UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EARLY FIRE DETECTION WITH ALARM SYSTEM USING DIGITAL IMAGE PROCESSING

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

by

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I hereby, declared this report entitled EARLY FIRE DETECTION WITH ALARM SYSTEM USING DIGITAL IMAGE PROCESSING is the results of my own research except as cited in references.

Signature: ……

Author : MOHAMAD AZRUL FAHMI BIN MUSTAPHA

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Projek ini adalah mengenai Pengesanan Kebakaran awal dengan Sistem Penggera menggunakan Pemprosesan Imej Digital. Komponen utama yang digunakan ialah Raspberry Pi 3 yang memproses input dari Camera Surveillance. Raspberry Pi 3 juga bertindak sebagai sambungan antara komponen input dan output. Seperti sekarang, sistem penggera kebakaran biasa menggunakan asap dan sensor haba untuk mengesan api. Ia hanya akan mengesan apabila terdapat api yang berat. Berbeza dengan projek ini, kamera pengawasan bertindak sebagai sensor untuk mengesan api walaupun dengan api minimum. Kamera pengawasan mengesan api dengan menangkap algoritma api. Segmen warna adalah titik utama bagaimana kamera pengawasan mengesan api. Kamera Pengawasan akan merakam kawasan tertentu dan jika terdapat kebakaran, segmen warna akan berbeza. Raspberry Pi 3 akan diproses apabila warna RGB (Merah, Hijau, Biru) berubah. Batasan warna untuk mengesan kebakaran ialah 128 segmen. Jika R-G> 128 / R-B> 128 ia akan mengesan bahawa api. Suhu api juga boleh ditentukan oleh warna api. Susunan warna dari panas ke paling hangat adalah berdasarkan warna merah kepada warna putih. Api paling hangat adalah warna putih lebih kuning. Kamera Pengawasan dihubungkan dengan kabel USB kepada Raspberry Pi 3 dan monitor disambungkan ke port HDMI. Penggera dan skrin LCD disambungkan ke port GPIO dengan menggunakan kabel GPIO untuk Raspberry Pi 3. Monitor dan penggera sebagai output. Hasilnya harus menjadi penggera yang berdering ketika ada api.

ABSTRACT

This project was about the early Fire Detection with Alarm System using Digital Image Processing. The main component that use was Raspberry Pi 3 that process the input from Surveillance Camera. Raspberry Pi 3 also act as connection between component of input and output. As nowadays, normal fire alarm system use smoke and heat sensor to detect fire. It will only detect when there was a heavy fire. Different from this project, surveillance camera act as the sensor to detect fire even with a minimum fire. The surveillance camera detect fire by capturing the algorithm of fire. The colour segment was the main point how the surveillance camera detect fire. Surveillance Camera will record the certain area and if there was a fire, the colour segment will be different. Raspberry Pi 3 will process when the RGB (Red, Green, Blue) colour change. The limit in colour to detect fire was 128 segment. If R-G>128 / R-B>128 it will detect that was fire. The temperature of fire also can be determine by colour of fire. The arrangement of colour from hot to hottest was based from faint red to white colour. The hottest fire was the white colour more then yellow. The Surveillance Camera was connected with USB cable to Raspberry Pi 3 and the monitor was connected to HDMI port. The alarm and LCD screen was connected to GPIO port by using GPIO cable to Raspberry Pi 3. Monitor and alarm as the output. The result should be the alarm ringing when there is fire.

DEDICATION

To my beloved father and mother.

Thank you for your physically and morally support

ACKNOWLEDGEMENTS

Alhamdulillah, thanks to Allah S.W.T the Final Year Project (FYP) is complete. I hereby would like to take this opportunity to express my sincere gratitude to several individuals who are involving and supporting me generously in helping and assisting me throughout completing this Project Thesis (PSM) which is compulsory to all Universiti Teknikal Malaysia Melaka (UTeM) students in order to complete our degree.

First and foremost, I wish to express my deepest gratitude and thanks to my project supervisor, Ts. Dr Rostam Affendi bin Hamzah for his undivided support morally and physically, insightful comments, invaluable suggestions, beneficial information, sensible advice and unceasing ideas which proved to help me constantly as to finish my Final Year Project (FYP).

I also would like to thank the panels, whose give me a comment during my presentation. I also wish to take this opportunity to express my deepest gratitude to my family unwavering support and encouragement is my source of strength, and friends for their patients, understanding and also for the undivided support that they had given me throughout the completion of my project.

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CHAPTER 1

INTRODUCTION

This chapter gives a general thought of this project. It discusses the background of this project, the problem statement, objectives, the scope of work, expected result of the project, cost involved in this project and thesis organisation.

1.1 Background

This project was about a fire detection control that detect only with camera by filtering the colour and algorithm base. The input comes from camera that capture fire and process in raspberry pi and also use algorithm detection for filtering only fire and give and output to alarm and also monitoring. Raspberry pi was is a device that process any incoming from other device and provide to output that needed. Its like control system in one fully complete device that compute and process.

This project was connection between camera, Raspberry Pi 3, alarm and also LCD screen. This project was to surveillance early fire from expose to critical damage. Nowadays, preventing earlier was better than it become wait for it turn to heavy fire. Currently, almost all fire detection systems use built-in sensors primarily depending on relative humidity sampling, temperature sampling, and smoke analysis. Besides the traditional fire detectors for ultraviolet and infrared. They are therefore not always reliable because of non-fire energy emissions or combustion products. This can be detected by misadventure in other ways. To provide fire information that is more reliable. Increasingly interesting is the visual-based approach. This prototype has been developed for real-time application as a new algorithm for fire detection.

Furthermore, the combination of visual sensor (i.e. camera) and fire detection system image processing is a new safety technology.

1.2 Problem statement

Today building had many problem of avoid critical damage from fire burning. Sometimes because of mini fire had affect to become worst if its not prevented earlier. This is why early fire detection system needed because its probably help reduce critical damage and high chance of extreme injuries. Normal fire detection system only use heat sensor that detect heat or smoke.. this only can detect if there is heavy fire. Normally if that happen it had affect 10% of the building damage. So, that heavy fire cannot be prevent earlier. The solution for using image processing was to provide early detect for fire so that fast prevention can be occur. Besides that, normal fire system need to use 24 hour human monitor so that sometimes effect to human reckless. This can effect due to highly chance of heavy burning. The normal system was not to accurate for validate the cause damage.

1.3 Objective project

The objective of this project comes from some short of research and problem statement. This objective shown the reason and the outcomes of this project. The objective had state below:

i. To construct early fire detection system.
ii. To develop an algorithm for fire detection system.
iii. To validate the accuracy of the propose system.

1.4 Scope of work

This project is follow to several scopes. initially, the programming will be done using Raspberry Pi. The data obtained from the capture of camera to the fire will be insert into raspberry pi and algorithm process. Its was monitor by LCD screen and also the alarm. This monitoring can be observed by anybody who has the authorities to access the data and information.

1.5 Expected result

This project should expect to give a result at monitor and alarm. At the monitor should show the camera view and at alarm should be ringing. The process comes from raspberry pi and algorithm process.

faint red	930	500	770
blood red	1075	580	855
dark cherry	1175	635	910
medium cherry	1275	0690	0965
cherry	1375	0745	1020
bright cherry	1450	0790	1060
salmon	1550	0845	1115
dark orange	1630	0890	1160
orange	1725	0940	1215
lemon	1830	1000	1270
light yellow	1975	1080	1355
white	2200	1205	1480

Figure 1.1 Fire Colour Code with Temperature

The figure 1.1 show the colour code of fire. When the surveillance camera detected based on this colour it will filter the colour so that it can sent the signal to

alarm. The result should show the alarm ringing based on the calculation of colour RGB. If the Red minus Green or Blue is higher then 128 colour segment it will detect that is fire. Colour of fire was mix based on the figure 1.1 above so that if other colour with red colour but not fire it will not detected.

1.6 Cost Involved in Project

Equipment/Material/Component	Price
Raspberry Pi 3 model B+	RM166.00
ACER K202HQL 20' LED MONITOR [FREE HDMI CABLE]	RM264.00
ANGEL 8MP Mini Webcam HD Web Computer Camera for Desktop Laptop USB Plug and Play	RM68.98
Sandisk SD Card 16GB class 10	RM60.00
USB to Micro USB 2.0 Cable	RM11.40
Buzzer (with wire)	RM2.00
LCD Display 1602 Yellow blacklight	RM7.90
EG 5V 3A Micro USB AC Adapter Power Supply Charger for Raspberry Pi	RM9.02
40p GPIO cable for Raspberry Pi	RM4.50

Table 1.0 Cost involve in project

1.7 Thesis Organisation

This consist of 5 chapter in total. The contect are shown below :

The chapter 1.0 consist of 7 main subject which is Introduction, Objective, Problem Statement, Scope of Work , Expected Result, Cost Involve in Project and Thesis Organisation that will be explained in this chapter.

Chapter 2.0 was about Literature Review. In this chapter was explain about similar project from article that shown almost same result and uses of component. This chapter also explain about the understanding of the hardware that need to use.

In chapter 3.0 was about Methodology, this explained about the component use and software that needed in this project. Basically, in this chapter show the theoritical of the component and software. Furthermore, this chapter also show the flowchart and block diagram of the project.

In chapter 4.0 was about Result, this explained about the output of the system. This chapter basically tell about the output that get from the coding, software and harware of the system. This chapter also show the visualize design and real design.

In chapter 5.0 was about the Conclusion and Future Work, this explained whether the objective had succesfully be follow and the recommendation for improvise this project

1.8 Summary

In this chapter there are five topics that start with an introduction, literature review, methodology, analysis of data and conclusion. The following chapter discusses this project's literature review.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

From this chapter, it was divided into two major part. First part was about Raspberry pi. This state the language use in Raspberry pi, hardware of Raspberry pi which is component that use in Raspberry pi. In this part also state about software use which is Raspbian and also method to use. The second part in this chapter was the project component. This state the hardware use to set up in this project.

2.2 Fire Detection in the Buildings Using Image Processing

An early warning is an imperative to reduce property and death. A fire detection system is proposed in the paper based on analysis and light detection. This system uses color models YCbCr and HSV to separate yellow, orange and high luminosity light from background and ambient light under certain conditions. The author (Seebamrungsat, Praising, & Riyamongkol, 2014) say that based on differences in the fire growth is analyzed, calculated and frame. The experiments ' overall accuracy was greater than 90 %.

Fire can cause high loss of life and property and spread rapidly , mainly fire in buildings. Early warning and detection of fire was therefore imperative. The author (Seebamrungsat, Praising, & Riyamongkol, 2014) say that fire detectors, temperature detectors and smoke detectors were commonly used for things protection and fire alert. Temperature and smoke detection, however, was Slower than detection of light, which is the method proposed in this paper for substantive detection. In addition, many smoke or temperature fire detectors are needed to cover the entire area potentially subject to fire. The author (Seebamrungsat et al., 2014) say that the objective of fire detection system based on light detection, as distinct from smoke or heat detection, to facilitate earlier fire detection and to monitor fire spread.