Thermal Camera Based Data Acquisition System for Target Analysis

Hardik Govani
Gtu Pg School Ahmedabad, Gujarat, India

Abstract—Thermal Infrared (IR) target detection camera detects infrared radiation from target through non-touch method and converts it into a visible photograph that depicts temperature variations across the goal-target [1]. The procedure of the usage of an Infrared detector for temperature sensing, records viewing, recording, analyzing, and reporting is called Thermography. Thermal data acquisition system allows to store data into system software for data analysis and system working understanding. In various domain thermal image analysis is very useful especially in space application, military application, in medical body analysis and diagnostic checking, and in industry visual inspections [1].

Keywords-- Data-Acquisition, LABVIEW, Thermal-image-processing, Thermography

I. INTRODUCTION

In this paper, I present an infrared thermal camera image acquisition system developed for various common application requirements. This complete development is done on the ULIS thermal camera sensors, ULIS provide very wide sensor range for camera sensor development, the complete image acquisition system board is developed on Microcontroller and FPGA. This board is calibrated with pre define methods and all the thing is finalize for the camera sensor image acquisition. And finally data is acquired in system software like LABVIEW.

So this paper is organized as follow. Section II describes thermal camera data acquisition system architecture and characteristics, Section III presents the system setup for data acquisition and system software development, Section IV shows result of first data store or acquired in system software and finally section V concludes the paper and presents some good relative ideas for future work.

II. THERMAL CAMERA ARCHITECTURE AND SYSTEM DEVELOPMENT

Thermal Camera or thermal detector sensor mostly made from the amorphous silicon, wide verity of application sensor now day available for application development, ULIS is the very well know thermal camera manufacture.

In this project ULIS camera having with 288*384 pixel array, which is the FPA of thermal camera, the readout incorporated circuit consists of a sequencer and a bias technology module so one can simplify the electrical interfaces. Therefore, the detector implementation calls for best one grasp clock, digital levels enter and six analog biases. The factor can be operated at a 60 Hz body rate in each digital and analog output modes [2].
Parameters along with advantage, photograph turn (left and right, up and down) and inner analog to digital converter (ADC) can be controlled via a serial commanding. Figure 2 represent the complete system architecture

III. SYSTEM SETUP AND SOFTWARE DEVELOPMENT

As shown in figure 3 the complete data acquisition setup is arranged, PCB is connected with the system, basically data acquisition system is based on the system software labview, the complete pcb sensor card is developed using Actel FPGA and with microcontroller system, FPGA deals with the camera sensor. The role of FPGA is to generate sequential pulse or clock signals for camera sensor.

Term “microcontroller system” is deal with the FPGA to collect the data from the FPGA and it will forward data to the system software LABVIEW, and finally LABVIEW software having with data acquisition program to save data into uniform manner it should be in video form or in .jpg format.

In LABVIEW system software the data acquisition camera sensor board is attached with HSDIO (high speed digital input output) cable, another option is to connect with NI analog data acquisition card, with help of three BNC connector, LABVIEW system software having with two different program for the image and video acquisition one for HSDIO and other for analog card acquisition. In a HSDIO program system software LABVIEW communicate with the FPGA, based on the system clock generated by LABVIEW system software FPGA deal with the camera sensor, and return back data to the system software with HSDIO line, camera sensor having the internal ADC, 12 bit internal ADC gives two separated data on single clock cycle, so 6 bit data comes on clock high level and next 6 bit data will come on clock low level, the combined 12 bit data acquired first into the FPGA and then after it will be available in the system software LABVIEW.

IV. SYSTEM CALIBRATION AND RESULT

Thermal camera gives the temperature information of each pixel form the acquire images, this thing is possible only after the thermal camera calibration and with some proven image processing algorithm for image acquisition. Some standard methods are used for camera calibration and image enhancement [3]. Like two point NUC (non-uniformity correction) basically its gain and offset correction method, another thing is to remove dark noise from the images it’s called dark image subtraction, and finally black body calibration method gives the exact temperature information from the image. And the system calibration main aim is to measure the pixel response as a main function of IRFPA temperature. That’s all are the summary of the calibration and validation for the thermal camera image acquisition system [4].
The developed image acquisition system is based on the uncooled ULIS bolometer sensor, and the sensor operated in LWIR (Long wavelength infrared) band of IR range for 8 to 14um, and the IRFPA matrix size is 288*384. And the good thing about sensor is it allow different windowing size for visualization. ULIS bolometer sensor having IRFPA 25um pitch. In this project I am going to use external camera lens for maximum field of view [1].

As show in figure 4 the first image is acquired in system software LABVIEW, figure shows the three sub graph of images, from them first one is raw video data from the camera sensor, here the target is soldering iron there is two more images second one is raw image and third one is dark corrected images. The working flow is given in the figure 5.

Basically there is power up command sequence is implemented for proper device initialization, LABVIEW user interface is developed for commanding and image acquisition, if there is any error due to power up sequence or bad commanding it will gives time out error and no image or video are available for processing. Figure 5 clearly shows the working flow of the project.

V. RESULTANT IMAGES

The system setup is done for data image and video acquisition. As shown in figure 6 and figure 7 the image acquiring is done for different target @ different temperature. These images are very useful for target analysis, figure 7 shows the human palm thermal image which is more useful in medical line where hand or other body part diagnostic is done for diesis analysis. Other industrial inspection, fault finding, military application development and target analysis and many more application can be developed easily with this thermal camera setup.
VI. CONCLUSION

The proposed system is tested for thermal camera image/video data acquisition, and its works as expected, the acquired images and video are used for various data analysis and information extractions. In future it is advisable to make it portable for remote data acquisition with help of SOC.

REFERENCES


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