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Intelligent Colour Sorting Machine For Enhanced Efficiency

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Abstract *- The "Intelligent Colour Sorting Machine For Enhanced Efficiency" is an integrated solution designed to represents a pioneering advancement in industrial automation, aimed at optimizing color-based sorting processes. Leveraging the power of Internet of Things (IoT) technology, this system revolutionizes traditional sorting methodologies by integrating intelligent sensors, real-time data processing, and remote accessibility. At its core, the machine employs a conveyor belt mechanism to transport objects for sorting, while an array of color sensors precisely identifies the color attributes of each item. A microcontroller unit orchestrates the sorting process, swiftly categorizing objects based on their color characteristics. The IoT connectivity empowers operators with remote monitoring capabilities, allowing them to oversee operations, adjust sorting parameters, and receive timely notifications regardless of their physical location. This seamless integration of IoT not only enhances operational efficiency but also promotes scalability and adaptability to diverse production environments. Furthermore, the system's data analytics capabilities enable insights-driven decision-making, fostering continuous improvement and optimization. Overall, the IoT-based Color Sorting Machine embodies the convergence of cutting-edge technology and industrial innovation, poised to redefine the standards of automated sorting solutions across various industries.*

Key words- IoT, NodeMcu, Color sensor, Arduino Nano, hardware, software.

1. INTRODUCTION

Automation refers to the use of technology to streamline the production and delivery of goods and services with minimal human involvement. It improves efficiency and speed across various sectors like manufacturing, transportation, utilities, defense, and information technology. As technology advances rapidly, there's an increasing demand for high-quality products and services, leading to a need for enhanced productivity. Industrial automation plays a crucial role in meeting these demands through process engineering systems and automated manufacturing solutions. One such system automates the sorting of color-coded boxes on a conveyor belt using a color sensor for precise detection, reducing the need for manual labor while ensuring accuracy.

Additionally, the system tracks the number of objects passing through the process. Connectivity between the conveyor system and the operating station is facilitated by a Node MCU with a built-in WIFI module. The Internet of Things (IoT) represents a modern communication model where everyday objects, microcontrollers, electronic devices, and smart systems communicate seamlessly, becoming integral parts of the web. IoT aims to make the internet more immersive and ubiquitous, enabling easy access and interaction with a wide range of devices, from home appliances to surveillance cameras and vehicles. It fosters the development of various applications utilizing the vast amount of data generated by these devices to offer new services to individuals, businesses, and public institutions. In the near future, IoT is expected to have widespread applications in households and businesses, improving quality of life by enabling physical objects to communicate, share data, and make decisions. This transformation from conventional to smart objects is driven by IoT's underlying technologies such as global computing, embedded devices, and communication protocols. For example, smart homes will allow residents to automate tasks like opening garage doors upon arrival or preparing coffee. To realize this potential, emerging technologies and service applications need to evolve in sync with market demands and consumer needs, with a focus on device accessibility and communication compatibility standards.

Moreover, our system exemplifies the seamless integration of automation with the Internet of Things (IoT), heralding a future where interconnected devices communicate effortlessly to enhance productivity and user experience. By harnessing the power of IoT, our solution facilitates seamless connectivity between the conveyor system and operating stations, enabling remote monitoring and control for enhanced efficiency and responsiveness. As we navigate the ever-expanding horizons of automation and IoT, it becomes increasingly evident that the future belongs to those who embrace innovation and adaptability. By staying at the forefront of te,chnological advancements and

continually refining our solutions to meet the evolving needs of industries, we are poised to usher in a new era of efficiency, reliability, and connectivity. By leveraging advanced color sensing technology and real-time object tracking capabilities, our solution not only minimizes errors but also maximizes throughput, ultimately saving valuable manpower and resources.

1.1 Background

It's crucial to get an understanding of some of the services and keywords before we dive into the project's execution.

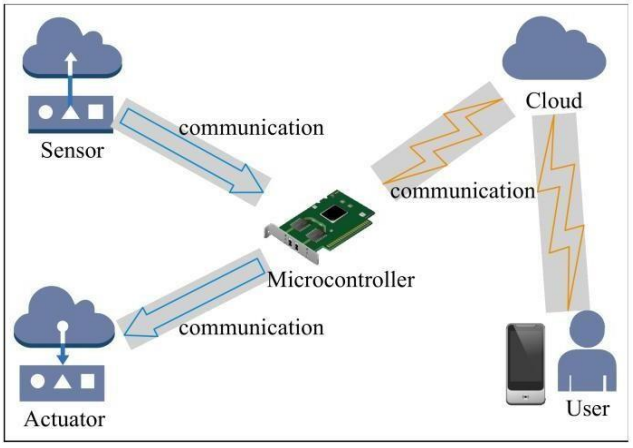

Fig: Microcontroller Ecosystem

A microcontroller (MCU) is a little chip with a straightforward operation that is used in several products, such as sensors, home appliances, health monitors, cars, and industrial automation. Several of these gadgets might gain from device access to the cloud. For instance, in order to record use, smart energy meters will need to connect to the cloud, and building security systems will need to interact locally in order to release doors when a badge is scanned . The computation and memory resources of the MCU are constrained to enable the completion of straightforward functional activities. IoT applications are made more difficult by the fact that microcontrollers often run operating systems without built-in capability to connect to the cloud or local networks. Free on Amazon. This issue is resolved by RTOS, which offers both the core operating system and software libraries (to operate the edge device). This makes it simple to connect securely to the cloud (or other edge devices) so that data can be gathered from them for IoT applications to take action.

2. METHODOLOGY

An IoT-based color sorting system employing a conveyor has diverse applications across industries like food processing, recycling, and manufacturing. Its main aim is automating object sorting by color, enhancing efficiency and accuracy.This system vastly improves sorting speed compared to manual methods, boosting throughput and productivity. It efficiently handles large volumes of objects, streamlining operations. Through IoT integration,it enables real-time monitoring and control, collecting and analyzing data on sorting processes for quality control, optimization, and performance tracking.

Prior to commencing the project, a brief examination was conducted on existing systems in this field. The work of prominent researchers was thoroughly reviewed, with key insights documented in the literature review. For instance, one study explored automated object sorting using Arduino nano, proposing various sorting mechanisms. The system comprises a conveyor belt transporting objects such as bottles or boxes past sensors, with sorting logic determined by NODEMCU. Color sensors, an inductive sensor, and a load cell detect object colors. Based on color detection, the system activates a DC motor with a circular container divided into compartments, sorting objects accordingly. Another system employs Arduino to code color recognition, segregating desired objects into bins using servo motors. This proposed high-speed color sorting machine utilizes robust mechanical structure, advanced sensing technology, sophisticated image processing algorithms, and user-friendly interface components to accurately sort objects based on color properties.

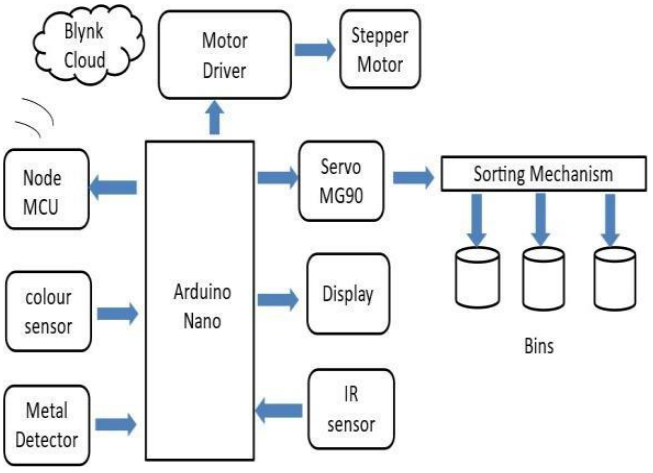

Fig:Block Diagram Of The Proposed Method

The Flow chart of this proposed which depicts the process of an intelligent color sorting machine that uses IoT (Internet of Things) to enhance efficiency.

In enhancing efficiency, this intelligent color sorting machine leverages IoT technology. The process starts with a colored ball placed on a sensor that detects its color. This information is then relayed to a controller, which analyzes it and sends instructions to a servo motor. . The servo motor, based on the controller's signal, positions a sliding platform over the appropriate chute. Finally, the ball rolls down the designated chute and lands in the bin matching its color.

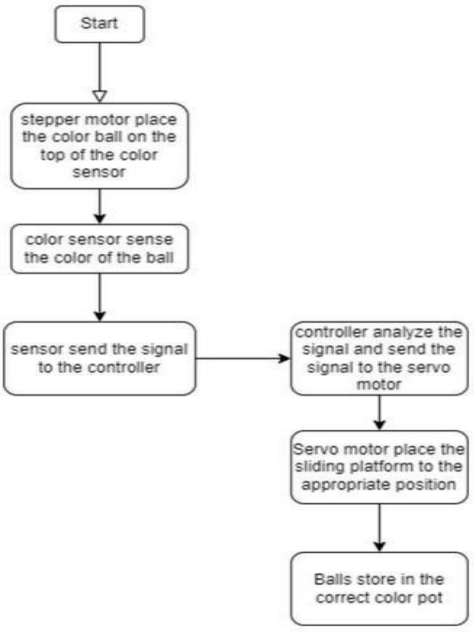

Fig: Flow chart of the proposed System

This automated system, driven by IoT, streamlines the sorting process and eliminates the need for manual color identification and sorting.

2.1 Hardware and Software Requirements:

Hardware Description:
The following Hardware Components are used in this project

IR Sensor

An IR sensor serves a dual purpose: measuring an object's heat and detecting motion. In the infrared spectrum, all objects emit thermal radiation, which is invisible to the naked eye but detectable by IR sensors. These sensors typically consist of an IR LED emitter and an IR photodiode detector.

The photodiode is sensitive to IR light of the same wavelength emitted by the IR LED. When IR light reaches the photodiode, it causes changes in resistance and output voltage proportional to the intensity of the received IR light.

Fig:Image of IR Sensor

LCD Display

The liquid crystal display (LCD) offers several advantages over LEDs, including lower power consumption, typically measured in microwatts compared to milliwatts for LEDs. This low power requirement makes it compatible with MOS integrated logic circuits. LCDs are also known for their affordability, good contrast, and ability to operate within a limited temperature range of 0 to 60°C. However, they do have drawbacks such as the need for an external light source, limited reliability and operating life, poor visibility in low ambient light, slow speed, and the requirement for AC drive. A typical liquid crystal cell consists of a thin layer (approximately 10 µm) of liquid crystal sandwiched between two glass sheets with transparent electrodes. These electrodes can be configured to create either a transmissive type cell, with both glass sheets being transparent, or areflective type cell, where one glass sheet is transparent and the other has a reflective coating. Unlike LEDs, LCDs do not produce their own illumination and rely entirely on external light sources for visibility.

Fig:Image of LCD display

Servo Motor

A servo motor is a rotary actuator that enables precise control of angular position by integrating a motor with a position feedback sensor. To complete the system, a servo drive is essential. This drive utilizes the feedback sensor to accurately manage the rotary position of the motor. The position sensor provides a feedback signal indicating the current load position.

Typically, this sensor is a potentiometer that generates a voltage proportional to the motor shaft's absolute angle via a gear mechanism. It is compact and lightweight yet offers high output power.This servo can rotate approximately 180 degrees (90 degrees in each direction) and operates similarly to standard models but in a smaller form factor.

A servo motor is a type of motor that uses feedback to control its position accurately. It consists of a DC motor, a gear train, a position sensor, and a control circuit. When you send a signal (like a PWM signal) to a servo motor, it rotates to the desired position based on the input.

Fig: Image Of Servo Motor

Arduino Nano

The Arduino Nano is a compact microcontroller board designed for prototyping and DIY electronics projects. It features the ATmega328P microcontroller chip running at 16 MHz, providing 32KB of Flash memory, 2KB of SRAM, and 1KB of EEPROM. Despite its small size (18 x 45 mm), it offers various connectivity options, including a USB interface for programming and serial communication through a Mini-B USB connector. With 14 digital I/O pins, 8 analog input pins, and 6 PWM output pins, users can interface with sensors, actuators, and other electronic components. The Nano can be powered via USB or an external power supply (7-12V DC), with built-in voltage regulation for stable operation.

Fig:Image of Arduino Nano

The TCS3200 color sensor is a versatile and popular device used for color detection and measurement in various applications. This sensor is capable of detecting a wide range of colors by utilizing an array of photodiodes and a light-to- frequency converter. It operates by illuminating an object with white light and then measuring the reflected light through its photodiodes, which are sensitive to red, green, blue, and clear light. The TCS3200 can provide digital outputs corresponding to the intensity of each color component detected, enabling precise color sensing and analysis. This sensor is commonly used in robotics, industrial automation, printing, and other fields where accurate color detection is essential. Its compact size, ease of integration, and reliability make it a preferred choice for projects requiring color sensing capabilities. Configuration and interfacing 0 incident light distribution.

with microcontrollers are straightforward, making it accessible for hobbyists and professionals alike in the realm of electronics and sensor technology.

Fig:Image of TCS3200 Colour Sensor

ESP8266 NodeMCU

The term "NodeMCU" originates from "node" and "MCU" (micro-controller unit). It primarily refers to the firmware, rather than the associated development kits, and both the firmware and prototyping board designs are open source. NodeMCU utilizes the Lua scripting language. Its main purpose is to facilitate IoT projects needing wireless connectivity, including smart home devices, remote sensors, data loggers, and other internet-enabled devices.

Fig:Image Of ESP8266 Nodemcu

Software Description Arduino IDE:

The Arduino IDE is the software used to program microcontrollers. Arduino, an open-source company and community, creates kits for building digital devices and interactive objects. These kits can sense and control the physical world. Arduino boards are available preassembled or as kits, with hardware design information accessible for DIY assembly. These microcontroller boards, primarily manufactured by Smart Projects in Italy, utilize 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. They offer digital and analog I/O pins for interfacing with extension boards and circuits. The Arduino IDE, based on the Processing project, supports C and C++ programming languages. Programs are loaded onto the microcontroller boards via serial communications interfaces, including USB on some models. The Arduino IDE facilitates compiling and uploading programs to Arduino boards.

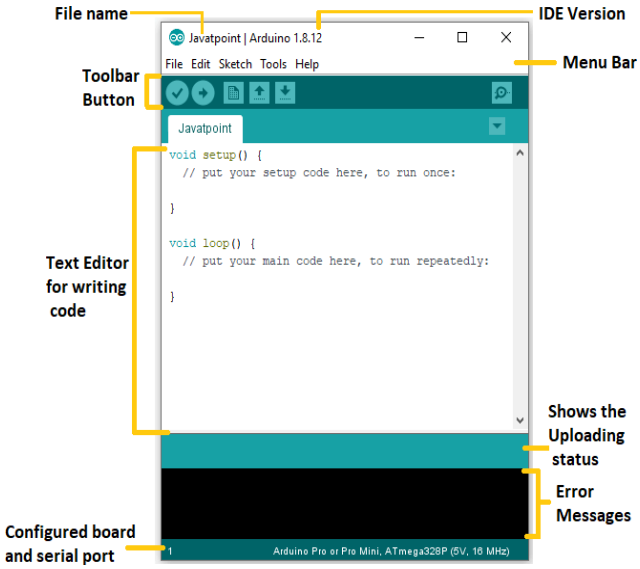

Fig:Image of Editor Window of Arduino

Blynk

Blynk provides a comprehensive ecosystem of software tools and services designed to simplify the development of IoT applications. It consists of a mobile app, a cloud platform, and a library of supported hardware. The Blynk mobile app, available for both iOS and Android devices, serves as the user interface for controlling and monitoring IoT projects. Users can create custom dashboards with widgets such as buttons, sliders, graphs, and displays to interact with their devices. Blynk's cloud platform acts as a bridge between the mobile app and IoT devices, facilitating real-time communication and data exchange. It provides secure connectivity over the internet and allows users to remotely control and monitor their projects from anywhere in the world. Blynk supports a wide range of hardware platforms, including popular microcontrollers such as Arduino, Raspberry Pi, ESP8266, ESP32, and others. It offers a library of code examples and libraries that developers can use to integrate Blynk functionality into their projects seamlessly.Blynk's mobile app features a drag-and-drop interface that allows users to create custom user interfaces for their IoT projects without writing a single line of code. Widgets can be easily added, configured, and arranged on the dashboard to create intuitive and visually appealing interfaces.

Blynk's cloud platform enables cloud-based development and deployment of IoT applications, eliminating the need for users to set up and manage their own servers. Projects can be easily shared with collaborators or made public for others to use and modify. Blynk prioritizes security and privacy, implementing encryption and authentication mechanisms to protect user data and ensure secure communication between devices and the cloud platform. Blnyk's sorting machines are designed for scalability, capable of handling different types and sizes of items while maintaining high sorting rates. Blnyk's solutions revolutionize the sorting process, enhancing productivity and product quality for businesses worldwide.

3. SUMMARY

The intelligence color sorting machine project encompasses research, design, development, and implementation phases. It involves collaboration between engineers, data scientists, and industry experts to create a robust sorting system. Key components include the selection of high-quality sensors, the development of precise algorithms for color recognition, and the integration of user-friendly interfaces for operators. Throughout the project, rigorous testing and optimization are conducted to ensure the machine's reliability, accuracy, and efficiency in various operating conditions. The end result is a cutting-edge solution that revolutionizes the sorting process in industries, improving product quality, reducing labor costs, and minimizing waste.

Scalability is prioritized, accommodating different items and sizes while optimizing speed and throughput. Integration with existing production lines, user training, and sustainability considerations are central. Partnerships with industry stakeholders provide valuable feedback, guiding customization to meet specific market needs. Future enhancements may include defect detection, size sorting, or advanced imaging capabilities for enhanced quality control.

4.RESULTS AND DISCUSSION

An IoT-based color sorting machine utilizes various components to automate the sorting process according to object color. A color sensor, like the TCS3200, identifies the object's color. This data is then relayed to a microcontroller, such as the Arduino Nano, which makes a decision based on the color. A signal is then sent to a motor driver, controlling a stepper or servo motor to divert the object into the designated bin. The system can be further enhanced with an IoT platform like Blynk Cloud for remote monitoring and control via smartphone app. This technology offers increased efficiency, accuracy, and product quality while reducing labor costs.

Fig :Image of colour sorting machine

5.CONCLUSION

We've developed a prototype utilizing a microcontroller to automatically sort color discs into respective color pots. This setup aims to minimize human effort and errors. The circuit includes an ESP32,TCS3200 color sensor, stepper motor with driver, and servo motor. Upon power-up, the stepper motor positions the color disc above the TSC230 sensor. After sensing the color, , the servo motor moves the disc to the corresponding color pot using a sliding platform. All motors are controlled by the microcontroller. The prototype, built according to the circuit diagram. yielded expected results, effectively sorting the discs with the assistance of the colour sensor and motors.

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