Faculty of Electrical and Electronic Engineering Technology

Development of an IoT-based Sorting System for Colour-based Products

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MUHAMMAD RAZIN BIN ROZALI

Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

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Development of an IoT-based Sorting System for Colour-based Products

MUHAMMAD RAZIN BIN ROZALI

A project report submitted
in partial fulfillment of the requirements for the degree of
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TAMAN DESA PERMAI,73400,
GEMAS,NEGERI SEMBILAN

Cop Rasmi: Ts. MASLAN BIN ZAINON
Pensyarah Kanan (Senior Lecturer)
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
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Date : 6/2/2022

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

Signature : .....

Supervisor Name : Ts. MASLAN BIN ZAINON
Pensyarah Kanan (Senior Lecturer)
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
Universiti Teknikal Malaysia Melaka

Date : 6/2/2022

Signature : .....

Co-Supervisor : .....

Name (if any)

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ABSTRACT

Following the currents of modernity must be consistent with the development of technologies that can support the development of technological systems. In order to do justice to the revolution of industrial expansion IR 4.0, colour-based product isolation systems have to be developed from time to time. The entire industry needs work-controlled image processing. Immediately afterwards, the Internet of Things (IoT) can help people monitor the image processing process with the help of the Raspberry Pi usage system. This project aims to automate the product classification system by colour through image processing; Next, the project consists of developing a goods separation system using intelligent devices with monitors. Additionally, by analyzing the performance of the image processing and system monitoring; The method to make this project a success was to process product images for analysis by the Raspberry Pi with a camera. The way this image is processed is by capturing the number of pixels and separating red, blue and green. To successful the project, several data need to be taken. The data been taken is ideal data for image processing image for three types of colours, ideal angular of the sorting product, the servostep for decreasing time taken for one cycle product and the IoT data analysis for tracking the counter for each type of colour product. This prototype project is suitable for iii manufacturing process that have sorting system process to improve quality of logistic and less burden of worker.

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ABSTRAK

Mengikuti arus zaman permodenan perlulah sejajar dengan perkembangan teknologi yang dapat membantu perkembangan sistem teknologi. Bagi memenuhi Revolusi perkembangan industri IR 4.0. sistem pengasingan barang berdasarkan warna harus diperkembangkan dari semasa ke semasa. Seterusnya, hampir seluruh industri memerlukan pemprosesan imej tetapi dikawal oleh tenaga manusia. Sejurus dengan hal tersebut, Internet Pelbgai Benda (IPB) dapat membantu manusia memantau proses imej pemprosesan dengan bantuan sistem pengaturan kawalan Raspberry Pi. Projek ini bertujuan untuk, mencipta sistem automasi pengasingan barang menikut warna dengan mengunakan pemprosean imej. Seterusnya, projek ini adalah untuk mengembangkan sistem pengasingan barang dengan menggunakan peranti pintar dengan memantau ataupun memberi arahan. Tambahan pula, dengan menganalisis prestasi pemprosesan imej dan pemantauan sistem. Kaedah yang digunakan untuk menjayakan projek ini adalha dengan menggunakan kamera untuk memproses imej produk untuk di analisis oleh Raspberry Pi. Produk yang telah di analisis akan diasingkan dalam tiga bekas. Seterusnya dengan menganalisis prestasi pemprosesan imej dan pemantauan sistem. Kaedah yang digunakan untuk menjayakan projek ini adalha dengan menggunakan kamera untuk memproses imej produk untuk di analisis oleh Raspberry Pi. Data yang telah di analisis dalam projek ini adalah, pemprosesan imej, bilangan langkah untuk servomotor2 dan kecekapan aplikasi Blynks pada projek ini. Akhir sekali adalah rekomendasi dan kesimpulan adalah projek ini berjaya dilaksanakan dengan lancar.

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CHAPTER 1

INTRODUCTION

1.1 Background

This project aims to develop an IoT color-based product sorting system using the Raspberry Pi, which will calculate the program in this project. The system controls the feeder is a servo motor in this project. The color-based sorting system will improve innovation using less human power and production errors. After this project completed, the output production will increase further due to the improvements made in this project. In this project, the camera will be developed to detect the colour of the product to provide the Raspberry Pi program. If the information was a Raspberry Pi program, the mechanical part of this project would react. The mechanical part required in this project is the servo motor, which moves the mechanism to select the product of the collapse. Next, the Raspberry Pi will be supported by a camera sensor to scan the product colour, providing the microcontroller with information. In addition, the camera detects only three types of green, blue and red colours. The software Raspberry Pi is a program to monitor and meet the system requirements of the project. Finally, for smartphone devices, Blynk apps are being used to extract product information, such as the number of products being sorted, the types of product colours sorted and the time taken to complete a cycle system.

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1.2 Problem Statement

Industry trial system automation gave a lot of advantage to the industry's production. The automation industry uses the sorting system to trial its product followed by its class holistically around the world. The output production of each industry is also increasing because of customer demand. Next, the sorting system helps most people to continuously sort the product without reducing its performance. Besides that, nowadays the sorting system has a minor problem. Many sorting systems in the industry use manual systems which make output production very difficult. The quality of workers can be influenced by their performance. As a result, the human power in the sorting system industry is exposed to a risk, which can lead to several possibilities.

The previous solution proposed by the engineer is to try to implement the PLC system, which offers industry many benefits. The functioning principle of PLC is the sorting system in which the project uses pneumatic cylinders with colour sensors to automate the system in its entirety. Next, the system includes a product conveyor belts and a colour sensor to feel the product colour type. The system then uses 2 pneumatic cylinders with solenoid valves to push the product into its respective collection station. The PLC system component could be very expensive to implement in the automation sorting system.

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The next problem with using PLC in the sorting system is the power problem because the PLC devices will need the high power needed to consume the system. PLC system maintenance could be very expensive because the PLC device component is difficult to repair. Therefore, the Raspberry Pi will be implemented to improve the current problem in this system.

By using the colour sensor on the sorting system and implementing Raspberry Pi in the system, production will increase. The component that is low cost and easy to carry out in

this project. By using Python language in the coding of the Raspberry Pi, employees can easily check for system errors. The Iot system in the sorting system will allow the system to operate far from the system.

1.3 Project Objective

For this project to be succeeded, the objectives which need to be achieved are:

- To design and develop microcontroller-based circuits and hardware for a colour-based sorting system.
- To apply an IoT technology on the sorting system via a smartphone for control and monitoring purposes
- To analyse the performance of the sorting system in terms of its detection effectiveness of colour-based products.

1.4 Scope of Project

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For this subtopic, the scope had been laid out to achieve an expected outcome and accomplish the given task.

- The system is using Raspberry Pi as microcontroller and microprocessor
- Just three type of coloured will be sorting in this system (Green,Red,Blue)
- Smartphone will be used as sorting system monitoring.
- To link the smartphone and Raspberry Pi, Blynk will be used.
- Only round-shaped object will be sorted

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Things are usually arranged by hand, which requires human labour. Identifying and ordering a particular item is a difficult task. Based on this paper, the system takes account of the above considerations and offers a cost-effective solution. Using the Raspberry Pi, an open board powered by intelligence. Raspberry Pi technology has now played an important role in a variety of automation applications. The production line is an industrial production line equipped with industrial robots and industrial IP cameras(Szabo and Gontean, 2016) . The aim of this project is to evaluate its usefulness and effectiveness as a mechanical device for the sorting of objects. Identifying and arranging a specific object is a difficult task, especially in the industry, where many objects must be sorted within a short period of time, while also bearing in mind that the weight of the items is much larger than the average person could bear. Using a Raspberry Pi, a Linux-based open-source board, in this project. Raspberry Pi has played a major role in a wide range of automation applications in today's technology. The objective is to assess its usefulness and effectiveness as a mechanical device for the sorting of objects. Sensor or detector provides a way to collect data on operations and approaches(Yadav *et al.*, 2019)

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2.2 Review of The Current Situation

Automation is the use of control systems to handle various processes and machines in order to replace human efforts. A sophisticated algorithm is used by an automated system to increase the value of the planning. However, this not only reduces manual efforts and time consumption, but also allows for more time to consider factors such as aesthetics. Using automation also eliminates the danger that could occur when humans are forced to work in hazardous environments. As a result, the use of automation is extremely beneficial in the manufacturing industry. Automated sorting also reduced labour costs and, as a result, production time. The use of an automated system by color-based sorting employing a colour sensor eliminates errors caused by human negligence. Errors occur because of fatigue and subjectivity associated with manual colour sorting of components, and productivity is also reduced. Figure 2.1 showed the worker do sorting task that need repetitive task to do,

Figure 2.1: The Worker Sorting the Product

2.2.1 Review of Sorting System

The sorting system is the process by which the product is separated by certain specific characteristics such as size, shape, and weight. In the manufacturing industry, human power is used manually to save machine cost maintenance. Because of this, people have their faintness, such as human error, fatigue, and emotional control. To reduce the error, the system needs to be improved day after day to increase the product output in the industry. To increase production, the industry must employ workers to sort the product manually. It gives more to the cost of the company which affected human health's performance. The colour-based product sorting system will be improved if this project complies with all the requirements. Sorting is currently primarily carried out artificially, but there is no effective automated production machine. (Tian *et al.*, 2017)

2.3 Theory

2.3.1 Microcontroller Devices

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Microcontroller devices are the main integrated compact circuit for the operation. A microcontroller needs the 5V energy supply. The electronic device usually needs the microcontroller to calculate the entire system program. Chip CPU (Central Processing Unit) RAM (Random Access Memory), ROM are all microcontrollers (Read Only Memory). Microcontrollers shall be used in products and devices such as automotive motor control, medical equipment, actuator program and remote control automatically. The base internal bus width, the memory and the instructions can be classified as 4-bit, 8-bit, 16-bit and 32bit microcontroller. The 8-bit microcontroller chip implemented in the system is mainly used in electronic devices. A digital computer can monitor the various signals in a system and decide smartly on how to implement a control strategy Global automation has grown so rapidly

every day in the 21st century to increase production. Extensive mixed signals are used to integrate the analogue components necessary for the control of non-digital electronic systems. Microcontrollers were famous and were a cost-effective way to collect, recognise and react to physical worlds on the internet. For low power consumption, different microcontrollers can even use four-bit words or ramp it up to 4 kHz. Usually, the system can process functions while waiting for a keypress or other interrupt to create a majority of them for long term applications. These microcontrollers can play an important role in performing similar DSPs with higher clock rates and higher power consumption. There are many different types of microcontrollers like Arduino, PIC, Raspberry PI and more in this stream. It shows the functional system working on the basis of the figure 2.2.

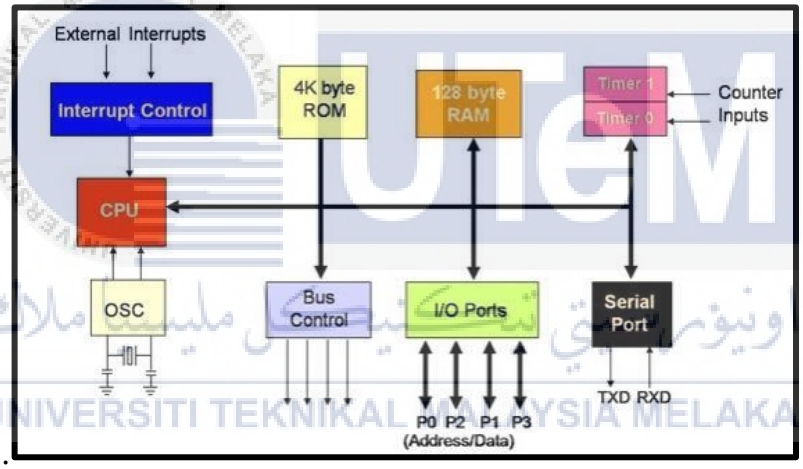

Figure 2.2: Parts of Microcontroller

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2.3.2 Comparison Microcontroller and Microprocessor

Table 2.1 shows the comparison between microcontroller and microprocessor.

Table 2.1: Comparison Microcontroller and Microprocessor

Microcontroller	Microprocessor
A compact integrated circuit designed in an embedded system for a specific operation.	A component that can performs the instruction and task involved in computer processing
Used for application that performs task	Used for application that require intensive processing
CPU and all other elements are intetrated into a single chip board	Memory, I/O ports, and timers are connected to the CPU
Performs a single task. Therefore, it does not rewuire more memory and I/O ports	Microprocessor based application performs multiple tasks. There, it required more memory
Has a lower clock speed (Hz) 1 MHz to 300 MHz.	Has high clock speed (Hz) 1GHz to 4 GHz

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