InMo: IoT based Industrial Safety and Monitoring System

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Abstract

Internet of Things (IoT) is a quickly expanding innovation sector. The internet of things is an arrangement of interrelated figuring gadgets, mechanical and superior machines which can be supplied with one in all kind identifiers and the ability to move data over a device without looking forward to human-to-human or human-to-PC co-operation. This paper centers around building up a framework which will consequently screen the modern applications and produce cautions/alerts and show reports utilizing information got with the help of IoT. This framework utilizes Raspberry Pi 3 Model B and sensors for different parameters, for example, temperature, mugginess, smoke, and fire. Different alarms would be sounded depending on the type of situation. A beeping alarm will be raised, which will have a unique number of beeps for different types of alarms. Also, SMS/email alerts will be sent to the concerned people in any crisis circumstance which contains gathered qualities from the sensor. The person monitoring the system will have a complete view and control of all the sensors. The workers of the industry will be shown an evacuation plan to exit the premises safely in case of an emergency.

1. INTRODUCTION

Ecological consideration has gotten one of the prime worries for pretty much every nation. Despite the fact that an excessive number of modern mishaps have occurred over the most recent couple of decades, the present situations have not improved [1]. The vast majority of the enterprises are in serious danger of bursting into flames because of numerous reasons. Workers likewise, ordinarily have only general information about the apparatus. They are not prepared about how to respond if there should arise an occurrence of crises. The remote assessment will assist with taking out the perils related to the customary wiring frameworks to make information estimation and administering processes a lot simpler and practical. IoT based frameworks take a colossal jump towards observing frameworks by settling on smart choices from the web.

Industrial Internet of Things (IIoT) is the ideal method for associating mechanical apparatuses and sensors, to one another, over the web, permitting the approved client of the business to utilize data from these associated gadgets to process the acquired information in a valuable manner [2]. Normally IoT-associated frameworks empower information procurement, handling, examination, and representation. The IoT engineering incorporates most recent advances, for example, PCs, savvy gadgets, wired and remote correspondence, and distributed computing. Right now, propose a mix of continuous checking innovation with the sensors to keep an opportunity to time track of the different components which are perceived to cause a mishap on location.[3]

Beforehand, bluetooth and RF (radio frequency) innovations were utilized to control and screen the modern applications, however, they were constrained to short separation. The administrator must be in the scope of the Bluetooth network or in the Radio Recurrence region. Answer for the short separation correspondence is the IoT based industry mechanization [4].

2. LITERATURE SURVEY

At first, mechanization in industries was done using steam and water power. As the progression occurred, power was presented and was utilized in enterprises for large scale manufacturing. At the point when PCs were developed, it was intended to play out different capacities. As time went on, PCs have become less pricey, and afterward, almost all ventures commenced making use of it for monitoring when you consider that it diminished an important awesome mission at hand experienced by human beings and still it is taken into consideration as the high-quality preference to govern and screen an application [5]. In any case, numerous industries regularly have only a fundamental alert framework regardless of the sort which is turned on by squeezing a solitary catch. IoT is once in a while utilized, and regardless of whether they do have utilized IoT, just a few sensors are utilized, which is the reason the framework isn't bombed verification and accordingly

incapable. Laborers don't think about the circumstance since they are advised to empty the premises on the off chance that the alert goes off. The vast majority of the modern mishaps have had terrible outcomes as forever, property and condition is a burdensome errand [6]. Wellbeing in such a domain and security, if there should arise an occurrence of any disaster, can be generally significant for compassionate, legitimate, and budgetary reasons. Ongoing checking is for the most part required in such cases as it just takes matters of seconds for the circumstance to go from awful to more regrettable if no moves are made. Mechanization is given essential concentration in the framework for what it's worth in the essential necessity in the businesses in the twenty-first century. Distinctive control advances are utilized for checking and control of the frameworks, while the correspondence between a framework and a client is commonly acknowledged online through remote correspondence systems[7].

3. PROPOSED SYSTEM

3.1. System Design Overview

The working of the system can be broken down into 5 steps:

- Setting up the Raspberry Pi 3 module and the relevant sensors at the required position.
- Collecting the data - The sensor module collects the relevant data to monitor the industry environment for flames, gas, temperature, etc.
- Data Transmission - The sensors are connected to the Raspberry Pi which sends data to the cloud server using the internet and TCP/IP protocol.
- Data Analysis-an arrangement of accessing the server remotely is made. This allows the system to analyze and process the data. If any threshold values are crossed, then alerts are sent.
- Data Visualization - User accesses the data processed by the system. This data is presented to the user via graphs and maps. Remote control of the hardware module also gives the user to check and change system sensor status.

Fig. 1 shows the overall system flow diagram consisting of sensors viz. DHT11, MQ2 Gas sensor, and flame connected to Raspberry pi, which sends the data to the cloud server. A push (panic) button, webcam module, and LCD display are also connected to Raspberry pi.

The data over the cloud server is processed and visualized through the web interface and Android application.

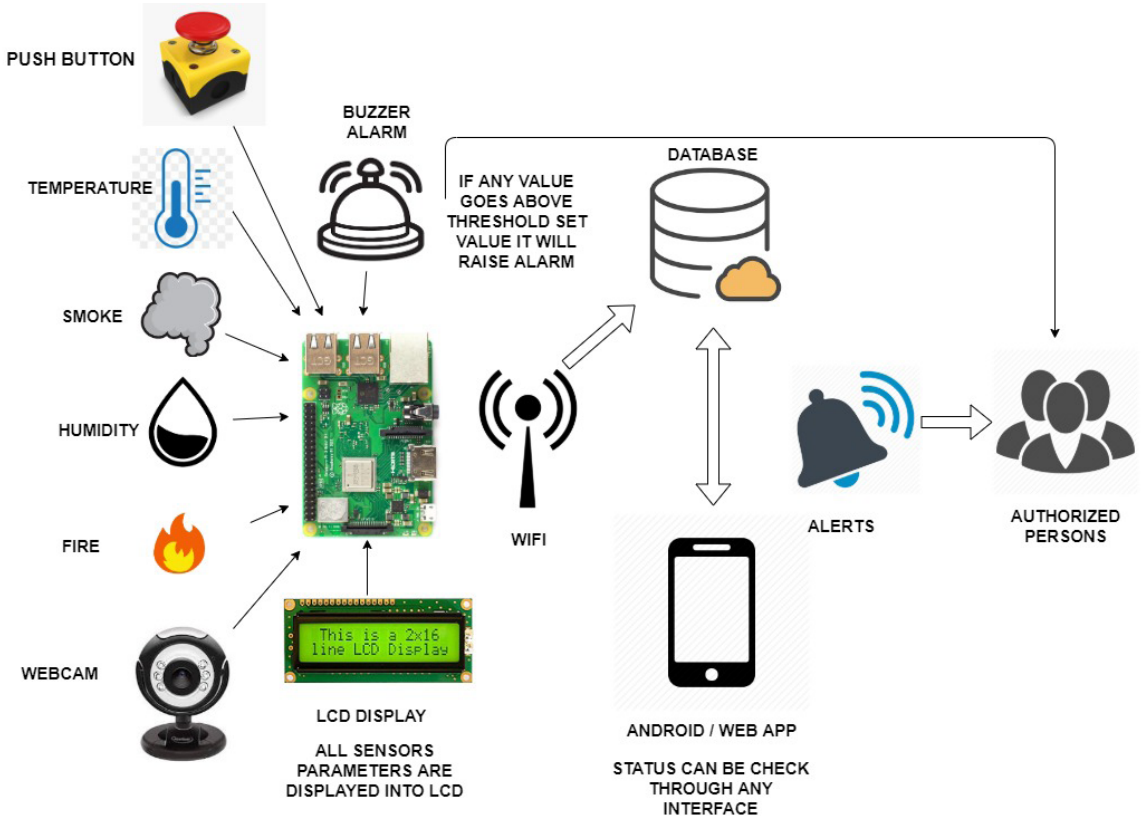

Fig. 1: Overall System Flow Diagram

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4. TECHNOLOGY STACK

4.1. Hardware

4.1.1. Raspberry Pi 3

Raspberry Pi 3 is a compact single-board computer developed by the Raspberry Pi foundation. It supports 1.2GHz Quad-Core ARM Cortex-A53, wireless LAN and Bluetooth connectivity, 1GB ram of memory, 64bit CPU, camera port for connecting Raspberry Pi camera, display port for displaying Raspberry Pi touch screen display, audio output, micro SD card port for loading operating system and storing data, 4 USB ports, 40 general-purpose input/output pins, Ethernet socket to connect Raspberry Pi to the internet quickly.

4.1.2. DHT11 Sensor

It is commonly used for measuring temperature and humidity. The sensor can measure temperature from 0 to 50^{o}C and humidity from 20 to 90%. The sensor comes with a devoted NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

4.1.3. MQ2 Sensor

It can detect or measure gases like LPG, Alcohol, Propane, Hydrogen, CO, and even methane. The sensor has both analog and digital pins by which we can detect only one particular gas. It can detect gases in the concentration of range 200 to 10000 parts per million.

It is used for air quality monitoring, gas leakage alarms and maintaining environmental standards.

4.1.4. Flame Sensor

It can detect the occurrence of fire or flame. It can detect flame in the range of wavelength 760nm-1100nm or up to 50cm. It is used for fire alarms, industrial heating and industrial gas turbines.

4.1.5. Webcam Module

It is a high-quality Quantum QHM495LM 6 Light Webcam for Raspberry Pi, featuring a fixed focus lens. It's capable of 3280 x 2464 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video.

4.1.6. 16 x 2 LCD Display

It displays 16 characters per line out of 2 such lines. The characters are displayed in a 5x7 pixel matrix. Pins are documented on the back of the LCD to assist in wiring it up and a single row for easy breadboarding and wiring.

4.1.7. Buzzer Alarm

It is used to add an audio alert for emergency purposes. It operates on 5V supply, uses a coil element to generate an audible tone, and can generate sound pressure up to 80dB.

4.1.8. Push Button

It is used as an emergency button in the system. The pins are normally open and when the button is pressed they are momentarily closed and complete the circuit. It is highly compact and lightweight, easy to carry and dismantling.

4.2. Software:

4.2.1. Python:

Python is a high-level, general-purpose programming language. Python's plan theory underscores code comprehensibility with its remarkable utilization of huge white spaces. It is simple and easy to learn. It is interpreted. It does not require compilation before execution. It has keywords, the structure is simple, and patterns are designated. It has many extension libraries. Python is used for Raspberry Pi and sensor programming.

4.2.2. Laravel

Laravel is a web application framework. It is free and open-source. It is planned for the improvement of web applications following the model-view-controller architecture. Laravel reuses existing components from various frameworks that help to create a web application. So the designed web application is more structured and realistic. The web application is developed using Laravel. Using the web application, the concerned person can view and change the status of the sensors.

4.2.3. Flutter

A flutter is a UI software development kit by Google. It is free and open-source. It uses the dart programming language. The cross-platform development framework enables one to maintain the same code base and deploy the application on multiple platforms (Android, iOS, and Desktop). It saves a lot of time and development efforts of developers. It is free and open-source. The admin and unit in charge can log in and view and control the status of the sensors, view the system logs. The app has an alert system which will generate alerts in case of an emergency

5. WORKING

The data collected from sensors is analyzed and charted. The values for sensors based on designated limits are defined in safe, warning, and alert range. When in alert range, the system gives an alarm and marks the sector with the concerned values. When the threshold values are crossed, alerts are sent to all the registered users.

E.g., Considering Fig. 2, if the threshold values have been crossed in the areas in RED color, then an evacuation plan applicable to the situation is dynamically suggested.

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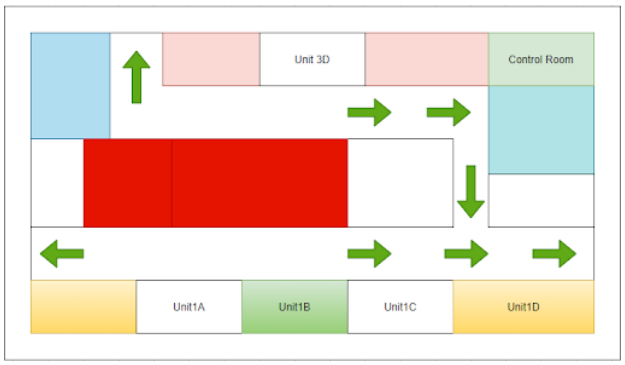

Fig. 2: Evacuation map generated

Fig. 3: Website Dashboard

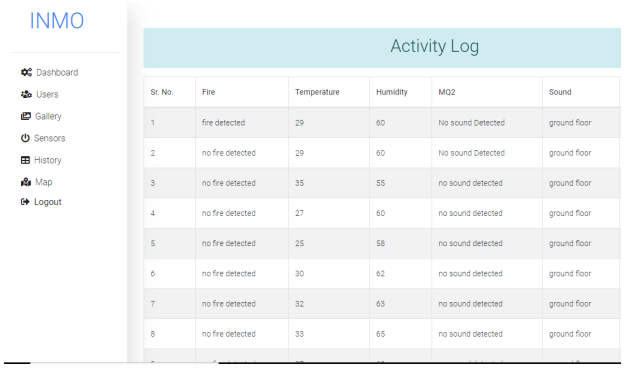

Fig. 4: Sensor log

There is a chance that adjacent areas to dangerous areas might also get affected. In such cases again, a new relevant evacuation plan is suggested.

6. CONCLUSION

This paper shows the design and implementation of industry safety and monitoring system using Raspberry Pi 3 Model B as the main component. The key to the implementation is that the project provides an evacuation plan in case of the occurrence of the incidence. The advantages of the system are continuous monitoring of the industry environment and knowing when the sensors detect values over the threshold. The internet helps provide all of this in the palm of your hands. This project is secure and easy to understand and can be utilized by the government in enormous scope to help

Fig. 5: Mobile application-dashboard

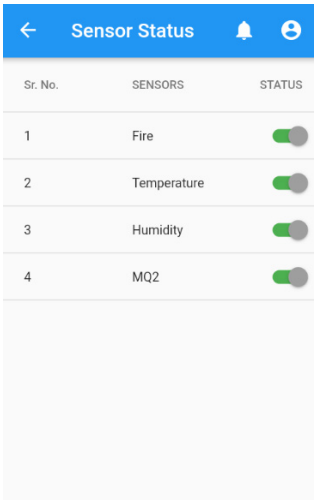

Fig. 6: Mobile application-sensor status

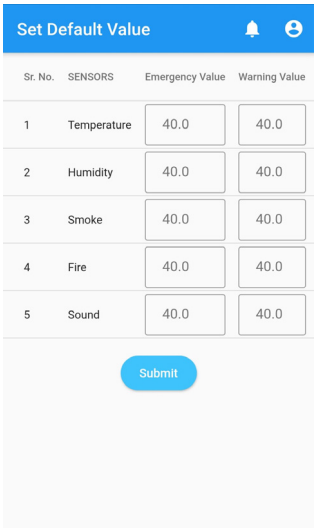

Fig. 7: Mobile application - set emergency value of sensors

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enterprises as well. The industry is considerably protected from fire mishaps, voltage changes, and gas spillage.

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