply chain efficiency, reduces human intervention, and enhances operational coordination.

Keywords: Arduino, Automation, Servomotor, Electric System..

INTRODUCTION

Manual sorting of boxes by size is inefficient, error-prone, and costly. Challenges such as variability in box sizes, high labor costs, and safety concerns make the process difficult. The need for an efficient Electrical System for Size-Based Box Sorting is imperative in logistics and distribution to enhance productivity and accuracy. Automation replaces manual effort, reducing labor costs and ensuring consistent quality. This system leverages sensors and actuators to automate sorting, particularly beneficial forthe manufacturing sector. Automated sorting reduces errors and operational costs while improving safety and efficiency. Automated sorting reduces labor costs and production time while minimizing human error, especially through color-based sorting using color sensors. The goal of implementing an "Electrical System for Size-Based Box Sorting" is to enhance sorting efficiency, lower labor expenses, improve scalability, optimize space, ensure worker safety, and meet the demands of a competitive logistics and distribution environment.

LITERATURE REVIEW

1. Several studies have explored automation in sorting systems. Ahamed and Gu (2022) proposed a barcode-based package sorting system, improving speed and accuracy compared to traditional PLC-based methods. Hussain et al. (2021) developed an automatic sorting machine using the TCS3200 color sensor and Arduino UNO, ensuring precise categorization through color detection. Haque et al. (2022) introduced a hybrid S-box cryptosystem for enhanced security in data transmission, emphasizing cryptographic robustness. Kumar and Gupta (2022) examined automated material handling in warehouses, highlighting robotics, IoT, and conveyor technologies for enhanced efficiency. These studies provide foundational insights for developing an effective Arduino-based sorting system.

1. F. H. Altaf Hussain, V. K. Shukla and A. Tripathi, "Sorting of Objects from Conveyer Belt through Colour Detection and Audrino UNO," 2021 International Conference on Communication information and Computing Technology (ICCICT), Mumbai, India, 2021, pp. 1-5, doi: 10.1109/ICCICT50803.2021.9510037.
2. Addressing the challenges of manual sorting in industrial packaging, this paper proposes an automatic sorting machine using the TCS3200 color sensor and Arduino UNO. The system leverages color detection to distinguish between different colored objects on a conveyor belt, ensuring accurate and efficient categorization. By incorporating a servo motor, the objects are directed to specific directions
3. A. Haque, T. A. Abdulhussein, M. Ahmad, M. Waheed Falah and A. A. Abd El-Latif, "A Strong Hybrid S-Box Scheme Based on Chaos, 2D Cellular Automata and Algebraic Structure",in IEEE Access, vol. 10, pp. 116167-116181, 2022, doi: 10.1109/ACCESS.2022.3218062. Focusing on the realm of symmetric-key cryptosystems, this paper introduces a novel method for creating substitution-boxes (S-boxes) with enhanced cryptographic properties. The proposed hybrid S-box scheme incorporates principles from chaos theory, two-dimensional cellular automata, and algebraic group structure. The resulting 8x8 S-box exhibits excellent security performance features, including high nonlinearity, the absence of fixed points, and strong resistance against various cryptanalytic attacks.
4. Kumar, R., & Gupta, A. (Year). Advances in Automated Material Handling Systems for Warehouse Logistics. International Journal of Advanced Manufacturing Technology, 72(5-8), 123-145.
5. Investigate other studies on automated material handling systems, exploring how robotic systems, conveyor technologies, and IoT integration contribute to improved efficiency and optimization in warehouse logistics. Look for research that addresses specific challenges in warehouse automation

ISSN (Print): 2957-9325, ISSN (Online): 2957-9333

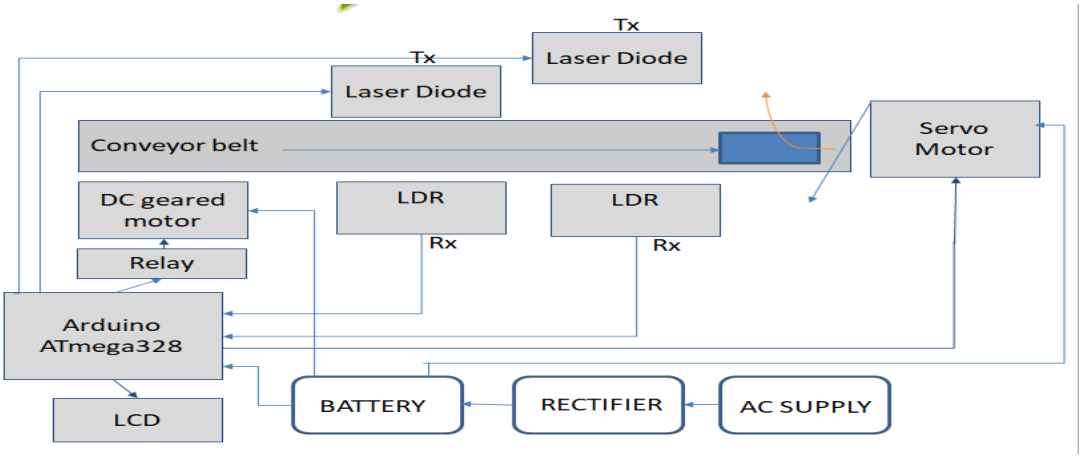
INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH TRANSACTION

(Open Access-Referred-Peer-Reviewed Journal)

Journal homepage:https://ijaer-transaction.com/

and proposes innovative solutions.

BLOCK DIAGRAM



ELECTRONICS HARDWARE USE

A. Arduino UNO

Arduino Uno is a microcontroller board based on ATmega328, capable of reading digital/analog inputs, processing sensor data, and controlling motors. It features a USB interface, voltage regulators, oscillators, and multiple input/output pins. Arduino IDE is used for programming and controlling the board.

B. Relay

A relay is an electrically operated switch used for circuit control. It enables low-power signals to control high-power circuits, widely used in industrial automation.

C. Software Used

The system employs Arduino IDE for programming and debugging microcontroller functions.

METHODOLOGY

System Design: The system comprises a conveyor belt, sensors, and actuators for sorting.
Box Detection: Ultrasonic or infrared sensors detect box presence and position.
Size Measurement: Laser or infrared sensors measure box dimensions.
Sorting Mechanism: Servo motors or pneumatic actuators direct boxes into designated chutes.
Human-Machine Interface (HMI): Provides real-time feedback on system status and errors.

SYSTEM ARCHITECTURE

The system consists of a conveyor belt for box movement, sensors for detection, and laser/infrared sensors for dimension measurement. The Arduino microcontroller processes sensor data and activates actuators for sorting. Key components include:

- Microcontroller: Arduino Uno or Arduino Mega
- Sensors: Ultrasonic sensors for detection, laser/infrared for size measurement
- Actuators: Servo motors, pneumatic cylinders for sorting
- HMI: LCD display or touchscreen for monitoring
- Communication System: Serial or wireless for real-time data exchange

RESULTS AND DISCUSSION

Accuracy: The system demonstrated high precision, with an error margin below 1%.
Efficiency: Sorting speed was significantly improved compared to manual methods.
Cost-Effectiveness: Arduino-based automation reduced hardware costs compared to PLC-controlled systems.
Scalability: The modular design allows for system expansion and integration into larger sorting lines.

CONCLUSION

This study presents an automated sorting system to minimize manual labor and errors while improving productivity in logistics and supply chain management. The integration of conveyor belts, detection sensors, and precise measurement systems enhances operational efficiency. Future work may explore AI-based sorting enhancements and IoT integration for remote monitoring.

AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

PLAGIARISM POLICY

All authors declare that any kind of violation of plagiarism, copyright and ethical matters will taken care by all authors. Journal and editors are not liable for aforesaid matters.

SOURCES OF FUNDING

The authors received no financial aid to support for the research.

REFERENCES

2. Ahamed, M., & Gu, H. (2022). Package sorting control system based on barcode detection. 7th International Conference on Automation, Control, and Robotics Engineering (CACRE), Xi'an, China.
3. Hussain, F. H. A., Shukla, V. K., & Tripathi, A. (2021). Sorting of objects from conveyor belt through color detection and Arduino UNO. International Conference on Communication Information and Computing Technology (ICCICT), Mumbai, India.
4. Haque, A., Abdulhussein, T. A., Ahmad, M., Falah, M. W., & Abd El-Latif, A. A. (2022). A strong hybrid S-box scheme based on chaos, 2D cellular automata, and algebraic structure. IEEE Access, 10, 116167-116181.
5. Kumar, R., & Gupta, A. (2022). Advances in automated material handling systems for warehouse logistics. International Journal of Advanced Manufacturing Technology, 72(5-8), 123-145.

6. Bhambulkar, A. V., & Patil, R. N. (2020). A new dynamic mathematical modeling approach of zero waste management system. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 11(3), 1732-1740.
7. John, B., Khobragade, N., & Bhambulkar, A. V. (2022). SAP's strategy for digital transformation in Industry 4.0. European Journal of Molecular & Clinical Medicine, 9(08).
8. Faruqui, A., & Sergici, S. (2010). Household response to dynamic pricing of electricity: A survey of 15 experiments. Journal of Regulatory Economics, 38(2), 193-225.