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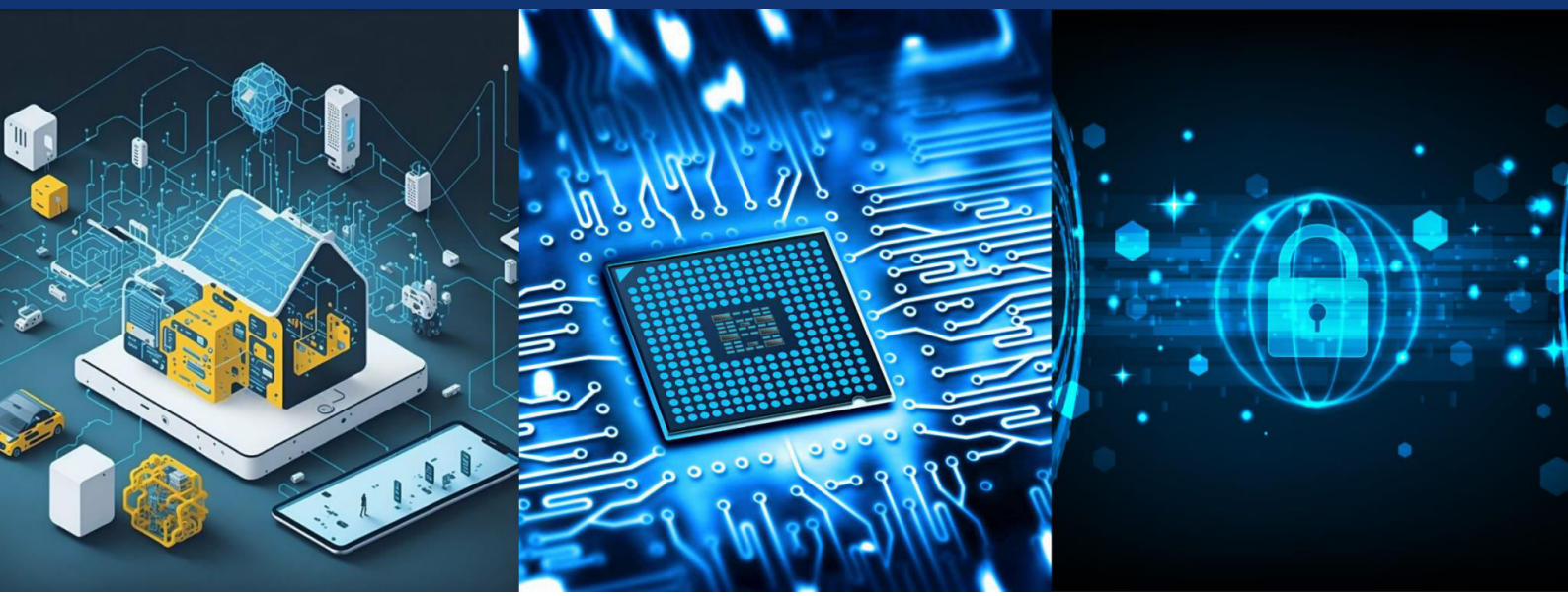

International Journal of Innovative Research in Computer and Communication Engineering

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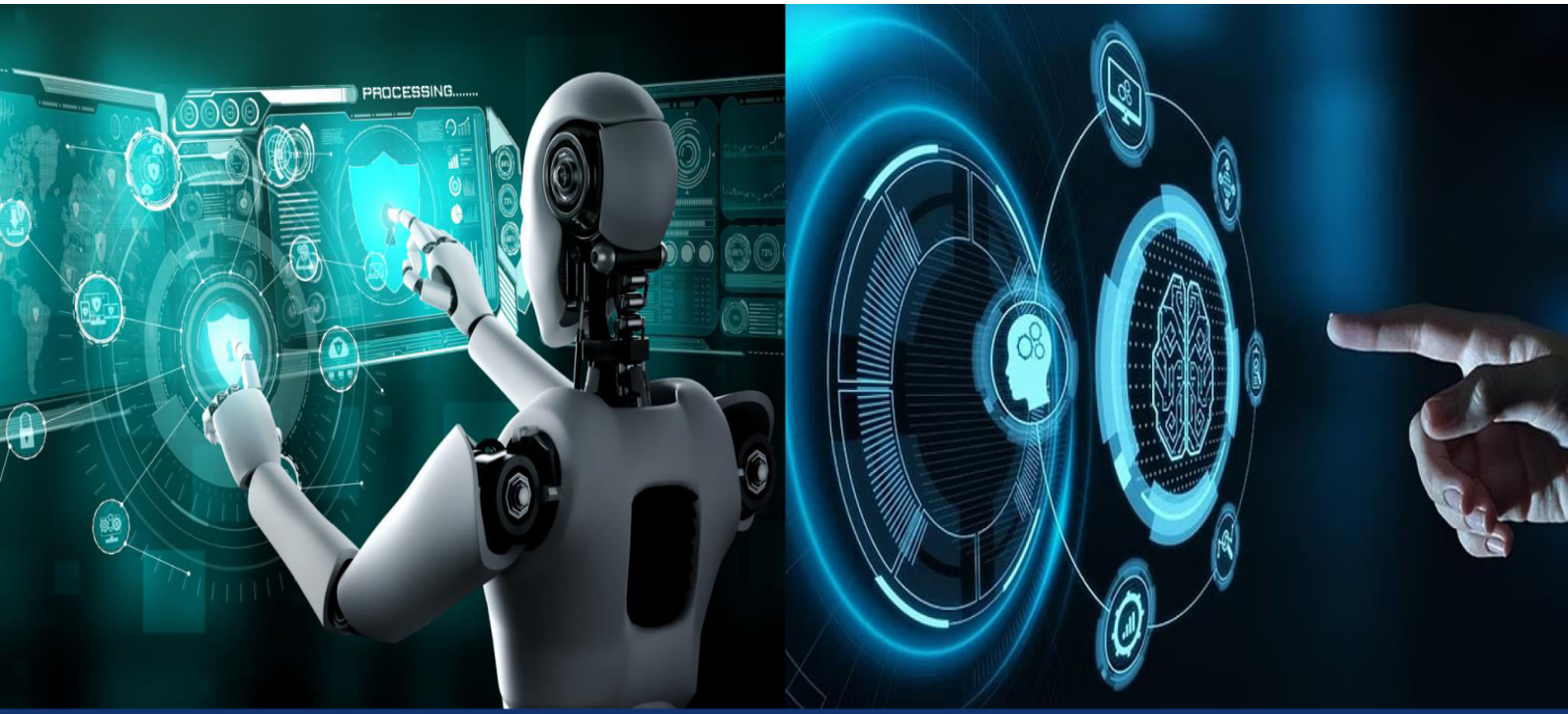

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Smart Industrial Automation System for Problem Solving Using STM32 and ATMEGA8

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ABSTRACT: In modern industries, automation has become essential for achieving high productivity, precision, and quality. Manual sorting and packaging processes are time-consuming, error-prone, and inefficient. To overcome these limitations, this paper proposes a Smart Industrial Automation System for Problem Solving using STM32 and ATmega8, designed to perform automatic color-based sorting, packing, and storage using a robotic arm. The system integrates two microcontrollers — STM32 as the main controller for overall coordination and robotic arm control, and ATmega8 as a supporting controller for color detection and sensor data processing. A TCS3200 color sensor is used to identify object color on a conveyor belt. Based on detected color, commands are transmitted to STM32 which controls servo motors for pick-and-place operations.This dual-controller architecture ensures parallel processing, improved efficiency, and accurate control. The system reduces human effort, increases productivity, and provides a cost-effective and scalable industrial automation solution.

KEYWORDS: Industrial Automation, STM32, ATmega8, Color Sensor, Robotic Arm, Conveyor Belt.

I. INTRODUCTION

In today's industrial environment, automation has become an important requirement for improving productivity, maintaining quality, and reducing operating costs. Manufacturing industries continuously look for methods that can increase production speed while minimizing human effort and mistakes. Traditional tasks such as sorting, packing, and material movement often depend on manual labor, which can be slow, inconsistent, and affected by worker fatigue. Because of these limitations, industries are shifting toward intelligent automated systems that can perform repetitive tasks with better speed and accuracy.Automation mainly refers to the use of controllers, sensors, and actuators to run machines with minimum human involvement. In production units, sorting and packaging are essential operations because they directly affect product quality and workflow efficiency. Manual methods are not suitable for high-volume production, as they consume more time and may create errors during operation. Therefore, industries require smart systems that can identify products, classify them correctly, and complete packing processes automatically.The proposed project, Smart Industrial Automation System for Problem Solving using STM32 and ATmega8, is developed to address these industrial challenges. The system combines dual microcontrollers, sensing devices, motors, and mechanical mechanisms to create an efficient automated model for color-based sorting and packing operations.Two controllers are used in the project to divide tasks effectively. The ATmega8 controller is mainly responsible for sensor interfacing and collecting data from the TCS3200 color sensor. Once the object color is identified, the processed information is transmitted to the STM32 controller through serial communication. STM32 acts as the main controller and takes further decisions for robotic arm movement and conveyor control.

II. PROBLEM DEFINITION

In modern industries, processes such as sorting, packing, and material handling are still performed manually in many production units. These activities require continuous human effort and are often repetitive, time-consuming, and less efficient. Manual operations can lead to mistakes such as wrong sorting, improper packing, delays in production, and

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inconsistent product quality. Human fatigue during long working hours also reduces speed and accuracy, which directly affects industrial productivity.Another major challenge is the increasing demand for faster production with higher precision. Traditional methods are not suitable for handling large numbers of products within limited time. As production volume increases, industries need systems that can operate continuously without interruption while maintaining reliability and uniformity.Existing small-scale automation systems often depend on a single controller, which may create limitations in multitasking, response speed, and simultaneous control of multiple devices. Handling sensors, motors, conveyor systems, and robotic mechanisms together with one controller may reduce overall performance.To overcome these problems, there is a need for an intelligent and efficient automation system that can automatically detect objects, identify their properties such as color, and perform sorting and packing operations accurately. The system should reduce human intervention, improve speed, minimize errors, and provide smooth coordination between sensors, controllers, and actuators.

III. LITERATURE SURVEY

Industrial automation has become an essential part of modern manufacturing systems due to the increasing demand for productivity, precision, and reduced human effort. Many industries are adopting automated systems that combine controllers, sensors, motors, and robotic mechanisms to improve operational efficiency. Some platforms from where we took our idea for smart industrial automation system for problem solving using stm32 and atmega8:

1. M. Groover (2015), in “Automation, Production Systems and Computer-Integrated Manufacturing”, discussed the importance of automation in improving industrial productivity and reducing human intervention. The study highlights how automated conveyor systems and robotic mechanisms enhance efficiency in manufacturing processes. However, the work mainly focuses on theoretical models and lacks implementation details using modern embedded controllers like STM32 [9].
2. B. Siciliano and O. Khatib (2016), in “Springer Handbook of Robotics”, presented detailed concepts of robotic arms and their applications in industrial automation. Their research emphasizes high precision, repeatability, and continuous operation of robotic systems. However, the study does not focus on low-cost microcontroller-based implementations suitable for small-scale industries [3].

IV. SYSTEM DESIGN

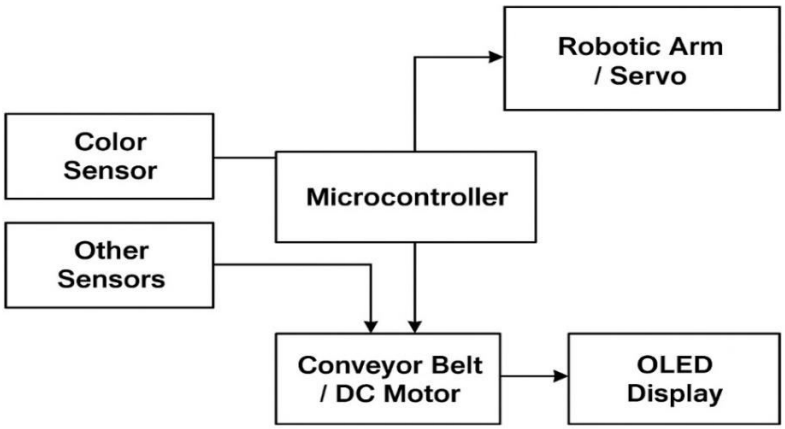

FIGURE.1. BLOCK DIAGRAM

A. System Overview

The system consists of:

- Conveyor belt (object movement)
- Color sensor (object detection)
- ATmega8 (data processing)
- STM32 (decision making & control)
- Robotic arm (sorting mechanism)
- OLED display (monitoring)

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Working Process:
1. Object placed on conveyor belt
2. Color detected using sensor
3. ATmega8 processes data
4. Data sent to STM32
5. STM32 controls robotic arm
6. Object placed in respective container

B. System Requirements
Hardware:
- STM32 Microcontroller
- ATmega8 Microcontroller
- TCS3200 Color Sensor
- Servo Motors
- DC Motor
- Conveyor Belt
- Robotic Arm
- OLED Display

Software:
- Embedded C
- STM32CubeIDE / Keil
- Arduino IDE
- Proteus

V. FLOWCHART

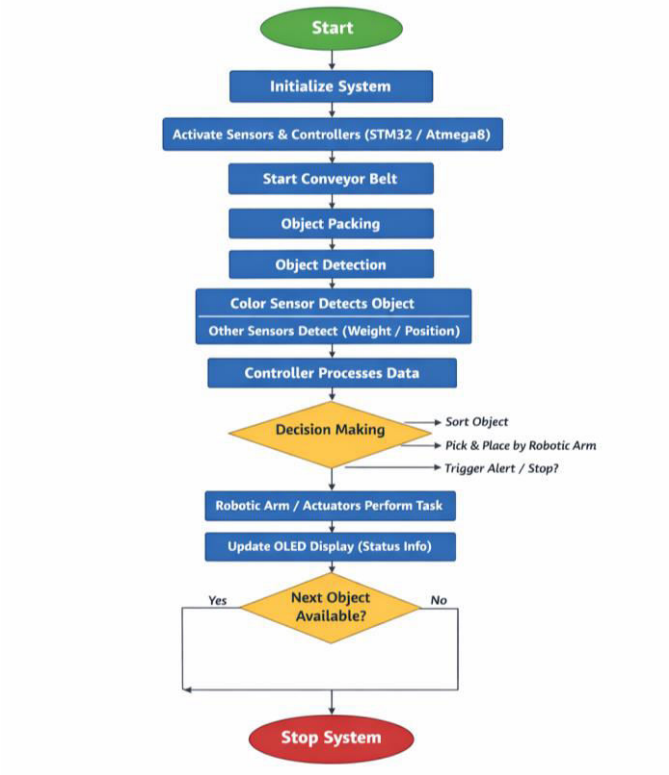

FIGURE.2.FLOWCHART

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VI. FINAL RESULT

The proposed Smart Industrial Automation System using STM32 and ATmega8 was successfully designed, implemented, and tested. The system demonstrated efficient performance in automatic object detection, color-based sorting, and robotic pick-and-place operations.During testing, objects of different colors (Red, Green, and Blue) were placed on the conveyor belt. The TCS3200 color sensor accurately detected the color of each object and transmitted the data to the ATmega8 microcontroller. The processed data was then sent to the STM32 controller, which performed decision-making and controlled the robotic arm accordingly.The robotic arm successfully picked the objects from the conveyor belt and placed them into the correct containers based on their detected color. The system operated continuously without interruption, demonstrating reliable automation performance.The Final Result of Smart Industrial Automation System using STM32 and ATmega8 is shown in Figure.4

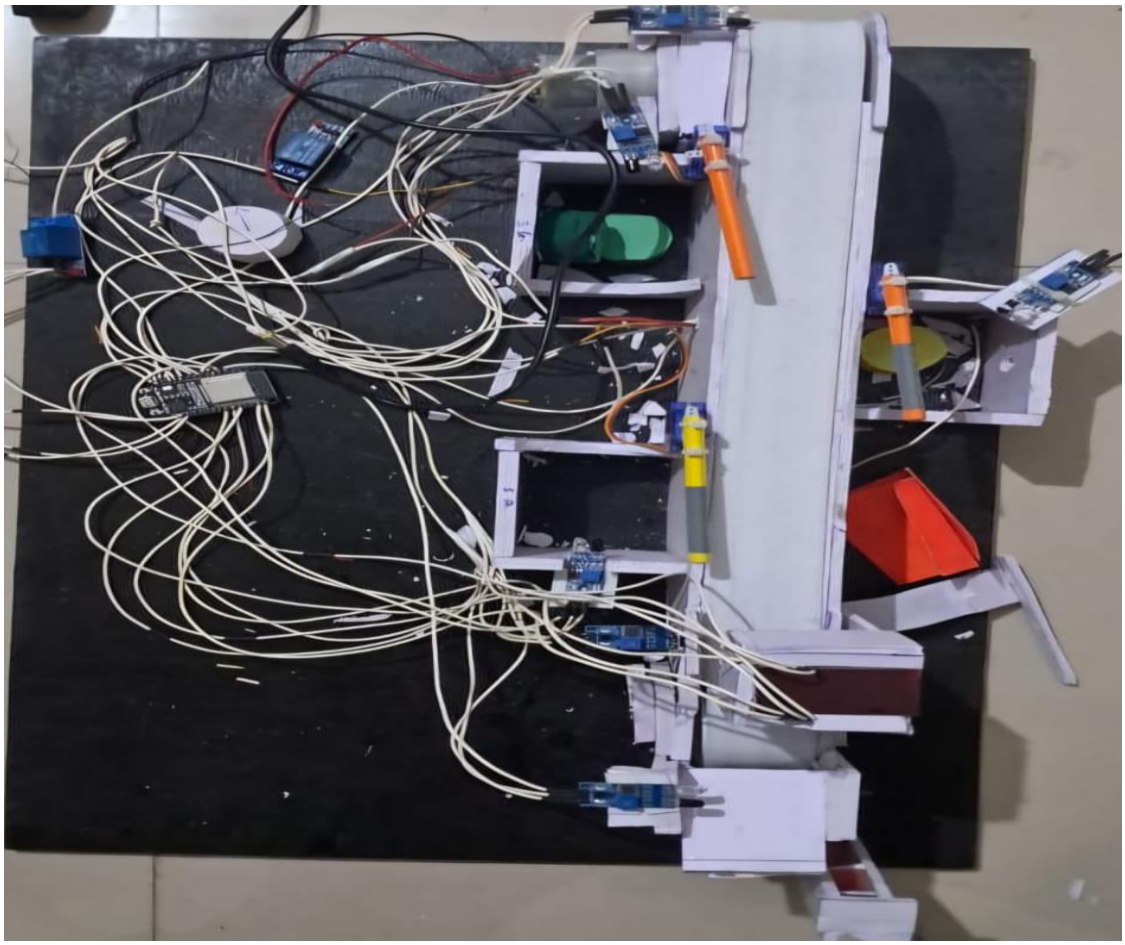

FIGURE.3. RESULT

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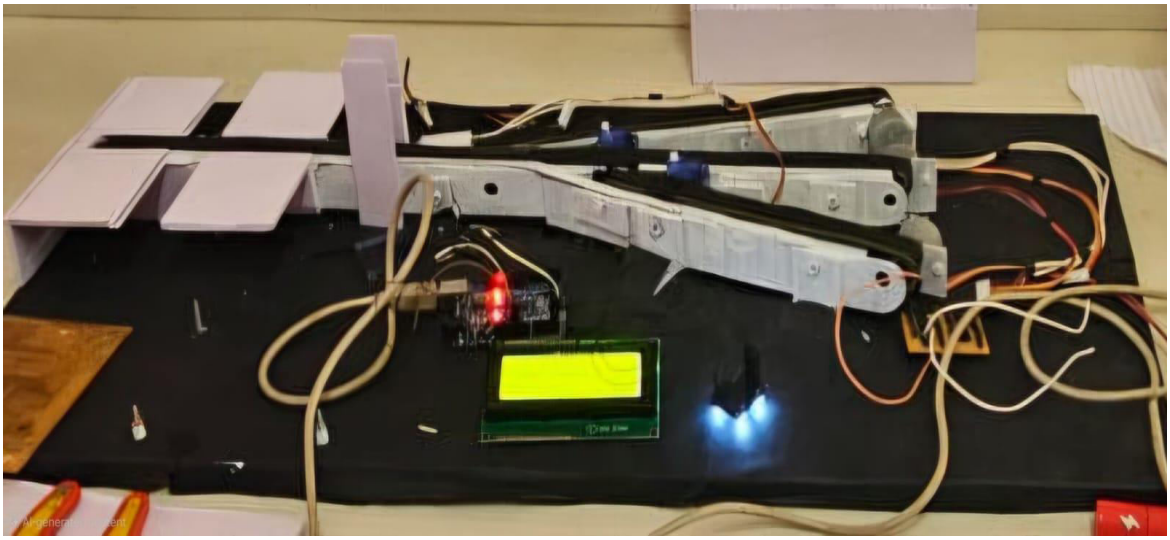

FIGURE.4. RESULT(2)

VII. CONCLUSION AND FUTURE SCOPE

The proposed Smart Industrial Automation System for Problem Solving using STM32 and ATmega8 successfully demonstrates an effective solution for automating industrial tasks such as object detection, sorting, packing, and material handling. The combination of sensors, microcontrollers, motors, conveyor systems, robotic arms, and display modules results in a dependable and intelligent automation setup that can carry out tasks with very little human involvement.The proposed system has significant potential for future improvements by integrating advanced technologies. One of the key future improvements involves integrating Artificial Intelligence (AI) and Machine Learning (ML) into the system. These advanced technologies can support automatic object recognition, identification of defects, and smarter decision-making using real-time data analysis.Another important upgrade is the inclusion of IoT and cloud-based connectivity. By linking the system with cloud platforms, users can monitor operations from remote locations, access production insights, evaluate system performance, and implement predictive maintenance strategies. This transformation would make the system a fully connected and intelligent industrial solution.

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