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IOT BASED THERMAL SURVILLANCE AND SECURITY SYSTEM

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ABSTRACT

Security is the need in day to day life. Use of intruder detection systems were increasing year by year. IR surveillance method for the detection of illegal intruder in low light condition is more easy unlike optical camera systems. This paper presents the design and implementation of intruder detection using IR sensor based system for application in the field of security and surveillance. Presenting methods are based on use of IR thermal detection system for the intruder detection, recognition and alerting. The use of such systems has special significance in the context of security in the domain of timely detection of abnormal movements inside the buildings. IR thermal imaging has higher advantages compared to optical camera surveillance systems because thermal imaging is effected by to weather conditions and can be used any time in a day. Presenting system are mainly used for illegal intruder detection inside buildings as well as infrared thermal imagers mounted on autonomous vehicles and unmanned aerial vehicles (UAV) and Banking Security Systems for intruder detection. Thermal sensors are used to detect the hot body by IR radiation detection. Thermal sensors are combined with microwave motion detection sensors to detect abnormal movement of hot bodies. Motion sensors also helps in prevention of false alarm due to external environmental condition. After detection of intruder alert the user using IoT systems.

***KEYWORDS**: Internet of Things(IoT), Doppler effect, Infrared radiation, Thermal sensors, Security*

INTRODUCTION

Security is a most important issue of our daily life. Everyone around would want to be as much safe and secure as possible. Security is essential even if we have excellent agencies for public (police, fire, highway patrol, etc.). In comparison to the no of police officers there are far more homes situated at any place, not forgetting to mention the skilled thieves. Because of increasing cases of crime and theft, system ensuring security has even become more essential. The cameras that examine the space for the entire time and reacts accordingly to the conditions are in great demand. There are different types of security systems available in the market for all the kinds of applications. However many of these units have the problem of high installation cost, higher consumption of electricity, huge memory space consumption of the recording system and difficulty of the hardware circuits, etc. Various techniques have been implemented in this direction to ensure safe homes and other places. Installation of all time working CCTV Cameras and

our security guards are major amongst these. But these approaches have come up with the limitation of being highly expensive and ineffective and inefficient too. The most important action in cases like burglary and thefts is to instantly alert the owner and alarm him about the situation. And this process is required to be low on price scales and highly effective and efficient so that it is affordable by all.

Since thermal imaging is a easy, continuous and independent of time, it then further offer easy imaging method, accurate and automatic focusing on difference changes of temperature, it is also useful in detection of internal tumors in medical technologies just and research.

Recent image technologies rapidly developed more featured to improved accuracy of data result. In medical technologies, doctor use temperature sensing in disease diagnosis, infrared thermography helps us to find the internal organs thermal imaging and pinpoint problems based on the temperature difference, Temperature provides an excellent indication of the condition of human body.

Thermal infrared video cameras works by absorbing infrared energy packets emitted or reflected from objects in the surrounding environment. As long as exist differences in the thermal properties interest region in a thermal image appears at a difference from environment. In optical flow analysis, motion and dimension of human or objects are random and non-sequence. Operation mode in thermal screening for flu or fever detection system have to be more reliable with situation exist.

SYSTEM ANALYSIS

PURPOSE OF IMPLEMENTATION

Security is essential even if we have excellent agencies for public (police, fire, highway patrol, etc.). The employ of infrared (IR) thermal imaging systems is not new, since the thermal imaging camera is before now generally applied in varied areas, security and surveillance [1], medical diagnostics and detection of various anomalies in architecture, civil engineering, building construction, mechanical engineering, etc.

Infrared (IR) thermal sensors are special types of sensors designed to detect the infrared radiation of different wavelengths. IR offers the capability of imaging scenes based upon also the IR light reflectance or upon the IR radiation they are emitting.

The Internet of Things is the network of "things" which are connected to a common network path in order to communicate, exchange data or control each other. The network path can be interconnected or interconnected with the "things" being also embedded software, hardware or any sensor. It refers to the state where the things will have more and more data and information associated with them and have a ability to communicate, produce new information and become the integral part of the free world wide web.

It not only features internet connectivity but also features cloud and data management, security management and all other fields concerned with the era of internet. Paper is based on combination of IoT and Thermal Surveillance System. It will detect non rhythmic motions and alert the user through IoT at night time.

BLOCK DIAGRAM

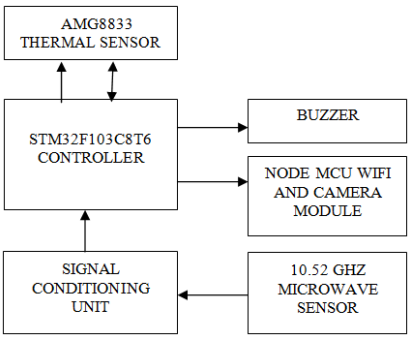

FIGURE 2.1

The thermal imaging surveillance system model planned in this project is shown in Fig. 2.1. The system is very simple, it required a fine resolution thermal camera, microwave motion sensor, microcontroller, Wi-Fi module and optical camera module. First, thermal camera sensor will produce thermal image based on Infrared radiation emitted by objects. It will generate voltages with respect to IR intensity. Here AMG8833 thermal sensor is used. That image is transferred to Microcontroller. A microwave sensor of frequency 10.52GHz motion sensor is used to detect the abnormal motion of the object, if any. Microwave detected in receiver is conditioned in signal conditioning unit. That signal is transferred to microcontroller. Microcontroller processes both thermal and microwave sensor output data and activates the buzzer if it gets positive output from both sensors. Wi-Fi module ESP-12 is used to stream continues optical video to user over internet.

COMPONENTS REQUIRED

THERMAL SENSOR (AMG8833)

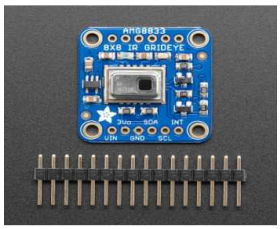

FIGURE 3.1: THERMAL SENSOR AMG 8833

The AMG8833 thermal sensor is the upgraded version AMG8831 sensor. It consists of 8x8 thermal IR sensors and made by Panasonic, and offers higher performance than its precursor. The sensor supports I2C for data transmission to controller, and has a configurable interrupt pin. Interrupt can be fire when any individual pixel goes above or below a threshold that set.[2]

STM32 CONTROLLER (STM32F103C8T6)

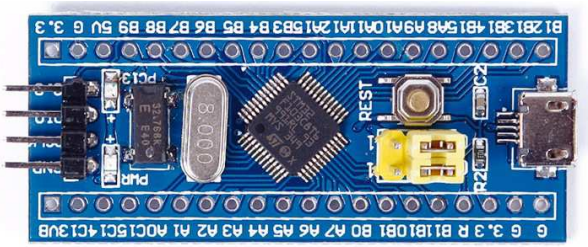

FIGURE 3.2: MICROCONTROLLER STM 32

The ARM® Cortex®-M3 processor is the new generation of ARM processors for embedded systems. It can helps to give a low-priced platform that meets the wants of MCU execution, with a reduced pin count and low-power consumption, but this processor delivering excellent computational performance and a superior system response to interrupts. The ARM® Cortex®-M3 32-bit RISC processor features extraordinary code-efficiency, delivering the high-performance expected from an ARM core in the memory size typically connected with 8- and 16-bit devices. The STM32F103xx performance line family having an embedded ARM core, is thus compatible with all ARM tools and software.[3]

MICROWAVE SENSOR (RCWL-0516)

FIGURE 3.3: MICROWAVE SENSOR

The RCWL-0516 Doppler radar sensor module is prepared with supporting DC 4-28V wide voltage. This is a small radar motion sensor module is prepared through RCWL-9196 chip based on the Doppler microwave induction technology. It'll automatically and incessantly output the high level TTL signal once there is motion. 360 degree no blind angle detection and utmost 7m sensing space with flexible delay time and sensitivity. It's an excellent for DIY microwave motion light switch, human movement sensing, toys, smart safety/security devices, etc.[4]

NODE MCU WI-FI MODULE (ESP12)

FIGURE 3.4: WI-FI MODULE ESP 12

ESP-12E module have 6 GPIOs, micro USB port for power, programming and debugging, 2x 2.54mm 15-pin header with contact to GPIOs, SPI, UART, ADC, and power pins Node MCU has ESP-12 based serial Wi-Fi included on board to provide GPIO, PWM, ADC, I2C and 1-WIRE resources at your fingertips, built-in USB-TTL serial with very good dependable manufacturing strength CH340 for advanced stability on every one supported platforms[5]

BUZZER

FIGURE 3.5: BUZZER

A buzzer or beeper (Fig.3.5) is an audio signaling device, which will be mechanical, electromechanical, or piezoelectric (piezo for short). Usual uses of buzzer and beepers contains alarm devices.

OPTICAL CAMERA MODULE (ESP-32 M5)

FIGURE 3.6: OPTICAL CAMERA ESP32

The ESP32 M5 Camera is a module based on ESP32 chip and OV2640 sensor. It is programed through the ESP-IDF. The board consists of MPU6050, BME280 and an analog mic. This module with IP5306 IC chip. The camera is CMOS camera, field of View is 78°, max sensor resolution is 1600 * 1200 pixels. This module used in mini projects, live video streaming etc.

DESIGN IMPLEMENTATION

FLOW CHART

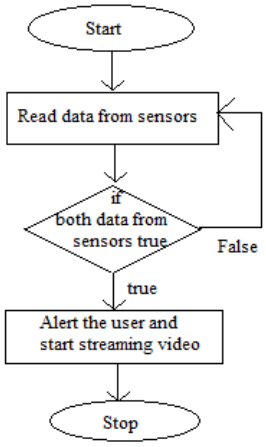

FIGURE 4.1: DATA FLOW CHART

ALGORITHM

Step 1: Power up the microcontroller with regulated supply.

Step 2: Connect the thermal sensor and microwave motion sensor to STM32 microcontroller.

Step 3: Read data from thermal sensor and microwave sensor.

Step 4: Process thermal sensor data for any differential temperature between pixels.

Step 5: Check for any motion is detected in motion sensor.

Step 6: If both sensor gives positive result, Alert the user by activating alarm.

Step 7: Start the live video streaming throw node MCU Wi-Fi from M5 Camera module.

Step 8: Return to step 3 for further continuation of surveillance.

Step 9: Stop when completed and shutdown.

WORKING

The AMG8833 thermal sensor is used to capture the IR image which is transferred to STM32 controller. The image is processed to check for the differential temperature between pixel. In parallel to the thermal sensor, microwave

motion sensor data is transmitted to controller. Where it checks for the motion. If both the data are positive, the buzzer is turned on to alert the user. Further the optical video is streamed to the user through NODE MCU Wi-Fi.

CONCLUSIONS

In day time, Optical camera surveillance system provides best security. But in low light condition that fails to detect the object. Through optical camera image, objects or intruders can be detected by advanced image processing and detection algorithms. That system needs more complicated circuits and high efficient microprocessors to analyse the data smoothly and efficiently. That systems are comparatively much costlier than normal surveillance system. To store large amount of captured data is also needs large memory. In some cases large captured surveillance data is stored in cloud storages, that produces large data traffic and requires high bandwidth for uploading. Our proposed system provides easy detection of intruder and alerts the user. In proposed system video streaming starts only if intruder is detected by the system. This helps in saving huge amount of bandwidth if data is uploading to cloud servers, otherwise if data is saving in local memory also, it requires only small memory to store that captured data.

ACKNOWLEDGMENT

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