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Risk Management Using Raspberry Pi and Sensors

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Abstract:

Industries have been a key part in the growth of a nation's economy. The growth in industries has also lead to the growth of tragedies in the past decades, out of which majority caused by oversight or Human errors. This paper discusses a risk management system to detect hazardous gas leaks and the increase in temperature from the set value (or critical temperature) using a raspberry pi, MQ6 gas sensor and DS18B20 temperature sensor. Appropriate measures are taken by the raspberry pi such as switching on the exhaust fans, signaling alarms and alert notifications via an android application in a smart phone, with respect to the situation to minimize the risk of life and property.

Keywords — **Raspberry Pi, MQ6 gas sensor, DS18B20 temperature sensor, Risk Management.**

I. INTRODUCTION

Portability, low cost and flexibility of a raspberry pi has encouraged its involvement in almost every field of technological implementation. A credit card sized computer, which can be programmed to the specific requirements, can extend its scope of functionality by connecting additional hardware to the raspberry pi's GPIO pins. Industries and innocents have been a victim of several tragedies, some of many being the Bhopal gas tragedy (2nd -3rd December 1984, India) where 36 tones of poisonous methyl isocyanate was leaked into the city's air claiming above 4000 lives, Phillips disaster (23rd October 1989, USA) where ethylene leak caused the blasts, and many more. The above are perfect examples where the disastrous outcome could have been avoided if acted early in the initial stages of the leak or the fire.[7] Since a round the clock human surveillance on every minute detail of the industry can be unfeasible, a self processing, low maintenance and a cost effective alternative is introduced. In the field of safety management, a raspberry pi can be used extensively. Thereby, reducing human errors and man power. Industries being a very high risk zone for faint errors are a perfect area to implement this system.

The proposed system consists of a raspberry pi, a power source, MQ6 gas sensor, DS18B20 temperature sensor, two dc motors attached with propellers, which act like exhaust fans, and an alarm. The hardware is connected to the GPIO pins on the raspberry pi.[8] The raspberry pi fetches the current values from the MQ6 gas sensor and DS18B20 temperature sensor using a python program. The values from the MQ6 gas sensor are stored in the MySQL database on the raspberry pi directly. The values from the DS18B20 temperature sensor are written on a text file. The PHP program fetches the gas and temperature values and displays it in a tabular form along with date and time on the web page. The android application fetches the latest values from the raspberry pi with a periodic refresh rate. The raspberry pi monitors the alarms and the exhaust fans in case of leaks or increase in temperature. Notification is sent to the android application within the range of the raspberry Wi-Fi.

II. Design Implementation:

A. Block Diagram

In our project, the two sensors are connected to the Raspberry Pi 2. The Pi collects the data and stores in MySql Database, if the Gas or Temperature values exceed the critical value appropriate measures are taken by the raspberry pi such as switching on the exhaust fans, signaling alarms and alert notifications via an android application in a smart phone. The user can even monitor the values through the android application "Safetydroid". System block diagram is shown in figure1.

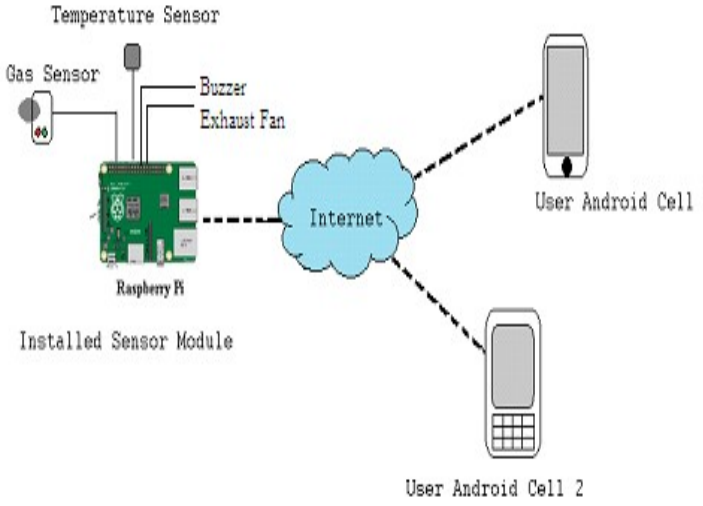


Fig. 1. Block Diagram

B. Hardware Requirements

***Temperature Sensor*:** In this, we will use the DS18B20 Temperature sensor. It can measures temperature from -55°C to +125°C (-67°F to +257°F) and it requires no external components. DS18B20 temperature sensor is shown in fig 2.

Advantages of DS18B20 Sensor:

- It has a one wire interface.
- It requires no external components.
- It is user definable and has a nonvolatile temperature alarm settings.

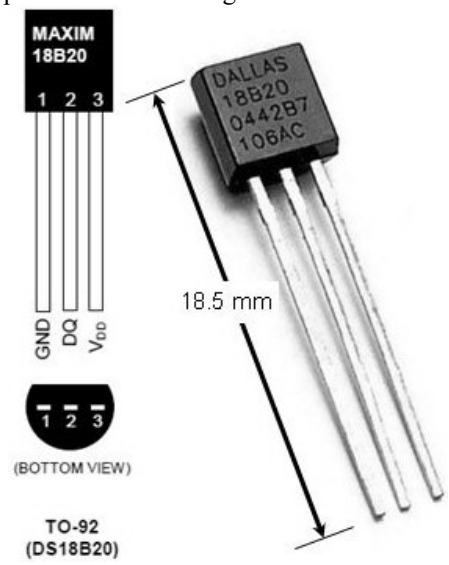


Fig 2 .DS18B20 Temperature Sensor

***Gas Sensor*:** In this, we will use MQ6 Gas Sensor. It has high sensitivity to LPG,iso-butane and propane.[1,5]It retorts very quickly and efficiently. It even has a long life. MQ6 Gas Sensor is shown in fig 3.

Advantages of MQ6 Sensor:

- They can be used to detect gas leakage in Industries and Houses.
- It has a very simple drive circuit.
- A green led is triggered after the detection of gas.

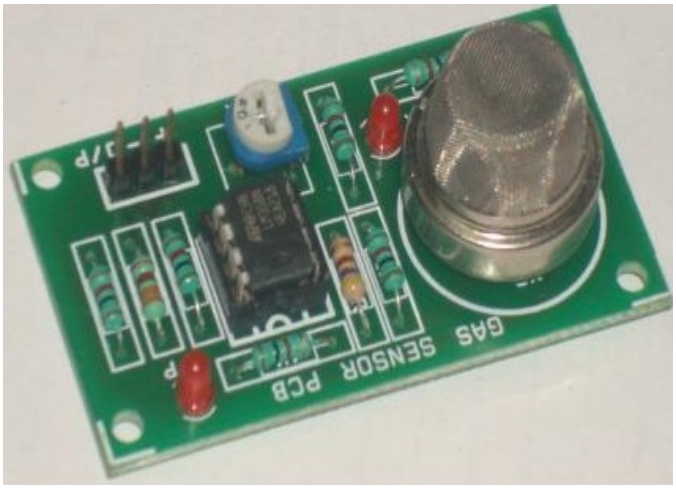


Fig 3 .MQ6 Gas Sensor

***Android Module*:** Android is a very easy to use operating system (OS). It is very customizable and is very amiable kind of Operating system. Here, the part of Android module is to keep the user updated with the Temperature and Gas values with the exact date and time through an Android Application (Safetydroid). Basically, in our Android application we show;

- The latest values of Temperature and Gas.
- It even refreshes the values periodically.
- The alert notification is send to android phone when the Temperature or gas values exceed the critical value[2] that has been set in a particular industry.

***Raspberry Pi Module*:** Raspberry Pi is like one of the Microcomputers. The Raspberry Pi 2 represents one of the best of its types. Above all, it uses Linux Operating System. This Microcomputer is used in every field now-a-days;[9] they are great for education projects and even to run many modern games.[11]It is supported on Raspbian Operating System (OS) and it uses Python as main

programming Language. Raspberry Pi Module 2 is shown

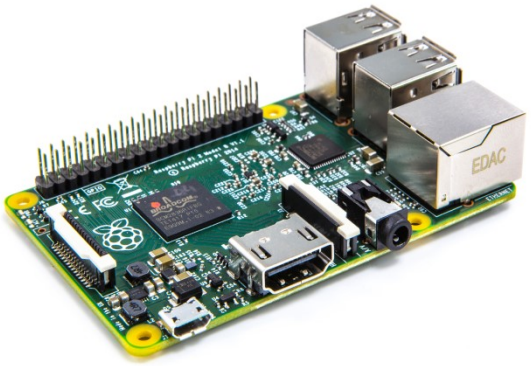


Fig 4 .Raspberry Pi 2

***Safety Module*:** Common jeopardy's exist in many workplaces. Our paper discusses a risk management system to detect the exceeded Gas or Temperature value, so the measures taken to ensure the safety are blowing an Alarm and Switching on the Exhaust Fan wherever our device is been fitted.[6] In our project we try eliminating the hazardous Gas or increased temperature by the Exhaust fan and notifying the workers by blowing an Alarm. This particular kind of arrangement would surely ensure the safety of workers working in that industry and even the raw materials stored.

C .*Software Requirements*:

Languages:

***Java Programming*:** It is one of the most recommended languages by most developers to create applications for Android devices. In our project, we use Java and Eclipse to create an Android application "SafetyDroid".

***Python Programming*:** Python is a powerful programming language that is even very easy to use with Raspberry Pi. It even uses very fewer lines of codes as compared to C or C++. In our project, we use Python in order to make connections with Raspberry Pi 2.

***PHP*:** The PHP Hypertext Preprocessor (PHP) is a programming language that is widely used by web developers to develop web based applications. In our project, we use PHP in order to keep the track of the Gas and Temperature values through the web based application.

III. ALGORITHM

1) The proposed system continuously monitors the industrial environment using the sensors and generates values.
2) The generated values are then stored in the MySQL database.
3) The generated values are used to detect whether it exceeds the safety limit.
4) If generated values are greater than the safety limit an alarm and the exhaust fans are started.
5) The data can be viewed continuously by connecting to the system and viewing the web page.
6) The data can be viewed by security official or the owner in his SafetyDroid Android app by connecting to the system.

IV. Results and Conclusion

```
ds18b20.sh  monitor.py  test.py
pi@raspberrypi ~/VRM $ ./ds18b20.sh
pi@raspberrypi ~/VRM $ sudo python monitor.py
Gas Not Present
33.625
Gas Not Present
33.625
Gas Not Present
33.562
Gas Not Present
33.625
Gas Not Present
33.875
Gas Not Present
34.312
Gas Not Present
34.5
Gas Not Present
34.375
Gas Not Present
34.312
Gas Not Present
34.5
Gas Not Present
34.625
Gas Not Present
34.562
Gas Present
34.375
Gas Not Present
34.375
```

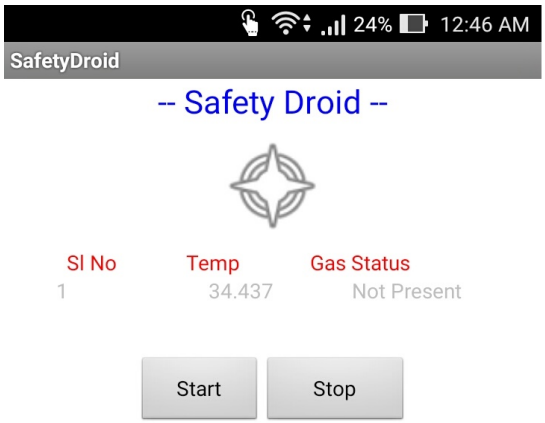
1. The above figure shows the execution of the generation of values from the sensors (shown in Step 1) and stores in the MySQL database (Step 2).

```
pi@
116.062
ALARM
Gas Not Present
101.625
ALARM
Gas Not Present
88.312
ALARM
Gas Not Present
77.312
ALARM
Gas Not Present
66.937
ALARM
Gas Not Present
60.312
ALARM
Gas Not Present
55.187
ALARM
Gas Not Present
51.437
ALARM
```

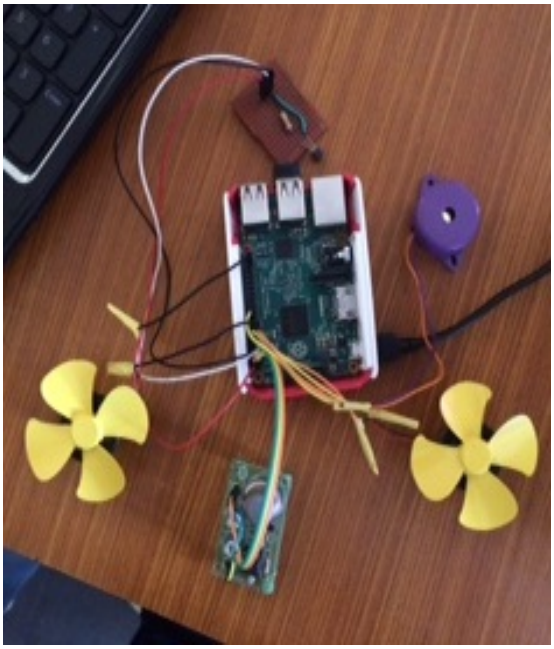
2. The above figure shows the system testing the values and starting the safety system (Step 3 of Algorithm).

21	31.125	Not Present	2016-04-18	18:56:06
22	31.125	Not Present	2016-04-18	18:56:09
23	31.125	Not Present	2016-04-18	18:56:12
24	31.125	Not Present	2016-04-18	18:56:15
25	31.125	Not Present	2016-04-18	18:56:18
26	31.125	Present	2016-04-18	18:56:21
27	31.125	Present	2016-04-18	18:56:23
28	31.125	Present	2016-04-18	18:56:26
29	31.125	Present	2016-04-18	18:56:29
30	31.125	Present	2016-04-18	18:56:32
31	31.125	Present	2016-04-18	18:56:35
32	31.125	Present	2016-04-18	18:56:38
33	31.125	Present	2016-04-18	18:56:41
34	31.125	Present	2016-04-18	18:56:43
35	31.125	Present	2016-04-18	18:56:46
36	31.125	Present	2016-04-18	18:56:49
37	31.125	Present	2016-04-18	18:56:52
38	31.125	Present	2016-04-18	18:56:55
39	31.125	Present	2016-04-18	18:56:58
40	31.125	Not Present	2016-04-18	18:57:00
41	31.187	Not Present	2016-04-18	18:57:03
42	31.187	Not Present	2016-04-18	18:57:06
43	31.062	Not Present	2016-04-18	18:57:37

3. The above figure shows the values stored in the MySQL database in the web browser[10](Step 5 of algorithm)



4. The above screenshot shows the SafetyDroid Android application and displays the latest values.
(Step 6 of algorithm)



5. The above screenshot shows the complete connections and the working of our project.

V. CONCLUSION

Risk management system is designed for industries and household environment for gas leaks and increase in temperature. The system continuously monitors the values and acts accordingly to minimize risk. Being cost effective, it can be implemented in diverse environments. The android device periodically refreshes with the latest values. Notification is sent to the android app when values exceed the critical values. The gas and temperature values along with time and date can be viewed on a webpage.

VI. FUTURE SCOPE

The raspberry pi can be connected over the internet and can be given a dedicated IP address. This will make the smart phone (installed with the "safetydroid" android application) fetch the latest values from the raspberry pi from any corner of the world. We use raspberry Wi-Fi for cost effectiveness. By taking suitable permissions, the raspberry pi can automatically alert the local fire station via SMS and an email with the details of the tragedy. The current MQ6 gas sensor can be updated to a MQ2 sensor

to detect a much wider spectrum of hazardous gasses and chemicals. Different varieties of sensors can be attached to the raspberry pi depending on the further requirements. Updating the python program with the additional GPIO pins used will make it operational.

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