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Design of an Internet of Things Approach for Fire Detection in Industry using Raspberry Pi

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ABSTRACT: Ensuring minimum rights and safety of the garment workers has become a burning issue nowadays. The workers of garment factories are facing some labyrinths and broken out of fire is surely one of them. The investors are losing their interest and the prominence of this sector is getting toneless. In this paper, we have propounded a system which is capable to detect fire and can provide the location of the affected region. Raspberry Pi 3 has been used to control multiple which are integrated with a couple of sensors and camera. A 360° relay motor is assembled with the camera so that it can snap the image in whatever angle the fire is detected. We have provided a confirmation of the fire suspecting system to avoid any false alarm. The system will immediately send a message along with the image of the affected spot. An admin can confirm or deny the impeachment and if the admin confirms the situation as a breaking out of fire, then the system will immediately raise an alarm and an automatic message will be sent to the nearby fire brigade.

KEYWORDS: Fire Detection; Raspberry Pi; WiFi module; Sensors; Camera; Authentication; Notification.

I. INTRODUCTION

Fire is an undesirable event that could bring a great loss of social wealth and human life. To prevent this losses, various alarm systems have been developed such as smoke detectors, temperature sensor based systems etc. As technologies evolved and instruments such as Gas sensors, camera etc becomes affordable, various automated fire alarm systems are now available. In conjunction with the cheaper instruments, internet based and wireless broadband technologies, have also improved and there are now various systems that enables cheap, high rate data transmission and wireless networking. The availability of cheap credit card sized single board computer such as the Raspberry Pi has enabled the creation of numerous automated and monitoring system that has low power consumption, faster processing ability at a lower cost. The fire alarm system proposed in this paper integrates the use of affordable instruments, connectivity and wireless communication.

The R-Pi, is a single-board computer which uses Linux based OS and that can be directly used in electronics projects because it has general purpose input/output (GPIO) pins right on the board. Raspberry pi is a credit-card sized computer. It functions almost as a computer. There are various surveillance systems such as camera, CCTV etc., In these types of surveillance systems, the person who is stationary and is located in that particular area can only view what is happening in that place. Whereas, here, even if the user is moving from one place to another, he/she can keep track of what is happening in that particular place. Also another advantage is that it offers privacy on both sides since it is being viewed by only one person. The other major advantage is that it is a simple circuit. The operating system used here is Raspbian OS. Raspbian OS has to be installed so that the image can be transmitted to the smartphone.

1.1 Problem Formulation

- The goal of the system is to create a small industrial environment and detect the fire in industry and specify the affected particular region.
- The goal of our project is to identify the correct reason for fire in the industry.

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1.2 Objective

- To make industrial environment which enable the owner of the industry to monitor and control the industrial parameter on the real time basis using mobile device.
- To save the power consumption of industry.

II. RELATED WORK

In this section, the related work of the IOT is explained. There are many ways to develop the system. In survey paper [1], system is based on Raspberry Pi which enables the cost-effective environment monitoring. Abhinav Kumar [1] have proposed Forest fire detection system is proposed to detect the fire by monitoring the values of CO₂ level and temperature. In this project, we have built fire detector using Raspberry Pi which is interfaced with a temperature sensor, a smoke sensor and buzzer. Whenever fire triggered, it burns objects nearby and produces smoke. In this project, we have built fire detector using Raspberry Pi which is interfaced with a temperature sensor, a smoke sensor and buzzer. With the help of IoT technology, we have tried to make it smarter by connecting the whole monitoring process to the webpage naming "FireSecurity System" created by the PHP tool and controlled by the Arduino programming.

Sathish Kumar [2] presented a review on existing fire-detector based on automated fire voice alerting system for alerting any fire incidents in industrial premises. This can benefit to the industries by saving their life during accidents using the automatic voice recorder instructions to operate the fire extinguisher. GSM is placed inside the system in order to send the up to date information about the status of surrounding area to the company IP address.

Arun Ganesh [3] have proposed method for Satellite-based Fire Detection System is based on MODIS the Moderate Resolution Imaging Spectroradiometer was sent to space by NASA for capturing the Earth surface to detect Forest Fires. The problems associated with this system is that it has a long scanning cycle (Fukuda et al.) i.e., it takes maximum of two entire days to capture the entire surface of the Earth before sending it to the Earth station for Forest Fire Detection analysis. It can be ensured that the system developed can be implemented on large scale due to its promising results. The system can also be upgraded with low-power elements, higher versions of ZigBee and a novel, high efficiency MPPT Algorithm in order to make the system run for longer periods.

Hence, our objective is to design an intelligent early warning fire detection and alarming system to detect the fire in the industry zone which has to overcome the deficiencies observed in the earlier system.

III. SYSTEM COMPOSITION

Hardware & Software Requirement

HARDWARE

- Raspberry Pi
- Flame sensor
- Smoke Sensor
- Gas sensor
- Web Camera
- Relay
- UART Cable
- Wi-Fi Module

SOFTWARE

- Python Idle
- Raspbian

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Hardware implementation

Raspberry pi

The Raspberry pi 3 microprocessor is used since this is compact in size and the power consumption is too low. Broadcom chip BCM2836 is placed in it and it has a memory of 1GB RAM with 900MHz frequency. Raspberry Pi 3 board is selected because it is fast when compared to the earlier versions. Many sensors or peripherals can be interfaced with it at the same time and can work very fast as the quad core processor is used in it. This processor allows us to interface many modules at a time. It has 26 GPIO pins, two 3.3V pins, two 5v pins and 8 ground pins. It has 4 USB ports also which allows us to connect the camera, Wi-Fi module etc.



MQ3 gas sensor is used in order to sense the gas leakage in the industry. A gas sensor is for detecting the combustible, flammable and the toxic gases. The voltage required is 5V which is provided from the GPIO pin. In the gas sensor, H-pins are allowed to heat for a while so that it can detect the gas. Once the gas is detected, an alert is given to the workers.

A normal USB camera is connected to the board. The camera captures and sends the live image signal to the receiver. Also, a Wi-Fi dongle is used. It has a coverage area of 100 feet. The data transmission rate is about 54Mbps. So the live image can be transmitted without any delay through mail.

The sensors is used in the system are

PIR sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually, this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose. The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead, they detect the infrared radiation emitted or reflected from an object.

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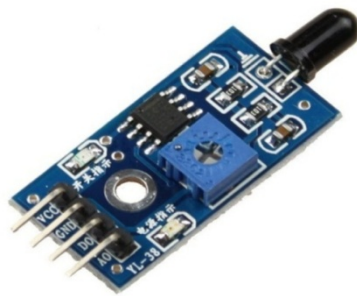
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Flame sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire. It also can detect ordinary light source in the range of a wavelength 760nm-1100 nm. The detection distance is up to 100 m. The Flame sensor can output digital or analog signal. It can be used as a flame alarm .The flame sensor is most sensitive to ordinary light. In this, a small panel output interface can be directly connected with the microcontroller IO port. The sensor and the flame have to maintain a certain distance of 80cm, so as not to damage the sensor temperature of the test flame lighters. As the flame increases, the distance also increases.It also has small plate analog output mode and the A/D conversion process is possible to get a higher accuracy. It has a black LED which indicates the power and the output signal.



Gas sensor

The fire detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down.



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Web Camera

A webcam is a video camera which feeds its images in real time to a computer or computer network, often via USB, Ethernet or Wi-Fi. This common use as a video camera for the World Wide Web gave the webcam its name. Other popular uses include security surveillance and computer vision. The Webcams are known for their low manufacturing cost and flexibility, making them the lowest cost form of video telephony. They have also become a source of security and privacy issues, as some built-in webcams can be remotely activated via spyware.



software implementation

RASPBIAN OS

The raspbian os is used in the raspberry pi board. It is a free operating system that is based on Debian which is particularly optimized for the Raspberry Pi hardware. It comes with over 35,000 packages and pre-compiled software bundled in a simple format for easy installation in the Raspberry Pi. The coding for all the sensors are done using the python coding. Python is preferred since it is a simple and a minimalistic language. It is also free and open source software. This can be used in many platforms such as Linux, VxWorks, and PocketPC etc. Also, it supports procedure-oriented programming as well as OOPS. The web browser is created by using HTML. The static IP address should be configured in the raspberry pi for the Wi-Fi dongle. This assigned static ip address is for connecting with the Wi-Fi of the mobile phone for the live image transmission. Since a normal usb camera is used it must be initially installed in the raspberry pi 3 board using the linux commands.

STEPS TO INSTALL RASPBIAN OS

In order to install Raspbian OS, first next out of box software has to be installed.

- First step is to allocate the drive for installing OS
- SD adaptor can also be used for this purpose.
- Download WINDISK 32 utility from source forge project which is a zip file.
- Extract and run the zip file .
- Select the file and click run as administrator.
- Select the image file which was extracted above.
- Select the drive letter of the SD card in the device box.
- Click write and wait for write process to complete.
- Exit the image and eject the SD card.

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PYTHON

- Python support the raspbian os.
- Python is an interpreted, high-level, general-purpose programming language.
- It provides constructs that enable clear programming on both small and large scales.

III. EXISTING SYSTEM

At industry surveillance system capable of recording/capturing video/image and transmitting to any system has been designed. Existing is sensor less capturing system based on arduino controller. It can't monitor exact motion without PIR sensor. It is advantageous as it offers reliability and privacy on both sides. It is authenticated and encrypted on the receiver side; hence it offers only the person concerned to view the details. Necessary action can be taken in short span of time in case of emergency conditions such as monitoring elder person, military areas, smart homes, offices, industries etc., Future work is to locate number of persons located exactly in that area and their position so that accurate information can be obtained on receiver side.

IV. PROPOSED SYSTEM

This paper deals with the design and implementation of industrial fire monitoring system using Raspberry pi and PIR sensor for mobile devices. It increases the usage of mobile technology to provide essential security to our homes and for other control applications. The proposed industrial security system captures information and transmits it to the respective mail using the internet. Raspberry pi operates and controls motion detectors and video cameras for remote sensing and surveillance, streams live photos and records it for future playback. It can also find the number of persons located with the help of the Infrared sensor. For example, when motion is detected, the cameras automatically initiate recording and the Raspberry pi device alerts the owner of the possible intrusion having a smart phone. Raspberry- Pi has two main components interacting with each other. we can able send it to the email automatically. We can able to alert the people using IOT technology.

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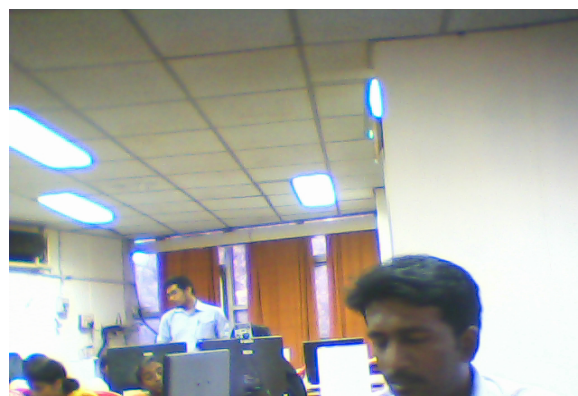
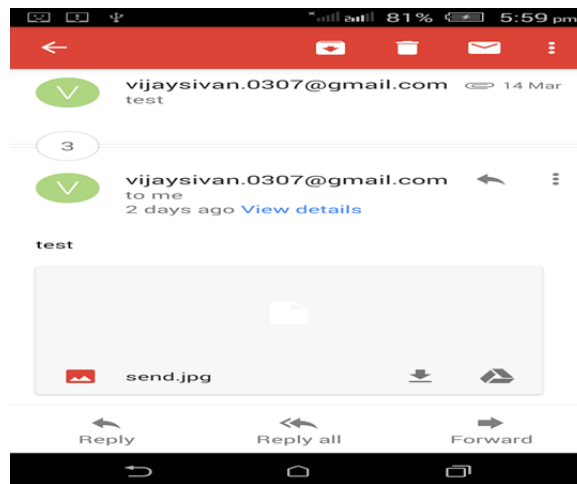
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V. IMPLEMENTATION RESULT

Phase detection shows unauthorized person after detecting it sends an email id to the authorized Person. The image is sent from the storage to the cloud and detect the fire that causes in industry.



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VI. CONCLUSION AND FUTURE WORK

Henceforth, by enhancing the capabilities of these technologies and integrating them, we hope to introduce the 'Motion Detection' system and to contribute to the current security system. This system would be an alternative for expensive security systems being used in the present day. This system does not require any special modifications to the infrastructure where installation is required and can be implemented without any hassle. I have tested these system for 180 days and have found 99.9% accurate notifications and results. Future work is to locate the number of persons located exactly on that area and their position so that accurate information can be obtained on the receiver side

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