Industry-Specific Intelligent Fire Management System

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IOT:

The Internet of things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Internet of things has been considered a misnomer because devices do not need to be connected to the public internet, they only need to be connected to a network and be individually addressable.

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning.Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. IoT is also used in healthcare systems.

There are number of concerns about the risks in the growth of IoT technologies and products, especially in the areas of privacy and security, and consequently, industry and governmental moves to address these concerns have begun, including the development of international and local standards, guidelines, and regulatory frameworks.

Types of IOT:

Consumer Internet of Things (CIoT)

Consumer IoT (CIoT) refers to the use of IoT for consumer applications and devices. Common CIoT products include smartphones, wearables, smart assistants, home appliances, etc.

Typically, CIoT solutions leverage Wi-Fi, Bluetooth, and ZigBee to facilitate connectivity. These technologies offer short-range communication suitable for deployments in smaller venues, such as homes and offices.

Commercial Internet of Things

While CIoT tends to focus on augmenting personal and home environments, Commercial IoT goes a bit further, delivering the benefits of IoT to larger venues. Think: commercial office buildings, supermarkets, stores, hotels, healthcare facilities, and entertainment venues.There are numerous use cases for commercial IoT, including monitoring environmental conditions, managing access to corporate facilities, and economizing utilities and consumption in hotels and other large venues. Many Commercial IoT solutions are geared towards improving customer experiences and business conditions.

Industrial Internet of Things (IIoT)

Industrial IoT (IIoT), is perhaps the most dynamic wing of the IoT industry. Its focus is on augmenting existing industrial systems, making them both more productive and more efficient. IIoT deployments are typically found in large-scale factories and manufacturing plants and are often associated with industries like healthcare, agriculture, automotive, and logistics.The Industrial Internet is perhaps the most well-known example of IIoT.

Infrastructure Internet of Things

Infrastructure IoT is concerned with the development of smart infrastructures that incorporate IoT technologies to boost efficiency, cost savings, maintenance, etc. This includes the ability to monitor and control operations of urban and rural infrastructures, such as bridges, railway tracks, and on- and offshore windfarms. Technically speaking, infrastructure IoT is a subset of IIoT. However, due to its significance, it’s often treated as its own separate thing.

Internet of Military Things (IoMT)

The last type of IoT is the Internet of Military Things (IoMT), often referred to as Battlefield IoT, the Internet of Battlefield Things, or simply IoBT. IoMT is precisely

what it sounds like — the use of IoT in military settings and battlefield situations. It is chiefly aimed at increasing situational awareness, bolstering risk assessment, and improving response times. Common IoMT applications include connecting ships, planes, tanks, soldiers, drones, and even Forward Operating Bases via an interconnected system. In addition, IoMT produces data that can be leveraged to improve military practices, systems, equipment, and strategy.

Advantages of IOT:

Internet of things facilitates the several advantages in day-to-day life in the business sector. Some of its benefits are given below:

- **Efficient resource utilization:** If we know the functionality and the way that how each device work we definitely increase the efficient resource utilization as well as monitor natural resources.
- **Minimize human effort:** As the devices of IoT interact and communicate with each other and do lot of task for us, then they minimize the human effort.
- **Save time:** As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform.
- **Enhance Data Collection:**
- **Improve security:** Now, if we have a system that all these things are interconnected then we can make the system more secure and efficient.

Disadvantages of IOT:

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

- **Security:** As the IoT systems are interconnected and communicate over networks. The system offers little control despite any security measures, and it can be lead the various kinds of network attacks.
- **Privacy:** Even without the active participation on the user, the IoT system provides substantial personal data in maximum detail.

- **Complexity:** The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.

ABSTRACT

Industries around the world have become complex and augmented. Given the structural characteristics of modern industrial buildings, quick evacuation using emergency exits or evacuee guidance markers during blackouts due to fire, building collapse, earthquakes, or aging of industrial buildings need to be possible. An Industrial fire is a type of industrial disaster involving a conflagration which occurs in an industrial setting. Industrial fires often, but not always, occur together with explosions. They are most likely to occur in facilities where there is a lot of flammable material present. This paper suggests an Internet of Things (IoT)-based intelligent fire detection and emergency response system that can control directional guidance intelligently according to the time and location of a disaster using fuzzy logic and the design of an integrated control system using sensor networks to address the problems with existing fire emergency response systems in times of fire disaster.

1. INTRODUCTION

Industrial-based intelligent smart emergency response system that can control security and safety of the industry intelligently within the minimum time and the design of a system using wireless sensor networks, fire alarm sensor, and human detecting sensor to address the problems with existing disaster emergency response systems in times of fire hazard .The system has decentralized control that can intelligently guide evacuees based on the detection of humans for removing them from industry to minimize the loss of human life and industrial assist. The existing system was able to secure the industry but not within enough time as the system was designed using various sensors but not as a single unit to address the problems in times of fire or any other. Each sensor were connected to the system separately and function individually which makes the system slow. The modified system can secure the industry intelligently within minimum time as the system is designed using different sensors as a single unit to address the problems in times of fire or any other.

2. LITERATURE SURVEY

LITERATURE SURVEY RELATED TO EXISTING SYSTEM

In this section latest fire accident detection technologies and intelligent prevention system are discussed. In [1] an efficient smart emergency response system for fire hazards using IoT is explained in detail which provide a quality public safety and security services to adopt leveraged data driven emergency response systems with urban IoT design standards. In [2] an intelligent fire detection and mitigation system safe from fire (sff) is being specified in detail with proper safety system. In [3] the design and Implementation of a fire

detection and control system for automobiles using fuzzy logic is given with early detection and exact fire location detection using fuzzy logic. In [4] the efficiency increase for electrical fire detection and alarm systems through implementation of fuzzy expert systems is explained with high efficiency detection system. In [5] the fire detection system using fuzzy logic and data aggregation using fuzzy logic is elaborated in detail. In [6] the Fire Detection System with GSM Using Arduino is explained which gives the approximation location of the fire. In [7] Internet of Things in Industries: A Survey is given which tells about the latest IOT based technologies used by industries in today's date. In [8] IoT-based Intelligent for Fire Emergency Response Systems explains the system designed using IOT for fire emergency response system. In [9] a study on the fire IOT development strategy gives the analysis on the development and advantages of fire IOT in several aspects, such as logistics of fighting products, the supervision of fighting product quality, the monitoring of construction firefighting facilities, the maintenance of firefighting facilities, home firefighting safety, firefighting equipment's etc. In [10] fire detection mechanism using fuzzy logic gives the improve accuracy of the detection system, as well as reduce the false alarm rate.

3. SYSTEM OVERVIEW

Internet of Things (IoT) has provided a promising opportunity to build powerful industrial systems and applications by leveraging the growing ubiquity of wireless sensor networks with radio-frequency identification (RFID), mobile and sensor devices. The entire proposed system is divided into two assembly points: Assembly point 1 and Assembly point 2.These assembly points are used both for security and safety purposes.

3.1 Assembly Point 1

Arduino based security system using RFID – The system designed under assembly point 1 as shown in figure 1, is a security based system for industries. The system is fully automatic and does not require any manual operation. The system contains the following components:

3.1.1 Arduino UNO R3 Board

It is the main processing unit of the system which controls the output devices, reads input from the RFID reader and send messages to the LCD display.

3.1.2 RFID Reader

RFID reader detects the RFID card and send a 12 digits alphanumeric unique code on the serial port.

3.1.3 Buzzer

Buzzer is a warning or an indication that an invalid attempt is made to gain access to the system.

3.1.4 NodeMCU ESP8266 Wifi Module

Wifi module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your wifi network. 3.2 Assembly Point 2 Fire Detection and Water Sprinkler system – This proposed system detects fire at early stage as shown in figure 2. This, in turn, helps in early reaction, solving lives and property of industries. It is totally designed for safety purposes. The proposed system can secure the industry intelligently within minimum time as the system is designed using different sensors as a single unit to address the problems in times of fire. Whenever the fire is detected by the sensor, it is indicated to the Arduino system. Then the Arduino takes the control action by switching on or off the water sprinkler with the help of relay coil and send a message or email to the industry in- charge and to fire brigade to provide their safety service as early as possible. It allows for a quick assessment of the fire with decentralized control that can intelligently guide evacuees based on the detection of humans. It reduces casualties and the time required for evacuation by guiding evacuees that bypass the fire. The system contains the following components:

3.2.1 Arduino UNO R3 Board

Arduino board is the main processing board or unit of the system which controls the entire system.

3.2.2 Buzzer/Alarm

It is warning or alert indication buzzer. 3.2.3 Power Supply Transformers/Battery adapter/9V high watt battery. 3.2.4 SPDT Relay Coil Single pull double through relay for the purpose of AC appliances (ON and OFF). 3.2.5 Water Sprinkler Water Sprinkler system is used for the purpose of reducing the fire and making the disaster under control. 3.2.6 NodeMCU ESP8266 Wifi Module This wifi module can give any microcontroller access to your wifi network. 3.2.7 Sensors 3.2.7.1 Thermistor Sensors (LM35) Thermistor Sensor Module is used to sense temperature and convert it into output signals. 3.2.7.2 IR Sensors IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. 3.2.7.3 Smoke/Gas Sensors (MQ5) Gas Sensor module is useful for gas leakage detection. 3.2.7.4 PIR Sensors PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. 3.2.8 GSM Module GSM module is used to establish communication between a mobile and a GSM system. 3.3 System Flow Figure 2 shows the system working using system flow diagram. Whenever the fire disaster took place, the fire is initially detected by the flame IR sensor which collects and check the data. If the data is collected, then the gas and temperature sensors gets initialized which collects and measures the data. Further if the system finalize that the fire is actually occurred, the buzzer/alarm starts ringing after which the PIR sensor (Human detecting sensor) also gets initialized which counts the number of employees or persons passes through the exit point so that the system can identify the employees under danger and find those employees with the help of

GPRS module. At last, the system automatically starts the water sprinkler and send a message or email to the industry in-charge and to fire-brigade to provide their safety service as early as possible.

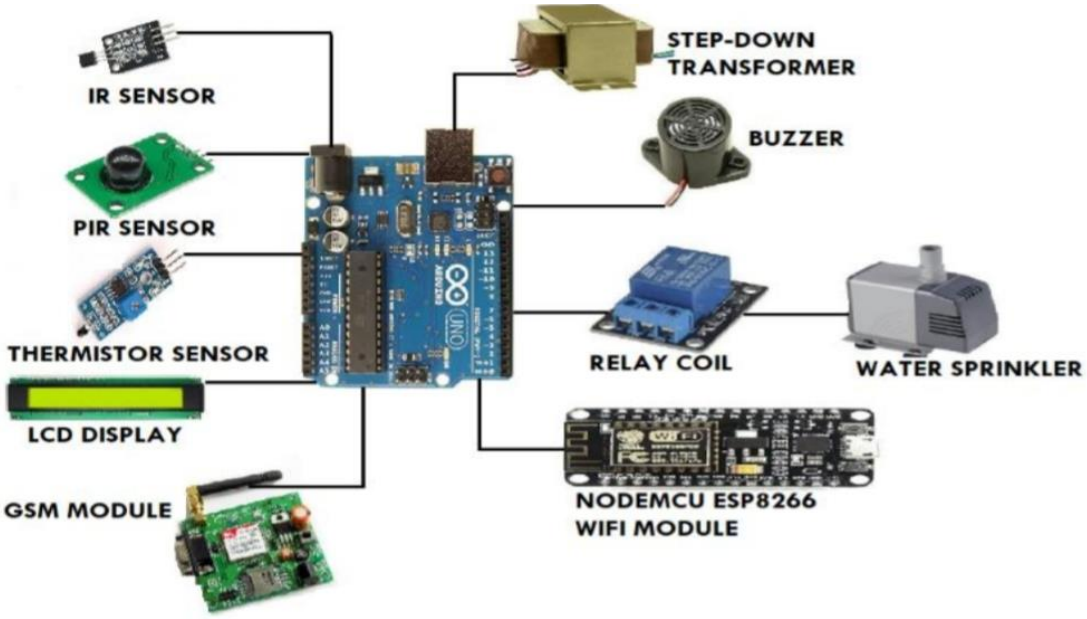

Fig 1: System Architecture of Assembly point 2-Fire Detection and Water Sprinkler System

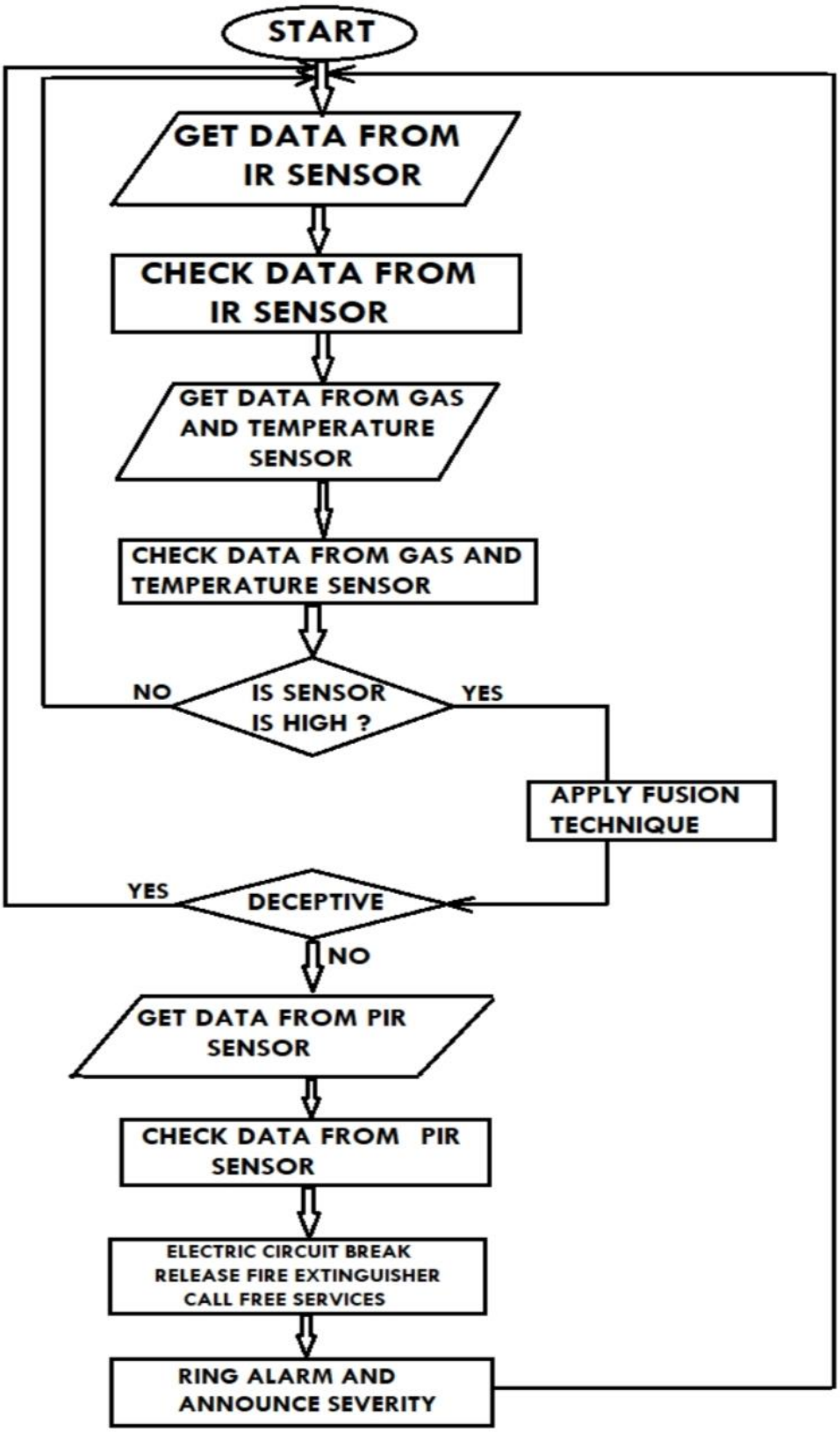

Fig 2: Flowchart of the System at Assembly Point 2

CONCLUSION

The Industrial based intelligent emergency response system can reduce the casualties of the disaster in industries to prevent the employees, industrial machines and infrastructure by providing appropriate evacuation guidance. The system can also aid disaster fighting with the help of water sprinklers because it allows for a quick assessment of the disaster with decentralized control that can intelligently guide evacuees based on the detection of humans.