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IOT based Automated Object Colour Sorting and Counting System

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Abstract: In current era, each and every process in different sections of industries such as manufacturing, processing, packaging sections, etc. are being revolutionized with automated systems, due to certain drawbacks in the manual system. The aim of the system is to reduce the drawbacks of the manual system such as low accuracy, low consistency, high expenses, etc. The proposed system sorts and counts objects based on their colours and the collected data is transferred to the cloud. In this system NodeMCU is being used as control unit and transmit the entire process.TCS3200 colour sensor is used to sort out the objects and are being directed with the help of servo motor.
Keywords: IOT, NodeMCU, TCS3200, colour shorting, Photodiode.

I. INTRODUCTION

Industrial processes are well refined with the help of automated system due to the drawbacks of the manual system [1][2][3]. The manual system of sorting objects is based on manpower. Human are highly capable to differentiate objects colours and to sort them. But repeating the same process may cause irritation and mental stress which can lead to certain manual errors such as low accuracy, low efficiency, etc. To reduce production time and to increase quality automated systems are being used [4][5]. The proposed system is able to sense, sort and count objects based on their colours and to display them in LCD display and stored using Cloud. It transfers the different coloured objects to different containers for several number of times.
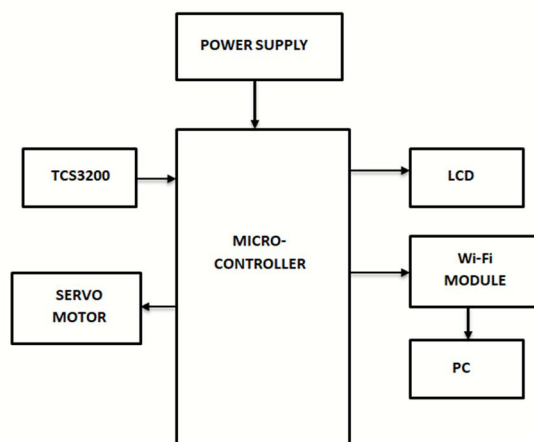
II. BLOCK DIAGRAM

Figure 1 : Block Diagram

III. BLOCK DIAGRAM EXPLANATION

A. Colour Sensor

Figure (1) shows the TCS3200 colour sensor which is used as input colour sensing module. The sensor consists of 8x8 matrix array of 64 photodiodes in it. These 64 are classified with four filters such as 16 RED filter, 16 GREEN filter, 16 BLUE filter and 16 clear photodiodes. It consists of a Current to Frequency convertor for converting the output current of photodiodes to corresponding frequency [6][7].

When a coloured object is placed before the sensor, the four LEDs in sensor illuminate the object. At the same time, the four types of photodiodes are being powered consecutively in order to sense the intensity of the light reflected from the object and creates a variation in the output current of the photodiodes [8][9]. The intensity sensed by photodiodes will differ in accordance to their filter. Then the output current is being converted into frequency with the help of current to frequency convertor.

Figure 2: TCS3200 Colour Sensor

B. NodeMCU

The NodeMCU firmware is used for the overall control of the system figure (3). It consists of a build-in Wi-Fi chip ESP8266 to transmit data.
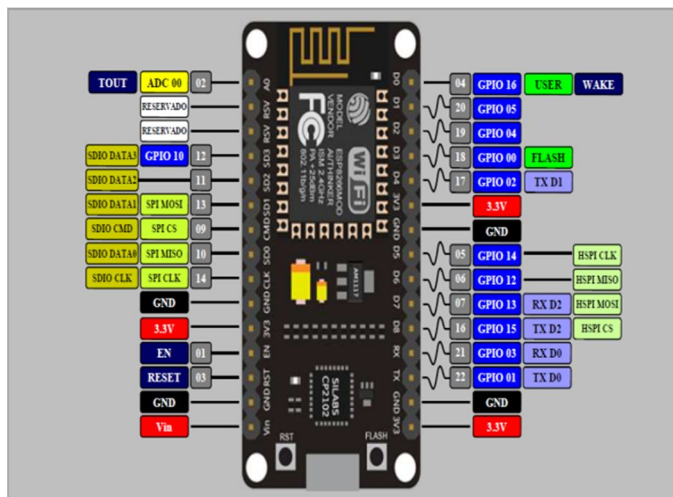

Figure 3: NodeMCU

NodeMCU consists of 128Kbytes of Memory and a storage space of about 4Mbytes. It consists of 17 GPIO pins where only 13 GPIO pins can be used by the user. It also has a single Analog input pin (A0). It consists of a inbuilt ESP8266 Wi-Fi chip in order to transmit or receive data [10].

In this system it receives the input signal from sensor and recognizes the colour and transmits them to the cloud through inbuilt ESP8266 Wi-Fi chip and also displays them in LCD Display.

C. LCD Display

The display composed of 16 characters and 2 line LCD display with a blue backlight and white characters with which each character is composed of 5x8 dot-matrix for character representation figure(4). The display incorporates an I2C interface that requires only 2 pins on a microcontroller to interface with and it has good library support to get up and running fast.   The I2C interface is a board attached to the back of the LCD module. It consists of a potentiometer to control the backlight of the LCD display.

Figure 4: I^{2}C LCD Display

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D. Servo Motor

The Servo motor which shown in figure (5) is interfaced with the NodeMCU and is used to stop and direct the incoming different coloured object which is sensed by the sensor to the corresponding colour containers.
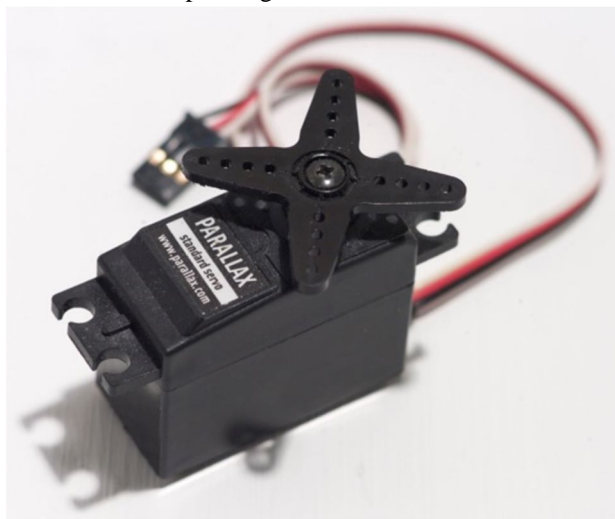

Figure 5: Servo Motor

A servo motor is a rotary actuator that allows for a precise control in terms of angular position, acceleration and velocity. The servo motor uses position feedback in a closed-loop servo-mechanism to control its rotational speed and position [11]. The input control signal is either analog or digital, which represents the final position command for the shaft.

E. Arduino IDE

In this system, the controller NodeMCU is being programmed by using Arduino IDE. The Arduino IDE is a cross-platform application for Windows, macOS, Linux, etc. The Arduino IDE contains a text editor, a message area, a text console and a toolbar. The programs written in Arduino IDE are similar to C++ and are called as Sketches. These sketches are stored with **.ino** extension file format [12].

F. IoT [Internet of Things]

The internet of things is a system which enables devices to communicate with each other without any manual interaction for transferring data over network. A thing in IOT represents any computing devices, mechanical and digital machines, objects and person provided with an unique identity [13]. Data of the devices or things connected to IOT can be stored and accessed through internet. In this system, the processed data such as colour and count of the object are being transmitted and stored to the cloud.

IV. WORKING PRINCIPLE

Figure (6) shows the circuit diagram of the implemented system. When the system is being powered on, the system initializes the connected components. Then the objects which are to be sorted are fed to the system. A servo motor is fixed near the colour sensor in order to hold the object against the colour sensor for sensing colour if the object. The TCS3200 Colour sensor lightens the object by the inbuilt LED and sense the colour with the help of photodiodes in the sensor which creates a variation in output current in accordance with the reflected light intensity of the object. This variation in current is then converted into different frequency square wave signal and sent to the controller.

The NodeMCU receives the input frequencies from TCS3200 and recognizes the colour based on the frequency combination provided by the TCS3200 for various filtered photodiodes. Then the controller transmits data to the cloud through the inbuilt ESP8266 Wi-Fi module and also displays them in the LCD module. At the same time another servo motor changes the output path which leads the object to the container corresponding to the object colour. Then the first servomotor will release the sensed object and blocks the next object to repeat the above process.
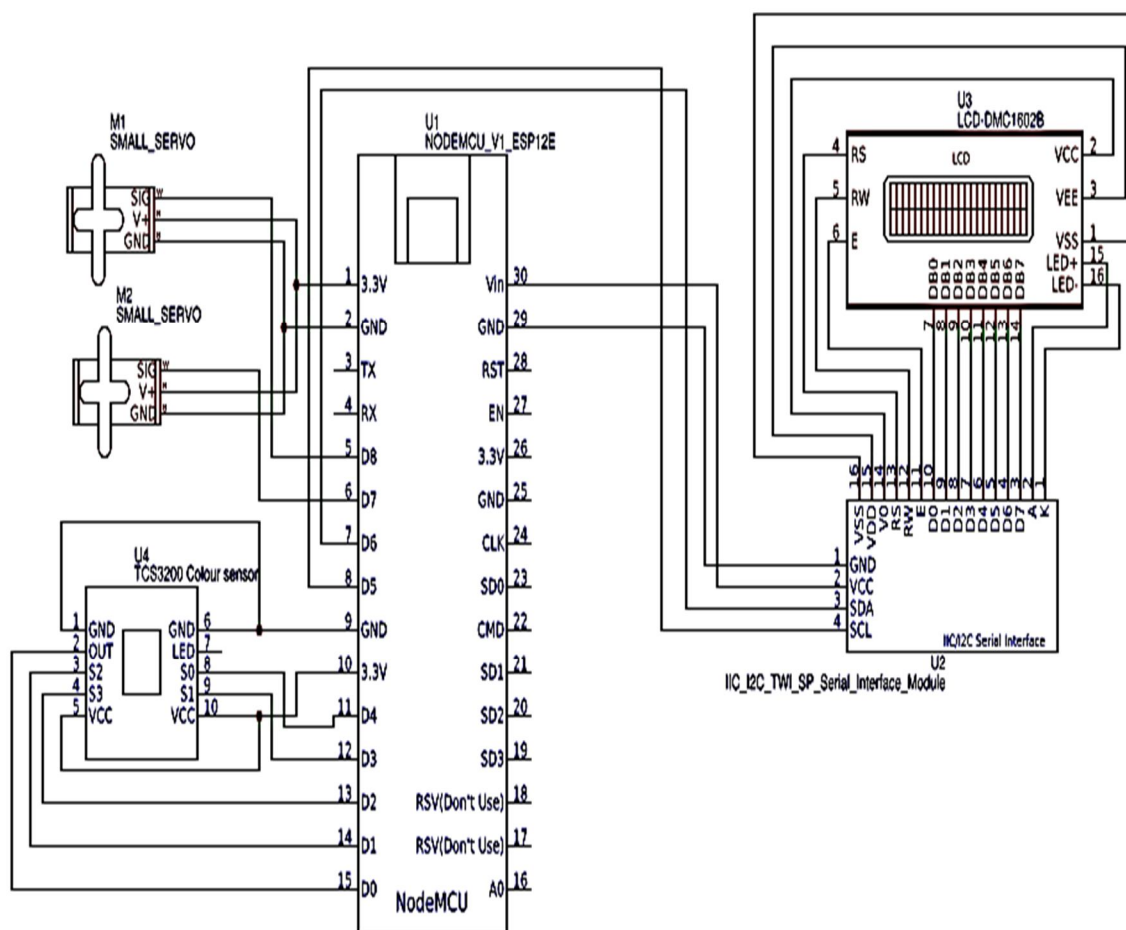
Figure 6: Circuit Diagram

The incoming objects are sorted based on their colour and are being directed corresponding containers. The colour and count of the each detected object are being displayed in both LCD display and transmitted to webserver. The proposed system can be further developed by adding cameras at the sensing section and using image processing techniques which can improve the accuracy of the system and also helps the user to gather additional details about the object [4]. We can also add load cells to the system in order to find the weight of the objects [6]. A robotic arm can also be used at the output section for directing objects to the corresponding containers.

The proposed system can also be used in the industries with different applications which are mentioned as follows:
A. With slight modifications the system can able to identify the coated colour accuracy and detect damages of clothes in textile industries and also can able to detect cracks and defects on an object surface [4].
B. Detect the rotted or damaged fruits and vegetables in food industries [7][14].
C. Categorizing different coloured objects to different or single package in the industrial packaging section.
D. The roasting or cooking level of food products can also be identified.

V. CONCLUSION

The proposed system is an inexpensive system with which even small scale industries can able to get updated with the automated system. With the help of this the sequence of objects can be sorted in basis of colour which can reduce the manpower and time in industries. Since the information of the objects is being displayed in LCD display and web-server it is easy for the person who supervises the system.

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