

Development of Automatic Product Sorting Machine Using Internet of Things

Submitted in fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechatronics

by

Rahul S (39090042)

Tharun Kumaar R (39090058)



**DEPARTMENT OF MECHATRONICS
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY - 2023

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DEPARTMENT OF MECHATRONICS

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **S.Rahul (39090042), R.Tharun Kumaar (39090058)** who have done the project work entitled "**Development of Automatic Product Sorting Machine Using Internet of Things**" under our supervision from June 2022 to May 2023.

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Mr. M. AMARNATH, M.E.,

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Submitted for Viva Voce examination held on ____ May 2023

Internal Examiner

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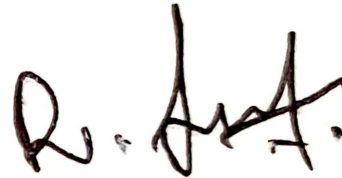
DECLARATION

We, **S.Rahul (39090042)** and **R.Tharun Kumaar (39090058)** hereby declare that the Project Report entitled “**Development of Automatic Product Sorting Machine Using Internet of Things**” done by us under the guidance of **Mr. M. Amarnath, M.E.**, is submitted in fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

1.



2.



DATE: ____ May 2023

PLACE: Chennai, Tamil Nadu

SIGNATURE OF THE CANDIDATE

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ABSTRACT

In this paper, we present an automated parcel sorting system that makes use of image processing rather than time consuming and laborious manual methods. Image data captured by a Pi Cam is fed into an image processing system, where text labels, shapes, and colors applied to the products are identified. The proposed approach makes use of Optical Character Recognition (OCR) powered by Raspberry Pi. Analysis of performance indicates a detection accuracy of 80% for both QR and Bar codes. In addition, the IoT-based app shows the sorted response in the end. Automatic search, filtering, inspection, image processing, and text recognition are all included in this index. This project presents the design and implementation of a product sorting machine using a Raspberry Pi microcontroller. The machine is designed to sort small objects based on color and shape, and it can be used in a variety of industrial and commercial applications. The sorting machine is composed of a conveyor belt, a camera module, a Raspberry Pi, and several sensors and actuators. The conveyor belt moves the objects to be sorted under the camera, which captures images of each object. The Raspberry Pi uses machine learning algorithms to analyze the images and classify the objects based on their color and shape. The sorted objects are then separated into different bins using pneumatic actuators controlled by the Raspberry Pi. The system is designed to be flexible and customizable, with the ability to sort different types of objects by simply changing the machine learning model and adjusting the sorting parameters. The Raspberry Pi also provides a user interface for monitoring the sorting process and configuring the system.

TABLE OF CONTENTS

Chapter No	Title	Page No
	ABSTRACT	v
	LIST OF FIGURES	ix
	LIST OF ABBREVIATIONS	x
1	INTRODUCTION	1
	1.1 TYPES OF SORTING MECHANISM	5
	1.1.1 Color identification and sorting	5
	1.1.2 Image processing	6
	1.1.3 Arduino based product sorting	7
	1.1.4 PLC based product sorting	8
	1.1.5 Matlab based product sorting	9
	1.2 SELECTION OF PRODUCT SORTING EQUIPMENT	10
2	LITERATURE SURVEY	12
	2.1 ANALYSING THE LITERATURE	13
3	AIM AND SCOPE	20
	3.1 AIM OF THE PRODUCT SORTING MACHINE	20
	3.2 BENEFITS OF PRODUCT SORTING MACHINE	21
	3.2.1 Increased Efficiency	21
	3.2.2 Improved Accuracy	21
	3.2.3 Cost Savings	21
	3.2.4 Versatility	21

	3.2.5 Improved Safety	21
	3.2.6 Scalability	22
	3.2.7 Quality Control	22
	3.2.8 Consistency	22
	3.2.9 Reduced Downtime:	22
	3.2.10 Data Collection	22
	3.3 FUTURE SCOPE OF PRODUCT SORTING MACHINE	23
	3.3.1 Automated sorting in warehouses	24
	3.3.2 Improved supply chain efficiency	24
	3.3.3 Enhanced data monitoring	24
	3.3.4 Integration with AI and machine learning technology	24
	3.3.5 Development of Robotic Sorting Machines	24
	3.3.6 Expansion of Applications	24
	3.3.7 Integration with IoT Big Data Analytics	25
	3.3.8 Development of Sustainable Sorting Machines	25
	3.3.9 Enhanced Sorting Capabilities	25
	3.3.10 Adoption of Autonomous Sorting	25
	3.3.11 Use of Virtual and Augmented Reality	25
4	EXPERIMENTAL SETUP AND METHODOLOGY	26
	4.1 EXPERIMENTAL SETUP OF THE PROJECT	26

	4.2 STRUCTURE AND OPERATION	27
	4.3 MATERIALS AND COMPONENTS USED	29
	4.3.1 Raspberry Pi	29
	4.3.2 Pi camera	31
	4.3.3 MG 995 servo motor	32
	4.3.4 LCD display	33
	4.3.5 LED lights	34
	4.3.6 DC motors	35
	4.3.7 Conveyor Belt	36
	4.3.8 Ultrasonic Sensor	37
	4.3.9 Cables and Connectors	38
	4.3.10 Relay	39
	4.3.11 Push Buttons	41
	4.3.12 Screws and Joints	42
	4.3.13 IOT Applications	43
	4.3.14 Image Processing	44
	4.3.15. Open CV	45
	4.3.16. Detection Mechanism	46
5	RESULTS AND DISCUSSION	47
	5.1. RESULTS AND DISCUSSION OF PRODUCT SORTING MACHINE	47
	5.2. PERFORMANCE ANALYSIS OF PRODUCT SORTING MACHINE	48
	5.3 OUTCOME OF THE PROJECT	49
6	SUMMARY AND CONCLUSIONS	50

6.1 SUMMARY OF PRODUCT SORTING MACHINE	50
6.2 CONCLUSION	51
REFERENCES	53
ANNEXURE	55

LIST OF FIGURES

Figure No.	Title	Page No:
1.1	Reference image of existing sorter mechanism	3
2.1	Flowchart of the Project	14
4.1	Experimental setup of product sorting machine	26
4.2	Automatic Sorting Device Based on Block IoT	27
4.3	Circuit Diagram	28
4.4	Raspberry Pi	30
4.5	Pi camera	32
4.6	MG 995 servo motor	33
4.7	LCD display	34
4.8	LED light	35
4.9	DC motor	36
4.10	Conveyor belt	37
4.11	Ultrasonic sensor	38
4.12	Cables and Connectors	39
4.13	Relay	40
4.14	Push Buttons	41
4.15	Screws and Joints	43
4.16	An example of image processing	44
4.17	Open CV	45

LIST OF ABBREVIATIONS

IOT	Internet of Things
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
MATLAB	Matrix Laboratory
ML	Machine Learning
OCR	Optical Character Recognition
LCD	Light Crystal Display
LED	Light Emitting Diode
CSI	Camera Serial Interface
PWM	Pulse Width Modulation
OPEN CV	Open Source Computer Vision Library

CHAPTER 1

INTRODUCTION

Product sorting machines are an essential tool for businesses and industries that deal with large volumes of products that require sorting and categorization. These machines automate the process of sorting products, saving time and reducing labor costs. Product sorting machines come in a variety of types, including conveyor systems, vision systems, and robotic systems. Conveyor systems use a series of belts or rollers to move products to their desired location. Vision systems use cameras and sensors to detect product characteristics such as size, shape, and color, and then sort the products accordingly. Robotic systems use mechanical arms or grippers to pick up and sort products. One of the main benefits of product sorting machines is their speed and accuracy. These machines can sort products at a much faster rate than manual sorting, while also reducing errors and ensuring consistency. This is especially important for industries such as food and beverage, pharmaceuticals, and e-commerce, where speed and accuracy are critical for maintaining customer satisfaction and meeting regulatory requirements.

Another benefit of product sorting machines is their versatility. These machines can sort a wide range of products, including packages, containers, and individual items. They can also sort products based on various criteria, such as weight, size, shape, and color. This versatility makes them an ideal solution for businesses that deal with a wide range of products and require flexible sorting options. In addition to improving efficiency and accuracy, product sorting machines can also enhance workplace safety. By automating the sorting process, these machines reduce the need for manual labor, which can be physically demanding and potentially hazardous. This can help reduce workplace injuries and improve overall safety conditions. Product sorting machines also offer long-term cost savings. While the initial investment in a sorting machine may be significant, the savings in labor costs and increased productivity can result in a rapid return on investment. In addition, the accuracy and

consistency of product sorting machines can help reduce waste and prevent costly errors. Overall, product sorting machines are a valuable tool for businesses and industries that deal with large volumes of products. They offer a range of benefits, including increased efficiency, accuracy, and safety, as well as long-term cost savings. With the ability to sort a wide range of products based on various criteria, these machines are an essential investment for businesses looking to streamline their operations and maintain a competitive edge.

Sorting mechanism in products refers to the process of arranging items in a particular order based on certain criteria. This can be done manually or through the use of technology. The importance of sorting mechanisms in products cannot be overemphasized as it helps to increase efficiency in various areas such as manufacturing, inventory management, and e-commerce. There are different methods of sorting products which include alphabetical, numerical, chronological, and categorical sorting. The choice of sorting mechanism depends on the nature of the product and the purpose for which it is being sorted.

In manufacturing, sorting mechanisms help to streamline production processes, reduce errors, and improve quality control. In inventory management, sorting mechanisms help to ensure that items are located easily and quickly, reducing the time it takes to find products and improving order fulfillment. Sorting mechanisms are also important in e-commerce as they help customers find products easily and quickly, leading to increased customer satisfaction and repeat business. In conclusion, sorting mechanisms are a critical component of modern product management, and businesses must pay careful attention to the methods they use to sort their products to maximize efficiency and profitability. The Internet of Things (IoT) has revolutionized the way machines function in various industries, including product sorting. IoT technology can be integrated into product sorting machines to improve their efficiency and accuracy.

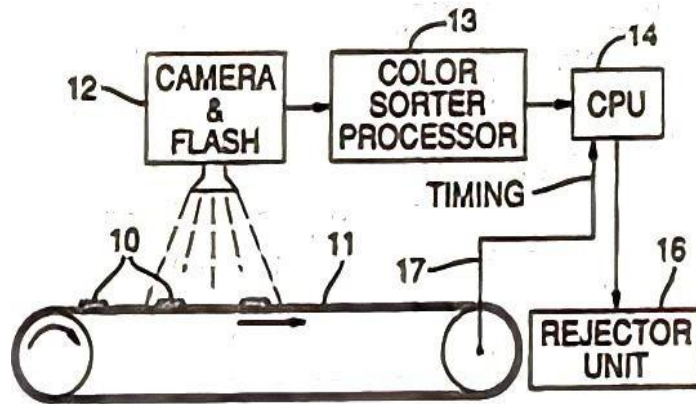


Fig: 1.1: Reference image of existing sorter mechanism

IoT technology can be integrated into product sorting machines to improve their efficiency and accuracy. By incorporating sensors and connected devices, product sorting machines can now collect and transmit real-time data about the products being sorted. This data can be analyzed to optimize the sorting process, reduce errors and enhance the overall performance of the machine. IoT-enabled product sorting machines can be designed to communicate with other machines and systems in the production line, making the entire process more streamlined and efficient. This means that product sorting machines can automatically adjust their sorting speed and configuration based on the needs of the downstream machines.

Another significant advantage of IoT-enabled product sorting machines is their ability to improve the traceability of products. Each product can be tagged with a unique identifier, which can be tracked throughout the production process. This allows for better quality control and easier recall management if necessary. In summary, the integration of IoT technology into product sorting machines has significantly enhanced their capabilities and improved their efficiency, accuracy, and traceability. This has resulted in more effective and streamlined production processes, leading to cost savings and increased profitability for businesses. A product sorting machine based on IoT is a machine that uses the Internet of Things (IoT) technology to sort and classify products based on their specific properties or characteristics. It is an automated system that can increase efficiency, accuracy, and speed in sorting

products, thereby reducing human error and labor costs. The sorting process in such a machine is typically carried out in several stages. Firstly, the products are placed on a conveyor belt or a loading dock. Then, they are transported to the sorting section of the machine, where they are scanned and sorted based on their size, weight, shape, color, or any other pre-defined criteria. The machine uses sensors and cameras to capture and analyze data from the products, and sends the information to a central control unit or a cloud-based platform for further processing. In addition to sorting products, an IoT-based sorting machine can also be integrated with other systems, such as inventory management and shipping systems. This allows for real-time tracking and monitoring of the products, from the moment they enter the machine to the point of delivery. Moreover, the machine can be programmed to generate reports and analytics on the sorting process, which can be used to optimize the performance of the machine and improve the overall productivity of the production line. Overall, an IoT-based product sorting machine offers a scalable, efficient, and cost-effective solution to the challenges of product sorting and classification. It can be used in various industries, such as manufacturing, logistics, and retail, to streamline operations and enhance customer satisfaction.

Color sorting machines are advanced sorting systems that use advanced sensor technology to identify and remove defects and impurities from various types of materials based on color. These machines have a wide range of applications in various industries such as food processing, agriculture, recycling, and mining. The process of color sorting involves the use of a high-resolution camera and advanced image processing software. The camera captures an image of the material passing through the machine, and the software analyzes the image to determine the color and shape of each individual item. Once the color and shape of each item have been identified, the sorting machine uses a series of high-speed air jets to separate the items based on their color. The air jets are positioned in a way that they blow the unwanted items away from the main stream of material, leaving only the desired items behind. Color sorting machines are designed to be highly efficient and accurate. They are capable of processing large quantities of material quickly and can sort items at a rate of up to several thousand pieces per second. They can also

be programmed to sort items based on multiple criteria such as size, shape, and density, in addition to color. The use of color sorting machines can help businesses to increase their productivity and reduce their waste. By removing defective items and impurities from their raw materials, businesses can improve the quality of their products, reduce the risk of recalls, and increase customer satisfaction

1.1 TYPES OF SORTING MECHANISM IN PRODUCT SORTING MACHINE

1.1.1 Color identification and sorting

Color identification and sorting in product sorting machines are essential processes for many industries, including food and beverage, pharmaceuticals, cosmetics, and electronics. The process involves the use of sensors and software to identify and separate products based on their colors. The first step in color identification and sorting is the use of sensors to detect the presence of products on the sorting machine's conveyor belt. These sensors are typically mounted above or below the conveyor belt and use various technologies, such as optical or electromagnetic, to detect the products. Once the products have been detected, the sensors then capture an image of the product and analyze it to determine its color. The image analysis software uses algorithms to identify the color of the product and classify it according to predefined color categories. The sorting machine then uses pneumatic or mechanical devices, such as air jets or paddles, to separate the products into different bins or chutes based on their color. The sorting process may be performed in a single pass or multiple passes, depending on the complexity of the sorting task. During the sorting process, the machine may encounter challenges such as products with similar colors or lighting conditions that affect color recognition. To overcome these challenges, the sorting machine may use additional sensors or lighting sources to enhance color detection accuracy. So, color identification and sorting in product sorting machines involve the use of sensors, image analysis software, and pneumatic or mechanical devices to detect, classify, and separate products based on their color.

1.1.2 Image processing

Image processing is a field of computer science and engineering that focuses on analyzing and manipulating digital images. It involves using algorithms and techniques to transform, enhance, and analyze images for a variety of purposes. There are two main types of image processing: analog and digital. Analog image processing involves manipulating physical photographs and other types of images using techniques like cropping, resizing, and retouching. Digital image processing, on the other hand, involves using software and algorithms to manipulate digital images. There are many applications of image processing, including medical imaging, satellite imaging, video processing, and more. Image processing techniques can be used to enhance the quality of images, extract information from images, detect and recognize objects in images, and more. Some common techniques used in image processing include filtering, segmentation, feature extraction, and pattern recognition. Filtering involves applying a mathematical operation to an image to enhance or remove certain features. Segmentation involves dividing an image into smaller parts to isolate objects or regions of interest. Feature extraction involves identifying important features of an image, such as edges or corners. Pattern recognition involves using algorithms to recognize and classify objects in an image based on their features.

Image processing plays a crucial role in product sorting, especially in industries such as e-commerce, manufacturing, and logistics, where large quantities of products need to be sorted accurately and efficiently. Product sorting involves identifying and categorizing different products based on specific attributes such as size, shape, color, and texture. Image processing algorithms can automate this task by analyzing images of the products and extracting relevant information. One of the key applications of image processing in product sorting is object detection. This involves identifying objects within an image and determining their position, size, and orientation. Object detection algorithms can be trained to recognize different types of products, such as clothing, electronics, or food items, based on their unique visual characteristics. Once the objects have been detected, they can be sorted into

different categories based on predefined criteria. Another important application of image processing in product sorting is image segmentation. This involves separating an image into different regions or segments based on their visual properties. For example, a segmentation algorithm could be used to separate a pile of products into individual items based on their shape and color. Once the products have been segmented, they can be further analyzed and sorted based on additional criteria such as size or weight. So, image processing plays a crucial role in automating product sorting tasks, reducing errors, and improving efficiency in industries where large quantities of products need to be sorted accurately and quickly..

1.1.3 Arduino based product sorting

Arduino is an open-source electronics platform designed to enable users to create interactive electronic projects. It consists of both hardware and software components, with the hardware typically consisting of a microcontroller board and various input/output components such as sensors, buttons, and LEDs. The software component of Arduino includes an Integrated Development Environment (IDE) that is used to write and upload code to the microcontroller board. The code is written in a language that is similar to C++, and is often referred to as "Arduino code." One of the key features of Arduino is its ease of use, even for individuals with little to no experience in programming or electronics. This is due in part to the vast amount of online resources and tutorials available for beginners, as well as the relatively low cost of the hardware. Arduino boards can be used for a wide variety of projects, including robotics, home automation, and interactive art installations. Because of its open-source nature, the platform has also spawned a large community of developers who create libraries and code that can be shared and used by others.

An Arduino based product sorting machine is a system that utilizes the Arduino microcontroller board to sort and categorize different types of products. The machine is designed to sort products based on their physical characteristics such as size, shape, weight, color, and material composition. The system consists of a conveyor belt, a sensor array, a sorting mechanism, and an Arduino microcontroller

board. The conveyor belt is used to transport the products to the sensor array, where the sensors detect the physical characteristics of each product. The sensor array can consist of various sensors, such as proximity sensors, photoelectric sensors, and color sensors, depending on the sorting criteria. Once the sensors detect the characteristics of each product, the data is transmitted to the Arduino microcontroller board, which analyzes the data and activates the sorting mechanism. The sorting mechanism can consist of a series of pneumatic actuators or mechanical arms, which are used to sort the products into their respective categories. The Arduino microcontroller board is programmed with the necessary algorithms to process the sensor data and activate the sorting mechanism. The programming language used to write the code can be C or C++, which is compatible with the Arduino platform. An Arduino based product sorting machine can be used in various industries, such as manufacturing, agriculture, and packaging, to sort and categorize products efficiently and accurately.

1.1.4 PLC based product sorting

PLC stands for Programmable Logic Controller. It is a digital computer used in industrial automation and control systems. PLCs are designed to perform real-time control of various industrial processes and machines, such as assembly lines, water treatment plants, packaging machines, and more. A PLC works by receiving inputs from sensors or other devices, processing this data through its logic and control circuits, and then sending outputs to various actuators or other devices. PLCs can be programmed using specialized software that allows users to create programs and configure the controller's inputs and outputs. PLCs have a number of advantages over traditional relay-based control systems. They are faster, more reliable, and more flexible, allowing for greater control and automation of industrial processes. PLCs can also be easily reprogrammed and adapted to new situations, making them ideal for use in dynamic industrial environments. PLCs have become a vital component of modern industrial automation systems and are used in a wide variety of industries and applications. They are often used in conjunction with other control systems, such as SCADA systems, to provide a comprehensive solution for controlling and monitoring industrial processes.

PLC based product sorting machines are automated systems used in industries to sort and segregate products based on their size, shape, weight, and other characteristics. The system consists of a conveyor belt, sensors, and a Programmable Logic Controller (PLC) that controls the flow of products on the belt and directs them to different destinations based on predefined criteria. The sensors detect the attributes of the products as they move along the belt and send signals to the PLC, which then analyzes the data and directs the products to their respective sorting destinations. The sorting destinations can be bins, chutes, or other containers, depending on the requirements of the industry. PLC based sorting machines are widely used in various industries, including food and beverage, pharmaceuticals, and manufacturing, to improve production efficiency, reduce manual labor, and minimize errors. With advancements in technology, PLC-based sorting machines have become more sophisticated, allowing for higher accuracy, speed, and versatility.

1.1.5 Matlab based product sorting

MATLAB is a high-level programming language and interactive environment for numerical computation, visualization, and programming. It is widely used in engineering, science, and mathematics. MATLAB is developed by Math Works and was first released in 1984. MATLAB stands for "MATrix Laboratory" and is primarily used for manipulating matrices, but it also supports many other data types, such as arrays, structures, and cell arrays. It has a large number of built-in functions and toolboxes that allow for efficient programming and analysis of data. MATLAB's syntax is similar to that of other programming languages such as Python, C++, and Java, but its focus is on matrix and vector operations. It also provides a graphical user interface for interactive programming and data analysis. Some of the applications of MATLAB include signal processing, image processing, control systems, computational finance, and scientific research. It is also used in education and research for teaching and exploring mathematical concepts. MATLAB is proprietary software and requires a license to use, although there are some open-source alternatives available, such as Octave and Scilab, that provide similar functionality.

A Matlab-based product sorting machine is a system that uses a computer program written in Matlab to sort products based on their attributes such as size, shape, color, and weight. The system typically consists of a conveyor belt or a chute that moves the products towards a sensor or a camera that captures an image of the product. The image captured by the camera is then processed by the Matlab program to extract the relevant features of the product. The program uses image processing techniques such as segmentation, feature extraction, and classification to identify the product based on its attributes. Once the product is identified, the program sends a signal to an actuator or a mechanical device that sorts the product into the appropriate bin. The sorting mechanism can be a mechanical arm, a pneumatic device, or an electromechanical system that moves the product to the desired location. The Matlab program can be customized to sort different types of products based on their attributes. For example, it can sort fruits based on their color or size, or it can sort electronic components based on their shape or weight. The system can also be integrated with a database to store information about the products and their sorting history. The advantages of using a Matlab-based product sorting machine include high accuracy, speed, and flexibility. The system can handle a large volume of products with minimal human intervention, reducing labor costs and increasing efficiency. It also minimizes errors and ensures consistent sorting results.

1.2 SELECTION OF PRODUCT SORTING EQUIPMENT

Choosing the right sorting equipment is crucial for businesses to improve productivity, reduce labor costs, minimize errors, and meet customer requirements. The first step in selecting the product sorting equipment is to identify the type of products to be sorted and the desired sorting criteria. For instance, if a business deals with small and fragile products, a gentle handling system may be required to avoid product damage. On the other hand, if the products have irregular shapes or are difficult to sort, advanced sensors and imaging technology may be necessary for accurate sorting. The next consideration is the production capacity and throughput requirements. The sorting equipment should be able to handle the

required volume of products within the desired timeframe. A business should also factor in the potential growth of their operations when selecting sorting equipment to avoid the need for frequent upgrades. Another important consideration is the available space and layout of the production facility. Sorting equipment comes in different sizes and configurations, and a business should select one that fits into their production line seamlessly. A poorly placed sorting system can lead to inefficient workflows, bottlenecks, and wasted space. Cost is another factor that businesses should consider when selecting sorting equipment. The upfront cost of the equipment should be weighed against the potential long-term benefits and return on investment. A business should also consider maintenance and repair costs, energy efficiency, and the lifespan of the equipment. It is also important to consider the ease of use and maintenance of the sorting equipment. The equipment should be user-friendly, and the operator should be trained to use it effectively. Maintenance requirements such as cleaning, lubrication, and part replacements should be straightforward, and the equipment supplier should provide adequate support and spare parts. Lastly, a business should consider the reputation and experience of the sorting equipment supplier. A reliable supplier should have a track record of supplying high-quality equipment, providing after-sales support, and responding promptly to customer inquiries and concerns. It is also advisable to seek references from other businesses that have used the supplier's equipment. So, selecting the right product sorting equipment involves identifying the product characteristics and sorting criteria, considering the production capacity and space requirements, evaluating the cost and ease of use and maintenance, and choosing a reputable supplier. Careful consideration of these factors will ensure that a business selects the most appropriate sorting equipment to meet their needs and achieve their production goals.

CHAPTER 2

LITERATURE SURVEY

The use of IoT in product sorting machines has become increasingly popular in recent years due to the need for automated and efficient sorting processes. A literature survey reveals that many researchers have explored the use of IoT in this field, with a focus on various aspects such as machine learning, real-time data analysis, and cloud-based applications. One of the most critical components of any product sorting machine is the sensors that are used to detect products' characteristics. Researchers have explored various types of sensors that can be used in these machines, including infrared, ultrasonic, and color sensors. These sensors can detect different characteristics of the products such as size, shape, and color, enabling the machine to sort them accurately. Machine learning algorithms have also been studied in the context of product sorting machines. These algorithms can learn from historical data to make predictions about the characteristics of the products being sorted. This enables the machine to make accurate sorting decisions even when it encounters products it has not seen before. Real-time data analysis is another critical aspect of product sorting machines that use IoT. By analyzing data in real-time, the machine can make decisions quickly and accurately. Cloud-based applications have also been explored as a means of processing large amounts of data quickly and efficiently. One of the challenges of using IoT in product sorting machines is ensuring the security of the system. Researchers have explored various security measures, such as encryption and access control, to protect the system from cyber-attacks. So, the literature survey shows that IoT has great potential in the field of product sorting machines. By using sensors, machine learning algorithms, and real-time data analysis, these machines can sort products accurately and efficiently. However, ensuring the security of the system is also critical and must be taken into account when developing these machines.

2.1 ANALYSING THE LITERATURE

The primary goal in selecting this project was to create an automated machine that is user-friendly, streamlines the sorting procedure, and decreases industry-wide sorting costs. It connects the microcontroller to the hardware, which may include motors and sensors. Using Shape, Color, and Text on Packages, Image Processing is used in the proposed project to sort goods on a conveyor belt. Through this project, we see how parcels can be continuously sorted in real time. The first step in the literature review is to examine the structure and mechanism of various sorting systems used in the world. Previously, we discussed why and how automation first appeared in manufacturing. Most of the world's various sorting systems are put to use during the inspection phase, either at the end of the packaging process or in quality control. Since these businesses relied heavily on human labour to sort their goods, the process has become antiquated and convoluted. This is especially true given the need to maintain a steady stream of sorted objects despite the high turnover rate of human workers. Our team researched the many varieties of conveyor belts that can be used for a wide range of applications and are classified by their material, form, and function. Conveyor belts are typically used for product delivery, with items being retrieved from one location and transported to another. The conveyor belt is typically moved by a pair of rollers, one of which is stationary while the other is free to move in response to the input from the main DC geared motor. The DC motor and fixed roller gearbox combine to allow the sorting machine to transport packages weighing up to 10 kilograms'. When you buy an actuator, it already has the main motor attached, ready to talk to your microcontroller. Studying the mechanism for sorting the packages by the robotic arms installed on the structure to deliver the parcel to their switches to interface with the microcontroller for the movement of flipper arms comes after studying the mechanical design for the proposed structure of the project and conveyor belt. After the image on the parcel was recognized using image processing, these parts of our project were responsible for carrying out the ensuing tasks. Everything from food to medicine goes through the sorting system to make sure it's perfect before it reaches the consumer.

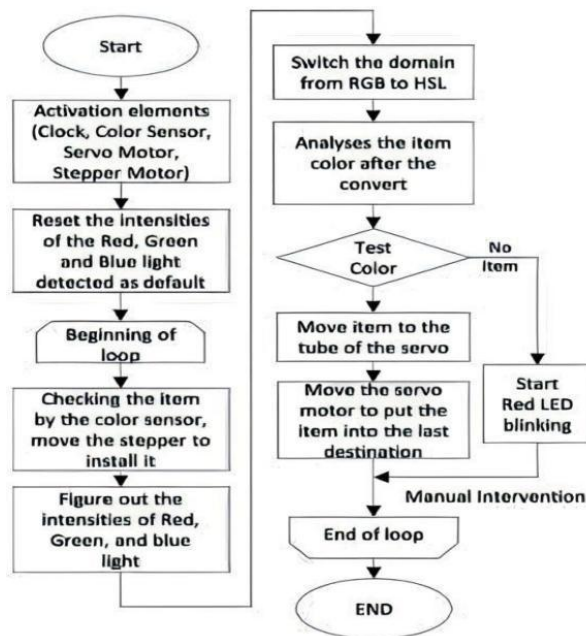


Fig: 2.1: Flowchart of the Project

Studying the mechanism for sorting the packages by the robotic arms installed on the structure to deliver the parcel to their switches to interface with the microcontroller for the movement of flipper arms comes after studying the mechanical design for the proposed structure of the project and conveyor belt. Researching proximity sensors, which send low signals to the microcontroller when an object comes into its visual range area, will help you detect the parcel under the raspberry cam, allowing it to capture the image on top of the parcel and send it to the raspberry pi for image processing. After the image on the parcel was recognized using image processing, these parts of our project were responsible for carrying out the ensuing tasks. After doing some research into the various methods of image processing employed by automation systems, we settled on the use of Open CV for detection, OCR for text recognition, and the Bar library for color and shape scanning. Everything from food to medicine goes through the sorting system to make sure it's perfect before it reaches the consumer. Experts in both academia and industry claim that sorting systems can automatically arrange different types of materials without any further intervention from human workers. This streamlines the labor-intensive and time-consuming global inspection processes. As can be seen in Fig.2.1, our project is depicted graphically in

the form of a flowchart, which details each stage of the development process.

Many literature reviews have been collected for this project and studied them completely. The study is based on the papers related to product sorting mechanism based on size, shape, color and so on. Some of the survey taken are listed and explained below:

Stepan Ozana, Zdenek Slanina, Martin Pies VSB, examines color-sorting machine simulation, control, and visualization. The foundation is Matlab. The suggested approach is applicable to a variety of areas, including Control Systems and the Design and Realization of Controllers. The concepts of the creation program and scheme for state-controlled processes in Simulink are condensed in this work. For color detection, certain artificial intelligence techniques were applied.

Harshita Borkar, Utilizing color processing in many industries provides us greater wiggle room to address the consistency issue with ongoing manual sorting. A color sorter is researched, developed, and built using the Arduino Nano microcontroller, TCS3200 color sensor, servo motor, and other electronic parts. The project might propose the technological comparison. The best color sensor is the TCS3200 color sensor, and we used an Arduino Nano to build a color sorting device.

Design And Development Of Color Sorting Robot (Lim Jie Shen, Irda Hassan)- 2015. The background material study is the first step in this method. Once the background study is complete, the next very important classification color detection connection and color recognition connection are made. Following these steps, the manufacturing of the robot body is done. Finally, the troubleshooting analysis is done.

Arduino Based Color Sorting Machine using TCS3200 Color Sensor (Ch. Shravani, G. Indira, V. Appalaraju)- 2019. Sorting things is a labor-intensive, largely mechanical procedure. Chronic manual organization causes challenges with consistency. Above all, machines can perform monotonous activities that are better left to humans. Worker burnout might cause diminished execution and purpose concerns when it comes to holding the object correctly in sequential manufacturing structures. A worker who conducts extensive study may eventually lose track of the

color of the item, but not a machine. The organization of items in this document was done so in close proximity to the shading of the TCS3200 shading sensor connected to the servo motors connected to the Arduino.

Automatic Color Sorting Machine Using Arduino Mega Microcontroller (Aye Myat Myat Myo , Zar Chi Soe)-2019. The system that can successfully categorize an object based on color is described in the study. The color sorting device might be an effective color sorter that can detect RGB color balls and drop the balls in the proper location. There are classifiers available, however they cannot use PIC microcontrollers. Many of these are quickly made using Arduino programming. "This technique's real contribution is that it can reduce the amount of time required for color sorting, making this system significantly more cost-effective than the one in use today." This sorter prevents color-blind people from choosing the incorrect color or being unable to decide on the right color, as well as reducing the manual work and time needed.

Arduino Based Color Sorting Machine (N. Monika, C.R. Pramod , B.S. Vinod)2020. The production of the numerous things we use on a daily basis takes place in both major and small industries. The company consistently emphasizes quality. Too many goods to sort through. Industry element organization is a laborious operation that is typically carried out manually. The physical classification of goods takes more time, though. We introduce automatic color sorting devices to save sorting time and improve accuracy. A color sorter is a tool that arranges items according to color. To determine the color of any item and after determining the color, we employ the TCS3200 color sensor. The object is assigned to a certain box by the mechanism as the servo motor rotates. They can be applied in many situations where color distinction and classification are crucial. Agribusiness (color sorting of grain), the food sector, the diamond and mining industries, recycling, etc. are a few of the application fields.

Arduino Based Lemon Sorter Machine (Ajay H. Chauhan, Neema Ukani, Pratik V. Yennewar, Sandeep Sonaskar, Nilakshi Hiwanj, Saurabh Chakole) 2021. In this study, lemons are sorted using a sensor. The need for automation in industry is

rising quickly everywhere in the world. It can be exceedingly challenging to arrange items according to their color tones. This article provides suggestions for choosing fruits based on their color scheme. This paper describes the design and implementation of an effective color sorter based on the Arduino NANO and the TCS3200 color sensor. With this design, accuracy, performance, and repeatability are best or higher. Reduces human error, human effort, and industry costs by being simple to use and manufacture. They can be applied in many situations where color distinction and classification are crucial.

Design and development of a color sorting machine using Arduino by T.S. Awoyera et al. (2020) In this study, the authors designed and developed a color sorting machine using Arduino microcontroller. The machine used a color sensor to detect the colors of the products and sorted them into different categories based on their color. The machine was found to be accurate and efficient in sorting different products based on their color.

Design and implementation of a fruit sorting system using machine vision by M. Alotaibi et al. (2018). In this study, the authors designed and implemented a fruit sorting system using machine vision. The system used a camera to capture images of the fruits and used image processing algorithms to classify the fruits based on their size, shape, and color. The system was found to be accurate and efficient in sorting different fruits based on their characteristics.

Real-time classification of agricultural products using machine learning by S. Wankhade et al. (2019). In this study, the authors developed a real-time classification system for agricultural products using machine learning algorithms. The system used sensors to detect the products' characteristics, and machine learning algorithms were used to classify the products into different categories based on their characteristics. The system was found to be accurate and efficient in sorting different agricultural products based on their characteristics.

Development of a sorting mechanism for different types of plastic waste using machine vision by S. El-Deib et al. (2020). In this study, the authors developed a sorting mechanism for different types of plastic waste using machine vision. The

system used a camera to capture images of the plastic waste and used image processing algorithms to classify the plastic waste into different categories based on their characteristics. The system was found to be accurate and efficient in sorting different types of plastic waste based on their characteristics.

Design and implementation of a sorting mechanism for recycling waste using IoT by H. Kim et al. (2021). In this study, the authors designed and implemented a sorting mechanism for recycling waste using IoT. The system used sensors to detect the waste's characteristics, and IoT technology was used to collect and analyze data in real-time. The system was found to be accurate and efficient in sorting different types of waste based on their characteristics.

Automated sorting of recyclable materials using machine vision and neural networks by D. H. Kim et al. (2018). In this study, the authors developed an automated sorting system for recyclable materials using machine vision and neural networks. The system used a camera to capture images of the materials and used neural networks to classify the materials into different categories based on their characteristics. The system was found to be accurate and efficient in sorting different types of recyclable materials based on their characteristics.

A review of sorting techniques in solid waste management by S. Gupta et al. (2019). In this literature review, the authors discussed various sorting techniques used in solid waste management. The review covered technologies such as mechanical sorting, manual sorting, magnetic sorting, and optical sorting. The authors concluded that each sorting technique has its advantages and disadvantages, and the choice of sorting technique depends on various factors such as the type of waste, cost, and efficiency.

A review of sorting systems for construction and demolition waste by J. Cao et al. (2020). In this literature review, the authors reviewed various sorting systems for construction and demolition waste. The review covered technologies such as manual sorting, mechanical sorting, and automated sorting. The authors found that automated sorting systems such as robotic sorting systems and AI-based sorting

systems are becoming increasingly popular due to their accuracy, efficiency, and cost-effectiveness. The authors concluded that the development of new and innovative sorting systems for construction and demolition waste is essential to reduce waste and increase resource efficiency.

CHAPTER 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM OF THE PRODUCT SORTING MACHINE

The aim of a product sorting machine is to automate the process of sorting and separating products based on specific criteria such as size, color, shape, weight, or any other relevant characteristic. This can be achieved through the use of advanced sensors, algorithms, and mechanical components that work together to identify and classify products according to their attributes. In the real world, product sorting machines have a wide range of applications in various industries such as food and beverage, pharmaceuticals, consumer goods, and logistics. For example, in the food industry, product sorting machines can be used to sort fruits and vegetables based on their size and quality, ensuring that only the best products make it to the shelves. In the pharmaceutical industry, these machines can be used to sort and package pills based on their size and shape, improving efficiency and reducing the risk of errors. In logistics, product sorting machines can be used to sort packages based on their destination, improving the speed and accuracy of delivery. So, the aim of a product sorting machine is to streamline the process of sorting and separating products, reducing manual labor, and increasing efficiency. With their advanced technology and versatility, these machines have the potential to revolutionize a wide range of products are sorted and processed. The aim also includes the efficiently and accurately sort various types of products according to their predefined criteria. The scope of a product sorting machine can range from small-scale applications such as sorting nuts and bolts in a factory to larger-scale applications such as sorting packages at a logistics center. Product sorting machines can be used in a variety of industries including manufacturing, food processing, and shipping and logistics. They can increase productivity, reduce labor costs, and improve overall efficiency in the supply chain process. The scope of a product sorting machine is constantly expanding as technology advances, making it possible to sort more products at higher speeds with greater accuracy.

3.2 BENEFITS OF PRODUCT SORTING MACHINE

3.2.1 Increased Efficiency

A product sorting machine can sort products at a much faster rate than humans, resulting in increased productivity and efficiency. With the ability to sort thousands of products per hour, a product sorting machine can significantly reduce the amount of time and resources needed for manual sorting.

3.2.2 Improved Accuracy

Product sorting machines use advanced sensors and algorithms to accurately sort products based on their attributes, such as size, shape, weight, and color. This helps to reduce errors and ensure that products are sorted correctly every time, which can lead to better customer satisfaction and fewer returns.

3.2.3 Cost Savings

By automating the sorting process, product sorting machines can reduce the need for manual labor, which can help to lower labor costs and increase profitability. Additionally, the use of product sorting machines can help to reduce waste and improve the overall efficiency of the production process, which can also lead to cost savings.

3.2.4 Versatility

Product sorting machines can be programmed to sort products based on a wide range of attributes, making them highly versatile and adaptable to different industries and applications. They can be used to sort products of various shapes, sizes, and materials, and can be customized to meet specific sorting requirements.

3.2.5 Improved Safety

Manual sorting can be a hazardous task, particularly when it comes to sorting heavy or sharp objects. Product sorting machines can help to improve safety in the workplace by automating the sorting process and reducing the manual labor.

3.2.6 Scalability

As businesses grow and production volumes increase, the use of product sorting machines can help to accommodate the increased demand. Product sorting machines can be easily integrated into existing production lines, and can be scaled up or down to meet changing production needs.

3.2.7 Quality Control

Product sorting machines can be programmed to sort products based on their quality, ensuring that only products that meet specific quality standards make it to the shelves. This can help to improve the reputation of a business and reduce the risk of customer complaints or returns.

3.2.8 Consistency

Product sorting machines can sort products consistently and accurately, regardless of the time of day, operator fatigue, or other factors that can affect manual sorting. This can help to maintain a consistent level of product quality and reduce variations in the sorting process.

3.2.9 Reduced Downtime:

Product sorting machines are designed to operate continuously, without the need for breaks or downtime. This can help to reduce production downtime and ensure that the sorting process is running smoothly around the clock.

3.2.10 Data Collection

Product sorting machines can collect data on the sorted products, such as their size, weight, and color. This data can be used to improve the production process, optimize inventory management, and enhance overall business operations.

These benefits make product sorting machines a valuable investment for businesses in a wide range of industries.

3.3 FUTURE SCOPE OF PRODUCT SORTING MACHINE

The future of product sorting machines is extremely promising, as technology continues to evolve and businesses seek to optimize their production processes. One of the key trends in the development of product sorting machines is the use of artificial intelligence and machine learning. These technologies enable machines to learn and adapt to changing sorting requirements, making them more versatile and adaptable to different industries and applications. This can help to improve the accuracy and efficiency of the sorting process, as well as reduce the need for manual intervention. Another trend in the development of product sorting machines is the use of robotics. Robotic sorting machines can perform a wide range of tasks, from simple sorting to more complex tasks such as quality control and packaging. With the ability to work autonomously and perform tasks around the clock, robotic sorting machines can significantly improve the speed and efficiency of the sorting process, as well as reduce the need for manual labor. In addition to these technological advances, the future of product sorting machines also includes new applications and use cases. For example, product sorting machines could be used to sort and recycle waste materials, helping to reduce the amount of waste that ends up in landfills. They could also be used to sort and process raw materials in industries such as mining and forestry, improving the efficiency and safety of these industries.

The future of product sorting machines also includes increased integration with other technologies, such as the Internet of Things (IoT) and big data analytics. By integrating product sorting machines with IoT sensors and data analytics tools, businesses can gain real-time insights into their production processes and make data-driven decisions to improve efficiency and reduce waste. Lastly, the future of product sorting machines is bright, with numerous technological advances and new applications on the horizon. As businesses seek to optimize their production processes and reduce costs, product sorting machines will continue to play a vital role in streamlining the sorting and processing of products, improving efficiency, reducing waste, and enhancing overall business operations.

The future scope using Raspberry Pi is vast, as it has the potential to revolutionize the manufacturing industry. Some potential future applications of this technology could include:

3.3.1 Automated sorting in warehouses

With the use of Raspberry Pi-powered sorting machines, warehouses could automate their sorting processes, minimizing human error and increasing speed and accuracy.

3.3.2 Improved supply chain efficiency

This technology could improve supply chain efficiency by automatically sorting products by destination, reducing the need for manual sorting and handling.

3.3.3 Enhanced data monitoring

Raspberry Pi-powered sorting machines have the potential to upload data to the cloud and real-time monitoring, allowing for analysis of sorting data to optimize machine performance and enhance overall production efficiency.

3.3.4 Integration with AI and machine learning technology

As AI and machine learning technology continues to advance, integrating this technology with Raspberry Pi-powered sorting machines could enable the machines to learn and improve their sorting capabilities over time.

3.3.5 Development of Robotic Sorting Machines

Robotic sorting machines will become more prevalent, performing a wide range of tasks from simple sorting to more complex tasks such as quality control and packaging.

3.3.6 Expansion of Applications

The applications of product sorting machines will expand to new industries, such as waste management and mining, improving efficiency and safety in these sectors.

3.3.7 Integration with IoT and Big Data Analytics

Product sorting machines will be integrated with IoT sensors and data analytics tools, enabling businesses to gain real-time insights into their production processes and make data-driven decisions.

3.3.8 Development of Sustainable Sorting Machines

There will be an increased focus on sustainable sorting machines that help reduce waste and promote recycling.

3.3.9 Enhanced Sorting Capabilities

Sorting machines will continue to improve their sorting capabilities, sorting products based on more complex attributes such as texture, smell, and taste.

3.3.10 Adoption of Autonomous Sorting

Sorting machines will become increasingly autonomous, operating around the clock with minimal human intervention.

3.3.11 Use of Virtual and Augmented Reality

Virtual and augmented reality will be integrated with sorting machines to provide a more immersive and interactive sorting experience for operators.

CHAPTER 4

EXPERIMENTAL SETUP AND METHODOLOGY

4.1 EXPERIMENTAL SETUP OF THE PROJECT

First, the product sorting machines is get into the workplace and first of all mixed color balls or put into the above chamber. Next the machine is turned on and the balls are pulled by the pulley one by one and then the color of the balls detected by the pi cam which is attached in front of the raspberry Pi microcontroller, then it is pushed into the next level of the prototype. The complete process here is controlled by the raspberry Pi microcontroller which is really fast and the results are accurate so be used to the microcontroller here. What's the color is sorted the appropriate color is sorted into the justified bins. so that's how the full mechanism is working here.

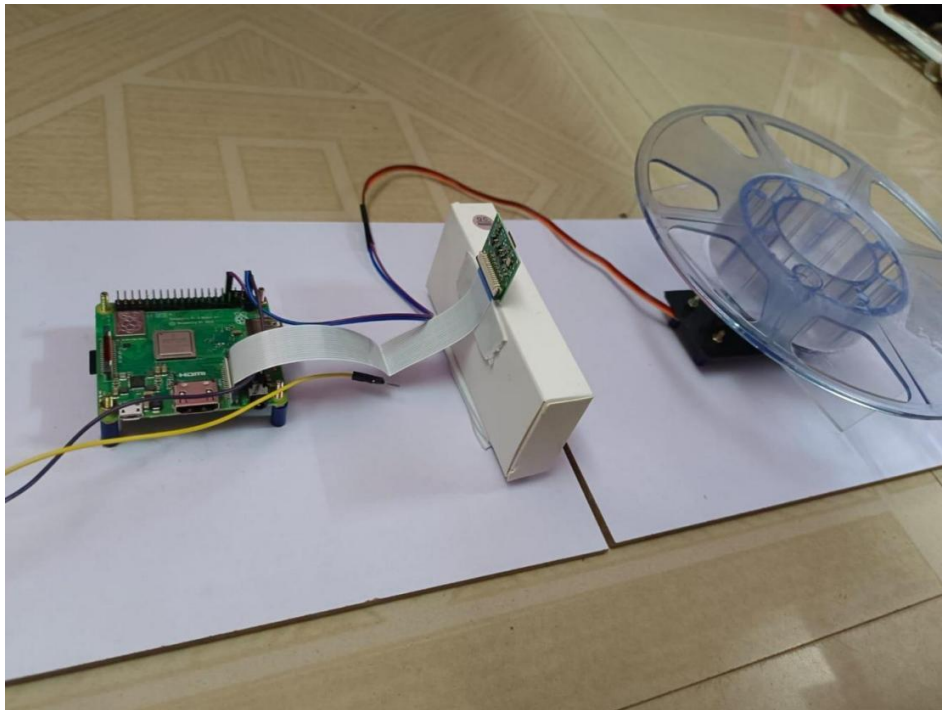


Fig: 4.1: Experimental setup of product sorting machine

4.2 STRUCTURE AND OPERATION

First, our sorting machine required a recognition section to locate the parcel or package on the conveyor belt beneath the raspberry cam, allowing for image processing and automatic sorting. Fig 4.2 is a block diagram of the entire system. The parcels on the conveyor belt can be identified by means of a sensor that uses nearby ultrasonic waves to pinpoint their precise location. There are a lot of cool features built into this hardware. Such as, their ability to identify different types of objects. They can detect the presence of liquids, chemical compositions, etc., in any nearby object. Second, a DC Geared Motor drives the belt, while a further three DC-Gear motors move the arms. In the proposed system, two relay modules with four relays on each are connected together as an H-Bridge to control the direction of the motor. Each relay is activated by a separate low power signal from the micro-controller. The motors in question run on 12 volts. Fig. 3 is a schematic representation of the entire system. Additionally, Ultrasonic sensors are mounted on each arm to distinguish between packages and guide goods into their designated containers as the arms rotate. Finally, an LCD panel showing the final destination of the product is mounted atop the electronic section.

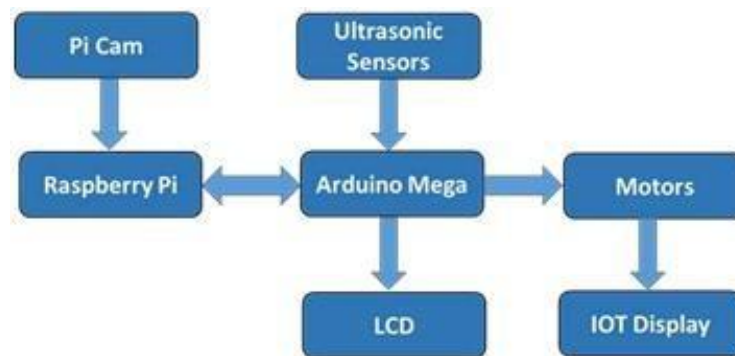


Fig: 4.2: Automatic Sorting Device Based on Block IoT

A product sorting machine is a complex system that uses various technologies to sort and classify products based on specific criteria such as size, shape, color, and weight. The working and methodology of a product sorting machine can vary depending on the specific type and application of the machine, but there are some

common elements that are found in most product sorting machines. The first step in the working of a product sorting machine is the input of products into the system. This can be done manually or through an automated system such as a conveyor belt. Once the products are inputted, they are scanned or analyzed by sensors or cameras to gather data about their specific attributes such as size, shape, color, and weight. After the data is gathered, the sorting process begins. The sorting process typically involves a combination of mechanical and pneumatic systems, as well as software that analyzes the data collected from the sensors or cameras. Based on the predetermined sorting criteria, the sorting machine identifies which products need to be sorted and how they need to be sorted. This information is then transmitted to the mechanical and pneumatic systems, which move the products to their appropriate destinations.

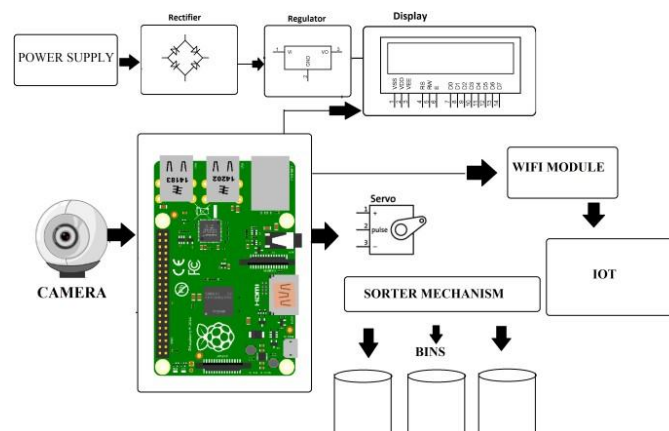


Fig: 4.3: Circuit Diagram

In a typical sorting system, there are several stages of sorting. The first stage typically involves rough sorting, where products are sorted based on their basic attributes such as size or weight. This is followed by more precise sorting, where products are sorted based on more complex attributes such as color or shape. Finally, the sorted products are transported to their final destinations, which could be storage bins, packaging machines, or other processing systems. The

methodology behind a product sorting machine is based on the use of advanced technologies such as computer vision, artificial intelligence, and machine learning. These technologies enable the machine to identify and sort products with a high degree of accuracy and precision, while minimizing errors and reducing the need for manual intervention. The methodology also involves the use of advanced algorithms and software that enable the machine to analyze data collected from sensors or cameras, and make decisions about how to sort the products based on this data. So, the working and methodology of a product sorting machine is a complex system that involves the use of advanced technologies such as computer vision, artificial intelligence, and machine learning. The machine uses sensors or cameras to gather data about the products, which is then analyzed by software to make decisions about how to sort the products based on predetermined criteria. The sorting process typically involves a combination of mechanical and pneumatic systems, which move the products to their appropriate destinations. Overall, product sorting machines play a critical role in streamlining the sorting and processing of products, improving efficiency, and reducing waste in a wide range of industries.

4.3 MATERIALS AND COMPONENTS USED

4.3.1 Raspberry Pi

Raspberry Pi is a low-cost, credit-card-sized computer that was first introduced in 2012 by the Raspberry Pi Foundation, a UK-based charity. The Raspberry Pi was designed to provide an affordable and accessible platform for individuals, hobbyists, and students to learn and experiment with computer programming and electronics. The Raspberry Pi is based on a system-on-a-chip (SoC) architecture, which means that all the major components of a computer (CPU, GPU, RAM, and other peripherals) are integrated onto a single chip. The Raspberry Pi uses an ARM-based processor and runs a variant of the Linux operating system. There have been several iterations of the Raspberry Pi since its initial release, with each new version featuring improvements in processing power, memory, and connectivity. The latest version, Raspberry Pi 4, features a quad-core ARM Cortex-A72 CPU, up

to 8GB of RAM, Gigabit Ethernet, dual-band Wi-Fi, and Bluetooth 5.0. One of the key features of the Raspberry Pi is its ability to interface with a wide range of external devices, such as cameras, sensors, and displays, making it ideal for a variety of applications including home automation, robotics, and media centers. The Raspberry Pi is also an excellent platform for learning and teaching programming, electronics, and computer science. Its low cost and accessibility make it a popular choice for educational institutions, where it is used to teach students about coding, electronics, and the Internet of Things (IoT). In addition to its hardware capabilities, the Raspberry Pi also has a thriving community of users and developers who have created a vast array of software and applications that run on the device. These include everything from media players and game consoles to home automation systems and security cameras. So, the Raspberry Pi is an incredibly versatile and powerful computer that has opened up new possibilities for individuals and communities to learn, experiment, and innovate with technology. Its low cost and accessibility make it an ideal platform for a wide range of applications, and its strong community ensures that there is a wealth of resources and support available for anyone who wants to get started with this amazing little computer.

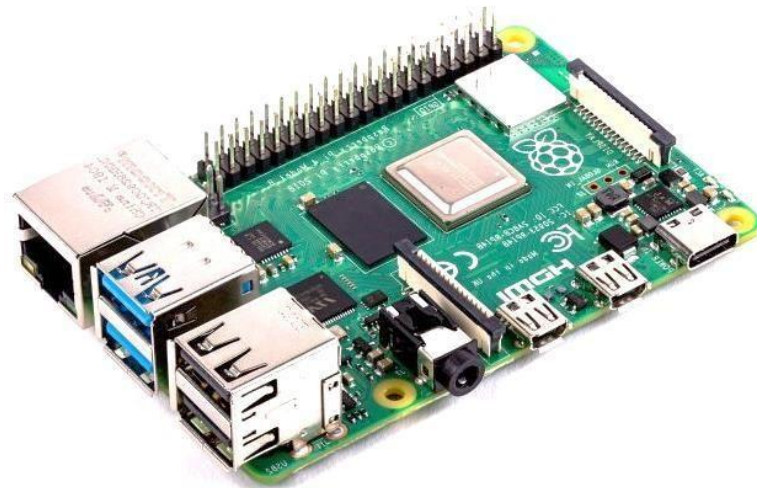


Fig: 4.4: Raspberry Pi

4.3.2 Pi camera

The Raspberry Pi Camera is a small, high-quality camera module designed to work specifically with the Raspberry Pi computer. The camera module is designed to be a plug-and-play accessory that connects directly to the Raspberry Pi's CSI (Camera Serial Interface) port, allowing users to capture high-quality photos and videos. There are several versions of the Raspberry Pi Camera available, including the original Raspberry Pi Camera Module, the Raspberry Pi Camera Module V2, and the Raspberry Pi High Quality Camera. Each version offers different features and capabilities, but all are designed to be easy to use and highly customizable. The original Raspberry Pi Camera Module features a 5-megapixel camera sensor and can capture still images up to 2592x 1944 pixels in size, as well as 1080p video at 30 frames per second. The camera module V2 features an 8-megapixel sensor, improved image quality, and the ability to capture 1080p video at 60 frames per second. The Raspberry Pi High Quality Camera is the most recent addition to the lineup and features a 12.3-megapixel sensor, improved low-light performance, and support for interchangeable lenses.

In addition to its hardware capabilities, the Raspberry Pi Camera also has a powerful software interface that allows users to control various settings such as resolution, frame rate, exposure, and white balance. The camera module can be controlled using a variety of programming languages, including Python, C++, and Java, making it an ideal tool for learning and experimenting with computer vision and image processing. The Raspberry Pi Camera has a wide range of applications, from home security and surveillance to wildlife monitoring and photography. It can also be used in robotics projects, as well as in educational settings to teach students about computer vision, image processing, and data analysis. So, the Raspberry Pi Camera is a powerful and versatile tool that can be used in a wide range of applications. Its low cost, plug-and-play design, and flexible software interface make it an ideal choice for anyone looking to experiment with computer vision or add a camera to their Raspberry Pi project.



Fig: 4.5: Pi camera

4.3.3 MG 995 servo motor

The MG995 servo motor is a high-torque, metal-gear servo motor that is commonly used in robotics, RC cars, airplanes, and other applications that require precise control of angular motion. The MG995 is a standard-sized servo motor, with dimensions of 40.7 x 19.7 x 42.9mm, and weighs around 55 grams. The MG995 servo motor is capable of providing up to 180 degrees of rotation, with a torque output of up to 10 kg-cm. This makes it a popular choice for applications that require high torque and precise control, such as robotic arms or grippers. One of the key features of the MG995 servo motor is its metal gears, which provide increased durability and strength compared to plastic gears. The metal gears are designed to withstand high loads and provide a smooth, precise motion. The MG995 servo motor can be controlled using a variety of methods, including pulse-width modulation (PWM) signals from a microcontroller or servo controller board. The servo motor responds to PWM signals by rotating to a specific angle, based on the duration of the pulse. A pulse of 1.5 milliseconds typically corresponds to a neutral position, while pulses shorter or longer than 1.5 milliseconds will cause the servo to rotate to a different position. So, the MG995 servo motor is a versatile and reliable motor that is widely used in a variety of applications. Its high torque output, precise control, and metal gears make it an ideal choice for robotics and other projects that require precise motion control.



Fig: 4.6: MG 995 servo motor

4.3.4 LCD display

An LCD (Liquid Crystal Display) is a common component used in electronic projects to display information or data to users. An LCD display is a flat-panel display that uses liquid crystals to control the amount of light that passes through it, allowing it to display text, images, and other graphical elements. There are many different types of LCD displays available, each with their own features and capabilities. Common types include character LCD displays, which can display a limited amount of text, and graphic LCD displays, which can display more complex images and graphics. When using an LCD display in a project, the display is typically connected to a microcontroller or other controller board using a set of wires. The controller board sends commands and data to the display to control what is displayed on the screen. One of the key advantages of using an LCD display in a project is its low power consumption. Unlike other types of displays, such as LED displays, LCD displays do not require a constant power source to display information. This makes them ideal for battery-powered projects or other projects where power consumption is a concern. Another advantage of LCD displays is their versatility. LCD displays can display a wide range of information, from simple text and numbers to more complex graphics and images. They can also be customized to display specific information or data, making them ideal for a variety of applications. However, there are also some

limitations to using LCD displays in projects. One of the main limitations is their size and resolution. LCD displays are typically limited in size and resolution, which can make it difficult to display large amounts of information or detailed graphics.



Fig: 4.7: LCD display

4.3.5 LED lights

LCD (Liquid Crystal Display) displays are a common component used in electronics to display information or data to users. They are flat-panel displays that use liquid crystals to control the amount of light that passes through them, allowing them to display text, images, and other graphical elements. LCD displays come in various sizes and resolutions, from small character displays with just a few lines of text, to larger graphic displays capable of displaying complex images. LCD displays are commonly used in a variety of electronic devices, including calculators, clocks, digital thermometers, and even mobile phones. They are also used in more complex devices, such as medical equipment, industrial control systems, and automotive displays. When using an LCD display in an electronic project, the display is typically connected to a microcontroller or other controller board using a set of wires. The controller board sends commands and data to the display to control what is displayed on the screen. One of the key advantages of using an LCD display in electronics is their low power consumption. Unlike other types of displays, such as LED displays, LCD displays do not require a constant power source to display information.



Fig: 4.8: LED light

4.3.6 DC motors

DC (direct current) motors are a type of electric motor that convert electrical energy into mechanical energy. They are widely used in a variety of applications, from small electronic devices to large industrial machines. DC motors consist of a rotor (the rotating part) and a stator (the stationary part). The stator contains a set of permanent magnets, while the rotor contains a set of electromagnets. When an electric current is applied to the electromagnets, they generate a magnetic field that interacts with the permanent magnets in the stator, causing the rotor to rotate. One of the key advantages of DC motors is their simplicity. They have relatively few parts and are easy to control, making them suitable for a wide range of applications. They can be controlled using a variety of methods, including simple on/off switches, variable resistors, and more complex motor controllers. DC motors are also highly efficient, converting a high percentage of electrical energy into mechanical energy. This makes them ideal for applications where energy efficiency is a concern, such as battery-powered devices. However, there are also some limitations to using DC motors. One of the main limitations is their speed control. DC motors typically have a fixed speed, and while their speed can be adjusted by varying the amount of electrical current, this can lead to issues with overheating and reduced efficiency.



Fig: 4.9: DC motor

4.3.7 Conveyor Belt

A conveyor belt is a mechanical device used to move materials or objects from one place to another. It typically consists of a belt that is looped around a series of pulleys, which are powered by a motor or other source of mechanical energy. Conveyor belts are commonly used in manufacturing, mining, and transportation industries to move goods and materials efficiently and quickly. The belts themselves can be made of a variety of materials, including rubber, PVC, nylon, or other synthetic fibers. They may be smooth or have textured surfaces to improve grip and prevent slippage. The belts are typically flexible and can be made to fit any length or width required. Conveyor belts can be designed to move materials in a straight line, or they can be curved or inclined to accommodate different types of materials or production processes. They can also be used in conjunction with other machinery, such as sorting systems or packing machines, to automate the manufacturing or transportation process. There are many different types of conveyor belts available, each with its own specific use case. For example, belt conveyors are commonly used to move bulk materials such as grain, coal, or sand. Roller conveyors use a series of rollers to move items along the belt, making them ideal for transporting heavy or bulky items. Screw conveyors use a rotating screw to

move materials along a trough, and are commonly used in the agriculture and food processing industries. Overall, conveyor belts are an essential component of many modern manufacturing and transportation systems. They offer a fast and efficient way to move materials and goods, reducing labor costs and increasing productivity.



Fig: 4.10: Conveyor belt

4.3.8 Ultrasonic Sensor

An ultrasonic sensor is a device that uses high-frequency sound waves to detect the distance or presence of objects. It works by emitting a sound wave at a frequency above the range of human hearing, typically in the range of 20 to 200 kHz. The sensor then listens for the echo of the sound wave as it bounces back off of objects in its path. Ultrasonic sensors are commonly used in a variety of applications, such as industrial automation, automotive safety, and robotics. They are particularly useful in situations where other types of sensors may not be effective, such as in environments with low visibility or where objects are difficult to detect. One of the primary advantages of ultrasonic sensors is their ability to measure distances with high accuracy. They can typically detect objects within a range of several centimeters to several meters, depending on the specific sensor and its configuration. They are also able to detect the presence of objects, regardless of their color, shape, or surface texture. There are several different types of ultrasonic sensors available, including through-beam sensors, retro-reflective sensors, and proximity sensors. Through-beam sensors consist of separate transmitter and receiver units that are mounted opposite each other, with the object

to be detected passing between them. Retro-reflective sensors use a reflector placed opposite the sensor to bounce the sound wave back to the sensor. Proximity sensors emit a sound wave and detect the echo that bounces back from nearby objects. So, ultrasonic sensors are a versatile and useful tool for a wide range of applications. They offer high accuracy and reliability, and can be used in a variety of environments and conditions.



Fig: 4.11: Ultrasonic sensor

4.3.9 Cables and Connectors

Connectors and cables are essential components in electronic systems that enable the transmission of electrical signals and power between different devices and components. They come in a wide variety of shapes, sizes, and types to meet the needs of different applications. Connectors are typically used to join two or more electrical components together, while cables are used to transmit electrical signals and power between components. Connectors can be male or female, with the male connector typically consisting of a set of pins or prongs that fit into the female connector, which has corresponding holes or receptacles. There are many different types of connectors and cables used in electronics, including coaxial, twisted pair, USB, HDMI, and Ethernet. Coaxial cables are commonly used to transmit radio frequency signals and are often used in cable TV systems, while twisted pair cables are used for data transmission in computer networks. USB cables are widely used to connect peripheral devices such as printers and external hard drives to computers, while HDMI cables are used to transmit audio and video signals

between devices such as TVs and gaming consoles. Ethernet cables are used to connect devices to local area networks (LANs) and the internet. Choosing the right connectors and cables for an electronic system is important to ensure optimal performance and reliability. Factors such as the type of signal being transmitted, the distance between components, and the environment in which the system will be used must all be considered. Another important consideration when selecting connectors and cables is their electrical characteristics, such as impedance and capacitance. These characteristics can affect signal integrity and can cause problems such as signal distortion and noise. To ensure optimal performance and reliability, it is important to select high-quality connectors and cables that are suitable for the specific application. This may involve choosing connectors and cables that meet specific industry standards or specifications. So, connectors and cables are essential components in electronic systems that enable the transmission of electrical signals and power between different devices and components. There are many different types of connectors and cables available to meet the needs of different applications, and choosing the right ones is important to ensure optimal performance and reliability.

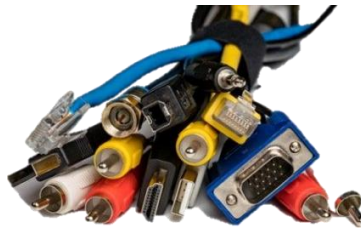


Fig: 4.12: Connectors and cables

4.3.10 Relay

A relay is an electrical switch that is controlled by an electrical signal. It consists of an electromagnet that, when energized, causes a mechanical armature to move and make or break electrical contacts. This allows a low-power signal to control a high-power circuit, providing isolation between the two circuits and allowing them to operate independently. Relays are commonly used in a variety of applications, including industrial automation, automotive systems, and home appliances. They

are particularly useful in situations where a low-power signal needs to control a high-power circuit, such as in motor control, lighting control, and power distribution. One of the main advantages of relays is their ability to provide electrical isolation between the control circuit and the load circuit. This means that the two circuits can operate independently, without affecting each other. This can help to improve safety and reliability, as well as reduce the risk of electrical interference and noise. A relay is an electromechanical device that is used to switch electrical circuits on and off. It consists of a coil, a set of contacts, and a mechanical assembly that moves the contacts when the coil is energized. Relays are commonly used in a variety of applications, from simple electronic circuits to complex industrial control systems. One of the key advantages of using relays is their ability to switch high currents and voltages using a low-power signal. This makes them ideal for use in applications where high-power loads need to be controlled using low-power electronic signals. For example, a relay can be used to control a high-power motor or lamp using a low-power switch or sensor. Relays are also commonly used for switching between different power sources, such as when switching between mains power and battery power in a backup power system. They can also be used for safety purposes, such as in emergency stop circuits where the relay is used to quickly shut down a system in the event of an emergency. In addition to their ability to switch high-power loads, relays are also highly reliable and have a long lifespan. They are not affected by voltage fluctuations or electrical noise, and they can withstand high temperatures and harsh environments.



Fig: 4.13: Relay

4.3.11 Push Buttons

A push button is a mechanical switch that is designed to be activated by pressing a button. It consists of a button or plunger that, when pushed, makes or breaks electrical contacts, allowing electrical current to flow or be interrupted. Push buttons are commonly used in a variety of applications, including industrial control systems, home appliances, and consumer electronics. They are often used in situations where a user needs to manually control a device or system, such as turning on a light or starting a machine. One of the main advantages of push buttons is their simplicity and ease of use. They are typically designed to be robust and reliable, and are available in a variety of sizes and shapes to meet the needs of different applications. Push buttons are simple electromechanical switches that are commonly used in a wide range of electronic and electrical applications. They consist of a button or plunger that, when pressed, makes contact with a pair of electrical contacts, completing a circuit and allowing current to flow through the switch. The significance of push buttons lies in their simplicity and versatility. They can be used in a wide range of applications, from simple control circuits to complex industrial control systems. They are also highly reliable, with a long lifespan and minimal maintenance requirements. Push buttons are commonly used for on/off control, as well as for momentary control, where the switch only remains closed for as long as the button is held down. They are also frequently used for emergency stop circuits, where they provide a quick and reliable means of shutting down a system in the event of an emergency.



Fig: 4.14: Push button

4.3.12 Screws and Joints

Screws and joints are commonly used in a variety of applications to fasten two or more objects together. They provide a reliable and secure connection that can withstand the forces and stresses that the objects may be subjected to. Screws are typically made of metal and consist of a cylindrical body with a helical thread wrapped around it. The thread is designed to grip into the material that it is being screwed into, providing a strong and secure connection. Screws are often used in applications where a permanent connection is required, such as in construction, furniture assembly, and automotive applications. Joints are a type of fastener that are used to connect two or more objects together in a flexible or adjustable manner. They are designed to allow for movement between the objects, while still providing a secure connection. Joints are often used in applications where the objects may need to be adjusted or moved, such as in robotics, machinery, and automotive applications. Screws and joints play a significant role in many different types of construction projects, from small DIY tasks to large-scale industrial projects. The significance of screws and joints lies in their ability to securely connect two or more pieces of material together, creating a strong and durable structure. Screws are a type of threaded fastener that are used to secure objects together. They consist of a cylindrical shaft with a threaded section that is inserted into a pre-drilled hole in one of the objects being joined. As the screw is tightened, the threads grip the material and create a strong, secure connection. Screws are commonly used in woodworking, construction, and metalworking applications, and are available in a wide range of sizes and types to suit different applications. Joints are another important element of construction projects. They are used to connect two or more pieces of material together in a way that allows them to move relative to each other while still maintaining a secure connection. Joints can be as simple as a butt joint, where two pieces of material are simply butted together and secured with screws or nails, or as complex as a mortise and tenon joint, which is commonly used in woodworking and involves cutting a slot or hole (the mortise) into one piece of material and inserting a protrusion (the tenon) from another piece into the slot.



Fig: 4.15: Screws and joints

4.3.13 IOT Applications

The Internet of Things (IoT) is a rapidly growing technology that connects physical objects and devices to the internet, enabling them to communicate with each other and with users in real time. The concept of IoT revolves around the idea of creating a network of interconnected devices and systems, which can share data and information with each other to enable intelligent decision-making and automation. IoT technology is used in a variety of applications, including home automation, industrial automation, healthcare, transportation, and more. In the context of home automation, IoT devices can be used to control everything from lights and temperature to security systems and appliances, providing users with greater convenience and control over their living spaces. In industrial automation, IoT technology is used to optimize manufacturing processes, reduce downtime, and improve overall efficiency. IoT devices can also provide valuable data and insights that can be used to inform decision-making and improve processes. However, there are also challenges and concerns associated with IoT, including data privacy and security risks, as well as the potential for increased complexity and the need for interoperability standards. So, the Internet of Things represents a major shift in the way that we interact with technology and the world around us. As the number of connected devices continues to grow and new applications are developed, IoT is poised to play an increasingly important role in our daily lives and in industries around the world.

4.3.14 Image Processing

Image processing refers to the manipulation and analysis of digital images using mathematical algorithms and computational methods. Image processing techniques are used in a wide range of applications, from improving image quality and enhancing features to extracting valuable information from images for scientific, medical, and industrial purposes. Image processing is a field of computer science that focuses on the analysis and manipulation of digital images. Image processing is used in a wide range of applications, including medical imaging, surveillance, robotics, and video processing. Image processing typically involves several stages, including image acquisition, pre-processing, feature extraction, and classification. In the image acquisition stage, images are captured using digital cameras, scanners, or other imaging devices. In the pre-processing stage, the images are cleaned up, filtered, and corrected for distortion or other anomalies. Feature extraction involves the identification and extraction of specific features or characteristics from the image, such as edges, corners, or textures. The applications of image processing are vast and varied. In medical imaging, it is used to analyze medical images such as X-rays, CT scans, and MRI scans to aid in diagnosis and treatment. In surveillance, image processing is used to analyze security camera footage and identify potential security threats. In robotics, image processing is used to enable robots to recognize and navigate their environment. As image processing continues to evolve, new techniques and applications are being developed. These include deep learning- based approaches, which use neural networks to process images, and real-time image processing, which allows for image processing to be performed in real time on streaming data.

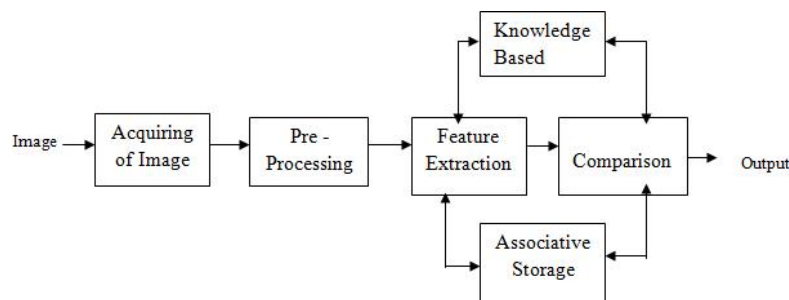


Fig: 4.16: An example of image processing

4.3.15 Open CV

OpenCV (Open Source Computer Vision Library) is an open-source computer vision and machine learning software library that is widely used for developing real-time computer vision applications. It was initially developed by Intel and is now maintained by the OpenCV community. OpenCV provides a wide range of functionalities for image and video processing, including image and video capture, filtering, feature detection, object detection and tracking, and machine learning algorithms. It supports a variety of programming languages, including C++, Python, and Java. OpenCV is widely used in various industries, including robotics, healthcare, entertainment, and automotive, for applications such as face recognition, object detection, gesture recognition, and medical image analysis. OpenCV, or Open Source Computer Vision Library, is a widely used open-source computer vision and machine learning software library. It is designed to be cross-platform and can be used on Windows, Linux, and Mac operating systems. OpenCV provides a wide range of functionalities for processing images. The library includes algorithms for basic image processing operations such as filtering, thresholding, edge detection, and morphological operations. It also includes advanced techniques for object detection and recognition, such as Haar cascades and deep neural networks. OpenCV can be used for a wide range of applications, including face detection, recognition, and tracking, surveillance systems, augmented reality, and robotics. OpenCV continues to evolve with new functionalities being added regularly, including support for new platforms and languages, as well as new algorithms and techniques. It is widely used by researchers and developers around the world, and is often used in combination with other machine learning and computer vision frameworks.

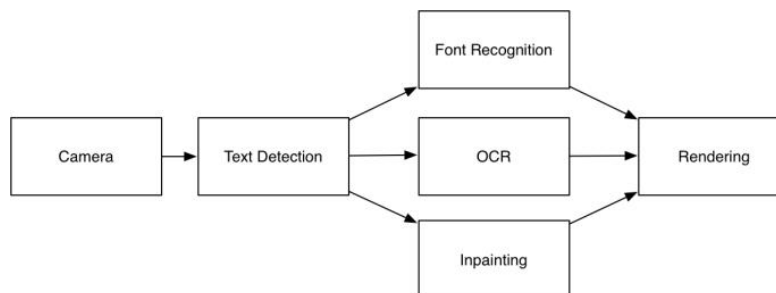


Fig: 4.17: Open cv

4.3.16 Detection Mechanism

Detection mechanism refers to the process of identifying the presence or occurrence of a particular object, event, or condition in a given environment. The detection mechanism is a crucial component of many automated systems, including security systems, monitoring systems, and quality control systems. The detection mechanism typically involves the use of sensors or detectors that are designed to sense specific physical or environmental conditions. These sensors can be based on a variety of technologies, including optical, acoustic, electromagnetic, or chemical principles, depending on the type of object or event being detected.

Detection mechanism refers to the process of identifying the presence of a specific object or event in a given environment. It is a critical component of many modern technologies, including surveillance systems, security systems, and autonomous vehicles. The detection mechanism can be achieved through various techniques, including sensors, computer vision, and machine learning. Sensors are often used for detection in applications such as motion detection and proximity sensing. They work by detecting changes in the environment, such as movement, heat, or sound, and triggering an alert or response. In computer vision-based detection, cameras or other imaging devices are used to analyze images and identify specific objects or events based on their features. This can be achieved using traditional image processing techniques, such as edge detection and object recognition, or more advanced techniques such as deep learning-based object detection and tracking. Machine learning is another powerful tool for detection, and can be used in conjunction with sensors or computer vision techniques to improve accuracy and reliability. Machine learning algorithms can be trained to recognize specific patterns or features in data, such as the presence of an object in an image or the occurrence of a specific event. Once trained, these algorithms can be used to detect the presence of the object or event in real-time.

CHAPTER 5

RESULTS AND DISCUSSION

5.1. RESULTS AND DISCUSSION OF PRODUCT SORTING MACHINE

Results and discussion of this project refer to the analysis and interpretation of data collected during the testing of the machine's performance. This analysis is crucial in identifying the strengths and weaknesses of the machine and determining the possible improvements that can be made. The results of the product sorting machine can be evaluated based on various parameters such as accuracy, speed, efficiency, and reliability. The accuracy of the machine can be measured by comparing the number of correctly sorted products with the total number of products processed. The speed of the machine can be measured by the number of products sorted per unit time. The efficiency of the machine can be measured by the ratio of the number of correctly sorted products to the total number of products processed. During the discussion of the results, the factors that affected the performance of the product sorting machine should be considered. These factors may include the type of products being sorted, the operating conditions of the machine, and the quality of the sensors and other components used in the machine. The discussion should also address any limitations of the machine and suggest possible improvements that can be made to overcome these limitations.

For example, the results and discussion of a product sorting machine may show that the accuracy of the machine is high, but the speed is relatively slow. The discussion may suggest that the speed can be improved by using a faster conveyor belt or optimizing the machine's software. Alternatively, the discussion may identify that the machine is not suitable for sorting irregularly shaped products and recommend modifications to the machine's design to improve its adaptability. So, the results and discussion of a product sorting machine provide insights into the performance of the machine and offer recommendations for improving its efficiency and effectiveness.

5.2. PERFORMANCE ANALYSIS OF PRODUCT SORTING MACHINE

Performance analysis of a product sorting machine is a process that involves evaluating the machine's performance based on specific metrics. These metrics can include accuracy, speed, throughput, efficiency, and reliability. The analysis helps to determine how well the machine is performing and identify areas where improvements can be made. To perform a performance analysis, the first step is to define the metrics that will be used to evaluate the machine's performance. This involves selecting the appropriate parameters based on the type of products being sorted and the intended use of the machine. Once the metrics have been defined, data is collected during the operation of the machine. This data can be collected manually or automatically using sensors and other data acquisition devices. The data collected should cover all aspects of the machine's operation, including the time taken to sort each product, the number of products sorted, and any errors or malfunctions that occur. The collected data is then analyzed to determine how well the machine is performing based on the defined metrics. To perform a performance analysis, the first step is to define the metrics that will be used to evaluate the machine's performance. This involves selecting the appropriate parameters based on the type of products being sorted and the intended use of the machine. For example, the accuracy of the machine can be calculated by comparing the number of correctly sorted products with the total number of products processed. The speed of the machine can be calculated by dividing the number of products sorted by the total time taken to sort the products. After analyzing the data, the performance of the machine can be evaluated against the defined metrics. Any areas where the machine is not performing up to the required standards can be identified, and improvements can be suggested. For example, if the accuracy of the machine is low, modifications can be made to improve the sensor or software used for sorting the products. So, performance analysis of a product sorting machine is essential for evaluating the machine's performance and identifying areas where improvements can be made. The analysis helps to optimize the machine's operation and ensure that it is performing to the required standards.

5.3 OUTCOME OF THE PROJECT

An effective Internet of Things–based automatic sorting machine that uses Image Processing to read the text of destination names, shapes of that destination, and colours of that destination in order to separate the parcel according to the concerned destination and display result on app. The outcome of Shape detection is displayed in Fig. 5. The parcel removing sorting arm is attached to the frame of our conveyor belt and is another feature of our sorting machine. Its intended use is as a demonstrative tool for the sorting of packages destined for various locations. It shows how a quality-based sorting industry can benefit greatly from implementing an automated inspection system. This work will pave the way for the widespread adoption of such automated systems in our industries, replacing the labour-intensive and time-consuming manual sorting processes that have long been the norm and are lowering our product quality standards on the international market. The need for automation to maximise output while minimising wasted effort is evident in the context of a rapidly developing global economy and trade in the last decade. This is the genesis of the parcel delivery or packaging industry's use of automation. The proposed Internet-of-Things-based Automatic Sorting Machine makes use of image processing to streamline the sorting process and boost manufacturing efficiency. Human resources spent on material handling and inspection can be reduced thanks to the findings of this study, which in turn should lead to fewer mistakes being made by humans. A high-quality inspection system to sort out the products is important because inspection can be seen as a strategic process to beat out the competition. As a result of a rise in production, an Automatic Sorting Machine would be the ideal solution to this issue, allowing for more efficient sorting. The IoT app also shows the results after they have been sorted.

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY OF PRODUCT SORTING MACHINE

Product sorting machines are becoming increasingly important in today's world as companies seek to improve efficiency and reduce costs in their manufacturing and logistics operations. These machines use a variety of technologies, including sensors, cameras, and machine learning algorithms, to sort and organize products based on their characteristics, such as size, shape, color, and weight. They can process large volumes of products quickly and consistently, reducing the need for manual labor and improving overall productivity. This can be especially important in industries such as e-commerce and logistics, where speed and efficiency are critical for meeting customer demands. By automating the sorting process, these machines can help ensure that products are correctly identified and routed to the appropriate destination, reducing the risk of mislabeling, misplacement, or damage. This can help improve overall customer satisfaction and reduce the cost of returns and refunds. In addition to improving efficiency and reducing errors, product sorting machines can also help companies optimize their supply chain operations. By providing real-time data on inventory levels, shipping times, and other key metrics, these machines can help companies make more informed decisions about production scheduling, inventory management, and shipping logistics. This can help reduce costs and improve overall business performance. By automating the sorting process, these machines can help ensure that products are correctly identified and routed to the appropriate destination, reducing the risk of mislabeling, misplacement, or damage. So, product sorting machines are a valuable tool for companies looking to improve efficiency, reduce costs, and optimize their supply chain operations. As technology continues to evolve and new applications for product sorting machines are developed, these machines are likely to become increasingly important in a wide range of industries and applications.

6.2 CONCLUSION

In conclusion, product sorting machines represent a significant advancement in modern manufacturing and logistics operations. By automating the process of sorting and organizing products based on their characteristics, these machines are able to greatly improve efficiency, accuracy, and quality control in a wide range of industries and applications. They are particularly valuable in industries such as e-commerce and logistics, where speed and accuracy are critical for meeting customer demands.

One of the key benefits of product sorting machines is that they enable companies to process large volumes of products quickly and consistently, reducing the need for manual labor and improving overall productivity. This not only helps to reduce costs, but also enables companies to meet growing customer demands in a timely and efficient manner. Additionally, these machines help to reduce errors and improve quality control by automating the sorting process, which can help improve overall customer satisfaction and reduce the cost of returns and refunds. Another advantage of product sorting machines is that they enable companies to optimize their supply chain operations by providing real-time data on inventory levels, shipping times, and other key metrics. This data can be used to make more informed decisions about production scheduling, inventory management, and shipping logistics, which can help reduce costs and improve overall business performance.

As technology continues to evolve, product sorting machines are likely to become even more advanced and versatile, offering even greater benefits to businesses. For example, new machine learning and artificial intelligence technologies are being developed that will enable these machines to identify and sort products based on even more complex and nuanced criteria, such as texture and material composition. So, product sorting machines represent a major breakthrough in modern manufacturing and logistics operations. They offer a wide range of benefits,

from improving efficiency and accuracy to reducing costs and optimizing supply chain operations. As more and more companies adopt these machines, they will undoubtedly become an even more important part of the modern business landscape.

REFERENCES

- [1] Akintoye, A. O., & Adetunde, I. A. (2015). Design and construction of a mechanical vegetable sorting machine. *International Journal of Engineering Research and Development*, 11(8), 1-7.
- [2] Anand, A., & Bhatia, M. (2015). Design and development of an automated product sorting system. *International Journal of Engineering Research and General Science*, 3(2), 120-125.
- [3] Chen, Y., Liu, H., & Zhang, J. (2018). Design and implementation of a cereal grains sorting machine based on machine vision. *Journal of Food Measurement and Characterization*, 12(2), 1266-1275.
- [4] Ding, H., Li, H., Li, M., Li, Y., & Li, Y. (2019). Research on the sorting technology and sorting machine of seafood. *Procedia Manufacturing*, 32, 1029-1034.
- [5] Fan, W., Chen, J., Zou, X., Liu, B., & Xu, J. (2019). A color sorting machine for agricultural products based on improved HSV color space. *Computers and Electronics in Agriculture*, 162, 69-78.
- [6] Gogate, M., & Kulkarni, M. (2017). Design and development of fruit sorting machine using image processing. *International Journal of Science, Engineering and Technology Research*, 6(5), 69-76.
- [7] Huang, X., Liu, Y., Sun, J., & Ren, L. (2020). Design and implementation of a fruit sorting machine based on machine vision. *Journal of Food Measurement and Characterization*, 14(2), 677-686.
- [8] Jagtap, S., & Bhakre, A. (2018). Development of a fruit sorting machine using computer vision. *International Journal of Innovative Research in Science, Engineering and Technology*, 7(3), 4666-4673.
- [9] Lee, J. W., & Hwang, Y. (2015). Sorting machine for agricultural products using machine vision technology. *Journal of Biosystems Engineering*, 40(4).

- [10] Liu, Q., & Zhu, Q. (2017). Design of an online sorting machine for rice based on machine vision technology. *Journal of Food Measurement and Characterization*, 11(2), 444-453.
- [11] Oboh, S. E., Oladimeji, T. E., & Adepoju, A. O. (2016). Design and development of a colour sorting machine. *International Journal of Engineering and Applied Sciences*, 6(2), 49-57.
- [12] Rizal, M., Tareq, M. I., Islam, M. N., Islam, M. S., & Hasan, M. K. (2019). Development of a rice sorting machine based on machine vision technology. *Journal of Food Process Engineering*, 42(8), e13188.
- [13] Singh, S. (2017). Automated vegetable sorting machine. *International Journal of Science, Engineering and Technology Research*, 6(1), 157-162.
- [14] Wu, J., Cao, X., Song, Y., & Wang, H. (2018). Design and development of a fruit and vegetable sorting machine based on the color and shape features. *Journal of Food Process Engineering*, 41(2), e12703.
- [15] Zhang, C., Zheng, Y., Li, Y., & Gao, Z. (2019). Development of a potato sorting machine based on machine vision technology. *Journal of Food Process Engineering*

ANNEXURE:

- A review paper titled “Various methods on sorting mechanism - Review of literature” by Rahul Selvakumaran, Tharun kumaar, Amarnath M has been presented at ICRDME conference conducted by Siddaganga Institute of Technology, Tumakuru on march 3rd, 2023.
- Looking forward to publish the review paper in Springer Journal.
- An experimental paper named “ Development of automatic product sorting machine using internet of things” by Rahul Selvakumaran, Tharun kumaar, Amarnath M has been presented at RASET conference conducted by Bannari Amman Institute of Technology, Erode on May 4th, 2023.
- Presented experimental paper is expected to be published in a scopus indexed journal very soon.



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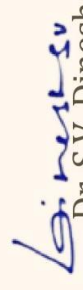
03rd and 04th March

CERTIFICATE OF PRESENTATION

This is to certify that the paper titled **“VARIOUS METHODS ON SORTING MECHANISM - A REVIEW OF LITERATURE”** paper ID **“109”** authored by **“Rahul Selvakumaran, Tharun Kumaar R and Amarnath M”** was presented in the “International Conference on Recent Developments in Mechanical Engineering” (ICRDME-2023) organized by Siddaganga Institute of Technology, Tumakuru, Karnataka, India.


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Various Methods on Sorting Mechanism - A Review of Literature

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Abstract

A **sorting machine** is a device used to organize materials, such as items, data, or information, into specific categories or sequences based on certain criteria. This system works on a **detecting mechanism**. They can use various methods such as size, weight, shape, color, or other characteristics to classify items. They are widely used in various industries, including postal services, waste management, manufacturing, food production, and distribution, for efficient and automated sorting processes. Particularly, these sorting machines are used in candy manufacturing industries, fruit shops, etc. The use of sorting machines can **reduce manual labor**, increase accuracy and productivity, and save time and resources. There are plenty of sorting systems available in the market which are helpful for both shopkeepers and customers in sorting the respective products according to their shape and size. In this paper, we are going to collect all the **types of sorting mechanism** and explain the best method with a **fast process and accurate results**.

Keywords: Product sorting; Image processing; Color sorting; MATLAB; Arduino; Logistics



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Dear Authors,

Greetings for the day!!!

We are pleased to inform you that your manuscript has been accepted* for oral presentation at the **Third National Conference on Recent Advancements in Science, Engineering & Technologies (RASET 2023)**, will be held on **3rd – 4th, May 2023**, hosted by the **Department of Electronics and Communication Engineering** in an association with **Unmanned Underwater Vehicle - Special laboratory**, **Bannari Amman Institute of Technology, Sathy**.

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