A Novel Disaster Detection and Environmental Monitoring System Developed for Simhastha 2016 at Ujjain

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ABSTRACT
In order to deal with disaster effectively, it is very important to identify the disaster scale and provide the accurate information about the site of disaster in real time. Sharing information on disaster situation helps to control and prevent the causalities during disaster. The Internet is a necessary tool to share the vital information about the disaster. This paper proposes an Internet of Things (IoT) based disaster alert system which can also be used to monitor the environmental conditions based on air, noise, temperature and humidity parameters. The system was successfully tested at Simhasth-2016 at Ujjain.

Keywords – IoT, Disaster Alert System, Sensor, Environmental Monitoring.

I INTRODUCTION

Kumbh Mela is a mass Hindu pilgrimage of faith in which pilgrims Indian gather to bathe in a sacred river. It is the world's largest religious gathering. It is held every third year at one of the four places by rotation: Haridwar, Allahabad (Prayag), Nasik and Ujjain. Thus the Kumbh Mela is held at each of these four places every twelfth year. Ardh ("Half") Kumbh Mela is held at only two places, Hardwar and Allahabad, every sixth year. The rivers at these four places are: the Ganges (Ganga) at Haridwar, the confluence (Sangam) of the Ganges and the Yamuna and the mythical Saraswati at Allahabad, the Godawari at Ujjain, and the Shipra at Ujjain. Nearly ten million devotees across the country graced the festival with their presence on this auspicious day.

It has been observed that when any disaster or kiosk happens in the crowded place, the very first indication of problem is sound. In case of fire disaster it can be gases. In this study air sensors and sound sensors were used to detect the disaster indicators.

The system proposed in this study is based on Internet of Things (IoT). The IoT is a paradigm in which all physical objects such as home appliances, vehicles, buildings, cloths, animals, humans and devices etc. are connected to Internet and are known as 'things'. The main benefit of IoT is that it allows to monitor and control 'things' remotely and acquire its state data in real time whenever required. [1] [2] [3]

II SYSTEM DESCRIPTION

The system presented in this study is based on IoT. The system consists of sound sensor, gas sensor and temperature & humidity sensor. The sensors are connected to FLIP microcontroller board from FRUGAL-LABS [4]. FLIP Board is equipped with WiFi connectivity module which let it connect to the Internet. (Fig.1)

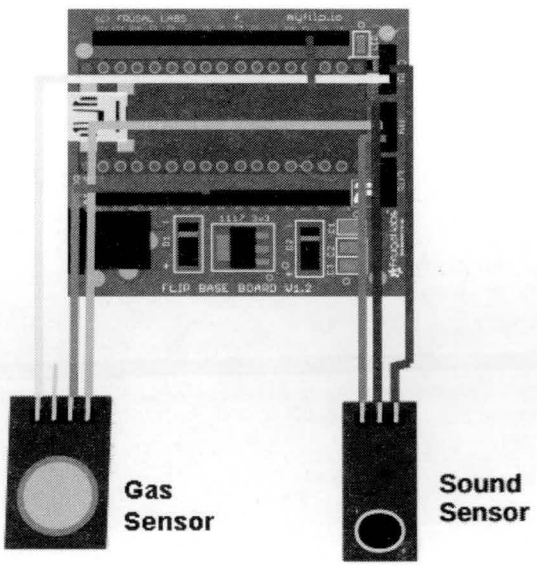

Fig. 1 – Sensor Node

Four sensor devices were installed at the place identified by AISECT University at Kumbh Ujjain Fig 2. All devices were connected to a dedicated cloud server via Internet connectivity. The devices connected were able to upload environmental data for noise and air to the cloud server using MQTT protocol. MQTT is a lightweight publish/subscribe messaging transport protocol developed for Machine to Machine (M2M) communication. It is also known as IoT protocol. Since MQTT is lightweight it gives faster connectivity to the system. [5]

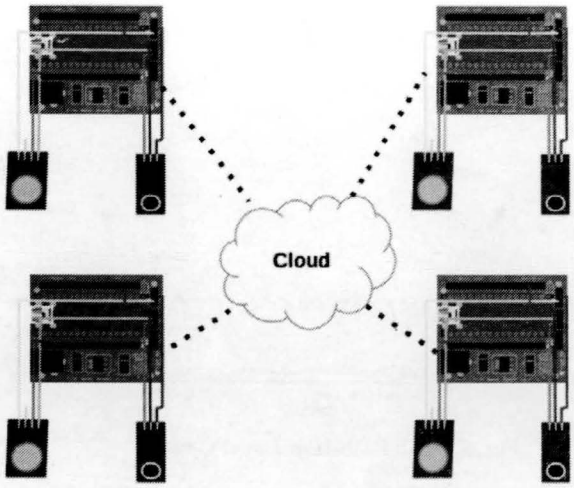

Fig. 2 – Device Communication

Devices used in this project are shown at Figure 3 and 4 the table no. 1 shows description of each device that was installed.

Table 1
Sensor on each device

	SENSOR 1	SENSOR 2	SENSOR 3
DEVICE - 1	GAS (MQ 135) SMOKE	ANALOG SOUND SENSOR	TEMPERATURE & HUMIDITY (DTH 11)
DEVICE - 2	GAS (MQ 5) CO	ANALOG SOUND SENSOR	NA
DEVICE - 3	GAS (MQ 7) CO2	ANALOG SOUND SENSOR	NA
DEVICE - 4	GAS (MQ2) LPG	ANALOG SOUND SENSOR	NA

Fig. 3 – Four sensor devices ready to operate

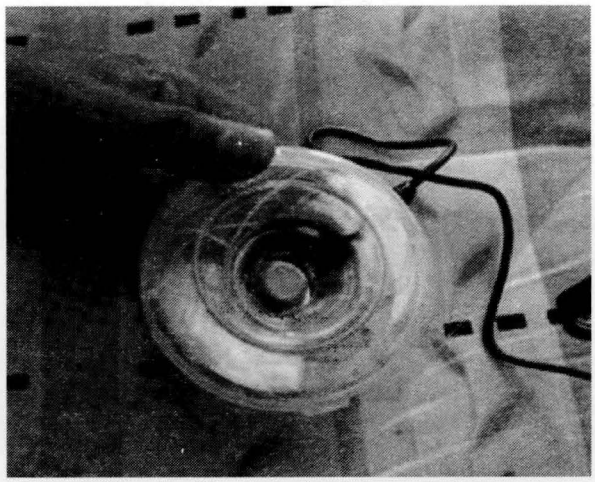

Fig. 4 – Close-up of a Sensor device

The main features of the system can be described in following points –

(a) The system is powered by *Internet of Things (IoT)*.
(b) The system provides 24x7 connectivity.
(c) When disaster occurs the user is alerted by the system.
(d) User of the system can monitor device remotely.
(e) The system provides user friendly data representation.
(f) The system has permanent data storage for future research.

III METHODOLOGY

The methodology of the system is fairly simple. Sensor devices continuously monitor the environment. The data is collected by these devices at predefined time. The data is uploaded to the dedicated cloud server for storage & analysis. When a disaster is detected immediately an alert is sent to control room and necessary actions can be taken. Finally the stored data can be utilized for further research.

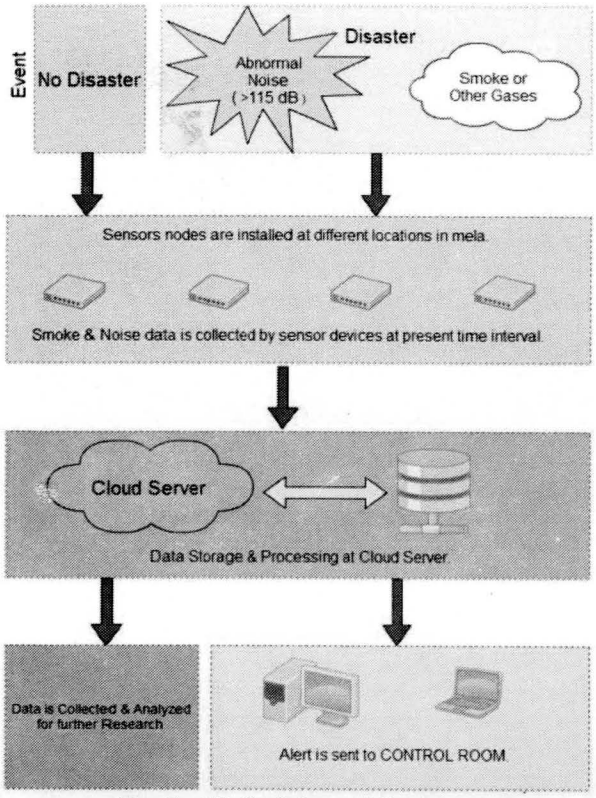

Fig. 5 – Methodology of System

IV RESULTS

The system has been implemented at Ujjain Kumbh 2016 at the place identified by AISECT University from 22 April 2016 till 21 May 2016. The Internet service for this purpose was provided by BSNL. During this period sensor nodes have collected environmental data at predefined time and uploaded it to the cloud. The data on the cloud server has been represented in graphical format. The data which has been displayed on user interface is for air quality, sound level, temperature and humidity.

With the help of this study no harmful level of gases has been detected in the environment except that a little smoke and LPG concentration in the air which wasn't much harmful for living. The figure 6 shows level of different gases in air.

The sound on the few occasions has been detected louder than the normal but not the indication for disaster. Sound detected was higher on 5, 6 and 9 May 2016. Possible causes are sound due to strong wind or noise made by vehicle horn or loudspeakers etc. Fig 7 depicts sound level graph monitored by the sensor.

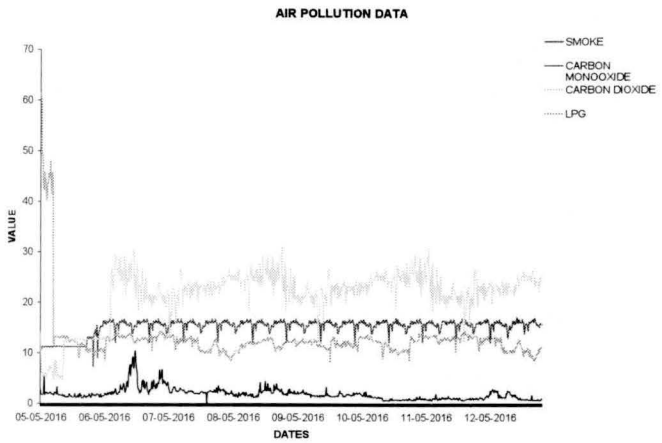

Fig. 6 – Air Pollution Level Graph

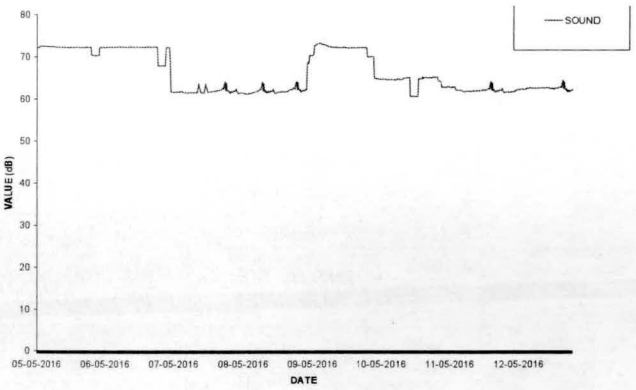

Fig. 7 – Sound Level Graph

The system was fundamentally designed to detect disaster based on noise and smoke and to alert control room in such case. Fortunately there was no disaster during Kumbh 2016. Nevertheless using this study it has been observed that there was high level of sound on 5th of May as detected by the system. It has been reported that there was heavy rain with strong wind due to which many tents at Kumbh mela were uprooted and few people were injured due to this on this day.

V CONCLUSION

This sensor based disaster detection system that works on air and noise parameter is helpful to design a reliable warning/detection system for disaster in real time and prevent or reduce human causalities. Since the system is based on IoT it works all the time and allows monitoring the environment from remote locations. The system has collected massive data which will be used to conduct further research for the design of the air and noise pollutions control system. It is proposed to use the system to study temperature and humidity level to find out ways to reduce it thus making human life safer and better for living. This is a preliminary study and use of the data collected may give many more innovative ideas during further analysis.

REFERENCES

[1] Shanzhi Chen, Hui Xu, Dake Liu, Bo Hu, and Hucheng Wang, A Vision of IoT: Applications, Challenges, and Opportunities With China Perspective, IEEE, August 2014.

[2] Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic, Marimuthu Palaniswami, Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions, Future Generation Computer Systems, Elsevier, September 2013, pp 1645-1660.

[3] Somayya Madakam, R. Ramaswamy, Siddharth Tripathi, Internet of Things (IoT): A Literature Review, Journal of Computer and Communications, 2015, 3, 164-173.

[4] FLIP IoT Platform. http://myflip.io/

[5] MQTT Essentials. http://www.hivemq.com/blog/mqtt-essentials-part-3-client-broker-connection-establishment.