Design Of An Iot Approach For Industrial Security Surveillance System

Praveena N G ,Deepa D, Manju M

Abstract: Internet of Things (IoT) is an emerging trend in various applications which include smart cities, physical security, smart grids, asset management, and logistics smart homes, e-health etc. Now a days industry is facing the security challenges. The machinery produced gases and the concentration of stored assets result in high risks. The security is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer. This system is capable of detecting fire by flame sensor, gas leakage using gas sensor and intrusion detection using PIR sensor and provides an alert to the workers. If intruder causes fire, the captured image by PIR will immediately be sent by message and an email alert. With such intelligent information, safety managers, workers, and fire fighters will also be able to make better decisions for fire response. The results show that SSIPM approach is superior to the state-of-the-art methods with improved efficiency.

Keyword: IoT ,Passive Infrared sensor,Grove Gas Sensor, data flow diagram, fire alarm, Raspberry pi

1.INTRODUCTION-

Internet of Things (IoT) is a system of several physical devices which are interconnected with each other and can communicate and send data through the Internet. It consists of the entire internet enabled devices which can collect, communicate and act upon data acquired using sensors, processors and communication hardware from the surrounding environments. IoT due to its connectivity, heterogeneity, dynamic nature and intelligence is widely used. It finds its application in several domains such as agriculture, industrial control, home automation, retail, healthcare, logistics, smart meterand smart cities. With the internet of things, the physical world is becoming one big information system. It is the next generation of the Internet and is taking a huge leap in automation. IoT plays a major role in industrial safety and control. Technologies based on IoT make the industries smarter, safer and more environmentally sustainable. Fire accidents are a major threat to industries. It results in severe losses. IoT can help in intelligent fire monitoring and detection by integrating information from sensors to detect fires and take immediate response action. It helps in speeding up the response times and provides information for evacuation, rescue and fire suppression. It can also help to identify the cause for the fire. The notification devices such as alarm, hornand buzzer can be activated to provide alerts in case of fire. Several advanced features in mass notification systems including the capability to communicate alerts via email to targeted recipients, can thus help in creating quick and effective awareness.The sensor information is transmitted over the internet and can be viewed using laptops, mobile phones. This data can also be used for investigation purposes after the accident has occurred.

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The main contributions of this paper are

(i) The distance and position of fire sensed by Gas Sensor and it was processed and controlled by Raspberry.

(ii) PIR Sensor captures the intruder image and sent through email as an alert.

The remainder of this paper is structured as follows. Section 2 deals with the related research works in various aspects. Section 3 mainly focuses on the proposed system for effective fire alarm environments. Section 4 discusses about the performance analysis. Lastly, Section 5 concludes the paper.

2. RELATED WORKS

In this section, the related work of IOT is explained. There are many ways to develop the System. Ahmed Imteaj et. al. [1], proposed a fire alarming system to control the fire in garment factories in which raspberry pi is coupled with several temperature and light intensity sensors for generating the alarm. It is not as efficient since the fire is not initially controlled by any water sprinkling process.Dong et.al.[2]. designed wireless communication protocol for fire detection and alarm. In this, to achieve rapid fire detection a wireless automatic fire alarm system is developed with low power consumption. But it fails to explain proper fire detection approach and authentication system for detecting false alarm. Sun et.al [3] cited massive high-rise buildings fire cases in a specific region which defines the clear picture for the fire risk level to fire engineers and architectures. Some scenarios and actions for fire were proposed in this. The authorin [4] proposed Bayesian network for analyzing fire alarm system which defines the relationship between fire alarm and the physical-chemical characteristics generated in the process of fire burning. Since this method uses multiple sensor nodes, it is costly and results in time consuming process. A fire alarming system based on video processing propounded in [5]. The authors have focused onhow to detect the intruder or any unusual event in the residence and minimize the delay by implementing pyroelectric Infrared (PIR) module and raspberry pi.The author in [6] implemented a safe from fire extinguisher system assembled with various sensors, actuators and controlled by micro-controller unit. The input signals from various sensors are taken and uses integrated fuzzy logic to identify the location of fire breakout and

provides messages and call notifications. It breaks the electric circuit in case of fire and releases extinguishing gas to exact fire locations. The system does not capture image and the sensor values cannot be monitored in real time. Adilet. Al [7] presentsanIoT based weather station for monitoring the weather using environmental sensors and the data was uploaded to a web server and the resultant weather reportwas provided. It also alerts the user if the weather parameters cross the reference values. K.M.Gaikwad et. al. [8] designed and implemented a GPS system for fire detection. It uses sensors for fire detection and provides message alert to the fire station and fire alarm to the people which has quick response time, easy deployment and to equally save time and cost rather than using techniques like image processing. The system fails to provide an email alert and hence there is no informationavailable about the sensor values or the state of the sensors at the time of fire for future investigation after the fire accident has occurred. T.Islam et.al. [9] developed a fire detection system using the ZigBee wireless system. The authors used Trilateration method forfinding the position and distance of fire. The system was proposed with few sensors and has a highrelative cost.The author in [10] incorporated Mobile agent in WSN for fire detection in the forest. The MA collects the data from the scattered sensor nodes and transmits them to the sink. The implementation of the system was not explained in this.Yu et al. [11] using WSN proposed a prototype for detecting forest fire. The data was processed by the sensors rather than detecting or sensing the fire. To make the network energy efficient a neural network is used forprocessing the collected data. In our proposed system, more sensors were used when compared to the existing system and these sensors were processed using centrally Raspberry that can handle Arduino along with various implemented sensors. Hence the proposed SSIPM method provides very smooth and efficient outcome. Figure1 gives the Taxonomy of an IoT based Fire Monitoring and alarm system.

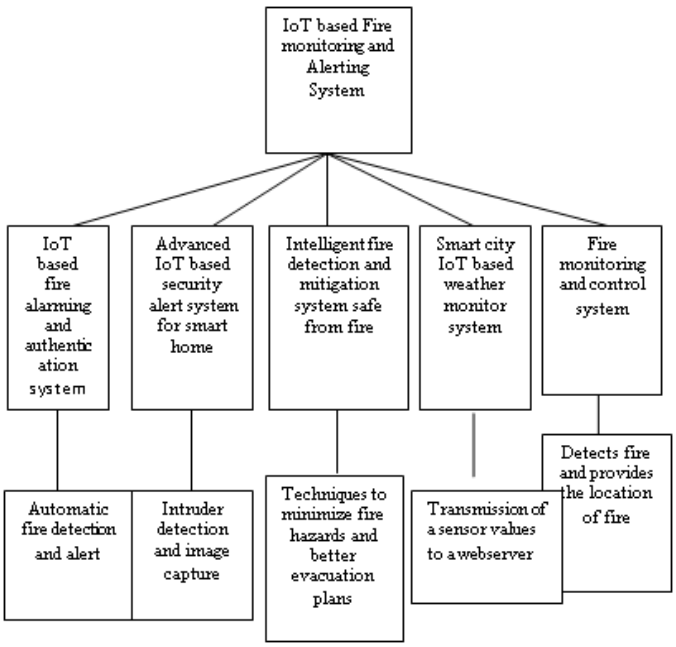

Figure 1.*Taxonomy of An IoT based Fire Monitoring and alarm system*

3.PROPOSED SYSTEM-

The Proposed system includes Grove Gas Sensor (MQ2) for detecting gas leakage and to actuate exhaust fan a Passive Infrared sensor(PIR) is firmly fixed which detects intrusion and activates camera to capture surveillance video. From the video key, frames are detected using Background Subtraction Algorithm(BSA) and hallucinated by Singular Value Decomposition to obtain high resolution images. Face region is segmented from the key frames using Viola Jones algorithm(VJA) and then the recognition is done using multi key point descriptor. Using color and shape evaluation the Fire detection is done and fake fire is recognized using growth evaluation.The proposed work gives optimal solutions for the following: monitoring and controlling the industrial applications from outside, monitoring the unauthorized person detection and monitoring the industry machineries etc. In addition to that, the proposed system avoids the usage of external cloud server for which amount has to be paid. For implementation purpose, Raspberry pi controller is used which captures the picture and finally these pictures are converted into video which is sent to created web Page or to one URL or one IP address. To incorporate this, Data flow diagram a graphical representation is created which elaborates the overview of the system and also can be used for the visualization of data processing. In this proposal, three levels of DFD are implemented.

3.1DFDLevel0:

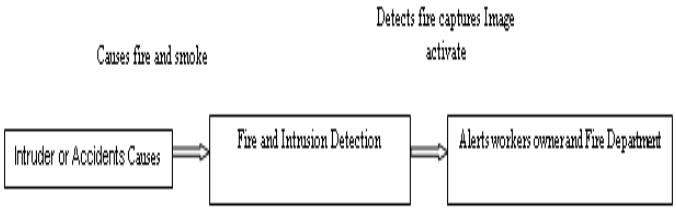

Figure 2. *DFD level 0 diagram for An IoT based Fire monitoring and alarm system*

A level 0 data flow diagram (DFD), also known as a context diagram, shows a data system as a whole and emphasizes the way it interacts with external entities. Figure 2 explains the cause of fire where the input can either be through an intruder or it may be an accident and alerts the workers regarding the detection.

3.2DFD Level 1:

DFD level 1 breaks down the main process into sub processes that can be analyzed and improved on a more intimate level which depicts the flow of data among various modules and sources of information. Figure 3 explains the cause of fire either by an intruder or by an accident. The MQ2 gas sensors are used for fire detection, once the fire is detected, fire alarm is initiated followed by an email alert to the industry owner and then the Continuous monitoring was done and sensor values were updated in the server.

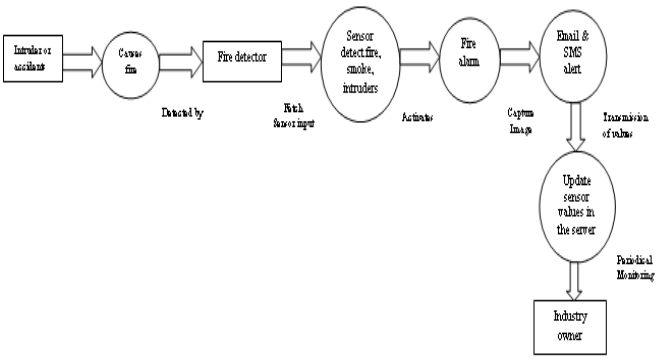

***Figure 3**. DFD level 1 diagram for An IoT based Fire monitoring and alarm system*

3.3DFDLevel2:

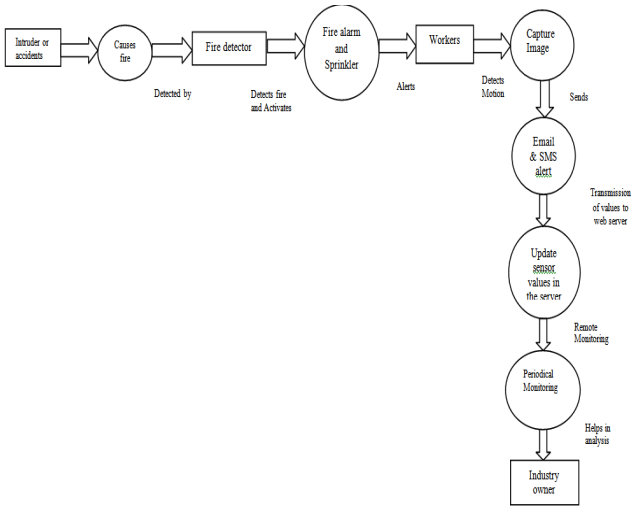

***Figure 3**. DFD level 1 diagram for An IoT based Fire monitoring and alarm system 3.3 DFD Level 2:*

This level explains about detailed working of IoT based fire monitoring and alerting system. Figure 4 explains how the fire is initiated (intruder or accident). The PIR sensors were used to detect fire and once the fire is detected, the fire alarm and sprinkler motor is activated and then the alert signal is given to workers. The intrusion or the affected area is captured and sent to the industry owner via email and then the Continuous monitoring was done and sensor values were updated in the server.

3.4 SYSTEM ARCHITECTURE

The system architecture of IoT based Fire Monitoring and Alerting system is shown in Figure 5 which consists of the following modules:

Module 1: Configuring the Raspberry Pi and interfacing the sensors

Module 2: Automatic fire detection and fire alarm

Module 3: Gas detection

Module 4: Intruder detection

Module 5: Email and message alert and Transmission of sensor values to the web server

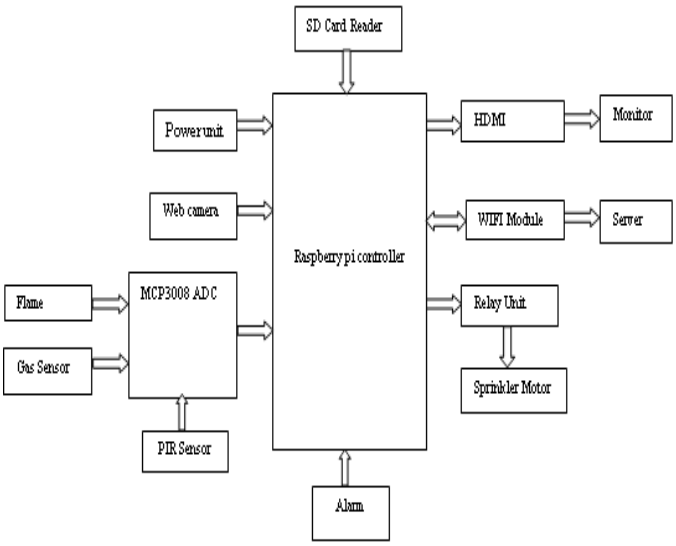

***Figure 5.** System Architecture*

The module 1 consists of configured Raspberry Pi 3 along with the analog sensors(flame, gas and PIR sensors). These sensors are interfaced with the GPIO pins of the Pi using an Analog to Digital Converter as the Raspberry Pi can accept only digital input. The module 2 consists of the flame sensor which is sensitive to flame and radiation. If the flame sensor detects fire, it is programmed to activate the fire alarm which alerts the workers and the relay switches on the sprinkler motor. It prints Fire detected on the terminal screen and the same information is updated to the server. The module 3 consists of MQ-2 gas sensor which has high sensitivity to LPG, Propane and Hydrogen CO and can also detect Methane and combustible steam. The gas sensor readings are taken and the gas level is displayed and updated to the server. The module 4 consists of passive infrared (PIR) sensor which measures infrared (IR) radiation emitted from objects in monitoring area. If fire is caused due to an intruder, the sensor is programmed to capture image of the intruder using the camera which is stored in the Raspberry Pi. The module 5 consists of wifi module and server which attach the captured image as email and sent to the email address of the industry owner. The sensor information is uploaded to the server which is created using php and MySQL database. The server is accessed using the username and password for information such as concentration levels of gases and fire and motion detection and then the information can be periodically monitored.

4. PERFORMANCE ANALYSIS

To validate the efficacy of the proposed scheme, the Raspberry Pi 3 Model B is used which has a high performance Quad core processor is implemented.Table 1 shows the features of Raspberry Pi 3 under complex conditions.

Feature	*Raspberry pi3Model B*	*Arduino*	*Raspberry pi2ModelB*	*Raspberry pi3Model B+*	*Raspberry pi Model A*
Ethernet Port	*Yes*	*Yes*	*Yes*	*Yes*	*No*
Process	*Quad core @1.2GHz*	*16MHz*	*Quad core @900MHz*	*Single core @700MHz*	*Single core @700MHz*
Built in Wi-Fi	*Yes*	*No*	*No*	*No*	*No*
Memory	*1GB RAM*	*256KB*	*1GB RAM*	*512MB RAM*	*256MB RAM*

***Table 1**. Comparison between different models of Raspberry Pi and Arduino.*

The data is collected from various sensors, through python language used in raspberry pi. The data can be displayed and monitored through the terminal along with information regarding fire and motion detection. It also displays a success message after email alert is sent which is shown in the Figure6.

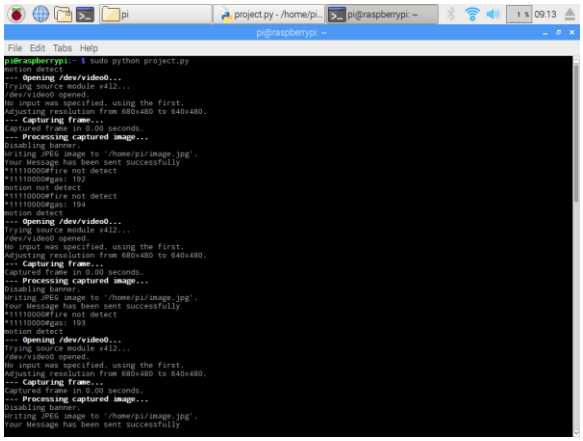

***Figure 6**. Terminal information*

Using web server the terminal data can be accessed from a remote location for periodical monitoring. It can also be used for later investigation regarding fire accident. These values are useful in identifying the time at which the accident has taken place which is shown in Figure 7.

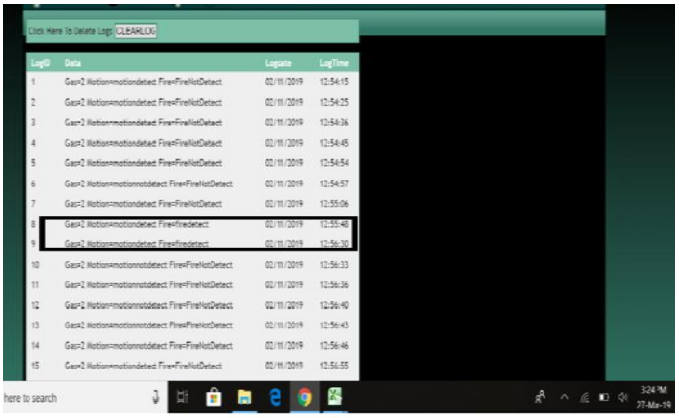

***Figure 7.**Sensor values updated in the web server*

Figure 8 shows the Performance analysis of the existing systems and the proposed system. The comparison shows that the proposed system has better performance and accurate response to fire at critical situations. This shows that the proposed IOT based Fire Monitoring and Alerting system is an efficient and reliable system.

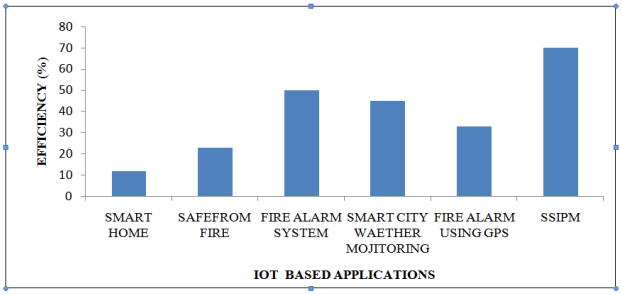

***Figure 8** Performance analysis of proposed system*

5.CONCLUSION AND FUTURE WORK

The technology of using highly effective sensors in the proposed system for monitoring fire and giving timely alert will reduce the fire accidents and hence will save the precious human life to a larger extent. The output of gas sensor assists in reducing the risks of high level emission of gases by the machinery and concentrated assets. The PIR sensor detects the intruder, captures the image and alerts the workers when fire exist through message and an email alert. The further enhancement can be done to provide confirmation on the decision to be taken on the outbreak of fire and the sensor data can be combined with algorithm and big data analytics to develop better emergency evacuation strategies.

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