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Rapport Final de Stage

Thermal Image Acquisition System .

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August 19, 2018

Contents

1 Objective

The main motto of this research axis is to make a compact system with the help of Low-end infrared cameras and mini computing devices for thermal image acquisition. The images will be stored on a drive attached in the set up for further analysis. Combining with the IoT and raspberry pi board, makes a powerful system connected with IR systems IR sensing capabilities become available.This system will be used in many places for monitoring, sensing ,and analyzing the thermal behavior of subjects and environment.In addition, there are two conical lenses are also include to acquire the 360-degree view of the surrounding.The obtained images will be distorted but this could be taken into account through proper infrared image processing. This will help to have a better and wide visual of all directions.

2 Introduction

Thermal Imaging is a technique which transforms infrared thermal energy radiated by any object into a thermal image. The images generated are called Thermograms and the analysis of these images is called thermography. Infrared Imaging technique is considered better for visibility of the objects in dark surroundings. Infrared images of objects provides a the better platform for studying thermal properties that cannot be captured in normal cameras. The thermal properties of the subject reveal some interesting features and help to study them. In addition, thermal images also motivate to see beyond our perception.
When the infrared camera is combined with the IoT(internet of things) and a computation device, it gives us a great opportunity for analysis of thermal images. In this project, the main objective is to store the infrared thermal images on a drive for further studies and also show these images to a viewer through a cell phone. The image stored should be accessible by many users at the same time and there should not be any conflict among them. In addition, it was also included that the overall size of the entire setup should be as small as possible. The compact size of the setup will make it handier and easy to install anywhere we want.
This project has many aspects for the different applications of infrared thermography. One of the applications is to use it in poultry farms. In this field the healthiness of broilers is one of the big concerns. Heat stress impairs overall poultry and egg production by modifying the bird's neuronedocrine profile by decreased feed intake. To resolve this problem the thermal images can play an important role. Since there are specific thermal features for unhealthy broilers and laying hen, that can help to find out the sick ones. It is found that broiler body temperature increased three degrees Celsius (41 - 44 °C), and skin temperature increased 6 °C (37-43 °C) when exposed to heat stress (36 °C) for three hours. The idea is to create an algorithm for pointing out the sick chicken among the other by making a bounding box around it. Similarly this concept can be used for monitoring other farms of pigs, cows and turkey.

3 Follow Up

In this project using raspberry pi board, we created a system for grabbing images from the camera on a pen drive. The other part of the project is to create a hotspot on a raspberry pi so that the live feed can be accessible to users. The hotspot should be compatible to the ip configuration of the camera. In addition, It should also be known that there is inbuilt wifi in raspberry board and another wifi is added to it for greater strength of signal.
Another ambition of this project is to obtain a 360- degree view of the surroundings .For this concept, two conical mirrors are included to develop 360 degree observation analysis in various contexts. A conical mirror is interesting since 360 degree of observation is obtained at once without requiring any pan-tilt unit to observe the same scene.
Since the Flir AX8 has both visual and thermal video streaming therefore if required we can also store the visible images for better visual information. For this purpose the different IP for visual and thermal video streaming can be fed in program.

4 Equipment and Resources

The equipments used in this project are listed below.

4.1 Camera :Flir AX8

Figure 1: FLIR Ax-8 Camera

The FLIR AX series camera/sensor offers an affordable and accurate temperature measurement solution for anyone who needs to solve problems that require built-in “smartness” such as analysis, alarm functionality, and autonomous communication using standard protocols. The FLIR AX series camera/sensor also has all the necessary features and functions to build distributed single or multi-camera solutions utilizing standard Ethernet hardware and software protocols

The camera support for the EthernetIP field bus protocol

- Support for the Modbus TCP field bus protocol
- Built-in analysis functionality.

- Alarm functionality, as a function of analysis and more.
- Built-in web server for control and setup.
- MJPEG/MPEG4/H.264 image streaming.
- PoE (Power over Ethernet).
- General-purpose I/O.
- 100 Mbps Ethernet (100 m cable).
  On alarm: file sending (FTP) or e-mail (SMTP) of analysis results or images.
  The camera has following parts
  - LED lamp.
  - Visual camera.
  - Infrared sensor.
  - Ethernet connector
  - Power—I/O connector.
  - Mounting holes.
  - Factory reset button.
  - Ethernet communication indicator LEDwhat is raspberry pi 3 (green).
  - Power/error indicator LED (blue/red).

4.2 Raspberry Pi

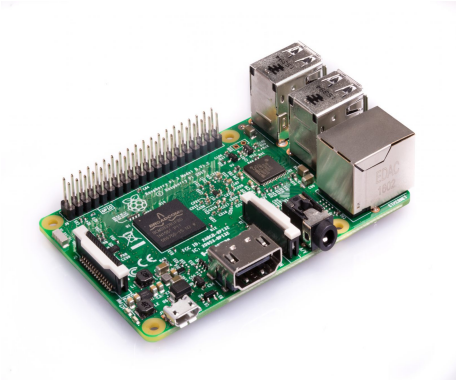

Figure 2: Raspberry Pi 3 Board

The Raspberry Pi 3 Model B is the latest version of the Raspberry Pi, a tiny credit card size computer. Add a keyboard, mouse, display, power supply, micro SD card with installed Linux Distribution and it will have a fully fledged computer that can run applications from word processors and spreadsheets to games.

- CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
- GPU: 400MHz VideoCore IV multimedia

- Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
- USB ports: 4
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
- Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Bluetooth: 4.1
- Power source: 5 V via Micro USB
- Size: 85.60mm * 56.5mm

4.3 Ethernet Cable

An Ethernet cable is required to connect PoE to Raspberry board. The specification of cable is as follow : M12 to RJ45, 2 m

4.4 Pen Drive

A pen drive is needed for storing the infrared images from camera. The pen drive has capacity of 128Gb.

4.5 SD Card

A SD card is is also used to load Linux on the Raspberry board. The SD card has a capacity of 2 Gb.

4.6 Power Supply

A power supply for the raspberry pi board is needed. The specification is Micro USB plug and Output voltage is 5V DC / 2.5A, Regulated Input on 100 - 240VAC.

4.7 POE injector and cable

On the input side, the injector is connected to its power adapter and a data source such as a router or a switch. On the output side, the injector is connected to a splitter, and then to a non-PoE device.
Specifications of PoE are given below

- 2 10/100/1000M Ethernet ports
- 15.4W power output
- Deliver power up to about 328.1 feet(100 meters)
- Support 100-240V voltage input

(a) (a) (b) (b)

Figure 3: PoE and Ethernet cable M12 to RJ45 Connection

4.8 Raspberry Case

An Aluminum Case, Customize for Raspberry Pi 3/Raspberry Pi 2 / Raspberry Pi B+ is required for containing the board safely.

5 Software

5.1 Python and Opencv

The acquisition of images is done with the help of Opencv and Python.

5.2 FLIR IPconfig

Flir IPconfig is a setup and configuration program for detecting and finding FLIR automation and science cameras on a network and automatically assigning or manually setting IP addresses

5.3 Chrome

The camera has web interface with some excellent features. One has to login as admin and set alarms and for other settings. The camera web interface has been developed for and tested on Google Chrome 24 and future versions. Browsers supporting the latest specification (RFC 6455) of the Web Socket protocol should theoretically work, but have not been fully tested.
Other browsers supporting the Web Socket protocol include the following:
• Microsoft Internet Explorer 11 and more recent versions.
• Mozilla Firefox 30 and later

5.4 VLC media player

The camera is connected through Ethernet therefore the image can also streamed through VLC media player. The following URLs can be used to establish streaming sessions with FLIR AX series cameras:

- rtsp://¡ip¿/avc
- rtsp://¡ip¿/mpeg4
- rtsp://¡ip¿/mjpg
- avc = H264 encoding with overlay graphics
- mpeg4 = MPEG4 encoding with overlay graphics
- mjpg = Motion JPEG encoding with overlay graphics

If you do not want an overlay in the image stream, use the following URLs:

- rtsp://¡ip-address¿/avc?overlay=off
- rtsp://¡ip-address¿/mpeg4?overlay=off
- rtsp://¡ip-address¿/mjpg?overlay=off

The stream resolution is 640 * 480. The bitrate is set to 3 Mbit/s (default), which means that the compression factor will vary according to the color palette chosen and the scene contents. The infrared detector has a resolution of 80 * 60, which means that the infrared image contents will be up sampled to 640 * 480.

6 Assistance help

Customer care for camera Chase.Downton@flir.com
ankesh.1200@gmail.com

7 Set up and implementation

7.1 Installing OS on Raspberry

- Go to this page: https://www.raspberrypi.org/downloads/noobs/
- Download the NOOBS zip file
- Download and install SD Formatterhttps://www.sdcard.org/downloads/formatter_4/
- Put SD card into your PC
- Open SD Formatter
- Click on options and set "FORMAT SIZE ADJUSTMENT" option to "ON
- Select your SD Card and click on Format.
- Then extract the files from the zip file.
- Now put SD Card in your Raspberry Pi

- connect the keyboard, mouse, HDMI monitor, power adapter.
- It will power up and will start running when you plug it in. A menu will appear, click on Raspbian and follow the instructions. Raspbian will be installed shortly and you will see the desktop.
- it asks for user name and password
- Set primary settings in raspberry eg. Keyboard ,time date etc.

Install Opencv and python 3 on raspberry
Connect the camera then Connect camera to Pi. Plug in the PoE to camera and then Insert Pen Drive to pi

7.2 Setting Stating Ip of Eth0

Putting the camera and the client on the same IP network. This ensures that there are no routing issues. The aim is for the camera to have an address of, e.g., 192.168.0.10/24 and the client an address of, e.g., 192.168.0.20/24. The /24 notation means that it is a class C network where the first three groups are fixed. Making sure the camera gets the correct voltage and power. If any glitches or peaks are suspected, hen test the camera in a controlled environment.
If any complex and strong electromagnetic fields is detected near camera, then test the camera in a controlled office environment. The FLIR IP Config scans for cameras automatically. We can identify the camera by the MAC address printed on a label on the side of the camera. Another way to connect is to enter the IP address of your camera into the address bar of a web browser.

7.3 Connect to Camera web Interface

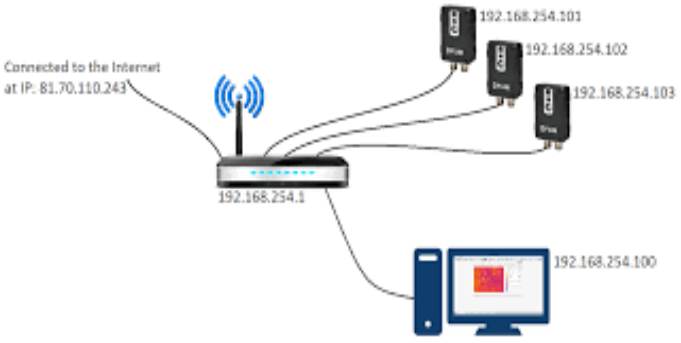

Figure 4: Set up

- Mount the camera.
- Download FLIR IP Config from http://tinyurl.com/o5wudd7.
- Install FLIR IP Config.

- Connect the camera to power, either via a PoE injector connected to the Ethernet cable or via the power–I/O connector (10.8–30 V DC).
- Connect the camera to the network, using the Ethernet connector.
- Start FLIR IP Config.
- In the main window, identify the camera and double-click it to open the camera user web.
- Log in using the user name admin and the password admin.

Then access the FLIR AX series user web interface and do primary settings.

7.4 Image acquisition

Flir AX works on GigE Vision Stream Protocol,therefore the video streaming can be accessed by Ehternet protocol. In Opencv using function vediocapture() with parameter as IP of the camera, we can grab images and store then on the given directory.

8 Applications

The idea of this project is to take advantage of the proposed systems in appropriate contexts which are endless. In cultural heritage, such unit (low-cost IR) could be used to for thermal stress, on paintings exhibited in museums. One can envisage such a unit mounted on a pan-tilt unit on the ceiling: the unit knows where the paintings are (the environment is static), surveys of temperature gradients over hanged paintings are done and abnormal conditions reported for corrective actions.Another innovative application could be in stores and shops to monitor 'intensity of customer activities' for better marketing.Same principle as for museums is to be deployed to gather information about what/where activities take place.Deployment o such system in stables could provide information on animal (cows, pigs, chickens, etc. activities, healthiness. stress. Another deployment could be to monitor beehives temperature during Winter: knowledge of the temperature could assess bee colony health without any disturbing actions such as opening the beehive. All these applications require com developments at extraction and interpretation of data in particular contexts.

9 Report summary

The project proceeds with assembling the hardware together and installing different software.Then the Ip configuration of camera and raspberry Pi are made compatible to each other to avoid any routing conflict.For this purpose the Ip is set static for both of the devices.Then the program for image acquisition is written in python with the help of Opencv and images are obtained on drive attached with the board.The setup has capacity to store images for one year.The stored images are in Jpeg format. The naming of images are done according to the time-stamps. Also the required

frequency(9 images per sec) for capturing images is also achieved.The set will be mounted on the ceiling so the size is kept compact.

10 Usefull links

1. https://producten.kwx.eu/sitecontent/media/Niet-Destructief-Meten/FLIR/Engels/Manual/Manual-FLIR-AX8.pdf
2. https://www.raspberrypi.org/forums/viewtopic.php?t=191140
3. https://www.youtube.com/watch?v=uJ2FVzEGF4Y&list=PLoGlGMhoF2Srmk0pT3Jz2Fi_YLGQZi0mx
4. https://www.youtube.com/watch?v=gA-GXixDYrs&list=PLoGlGMhoF2Srmk0pT3Jz2Fi_YLGQZi0mx&index=2
5. https://www.youtube.com/watch?v=ydyZKJpX20k&index=3&list=PLoGlGMhoF2Srmk0p_YLGQZi0mx
6. https://www.amazon.ca/Raspberry-Pi-RASPBERRYPI3-MODB-1GB-Model-Motherboard-dp/B01CD5VC92
7. https://www.flir.com/products/ax8-automation/
8. https://www.flir.co.uk/support/browse/security/
9. https://en.wikipedia.org/wiki/Infrared_photography
10. https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/
11. Lucas J. Lara1 and Marcos H. Rostagno Impact of Heat Stress on Poultry Production https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4494392/