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The Fire Prevention System Using Thermal Imaging Camera in Connection with CCTV

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Abstract

Thermal imaging camera to measure the temperature measurement is possible by moving objects in real-time and non-contact measurement can be used for a variety of tasks, such as industries, process are as, the electricity sector. In addition, environmental changes through the application S/W features for IT/ICT and Information Storage storage and processing of things Internet of CCTV enclosure internal temperature, humidity or higher status monitoring and supervisory control, information processing through the state monitoring areas it is required for ensuring data.

Keywords: *Supervisory control, Fire detection, Sensor, Fever, Thermal Imaging*

1. Introduction

Thermal imaging camera to detect radiating infrared light from objects measures the temperature from hour to hour and then display. It is mainly used not only to distinguish objects at night but also to identify living creatures according to body heat.

It is also used in not only industries field such as a machinery, an electric machine and maintenance control for buildings but also process field such as insulating refractory materials, steam system & trap, and pipe & valve, but also electric field such as load unbalance problem, wiring & component failure. There is likely to be a huge potential demand in industries due to usage of various measurement, but the expensive cost of existing thermal imaging camera makes it possible to purchase individually [1-3].

Single package product that is possible to control temperature inside the case needs to be developed for the early detection of heat due to overload as well as failure and bad connection. It can be also useful in many ways such as fire protection, buildings and boiler room that is not approached directly by a person, forest fire prevention, infrared light camera at night. Another application is to inspect machinery, factory facility maintenance, housing insulation, structure energy loss and to diagnosis the heat loss of blower door [4-6].

The components of this paper are composed of that a related study is presented in chapter two, a system manufacturing and an image processing using thermal imaging camera are described in chapter three, and a conclusion as well as its future study plan is discussed in chapter four.

2. Related Study

2.1. Sensor Module of Thermal Infrared Image

Inside structure of block in sensor module of thermal infrared image is shown in Figure 1 and each of cells are produced temperature value of thermal infrared image respectively and then transmitted to smart phone transferred MPU through SPI line.

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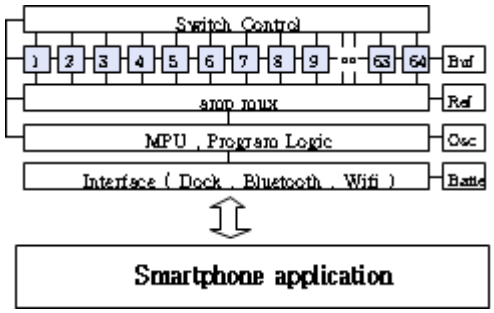

Figure 1. Infrared Sensor Module

2.2. Development of Application Software

Data process transmitted by sensor module of thermal infrared image is combined with framework image or pictures. Acceleration sensor or gyro sensor of smart phone make it possible to generate a frame combined resolution of configured image and pictures by moving sensor module of thermal infrared image according to direction and angle instructed by APP [5].

2.2.1. Temperature Calibration Method of Thermal Infrared Image Camera: It is needed for calibration process to realize image with same accuracy feature across thermal infrared image camera area due to fine temperature adjustment of thermal infrared image camera in Figure 2.

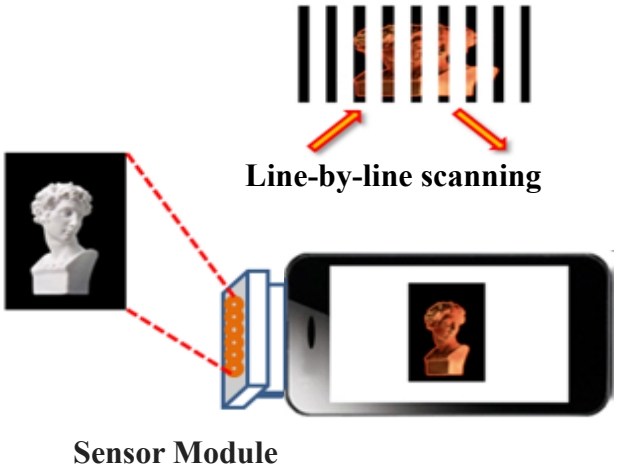

Figure 2. Thermal Imaging Camera Scans

Sensor module as a setting up reference voltage is supplied after regulating that sensor reference voltage of inside camera of thermal infrared image is adjusted in reference rate to semiconductor circuit of precise reference voltage for occurred voltage rate by D/A convertor.

The temperature will be entered after that the change of camera temperature done by firmware update makes it possible to apply same temperature across all camera area.

In addition, Figure 3, is an image sensed by the infrared sensor scanning system arranged in a line, and by connecting the images of each of the line-receiving unit generates a single copy of the image. And representing an image as separated by the color temperature, and displays the image on the finished smart phone screen.

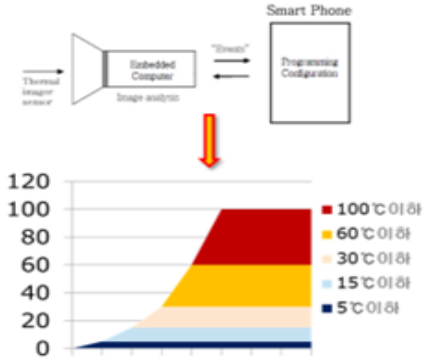

Figure 3. Thermal Image Representation

Every object is supposed to radiate its thermal energy. The amount of radiation energy is based on object surface real temperature and surface emissivity. Thermal infrared image device is able to detect thermal energy from the object surface and calculate the anticipated temperature value based its data. Its image is made by the expression of color according to each classification

2.2.2. Creation of Thermal Infrared Image and Process: Color will be filled with making pixel area moved in proportion to temperature color and its position(angle) from the pixel coordinate of thermal infrared image sensor equivalent to area after displaying camera image.

Thermal infrared image can be generated in a number of areas if the module is a little bit shaked or scanned up down left right side. Before image processing of thermal infrared image, precise control is preprocessed by a function of temperature compensation to able to fine control the temperature difference due to the characteristic of each thermal infrared image sensor module in order to adjust a wide angle between sensor and smart phone [7-9].

Thermal imaging scan process is to fill in the color area when a anat move in the same scanning process in Figure 4 illustrates the image processing corresponding to the movement of the screen pixels

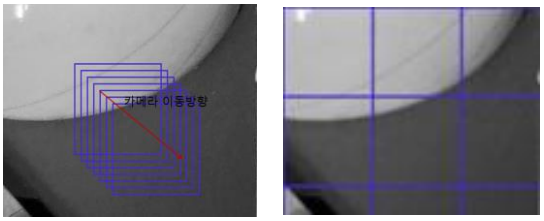

Figure 4. Thermal Imaging Scanning Process

2.2.3. Scanning Process Method of Thermal Infrared Image: Thermal infrared image data with low resolution equivalent to one pixel is changed to high resolution. Degree of precision can be distinguished from thermal infrared camera with high resolution due to rapid changes in temperature at small space by algorithm with mixing appropriate ratio of temperature characteristic.

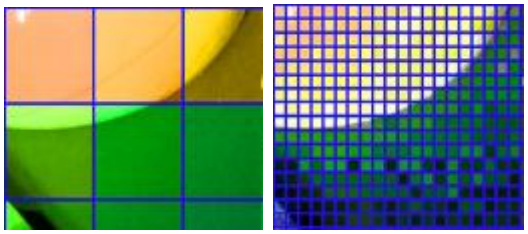

Figure 5. Thermal Imaging Scan Method

3. System Manufacturing Using Thermal Infrared Image Camera

3.1. PCB Design for Prototype

3.1.1. Layout of Front Scanner Engine: Program module that is implemented by computer and computer readable media that is included executable instruction is realized in Figure 6. Computer readable media may be random media accessible by computer and all are included in volatile and nonvolatile media as well as detachable and nondetachable media. Computer readable media is also included all media of computer storage and communication.

In thermal imager module circuit power supply circuit is the DC / DC power supply circuit to supply to the sensor module receives a smartphone 3.3V High efficiency transformation by booster LTC3401 design configuration from 5V conversion to be supplied to the sensor circuit.

Reference voltage of the sensor corresponding to the reference voltage generating circuit is supplied from the high-precision temperature accuracy is subject to the reference voltage generator to the LM4041.

Control circuit 25 Mips of equipped with a high-speed microcomputer reference clock generated in the sensor and SPI control and high-speed A / D conversion circuit for sending a smart phone to match the designed protocol, the data analysis process by the algorithm of the microprocessor to collect data it consists of.

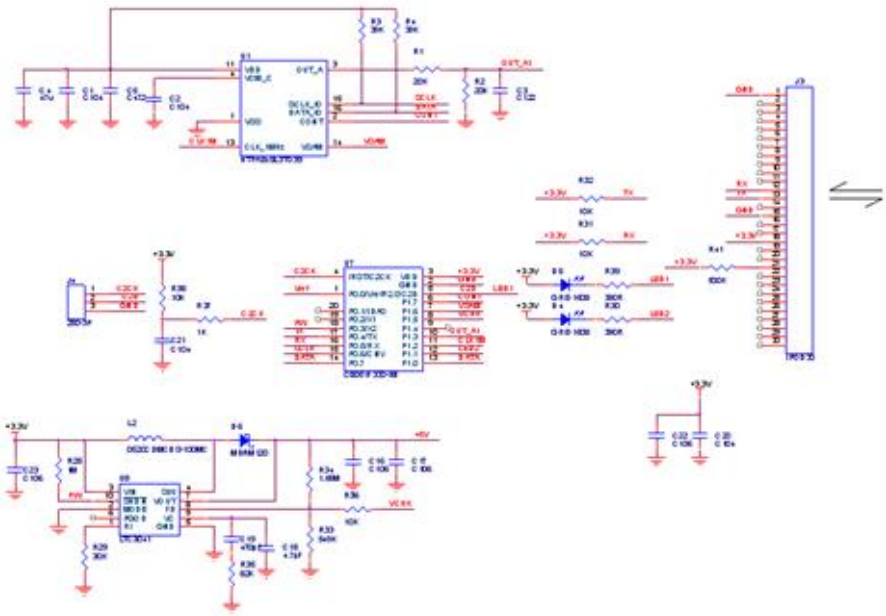

Figure 6. PCB Circuit Design

All media such as readable function commands as a computer storage media, data structure, program module and other data is included for storage of information shown in Figure 7~8. Communication media is included computer readable function command, data structure, program

module, other data of modulation data signal like carrier, other transmission mechanism and transmission media for random information. [2-4].

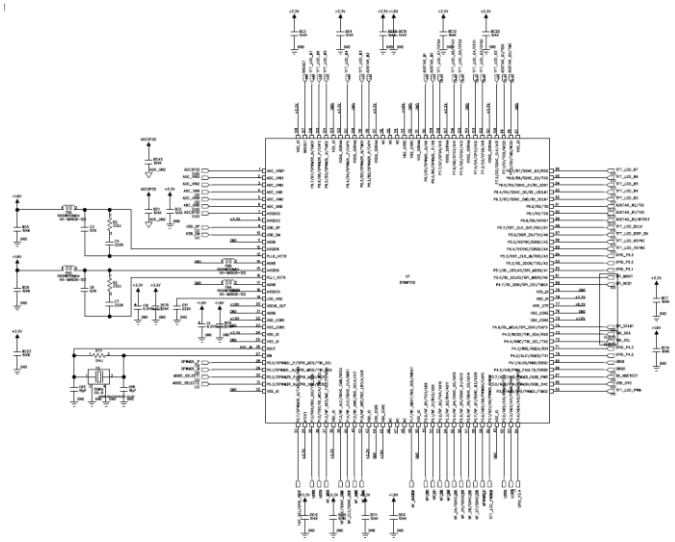

Figure 7. PCB Circuit Design

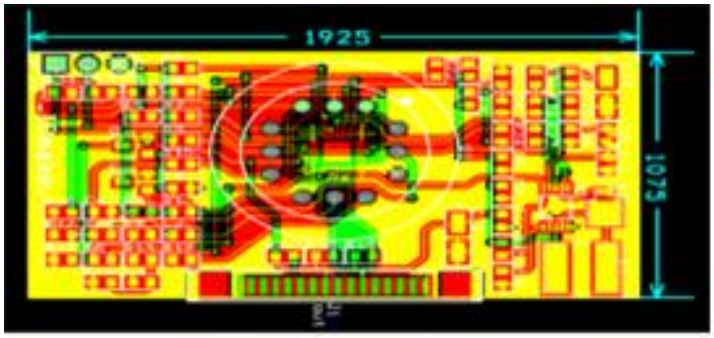

Figure 8. Control PCB Artwork

3.1.2. Making Image Processing Program: The following test shown in Figure 9 is done to acquire early stage image using TFT LCD display. The program is composed by main, LCD, and camera.

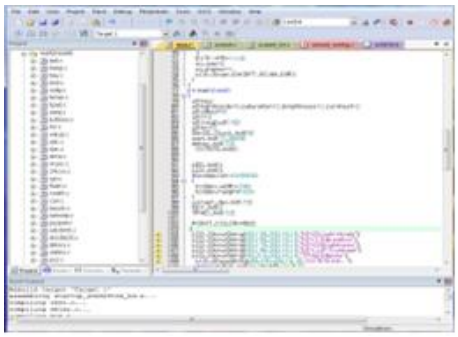

Figure 9. Image Processing Program Logic

3.2. Design of System Driving Application

3.2.1. Firmware Design for Driving: Data process transmitted from thermal infrared image sensor module is combined framework image or video by application program. Using acceleration sensor or gyro sensor of smart phone, user sets up the video of panoramic image type and a resolution of thermal infrared image for starting with first reference position is to generate frame combined image or video of configured size according to instructions for direction or angle.

3.2.2. Firmware Main Driving Program:

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```
 LED_Init();
 LCD_Init();
 if(lcddev.id==0X6804)
 {
        lcddev.width=240;
        lcddev.height=320;
 }
 usmart_dev.init(72);
 KEY_Init();
 TPAD_Init(72);
 POINT_COLOR=RED;
 LCD_ShowString(60,130,200,16,16,"KEY0:Light Mode");
 LCD_ShowString(60,150,200,16,16,"KEY1:Saturation");
  LCD_ShowString(60,170,200,16,16,"KEY2:Brightness");
 LCD_ShowString(60,190,200,16,16,"KEY_UP:Contrast");
 LCD_ShowString(60,210,200,16,16,"TPAD:Effects");
 while(OV7670_Init())

 {
  LCD_ShowString(60,230,200,16,16,"OV7670 Error!!");
delay_ms(200);
       LCD_Fill(60,230,239,246,WHITE);
        delay_ms(200);
 }
 . LCD Image acquisition section
        }
 }

#include "sys.h"
#include "ov7670.h"
#include "ov7670cfg.h"
#include "timer.h"
#include "delay.h"
#include "usart.h"
#include "sccb.h"
#include "exti.h"

u8 OV7670_Init(void)
{
 u8 temp;
 u16 i=0;
```



```
case 4://2
        reg4f5054val=0XC0;
                reg52val=0X33;
                reg53val=0X8D;
                break;
   }
   SCCB_WR_Reg(0X4F,reg4f5054val);
   SCCB_WR_Reg(0X50,reg4f5054val);
   SCCB_WR_Reg(0X51,0X00);
   SCCB_WR_Reg(0X52,reg52val);
   SCCB_WR_Reg(0X53,reg53val);
   SCCB_WR_Reg(0X54,reg4f5054val);
   SCCB_WR_Reg(0X58,0X9E);
}
end
```

3.3. Display & Controller

Modularity of product through hardware design optimization makes it possible not only for development of convergence type product utilized micro processor hardware design with compact size applied various applications but also for the operation of extension of popularization of technique in a higher value-added business such as enclosures, leakage detection, and fire prevention connected with CCTV. Information processing is added through the function of abnormal state monitoring, supervisory control, and observation of situation in mountainous territory. Figure 10 illustrates a concept. It is needed to secure application data for IoT environment of IT/ICT and information storage as well as process.

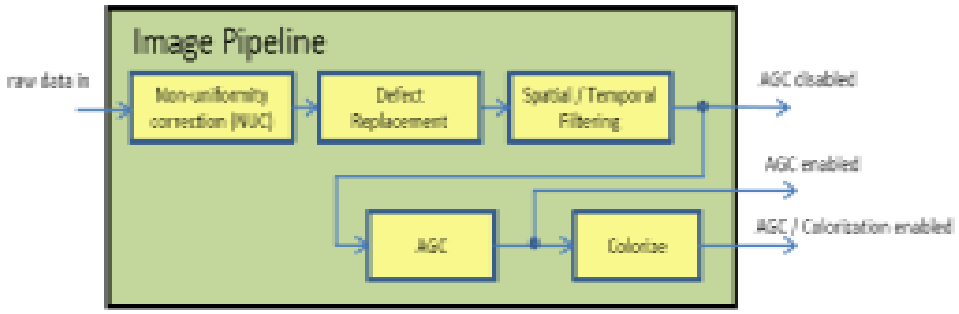
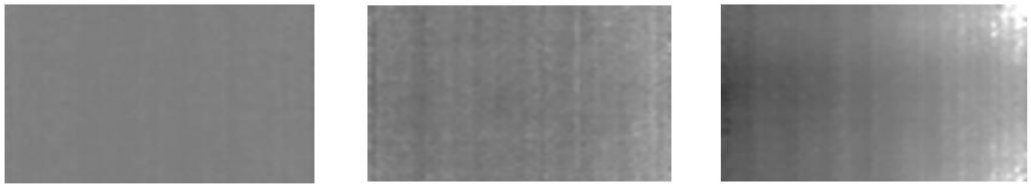


Figure 10. Image Pipeline Block Diagram

Figure 11, shows an example of a uniform, standing and spots in power sequencing



(a) Highly uniform image

(b) Grainy image
(high-spatial frequency noise)

(c) Blotchy image
(low-spatial frequency noise)

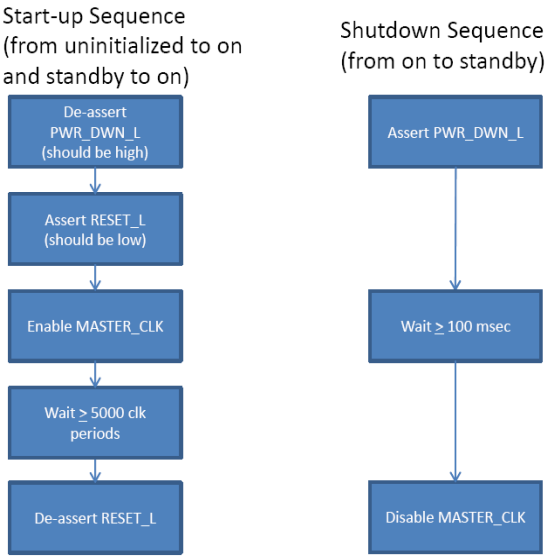


Figure 11. Power Sequencing

Generating and controlling input & output sensor signals through microprocessor is designed to Figure 12, achieve effective control in order to develop modular prototype.

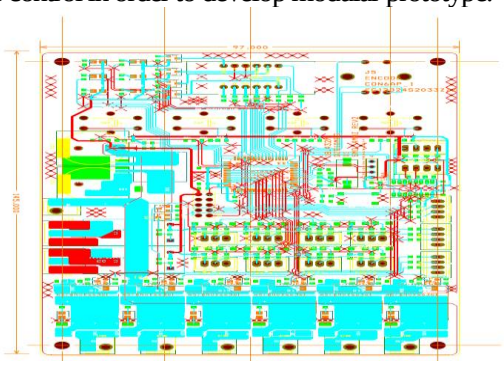


Figure 12. The Design of the Display and Controller

Manufacturing solid product and a variety of applications is needed for mechanically compact structure and is needed to secure the outside of I/O to add the function of control module. A system of condition of camera lens for thermal infrared image is shown in Figure 13. [6-7].

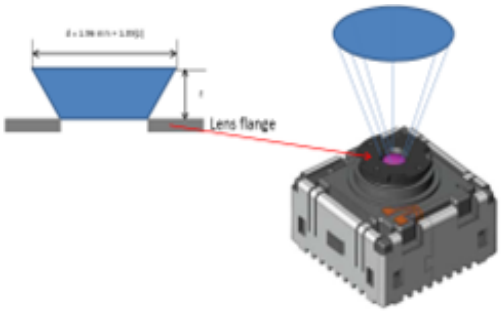


Figure 13. Camera Lens Conditions

3.4. Manufacturing Fire Prevention System

Fire prevention system which is used for thermal infrared image camera connected form of CCTV is shown in Figure 14. These systems are composed of CCTV which is possible for day and night photographing, thermal infrared image sensor module capable of connecting the CCTV, real time monitoring server which is received visual data from the CCTV, and gateway which can relay data transmitting and receiving between the CCTV and the server after connecting the CCTV with the server.

The CCTV is possible to operate as a thermal infrared image camera according to the combination of the thermal infrared image sensor module.

Depending on what the results of monitoring in the server, fire prevention system which is used the connection of the CCTV with thermal infrared light camera featuring the transmission of fire related information from the gate to user device as a result of monitoring in the server is developed in this study. Thermal infrared image sensor module which is installed user device and thermal infrared image module also have characteristics to be printed acquired information of image and temperature from user camera through user device of display.

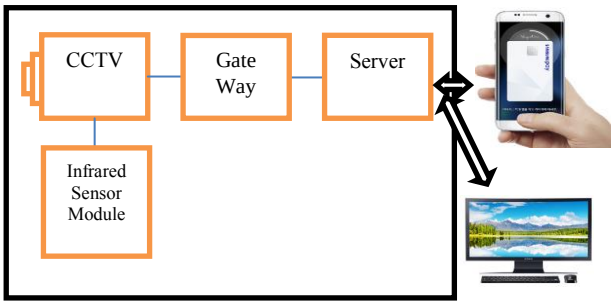


Figure 14. System Design

4. Conclusion

Fire related information can be transmitted according to monitoring results in server from gateway to user device and thermal infrared image camera in CCTV can be operated by combination of sensor module of thermal infrared image in this study.

The market scale of CCTV camera has grown to double from 7.7 billion dollars in 2007 to 14.4 billion dollar in 2012. IP camera which has a network function expects growth in sales to five times from 1.2 billion dollars in 2007 to 5.7 billion dollar in 2012 and that makes it considered to great influence of CCTV camera market from now on.

Measuring body heat for medical purposes makes it possible to check health condition of patient and to detect aching part. It is also easily used for a house call and temporary inspection due to carrying simply attached smart phone. There is still no powerful company to manufacture this device in consideration of the high potential growth of wireless CCTV-Network industry in the world as well as Korea.

Accordingly, this study will have significant meaning not only technological aspect but also economic and industry side.

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