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UTILIZING RASPBERRY PI3 AND GSM: AN IOT-ENABLED FIRE PREVENTION, DETECTION, AND MONITORING SYSTEM

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Abstract: The National Crime Records Bureau (NCRB) estimates that roughly 25,000 people per year lose their lives in India as a result of fires and other accidents relating to the same subject matter. The percentage of women who are expected to perish in flames is 66%. The number of daily deaths caused by fires in India ranged from 21 for men to 42 for women throughout the years of 2010 and 2016. Both business owners and employees in the textile industry face a significant challenge in the form of unintentional fires. The findings of this research present a novel approach to recognizing and localizing flames in space. A number of Node MCUs and sensors have been managed with the help of a Raspberry Pi 3, which has been employed. In the event that a fire is discovered, the camera's relay actuator will enable it to revolve through the full 360 degrees and snap photographs in every direction. The content of the webpage, including new pictures and information from sensors, is updated on a regular basis. We made certain that the equipment that was thought to be suspicious of a fire did not send out any false alarms. When an injury is found, the system will generate and send a message that includes pertinent information like the location of the Node MCU as well as an image of the area that is wounded. The impeachment will either receive approval from the administration or be denied. In the event that the system administrator discovers the beginning stages of a fire, the alarm will immediately ring and the fire department will be notified.

1. INTRODUCTION

The majority of people's computer use consisted of straightforward activities like sending and receiving emails and managing their own finances by utilizing various forms of online banking services. People are now able to carry out these chores with the assistance of IoT-enabled intelligent devices such as smartphones as a result of the rapid growth of the Internet of Things (IoT). India is home to both the second-largest population and the economy that is expanding at the quickest rate across the globe. Both business owners and employees in the textile industry face a significant challenge in the form of unintentional fires. At this time, there are a significant number of textile mills that do not have proper fire safety and rescue procedures. The use of antiquated fire detection systems puts a considerable number of commercial establishments at danger of experiencing fires on an annual basis. In addition, many places do not have an effective means for rapidly cutting off the fuel and electrical supply in the event that there is a fire. This causes the reaction time of the fire department to be delayed. As a consequence of this, there is a critical requirement for an early warning fire detection system that is capable of locating flames and advising people of their presence before they may spread. In today's world, it is absolutely necessary to provide garment workers with the fundamental safeguards and protections they need to keep themselves safe. The risk of fire is just one of the many dangers that workers in the textile sector are exposed to on a daily basis. In the event that there

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is a fire at the garment factory, the premises are found to be completely devoid of any people or animals. The investors run the danger of losing money due to a lack of vital information, which eliminates any option of conducting a comprehensive investigation into the underlying cause or making a claim with their insurance company. The lack of interest shown by investors is contributing to the diminishing significance of this sector. This research makes use of technology that is connected to the Internet of Things (IoT) in order to activate a water pump in the event of an emergency. This helps researchers quickly detect and put out flames. Numerous people's lives have been spared as a direct result of the implementation of this technique. Raspbian Linux is the operating system of choice for the Raspberry Pi3, which also includes a microSD card reader or a secure SD card reader built right in and is managed by a centralized control board. It has also been advised that you use Python, which is a well-known programming language. In order to determine whether or not there has been combustion, a number of different displays will be utilized. Installing the right sensors requires first doing an exhaustive analysis of the structure's potential for being damaged by fire. When it has been determined that the optimal positions have been identified, the displays will be turned on. The information gathered from the sensors will be sent to the cloud by the Wi-Fi module that is a part of the Node MCU. The microcontroller (MCU) that is contained within the node will make use of the data. The microcontroller unit (MCU) of each node will report to the Raspberry Pi computer, which will serve in the capacity of supervisor. The system starts the sprinklers, activates the alarm, and sends SMS messages to the fire department via WiFi connectivity. Additionally, it sends an image to the provided email address, and it activates the alarm. An LCD display has the capability of monitoring and recording a wide variety of data types. The web server is responsible for readings from the sensors and processing images.

2. LITERATURE SURVEY

Forest fires have a negative impact on the biodiversity and ecological stability of forest ecosystems. In addition to causing several deaths, they are responsible for the catastrophic damage that has been done to a huge number of residential properties as well as large tracts of forest area. Forest fires are consistently the biggest source of both human deaths and natural disasters on a yearly basis. This issue offers a variety of well-researched solutions, each of which is either completely ready for use or can be put to the test in a short amount of time. This subject has been the focus of a significant amount of investigation in the scientific community for a considerable amount of time.

Sowah et al. developed a method using fuzzy logic in order to create a system for recognizing and locating fires in automobiles. In order to determine whether or not there was a fire present, heat, flame, and fume detectors were deployed. The fire was extinguished by the air conditioning system in a matter of less than twenty seconds.

A video-based early warning system for fires was provided in the research. An examination of the smoke's hue as well as its speed was carried out in order to locate any possible fires. On the other hand, image retouching requires highly skilled skills in addition to cutting-edge technological equipment. Due to the combustible nature of fabrics, it is essential for businesses in the fashion industry to detect fires as soon as possible.

Fuzi et al. built a device for detecting fires using a ZigBee wireless module they developed themselves. This apparatus gets its power from a microcontroller called Arduino Uno, as well as some software, a temperature sensor, and an alarm system. Signals can be picked up by the receiver from a distance of up to 10 meters away. In addition, temperature sensors were the only type used by the system to identify fires.

Kwon and his colleagues designed and tested a method for detecting fires using cameras. Sensor-based fire warning systems are superior than prior approaches both in terms of their accuracy and their efficiency.

A prototype of a wireless sensor network that is able to detect forest fires was demonstrated and displayed. The information collected by sensor nodes was transmitted to the target using mobile

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software programs that made use of mobile agent software and sensor node deployment. The strategy was never actually put into action.

The research study conducted by Sudhir G. Nikhade demonstrates how to build up a wireless sensor network by utilizing the Raspberry Pi and Zigbee hardware platforms, all of which are available under an open-source license.

Table 1: An examination of the aggregate responses to the survey

Sr.NO	PROJECT	TECHNIQUES	RESULT	ISSUES
1	Wireless sensor network system using Raspberry Pi and ZigBee for environmental monitoring applications	Wireless sensor technology	The system is low cost, low power consuming and highly scalable	Costly and time- consuming as multiple sensor nodes decide the possibilities of fire occurrence
2	An early fire-detection method based on image processing	RGB(red, green, blue) model	The system is fully automatic surveillance of fire accident with a lower false alarm rate	Time consumption and power computation are very high.
3	Real-time fire detection for video-surveillance applications using a combination of experts based on color, shape	MES (multi expert system)	Identifies moving objects based on background subtraction is effective	Very high chance of false alarm

SYSTEM DESCRIPTION

The self-governing system that has been proposed is equipped with a variety of sensors and components. The flame sensor, the gas sensor, the servo motor, the camera module, the cellular module, and the relay module are all examples of components that have been discussed earlier. The Raspberry Pi 3 serves as the primary device in this configuration, while the Node MCU serves as the secondary device.

A servo motor is built into the camera module, which gives it the ability to rotate in a number of different directions. A passive infrared camera, often known as a PIR camera, has the ability to identify an intruder. The data generated by the Raspberry Pi will be transmitted to the administrator using the GSM module. The administrator will then validate or deny any doubts that may have been raised about the veracity of the notification that our system generated.

Block Diagram

The block style utilized in this work is uncomplicated and restricted to just a few fundamental aspects. Despite this, the plan is successful in achieving its objective.

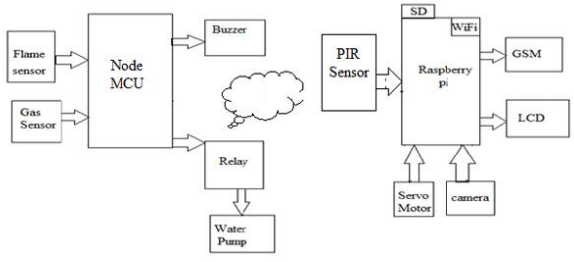

Fig 1. The individual components of the system are shown.

A variety of sensors and modules, such as servomotors, flame and gas sensors, camera modules, GSM modules, relay modules, and camera modules, are being considered for inclusion in the planned autonomous system. In the course of this inquiry, the Raspberry Pi 3 is serving as the primary device, and a node MCU is acting in the capacity of a backup. The alarm will go off when a predetermined threshold is reached, which is determined by the data acquired by the sensors. In the event that there is a fire, both an alarm and a water pump will activate. The alarm will only go off if there is a presence of gas. The Raspberry Pi device then takes images for publication on the internet in addition to sending emails and text messages to the homeowner as well as the fire department. It is possible to swivel the camera module in any direction thanks to the utilization of a servo motor. On the screen of the liquid crystal display (LCD), there is a graphical representation of the general state of the system. In the event that this takes place, the relay device will set off the fire alarm system. The investigation looks into a wide variety of different things. Monitors that make use of passive infrared (PIR) technology can be set up in such a way that they will send notifications whenever they identify an unauthorized person.

Software:

ARDUINO IDE:

The program can be obtained at no cost by downloading it. In this particular programming, the functions setup() and loop() are absolutely necessary.

PYTHON Language:

Python is a well-known high-level programming language that may be used for a variety of purposes. Programmers are able to explain their thoughts with less lines of code compared to languages such as Java and C++ thanks to the syntax and design philosophy of the language, which places a priority on the readability of the code. The architecture of the language may support programs that are as short as they are as long as they are substantial.

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3. WORKING PRINCIPLE

This idea for a technology that enables autonomous driving can be divided into two primary parts. The Raspberry Pi is used to receive and process the data generated by the node MCU so that more investigations can be conducted. The Raspberry Pi receives the data that has been collected from the sensors.

Flow process

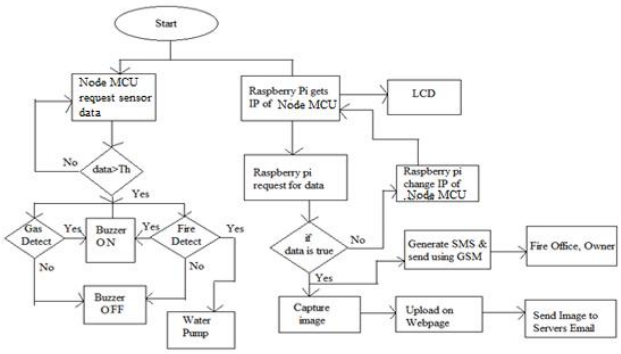

Fig. 2. The system's process flow diagram can be seen here.

This particular design only makes use of a select few sensor modules. The system is comprised of two distinct components: the gas detection module and the fire detection module. The criterion is regarded to have been satisfied when the findings from both sensors meet the threshold that was previously specified. One full rotation of the camera module can be accomplished with a servo motor. This requirement is satisfied if and only if each sensor that makes up a combination can be found nowhere else. Because the threshold value of each active pair is unique, the camera will aim in a different direction depending on which pair is active. Both the sprinkler system and the fire alarm will activate once it is determined that there is a fire.

After taking a picture with the Raspberry Pi 3, one of the camera modules on the device has the ability to power down the computer by itself. The Raspberry Pi device will make a comparison between the IP and sensor pair numbers that it has already collected and the Snap and sensor pair numbers that it has received. A Global System for Mobile Communications (GSM) module will send

It would be simple to locate and recognize each MCU within a node because it would have its own unique IP address. Each MCU node contains a server that is responsible for receiving sensor data and analyzing it in relation to a particular threshold. When the sensor readings go beyond the predetermined limit, the node MCU will react in the appropriate manner.

a Short Message Service (SMS) to the manager if the predefined conditions are satisfied.

STEPS OF IMPLEMENTATION:

The first thing you need to do in order to program programmable devices is to make all of the necessary preparations.

Applications are required for use with the following programmable devices: The package comes equipped with a Raspberry Pi 3, a Node MCU, and a SIM808 GSM Module already installed. The Python code that was being executed on the Raspberry Pi would make use of their respective IP addresses in order to communicate with the Node MCUs. It is necessary to configure the IP address of each Node MCU in conjunction with the Raspberry Pi application that will be running on it.

After removing the code from the Node MCU sketch, reconnect the Raspberry Pi 3 device that was previously disconnected.

Software needs to be incorporated into each and every Node MCU architecture. It is required that both the IP and MAC addresses be provided explicitly inside the code that is distributed.

a vital component of the educational program

```
if int(f_data) == 0:
  if not int(f_data):
      sms = subject + fire_text
      print "Fire detected"
      lcd.LCD_Byte(0x01,0)
      time.sleep(0.2)
      lcd.LCD_STRING(" Fire Detected ")
      lcd.LCD_Byte(0x80,0)
      time.sleep(02)
      lcd.LCD_STRING(" Captured Image ")
      time.sleep(2)
      for i in range(0, 2):
          message_send(Mobile[i], sms)
          time.sleep(1)
      send_email(sms)
```

During the third stage of the project, which is called Integrating Sensor Modules, each Node MCU device will be connected to two different

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sensors independently. The first one is designed to detect thermal energy, and the second one is intended to identify a variety of gases.

The servo motor is wired up to the digital input terminals on the relay module during the fourth stage of the process. The relay module provides the connection between the Node MCU and the water pump. The application of a servo system can be of assistance while rotating the camera. The Raspberry Pi is the central component in the connection movement.

The sixth step of the process involves customizing the Raspberry Pi 3 so that it can accommodate both the LCD and the PIR sensor. PIR sensors are able to recognize any illegal individuals that are attempting to enter the system. The GPIO 7 port on the Raspberry Pi board has been set to BOARD mode in its configuration.

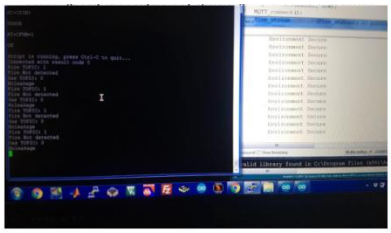
Connect the SIM808 GSM Module to the Raspberry Pi 3 as the seventh step in the process. A USB connection is used to establish a connection between the Raspberry Pi and the SIM808 GSM Module.

To begin, make sure that all of your electrical devices are turned on. Direct power connections are necessary for the Raspberry Pi 3, Node MCU, SIM808 GSM module, and router—these are the core components of the system that have been suggested. A 3.3v adapter power source is necessary for both the Node MCU and the Raspberry Pi 3.

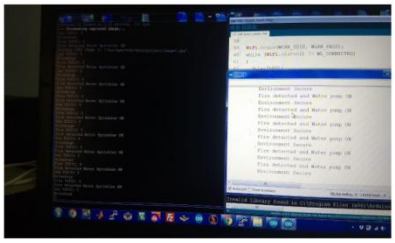
4. EXPERIMENTED RESULT

Following completion of our system, an analysis of the sensor data was performed. In order to run the primary Python application, you will need to type python project.py into the Terminal. Following the processing of the sensor inputs, the computer then generates outputs in accordance with the predetermined regulations. In addition, each line of code is executed in its entirety.

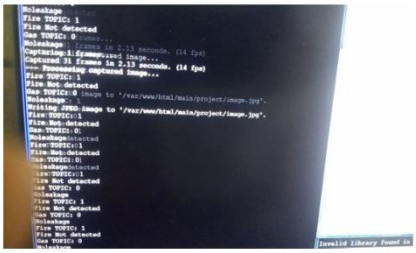
The following describes the stage 1 outcome of the effort in the event that there is no fire occurrence.



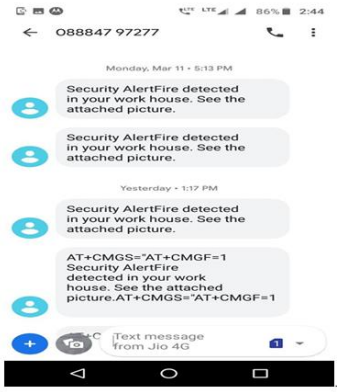
Following the discovery of a fire, the following step of the project is depicted in the graphic that is included here.



The completed work from the third phase is displayed in the diagram below.

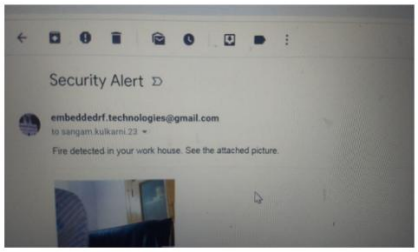


The outcomes of the project's fourth phase are displayed in the graph below. The proprietor was the recipient of a text message that was sent via SMS.



.

I am sorry if this causes you any inconvenience, but in order for me to make an accurate estimate, I require more information from you.



5. CONCLUSION

The findings of the project's fourth phase are

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depicted in the figure that may be found below. In order to initiate conversation, you should write an email to the proprietor.

In this piece of research, we took an in-depth look at the several imaginative approaches that may be taken to reduce the risk of catastrophic fires. After the system had been built, it underwent testing to see whether or not it met the requirements for usability and scalability. The effectiveness of the strategy, as well as the benefits it provides, will improve as sensor technology advances. It is anticipated that there will be a significant reduction in the number of people killed and the amount of property damaged as a result of fires if this method is effectively implemented in all industrial facilities. This will prevent adverse effects on the country's economy.

It is possible that the utility of the concept, as well as its level of safety, could be improved by the addition of other components. When there is a camera there, it is possible to precisely document the activities of a person who is not permitted to be there, such as an intruder.

REFERENCES

1. Ethirajan Anbarasan, Dhaka Bangladesh clothes factory fire kills more than 100, in BBC, 25 November 2012.
2. Oxfam, 31 die in Bangladesh factory fire as brands do too little, too late, in press.
3. Sowah, Robert, et al., Design and implementation of a fire detection and control system for automobiles using fuzzy logic, in Proceedings of Industry Applications Society Annual Meeting, 2016.
4. Yu, Liyang, Neng Wang, and Xiaoqiao Meng Real-time forest fire detection with wireless sensor networks, in Proceedings of International Conference on Wireless Communications, Networking and Mobile Computing, Vol. 2, 2005.
5. Chen, Thou-Ho, et al. The smoke detection for early fire- alarming system base on video processing, in Proceedings of International Conference on Intelligent Information Hiding and Multimedia, 2006.
6. Gaikwad, K. M., et al., Fire Monitoring and Control System, in Proceedings of International Research Journal of Engineering and Technology (IRJET), 2016.
7. Fuzi, Mohd Faris Mohd, et al., HOME FADS: A dedicated fire alert detection system using ZigBee wireless network, in Proceedings of Control and System Graduate Research Colloquium (ICSGRC), 2014.
8. Islam, Taoufikul, Hafiz Abdur Rahman, and Minhaz Ahmed Syrus, Fire detection system with indoor localization using ZigBee based wireless sensor network, in Proceedings of International Conference on Informatics, Electronics & Vision (ICIEV), 2015.
9. Trivedi, Kartik, and Ashish Kumar Srivastava, An energy efficient framework for detection and monitoring of forest fire using mobile agent in wireless sensor networks, in Proceedings of International Conference
10. Dong, Wen-hui, Li Wang, Guang-zhi Yu, and Zhi-bin Mei, Design of Wireless Automatic Fire Alarm System, in Proceedings of Procedia Engineering 135, 412-416, 2016.