UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **NEW FIRE ALARM AND SMOKE DETECTOR SENSOR USING CCTV**

SESI PENGAJIAN: **2011/2012**

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CHAPTER 1`

INTRODUCTION

1.1 Introduction

In electrical engineering field, image processing is any form of signal processing. For mostly the input is a photograph, which is in picture or video frame; while the output of image processing can be either an image or a set of characteristics or a parameter that related to the image. Most of the time image processing refers to digital image processing however optical and analog image processing also available. On the other hand, computer vision definition is the science and technology of machines that it can see, where see in this case means that the machine is able to extract information from an image that is necessary to solve some information. The main purpose of this study is to design system that capable to detect smoke and fire using the CCTV. Image analysis was done using software MATLAB until get desired output.

Image analysis is the process of extraction meaningful information from mages, mainly the digital images using the digital image processing method. Example of image analysis can be as simple as reading bar coded tags or complicated as identifying person face. Computer is capable to do large scale analysis of large amount of data, tasks that need complex computation or the extraction of quantitative information. This analysis is very useful for many field applications such as medicine, security and remotes sensing

Therefore, image analysis was used as another method to design a new fire alarm and smoke detector sensor, while the image was taken using CCTV or video camera. It was hoped that the result that was gathered through this project will solve the problem with already available fire alarm.

1.2 Objective

Objective is the main aim or purpose in doing the project research. In which it is the main reason of doing the research. Therefore, the objectives of doing this project are:-

To built new fire alarm and smoke detector sensor using image analysis.

To differentiate smoke using image analysis

1.3 Scope of the Project

Scope of the project is like the limitation of the project so that we know the project range of limit. As for this project the scopes are:

a) Small space room
b) Video camcorder

1.4 Problem Statement

Problem statements are the problems or issues that want to be solved during the implementation of the project. Then, few problem statements for this project which are:

a) Dead battery

   Certain smokes alarms are not hardwired into home electrical system rely on battery power. So, it require regular checking and not function when battery dead.

b) Steam interference

   False alarm also will trigger when steam (maybe from bathroom or steam room) interrupt the light beams of electrical current inside smoke detector.

c) Dusty deception

   High dusty area or insects can trip sensor inside alarm and make false alarm.

d) Residual smoke

   Smoke from burned food (stoves, toasters or oven) also can trigger wrong alarm.

e) Delay trigger alarm

   Available smoke sometime will take long delay although already detect smoke before trigger alarm to people.

CHAPTER 2

LITERATURE REVIEW

1.1 Definition of Literature Review

The writing of literature review can be simplify as the process of reading, analyzing, evaluating, and summarizing scholarly materials about a specific topic. The results of a literature review may be compiled in a report or they may serve as part of a research article, thesis, or grant proposal. Literature reviews consist of summary and explanation of the complete and current state of knowledge on a limited topic. Usually, accurate literature review easily found in academic books and journal articles. For this project there were various methods in detecting fire and smoke alarms have been created, the methods will be review in this literature review.

1.2 Fire and Smoke Detection Using Wavelet Analysis and Disorder Characteristics

Latest, method for fire and smoke detection are only use motion and color characteristic therefore many false alarms will trigger unconsciously that lower the alarm performance. This fire and smoke monitoring systems are quite useful in various field likes military, social security and economical. Because fire is a complex but not rigid visual phenomenon, therefore a multi-feature-based approach for algorithm was decided. The objective using an algorithm is to determine a combination of characteristics whose mutual occurrence where fire will become only combined possible cause. Fire has obvious characteristics likes color, motion, shape, growth, and smoke features. During this project they only aimed on few features such as color and motion and also plus additional feature analysis in future work.[1]

1.3 Video-based Smoke Detection

Method of detecting object in sequent frame is called as motion detection. Motion detection was done by comparing image frame in the image processing by defining a unique background. Therefore, the first frame was considered as the background and other images was compared and measures with it. Each image was included one or more labeled objects. If there was one object in the image then means there was a motion in that image.

When a fire burst, early detection is crucial to minimizing damage and saving lives. Current smoke sensors inherently suffer from the transport delay of the smoke from the fire to the sensor. A video smoke detection system would not have this delay. Further, video is a volume sensor, not a point sensor. A point sensor looks at a point in space. That point may not be affected by smoke or fire, so the smoke would not be detected. A volume sensor potentially monitors a larger area and has much higher probability of successful early detection of smoke or flame. Video smoke detection is a good option when smoke does not propagate in a "normal" manner, e.g., in tunnels, mines, and other areas with forced ventilation, and in areas with air stratification, e.g, hangars, warehouses, etc. Video is also a good option for large, open areas where there may be no heat or smoke propagation to a fixed point, e.g., sawmills petrochemical refineries, forest fires, etc. Research in detecting smoke using surveillance cameras has become very active recently. Just as the old saying "where there is smoke there is fire" puts, early smoke detection concerns people's life and property safety. However, video smoke detection still has great technical challenges since its current performance is inferior to those of traditional particle-sampling based detectors in terms of detection rate and false alarm rate [2].

1.4 Fire detection and Isolation for Intelligent Building Using Adaptive Sensory Fusion Method System

Detecting the presence of fire in images and videos can be a very helpful technique. Once this technique is honed and works well, it has the potential to save not only lives, but also property such as office buildings, schools, and homes. Nowadays, many institutions such as manufacturers, prisons, offices, restaurants, schools, etc. have harnessed the use of closed caption television, (CCTV) or video surveillance systems. Implementing a system that would detect the presence of fire through these video surveillance systems has the potential to yield many benefits, such as a quicker detection of fire than other methods, such as smoke detectors [3].

1.5 Fire detection and Isolation for Intelligent Building Using Adaptive Sensory Fusion Method System

These sensors can be classified into two groups, and each group has one smoke sensor; one flame sensor and one temperature sensor. The sensory failure and isolation techniques described in this paper are based on weight variation of the sensory adaptive fission method. From the simulation and experimental implementation results, it demonstrates that the method can exactly find out which sensor to be faulty and isolate. That is to say, when a sensory failure occurs, the system can exactly locate the sensory failure.[4]

CHAPTER 3

METHODOLOGY

4.1 Methodology

Methodology is the part where procedure that have been taken through out the project was summarized. Few procedure was designed that suitable with the project to get desired output. Therefore methodology have been divide into few step such as:

a) Image acquisition
b) Image pre processing
c) Image processing
d) Feature extraction
e) Decision

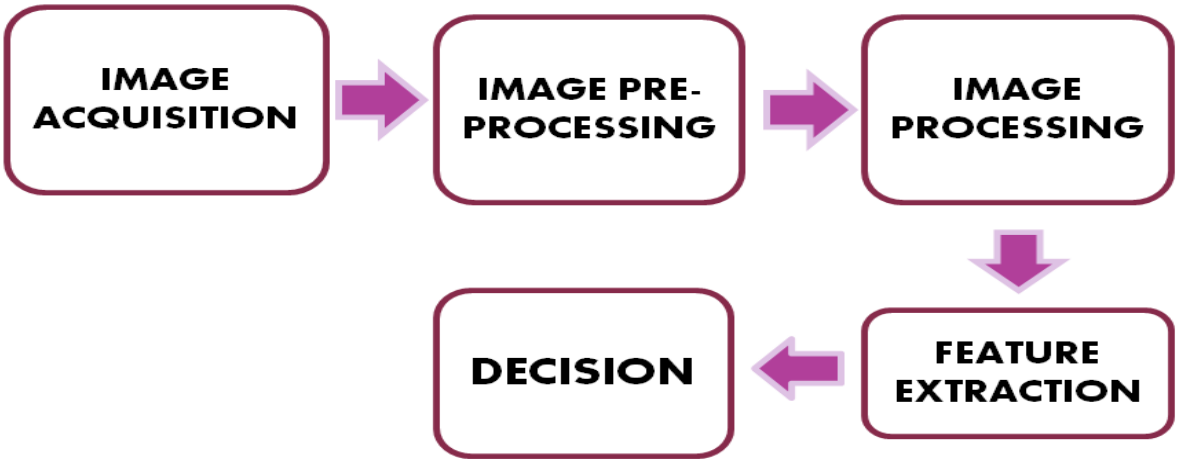

Figure 1: Methodology block diagram

3.2 Image Acquisition

Image acquisition is the first step to start the project. This step is very important in order to execute the project. In this step the data of smoke video was taken using camcorder which is sony handy cam DCRS47. The image will be captured in the small space room. Few characteristic will be invariable such as room condition, background colour, temperature and other in order to get desire accurate data to fulfill the objective. As for this project the data was collected for more that 20 times due to data was not suitable this project. The video was converted from MPEG (Moving Picture expert group) format into still image which is JPEG (Joint Photographic Experts Group) for easier image analysis. The video was taken in 35.44 seconds duration. The convert video was turned into 1063 still images which will make the further image analysis process easier.

Figure 1: Image without smoke from video that have been converted into JPEG format

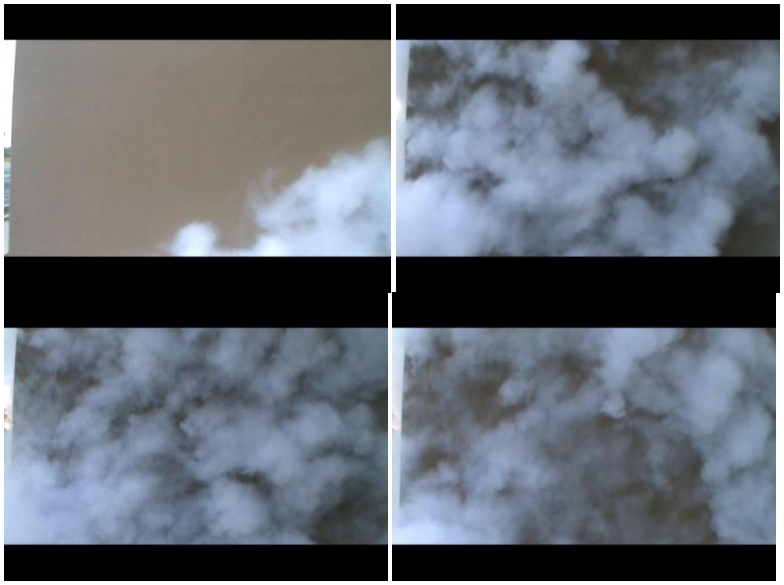

Figure 2: Image that contain smoke from video that have been converted into JPEG format

3.3 Image Pre-Processing

Following by image pre-processing step, here the video will be into format readable by Matlab Software. Moreover few conversion processes was done such as converted to grayscale to get the pixel value of each colour component. Every image has their own colour arrays which is combination of three colour which consist of red, green and blue (RGB). The RGB image was converted into grayscale which is in MATLAB known as rgb2gray function.

Figure 3: smoke image that have been converted to grey scale

3.4 Image Processing

Next, follow the image processing step where the desired feature will be selected while other will remove. Then the smoke can be detect using the threshold value that can be set. The threshold value was employed to form binary image. Pixel with value of range was set, while pixel with a out of range from threshold are set to 0. This process will allow the desired feature and remove other.

Colour	Digital Image Representation
Red	150-160
Green	150-220
Blue	180-220

Table 1: Threshold value for colour processing

3.5 Feature Extraction

This feature extraction process will represent output in easier form to apply decision. The grayscale image was converted into binary using im2bw function. With the binary image it is easier to differentiate the smoke and the background.

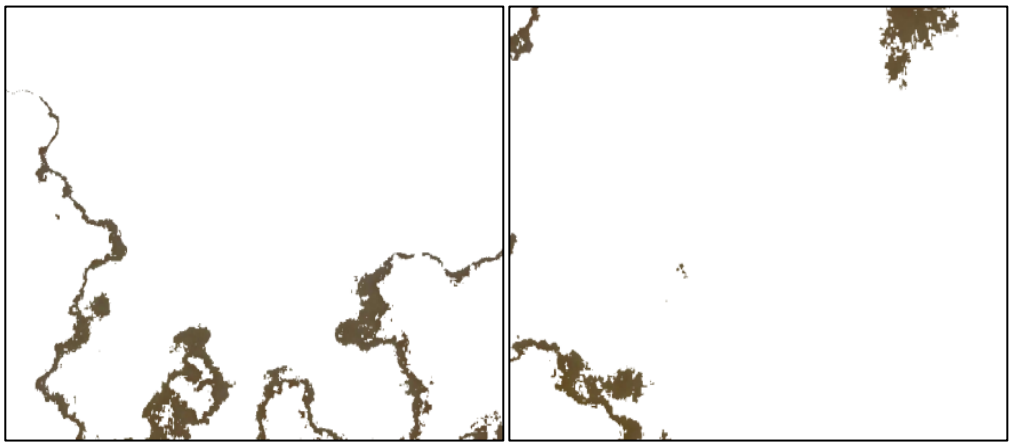

Figure 4: Image that already been extract

3.6 Decision

The decision of alarm trigger will be made based on colour pixel. The colour pixel of smoke that cause fire are different with the smoke that from source that are not harmful with the smoke that cause fire. This is due the smoke from harmful burning has lower pixel compare to smoke that not harmful like cigarette or stove. The image with larger than 50000 no of pixel will identify as image with smoke. While the image with lower pixel value will become image with no smoke. Therefore the smoke and no smoke image can be differentiate

CHAPTER 4

RESULT & ANALYSIS

4.1 Results

Results are the outputs that have been got after doing the project . As for this project the output was gathered in form of set of image that was transformed in set of readable image in the Matlab software. The warning of smoke will come out if the images have smoke. On the other hand, no smoke warning will come out if the image do not have smoke.

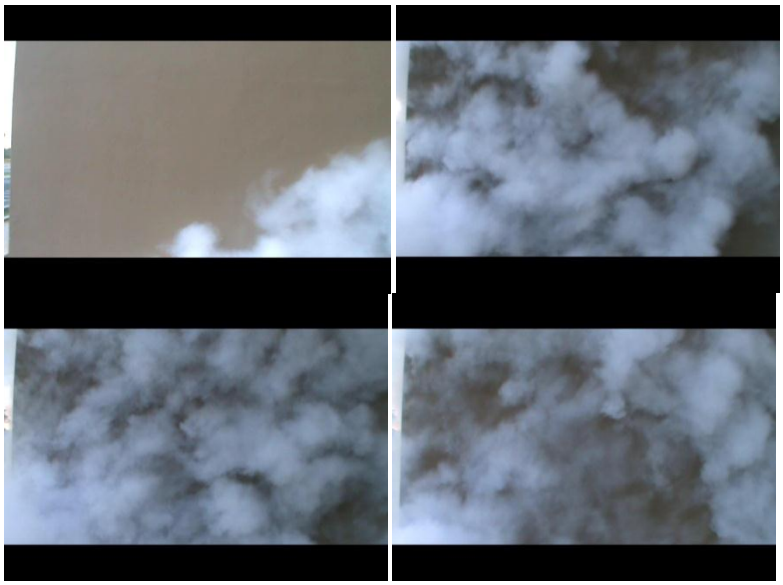

Figure 6: video that already converted into still image that contain smoke

Figure 7: video that already converted into still image that do not have smoke

Figure 8: smoke image that was converted into grey scale

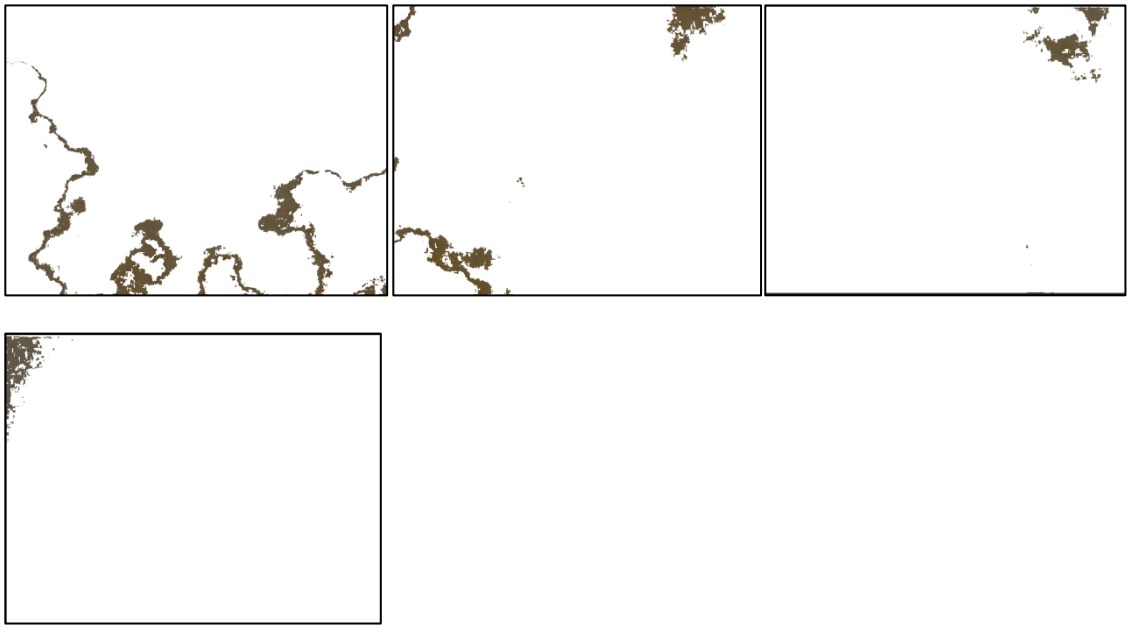

Figure 9: Output image of smoke after doing the feature extraction.

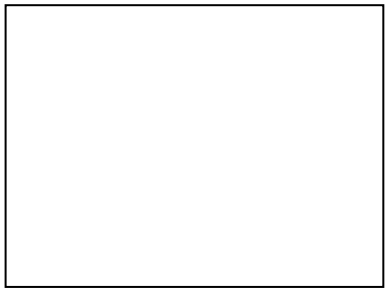

Figure 10: Output image with no smoke after doing image analysis

4.2 Results Analysis

The analysis was done based on the output image after doing the image processing in the Matlab. For this project the analysis can be measured on the image that contain smoke or do not have smoke. The output image shows that the smoke image has different color threshold when comparing with image background or other element. Therefore, output image that contained smoke can be seen clearly. In order, to decide the image that has smoke and image with no smoke the number of pixel 50000 was used. Therefore, the warning will come out if the image has smoke or do not have smoke.

The percentage error for this project was calculated:

$$\frac{\text{Desired output-actual output}}{\text{Total data}} \times 100\%$$

$$\frac{38}{1063} \times 100\% = 3.57\%$$

The percentage error was calculated by minus the desired output with the actual output, divide by total data and times with hundred percent. It was got the percentage error equal to 3.57%. By which the data output can be considered as almost accurate as the error value was lower than 10%.

CHAPTER 5

CONCLUSION

5.1 Conclusion

After doing this project the new fire alarm and smoke detector sensor can be made using CCTV image with image processing process. Plus, smoke also can be differentiating using image analysis. Normally, for a building which is not occupied with smoke detector, a normal CCTV can be used as a sensor to detect smoke from a fire. Image analysis will be use to detect the smoke so that it can trigger alarm same as function of a smoke sensor. This type of sensor can replace the function of smoke sensor whereby almost all the new building now equipped with CCTV for surveillance purposes.

5.2 Discussion

The common smoke alarm detector was based on light and heat, which is not effective as the house always produce the condition that will trigger alarm such as smoke from cooking. Most of the time the false alarm also will occur as the alarm very sensitive even to dust or insects that approach the alarm. Sometimes the smoke alarm have very long relay before detect the smoke that may cause harm and hazardous. The other type of smoke detector that use battery also will not function if the alarm run of battery, no live safe with the dead battery alarm. Therefore, this new alarm using available CCTV can solve this kind of problem.

5.3 Future Recommendation

Future recommendation is the improvement idea for this kind of project for future research. The recommendation for this project is to built new embedded system inside the CCTV or video camera.

5.4 Cost and commercialize

Cost for this new fire alarm and smoke detector design was actually no extra cost the building already occupied with the CCTV just few installments need to be done to the device to make it function as the desired fire alarm and smoke detector.

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APPENDIX A

```
clc
clear all
% fog =
%files=dir('C:\Users\Dell\Desktop\fog\*.jpg');
files=dir('C:\Users\user\Desktop\fog\*.jpg');
image_num=36;
text='C:\Users\user\Desktop\fog\*.jpg';
for im=10:image_num
a = imread(fullfile('C:\Users\user\Desktop\fog\',files(im).name));
b=imcrop(a,[83 177 1357 1082]);
   filname=strcat(text,int2str(im));
   filname=strcat(filname,'.jpg');
   imageaa=imread(filname);
   image1=imresize(imageaa,0.5);
red=b(:,:,1);
green=b(:,:,2);
blue=b(:,:,3);
      [r c]=size(red);
for loop1=1:r
for loop2=1:c
if red(loop1,loop2)>160 || red(loop1,loop2)<150|| green(loop1,loop2)>220 || green(loop1,loop2)<150 || ...
```

```
blue(loop1,loop2)>220 || blue(loop1,loop2)<180
b(loop1,loop2,:)=0;
end
end
end
imgray=rgb2gray(b);
% imgray(1:576,450:720)=0;
% imgray(1:576,1:250)=0;
% imgray(350:576,:)=0;
% imgray(1:200,:)=0;
% imbw=im2bw(imgray);
figure(1), imshow(b)
% figure(2), imshow(imageaa)
% figure(2), imshow(BWnobord)
% figure(3), imshow(noSmallStructures)
% for loop1=200:400
%     for loop2=1:size(a,2)
%         if a(loop1,loop2)==1;
%             aa=1;
%             break
%         end
%         if aa==1;
%             break
%         end
%     end
%     if aa==1;
%         break
```

```
%     end
% end
```