International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 7, Issue 12, December 2018 ISSN 2319 - 4847

An Efficient Automated ColourBased Customized Product Collation System

J. Pradeep[1], A. Lakshmi Narayanan[2], M. Harikrishan[3],S. Pushparaj[4] and K. Uthayasuriyan[5]

Department of Electronics and communication Engineering
Sri ManakulaVinayagar Engineering College, Pondicherry, India

ABSTRACT

In industries, the process of collating a product in manual operation, it consumes more time and also it occupies more storage space. In this paper, a colour based automated collation system is proposed, by means of considering the number of product count based on the customers need for the machine perform. The colour identification is done with the help of ambient proximity digital sensor, which execute through combination of RGB (red, green, blue) in presence of surrounding light conditions. The count of a product is calculated using IR sensor, when it moving through the conveyor belt.At last the products is collected through stepper motor which rotates a disk. In the paper, the system uses three colour products with four boxes in the rotating disk for collecting the particular colour in the mentioned boxes. Out of four boxes, three boxes for the different colour product and remaining one box for the excess product in line. The proposed system is design and implemented using raspberry pi board. The obtainedresultsarediscussedand it is compared with other colour sensor based system.

1. INTRODUCTION

In the manufacturing industries, varieties of products were manufactured in the production unit. But, still the most important challenge is to handle the products. When it isleaves from the production unit and it movestowards the packing unit. Now, the main issue is that the operations of the man power in the collection of the various products for the packing. Finally, the products are sealed and placed in the warehouse. Moreover, numerous human errors will occur during the collection products.In order to avoid this errors, the industries use fixed packages for collecting the product and finally it packing. In the case, the manufacturer is produced the same product with different varieties. For this, the industries use different method to handle the product. In earlier stage, thevarieties product was placedin the different conveyor line for the collection products. It occupies more space because of multiple conveyor line for the collation of different varieties of products [2] - [4].

In the literature, many related works are discussed with the theoretically results and few related works are explained with prototype for the collection of the varieties of product. For the varieties of product collation, the existing systems are used the different colour sensor. Initially, the products are moving from one end to another end using conveyor. The purpose of the colour sensor is used to identify the colour of product based on that the varieties of product are sorted. After that, the productsare collated at the end line, this type of work are done using controllers [5] - [8]. The controllers are the masters of the system to activate the signals for performing the task. In the existing prototype, the different types of automated setupswere used for collation of the varieties of product. Even though, the resolution is made, still various draw backs are found in the performance. Essentially, the industries are needs to save the time and cost with more accuracy in performance. Toattain the good quality performance, the automation is used for the disposes the production outcome in specify period. It should useful for industries. In this paper work, the optimized solution is suggested for collation of varieties of the product and the working prototype is discussed briefly in the remaining section of the paper.

2. LITRATURE SURVEY

Many researches are implemented different colour sorting machine in the literature and some of the related works are discussed in this section. In the existing work [9] - [10], Himanshu Patel and Riya Joy implemented an idea for sorting a product based on its colour and then it is collected in the respective baskets. TCS3200 colour sensor is used for sensing the product colour and, for the product collection using servo motor.Sattomhalder*et al* proposed an automatic coloursorting machine. In this work, the objects are moved through a conveyor belt and it is sensed the red and green colour only with help of LDR. Finally, the products are collected to right or left from conveyor using the servo motor[11].In the paper [12], Automatic Colour Sorting Machine is designed and implemented. In this work, two

conveyors belts were used for, moving the product from one place to another place and the other conveyor for collect the product. a DC motor is used for moving in forward and reverse direction in the conveyor.
An automatic multi-colour sorting and counting machine is proposed in the paper [13]. The colour objects are identified with the help of TCS3200 colour sensor and the products are sorted with using robotic arm and the count of total number of sorted product is calculated. The arm is mainly used for pick and drops the product and it returns to its initial position for the next sort. Rudresh and shubha proposed a Colour Sensor based object sorting Robot. The colour sensor and robotic arm are used for sorting the product [2]. In the existing systems, the researchers were explored different approaches for colour sorting machine. In their systems, different sensors and different motors for collecting the products are used. In order to reduces the complexity of existing system and to improve the performance of the system,an Efficient Automated Colour Based Customized Product Collation Systemis proposed. In this paper ambient proximity digital sensor is used for improve the efficiency of the system.in order to reduce the complexity of the system, a Stepper motor and a rotating disk is adapted for collecting the product. The process starts with entering the count of the product in the terminal box and the colour count of the products is identified using IR sensor. Finally, the product falls into the corresponding collation box among four boxes used in the proposed system. The obtained results are discussed in the corresponding section in the below paper.
The rest of the paper as follows as below.Section 3 presents the methodology of the proposed system. In section 4, the architecture of the proposed system and in Section 5,the components of the proposed system are discussed. Section 6 discusses the results and analysis of the proposed system. The performance comparison of the proposed system is discussed briefly in section 7. Finally, the paper is concluded in section 8.

3. Proposed System Methodology

The package stage of any concern; a person collects the various products at end of the line for packaging and then it is sealed. Finally, it kept in warehouse. In this process, the manual operation takes more time and it consumes man power. In order to reduce the time and manpower, an optimum solution is executed for the collation of various products in a single package without the manual operation. The execution of the process is explained through a flow chart and it is shown in the Fig.1

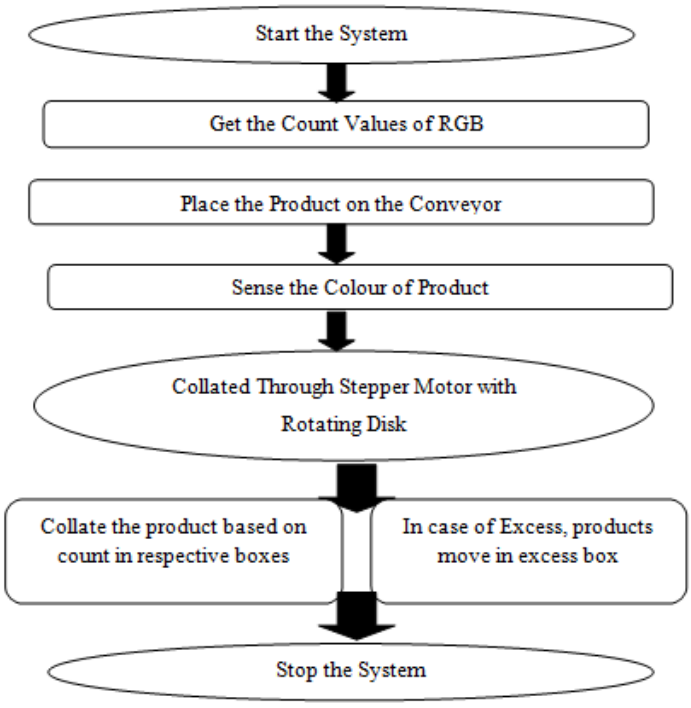


Fig.1 Proposed System Methodology

4. Architecture of the Proposed System

The block diagram of the proposed system consists of conveyor setup, raspberry pi, colour sensor, stepper motor, collecting boxes and power supply. The process starts with entering the count of the product in the terminal box of Red, Green and Blue and then the product is kept in the conveyor belt one after another. A colour sensor is placed in the end

of the line and the products passes through it, which identifies the colourof the products based on temperature presence on the product along surrounding light conditions. Finally, the colour count of the products is identified using IR sensor. After identifying the count of the products, it falls into the corresponding collation box among four boxes used in the system. It automatically collating the product depends on the colour of the product which sensed by the sensor. After the products fall on the respective boxes R, G and B. If any excess productspass, then it collated by the excess box. The block diagram of the proposed system is shown in Fig.2.

.

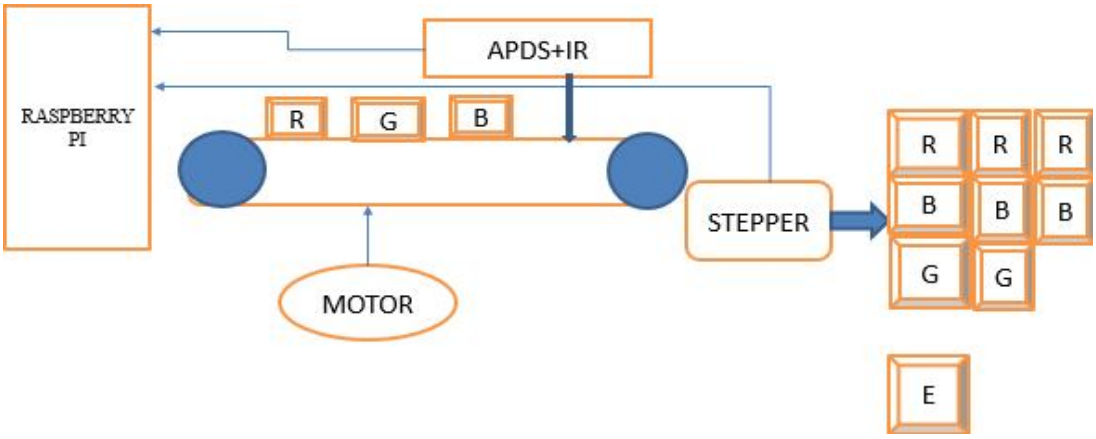


Fig.2 The block diagram of the proposed system

5. Description Components for the Proposed System

5.1 Raspberry Pi Broad:

Raspberry Pi Broad is a small device with open source and flexible platform for experimentation. It acts as like minicomputer with one gigabyte of ram and external memory installed through memory card. It needs a minimum of 8 gigabytes of memory for storage and booting the operating system. It contains of 40 pins for connecting the hardware for General Purpose Input/output Pins (GPIO), inter-integrated circuit, serial peripheral interface, universal asynchronous receiver/transmitter. It also contains of 4-universal serial bus, audio jack pin, high Definition Multimedia Interface Port (HDMI), Camera Serial Interface (CSI) camera port, display serial interface (DSI) display port, micro USB power, Bluetooth and Ethernet. It runs through the open source operating system. Thus, the process of this proposed system runs through the raspbian operating system. It performs faster, compared to other types of boards and it can be easily viewed on a monitor/mobile virtually. Here, the programming's of the proposed system is written on python 3. The libraries of python 3 help to shorten the programming lines and also complicated works are reduced. The Raspberry pi is shown in Fig.3

Fig.3 Raspberry pi

5.2 Colour Sensor:

In order to identify the colour of the product, ambient proximity digital sensor is used in the paper. The sensor consists of 6 pins namely Voltage pin(Vcc), Interrupt pin, serial clock (SCL) & serial data (SDA) pins, Voltage Trigger(VT) and ground pin. The sensor voltage is about 3-3.3vIt passes the 16-Bit data instantaneously and it senses

the colour at a distance of 6-10 cm. The inter-integrated circuit pin contains serial clock (SCL) & serial data (SDA), which performs through pull up resistor for enabling bidirectional operation.The sensor detects the intensity of Red (R), Green (G), Blue (B) and Clear(C) in order to sense the temperature of the product colour and it depends on the combination of red, blue and green with presence of surrounding light. It uses infrared blocking filter and ultraviolet blocking filter for determining the colour of the product accurately. It passes the 16-bit data instantaneously and it senses the colour from the distance of 6-10 cm. The colour sensor is shown in Fig.4

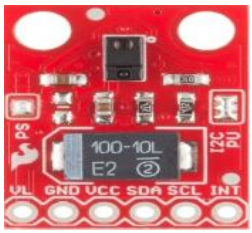
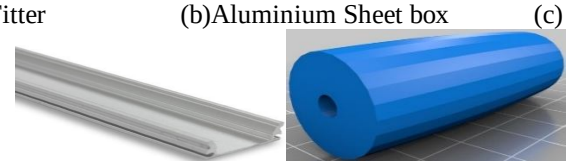


Fig.4 Ambient Proximity Digital Sensor

5.3 Conveyor Setup

For carrying, the product from one end to other ends is used in the paper. It is made up of 3D-designed rollers, motor fitter & angle holder and these items are joined with the help of aluminum steel sheet and aluminum angles, which are mentioned in Fig.5.The rollers are joined tightly with belt and then connected it through pulley for rolling the motor. Sensor unit setup made of aluminum sheet box. The sensor and two LED strip are placed in the top of the sensor unit box and the infrared sensor emitter & receiver are placed, in such way that it faces opposite to each other on the sides of the sensor unit box. Finally, the sensor unit box is placed over the conveyor as shown in Fig.6.

(a) Motor Fitter (b)Aluminium Sheet box (c) Angle Holder



(d)Aluminium angle (e) Roller

Fig.5 3-DModule and Aluminum Sheets

Fig.6 3-D Module and Aluminum Setup

5.4 Infrared Sensor

The count of products is identified using the infrared sensor in the paper. It has three pins, namely supply pin, ground pin and output pin. It also has two LEDs, emitter LED and receiver LED which is kept at sensor unit box. The emitter and receiver LED are placed opposite to each other for the counting of the product, whenever the product moves across the emitter and receiver LED in the exposed in Fig. 6 and the infrared sensor is shown below in Fig .7.

Fig.7IR Sensor

5.5 Collation Setup

In the collation process, a disk consists of boxes for collating the products with the help of stepper motor with motor driver, which is connected to raspberry pi broad. It has capable to rotate the disk in360 degrees direction and the step size depends on the product. In this work, the boxes are kept in both clockwise and counter clockwise direction rotates with the step size of 5 degrees in order to collect the products.The collation setup for the colour sensor based product collation system is shown in Fig. 8

Fig.8 Collation Set

6. RESULTS AND ANALYSIS

The colour based automated collation system is designed and implemented in the paper.Theperformance of the system is totallybased on product count and colour detection. Initially the count values of Red, Green, Blue products areentered onthe terminal box as shown in Fig.9. The input value of red, green and blue products should be filled in terminal box by the user. After entering the values of respectiveproducts. The system operation runs in a smarter manner due to the count of the products for the package is initialized at the beginning itself.

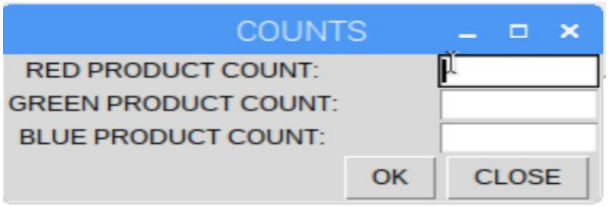


Fig.9 Terminal Box

When the products start to moves from one end to other end of the conveyor. The colour of products is detected at the sensor unit from the distance of 6 cm. Generally, the product colour is depends on the combination of the primary colour Red, Blue and Green colour. In the proposed system, the sensor identifies the colour from the three colour combination and the result is discussed below.

For red colour product, the value of red is high among the primary colour Red, Blue and Green values and it is shown in Fig.10, Similarly for the green colour product, the value of green is high of all the values of Red, Blue and Green and the values is shown in Fig.11. Finally, the value of blue is high from the combination of Red, Blue and Green values and the values are shown in Fig.12.

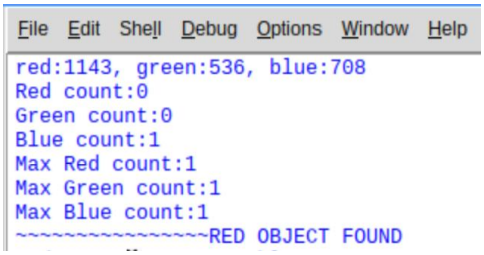


Fig.10 Red Colour Product Detected

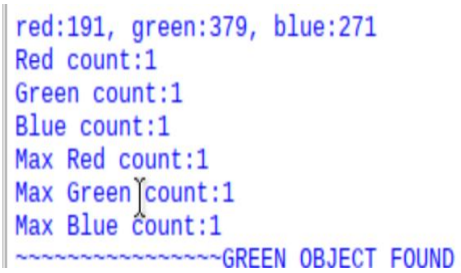


Fig.11 Green Colour Product Detected

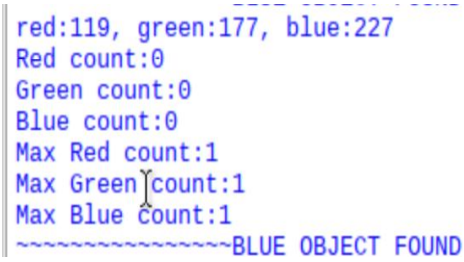
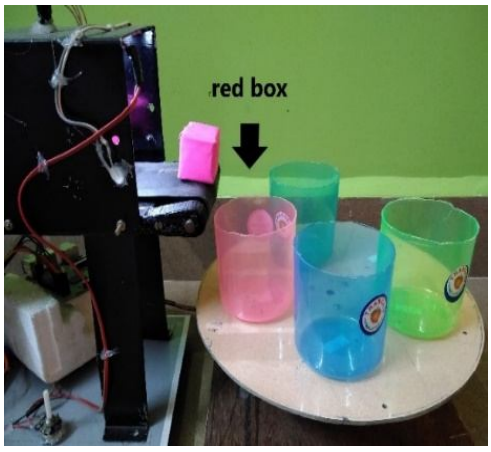
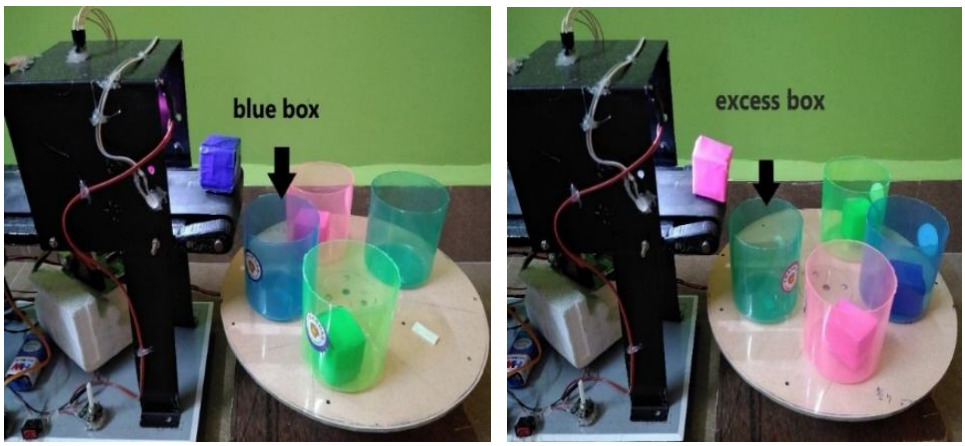


Fig.12 Blue colour Product Detected

After identifying the colour of the products, the count of the product is calculated using the infrared sensor kept on the sensor unit box. The final stage of the proposed system is product collating stage. The products collation is based on count value and the colour of the products. Thedisk rotates for collating the product with the help ofstepper motor. The products fall automatically into the respective colour boxes based on its colour of the product sensed previously. The products fall in the respectivecolour boxes in more accurately and efficiently. The probability of the error is negligible in the product collation. In case of excess product is found and it is moved to the excess boxes. The products collation on the respective boxes is shown in the Fig.13. The proposed and implemented colour based customized product collation systemshown in Fig.14.



(a) Red Colour Product Collation (b) Red Colour Product Collation



(c) Red Colour product collation (d) Excess Colour product collation

Fig.13 Products in Respective Boxes

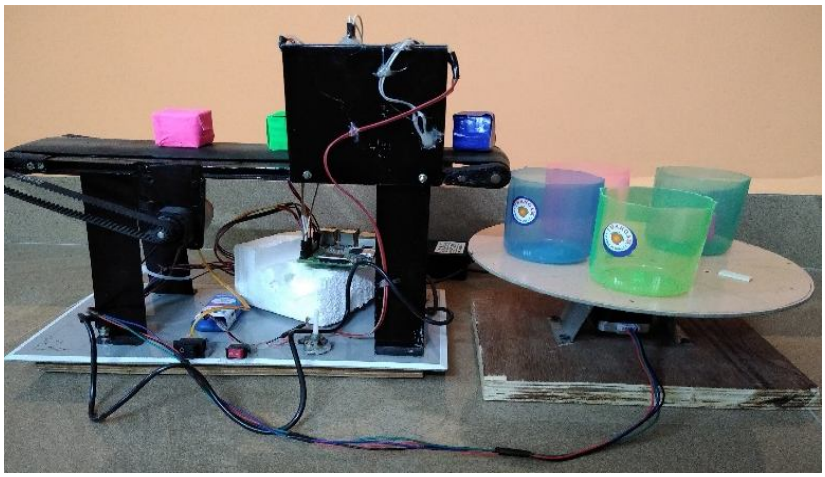


Fig.14 The proposed automated colourbased customized product collation system

7. PERFORMANCE COMPARISON OF THE PROPOSED SYSTEM

In existing system [11], the major drawback is light ambiance and the conveyor method for product collation is not more efficient. Moreover, it occupies more space. In another work [10], the sensing of the product colours poor due to it covers in broad range. In order to overcome these issues, an optimized solution is proposed in this paper and the results obtained are also discussed in above section. The main advantage of the proposed system is that, it senses the product colour in a wide range and it covers a distance of 6 cm. Moreover, it easy to implement for cheap cost with the fixed light ambiance. In order to verify the result TCS3200 sensor is used for determining the distance parameter and obtained sample results is show in Fig.15.The performance comparison of the proposed system with the existing system is tabulated in the Table.1 and it is shown below.

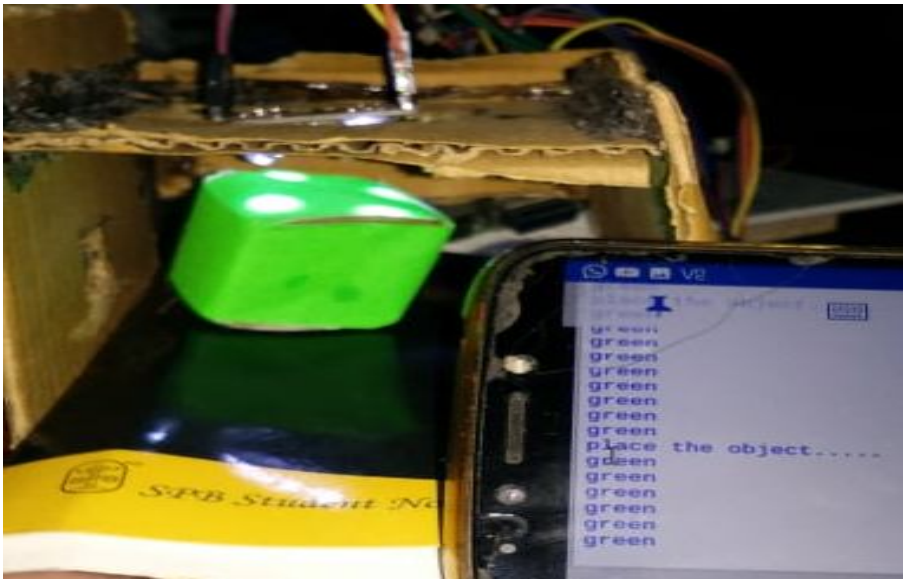


Fig.15 Sorted of Green Colour Using TCS3200

Table1.1 Comparison of Performance

Sl. No	Sensing Parameters	Sensor in the Existing Systems (TCS3200 and TCS230)	Sensor in the Proposed System (Ambient Proximity Digital Sensor)
1	Distance	1 - 2.5 cm (it operates in narrow region)	6 cm (it operates in wide range)
2	Insertion of the product	The product should be center of the conveyor facing toward the sensor for the sorting colour	No limitation.
3	Motors	➢ Dc motor is used for sort the product and it capable to move in forward and reverse direction and it won't stop in exact position ➢ Servo motors is used for sort the product and it is able to rotate in 180 degree of direction. But the major drawback is that, the micro steps size variation is not possible.	Stepper motor to collate a product and it has ability to cover in 360 degrees' direction with micro step size variation.
4	Conveyor	Two conveyor setup is used, one for the product collection and the for the carrying of the product	Only one conveyor setup is used for the carrying of the product and a disk is used for the product collection
5	Light Ambiance	Variation in Light Ambiance	Fixed Light Ambiance is used
6	Techniques used	Directly place and sort the object based on colour of the product	The counts of colour product should be entered by the user then; the system begins its performs for the task in smarter way.

8. CONCLUSION

The colour sensor based product customized and automated collation system is designed and implemented in this paper. A prototype of working model is done in an efficient approach and the performance of the system is tested with various inputs of the colour product counts. Its outcomes are more accurate and it recognizes the colour of the product in presence of surrounding lights.Moreover, it accurately counts the colour of the products and it is collated to the respective boxes. In case of any excess products, it is moved to the excess box. Finally, the performance of the system is compared and it outperformswell compare with other systems. In the future work, the machine learning techniques should be adapted for the learning the sensor for various colour products in the different light condition, and it operates more reliable.

REFERENCES

[1] NilimaBargal, Aditya Deshpande, Rucha Kulkarni and RuchaMoghe, "PLC Based Object Sorting Automation", International Research Journal of Engineering and Technology, vol.03,no.07,pp.103-108,2016.

[2] Rudresh.H.G,and Prof. Shubha.P,"Colour Sensor Based Object Sorting Robot",International Research Journal of Engineering and Technology,vol.04, no.08,PP.504-507,2018.

[3] Biles, William E., John S. Usher, and Magd E. Zohdi. "Chapter 10: Material Handling." In Mechanical Engineers' Handbook: Manufacturing and Management, Third Edition, by MyerKutz, vol.3, pp.360-36, 2006.

[4] Bozma and Yal-cin, "Visual processing and classification of items on a moving conveyor: a selective perception approach", Robotics and Computer Integrated Manufacturing, vol.18, no.2, pp125–133, 2002.

[5] W. Fritzsche and J. Popp, "Optical Nano and Microsystems for Bioanalytics", Springer Series on Chemical Sensors and Biosensors, vol.10, pp. 3–46, 2012.

[6] SelinMacwan and Hardik Modi, "IOT Colour Based Object Sorting Machine",International Journal of Applied Engineering Research,vol.13, no.10, pp. 7383-7387,2018.

[7] Bee, S. C., and M. J. Honeywood. "Colour sorting for the Bulk FoodIndustry", in Colour in Food: Improving Quality, Cambridge: Woodhead Publishing Limited by Douglas B.MacDougall, pp.115-117., 2000.

[8] P. D. Oram and J. Strine, "Colour measurement of a solid active pharmaceutical ingredient as an aid to identifying key process parameters", J. Pharm Biomed Anal, vol.40, pp. 1021-1024, 2006.

[9] Himanshu Patel and Riya Joy, "IOTColour Based Object Sorting Machine", International Journal of Applied Engineering Research, vol.13, no.10, pp7383-7387.

[10] SnehalShirgave, AishwryaSalunkhe, Khadija Shirgave and S. Y. Upadhye, "Color Sorting Robot", International Journal of Advanced Research in Computer and Communication Engineering, vol. 6, no.3, March 2017.

[11] SattomHalder, Md. KamrulIslam, Mahmood Sabria Chowdhury and S. C. Banik, "Development ofan Automatic Colour Sorting Machine On Belt Conveyer", International Conference on Mechanical Engineering and Renewable Energy, 2013.

[12] Kunhimohammed C. K, Muhammed Saifudeen K. K, Sahna S, Gokul M. S and Shaeez Usman Abdulla, "Automatic Colour Sorting Machine Using TCS230Colour Sensor and PIC Microcontroller", International Journal of Research and Innovations in Science and Technology, vol.2,no.2 ,2015.

[13] AmiteshaSachdeva, Mahesh Gupta, Manish Pandey and PrabhamKhandelwal, "Developmentof Industrial Automatic Multi Colour Sorting and Counting Machine Using Arduino Nano Microcontroller and TCS3200 Colour Sensor", International Journal of Engineering and Science, vol. 6, no.4, pp. 56-59, 2017