Disaster Management System Using IOT

[1]Soubhagyalaxmi D B, [2]Sushma L Bhosle, [3]Swetha T, [4]Veena P D, [5]Chetan B V

[1,2,3,4]Final year B E students, [5]Assistant Professor
Department of Electronics and Communication Engineering,
GM Institute of Technology, Davangere, Karnataka, India

***Abstract*—The disaster management system prototype using Internet of Things (IoT) proposed here is capable of sensing atmospheric changes and upload the data obtained to the cloud server i.e., Thingspeak server. On the occurrence of disastrous events, alerts are given via Gmail and Telegram application using IFTTT SaaS. Actuators like Fan and Sprinklers are used to control disasters like fire and extreme temperature. Smart cities mission is an urban renewal and retrofitting program by the Government of India with a mission to develop 100 cities all over the country making them citizen friendly and sustainable. Addressing to the disasters that may occur naturally or man-made disasters involves widespread human, material, economic or environmental impacts. This proposed system provides interconnected smart modules as a way to enable centralized data acquisition by sensing and communication technologies of Internet Of Things (IOT) and Wireless Sensor Networks (WSN) to coordinate disaster management at the national and local levels in coordination with relevant agencies, and raise awareness on disaster risks in real time. This system can be controlled and monitored from remote location and delivering real time notifications based on information analysis and processing without human intervention. The data stored can be utilized for prediction of risks in future.**

***Index Terms*—Internet of things, Disaster management, ThingSpeak, IFTTT.**

I. INTRODUCTION

In the recent days, progress of India towards smart cities and digitalization is noticeable. India's historic vulnerability cannot be overstated. Around 57% land is vulnerable to earthquakes. Of these, 12% is vulnerable to severe earthquakes, 68% land is vulnerable to drought, 12% land is vulnerable to floods, 8% land is vulnerable to cyclones, and many cities in India are also vulnerable to chemical, industrial and man-made disasters. Disaster management is the process of addressing an event that has the potential to seriously disrupt the social fabric of the community. Through disaster management we cannot completely counteract the damage but it is possible to minimize the risk through early warning. The types of disasters are natural and artificial disasters. Natural disasters include earthquake, landslides, floods, river erosion, cyclones, tsunami, forest fire etc. Artificial disasters includes nuclear, chemical, mine, biological disasters.

The Internet of Things (IOT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet. The IOT concept, hence, aims at making the Internet even more immersive and pervasive. In order to properly manage the catastrophic events, information needs to be collaborated, for example by sharing resources and/or data and coordinating actions, decisions, and activities. Furthermore, during an emergency, such resources and data have to be merged in order to accomplish complex tasks, such as evacuate a geographical area and perform operations by means of actuators. The lack of integrated platforms and infrastructures which assist in data acquisition results in a bad management of the emergency.

The main concept of Internet of things is machine to machine communication. Internet based sensor networks Internet-based sensor networks have recently been gaining attention. Sensors are connected to the Internet and the information from the sensors is gathered at a server through the Internet. Security and manageability of sensor information transmission and deploy ability of sensors connecting to the Internet wirelessly are the major issues though low cost and high scalability are expected. This research work aims at developing a system which facilitates aids in the collection of data with the help of interconnected modules consisting of multiple sensors useful for smart city monitoring as well as disaster management. This technique would consist of multiple Wi-Fi enabled modules that together share distributed and heterogeneous resources and data as well as capabilities provided by physical objects such as sensors and actuators [1]. Furthermore, the availability of different types of data, collected by a pervasive urban IOT, may also be exploited to increase the transparency and promote the actions of the local government toward the citizens, enhance the awareness of people about the status of their city, stimulate the active participation of the citizens in the management of public administration, and also stimulate the creation of new services upon those provided by the IOT.

II. RELATED WORKS

This work is carried out by referring the following from the literature.

Prabodh Sakhardande, et. al [1] have proposed a system of interconnected smart modules is developed as a way to enable centralized data acquisition as well as provide an interlinked network for transmission of data in absence of any existing infrastructure. Emphasis is given on how sensing and communication technologies of IOT can effectively be used in smart city monitoring as well as in case of disaster management. The hardware of the module used for this purpose is studied and elaborated in a detailed manner.

T.-Y. Chen, H.-W Wei, et.al [2], have proposed a solution for porting uIP library to the wireless sensor network devices and presents the integration of speaker module and IPv6 ready sensor device. They also proposed a safe building application based on the integrated system to help people escaping from disaster environment.

Andrea Zanella, et. al [3], have proposed a project based on Internet of Things (IOT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of a plethora of digital services. Building a general architecture for the IOT, this paper focus specifically to an urban IOT system that, while still being quite a broad category, are characterized by their specific application domain. Urban IOTs, in fact, are designed to support the Smart City vision, which aims at exploiting the most advanced communication technologies to support added-value services for the administration of the city and for the citizens.
Aziyati Yusoff et. al [4], have proposed project discusses one of the common disasters that occurred in both urban or rural housing areas and neighbourhood i.e. the flood. This article is proposing that the flood management and early warning detection can be resolved with cloud computing facility. Through the progressive appearance of cloud computing, it is also expected that this facility is complemented with the Green Cloud technology to promote the green environment towards a better living in the smart cities.
Asta Zelenkauskaite et. al [5], have proposed a project main focus is on the area of complex social networks and the dynamic social network construction within the context of IOT. This is by highlighting and addressing the tagging issues of the objects to the real-world domain such as in disaster management; these are in relation to their hierarchies and interrelation within the context of social network analysis. Specifically, suggest to investigate and deepen the understanding of the IOT paradigm through the application of social network analysis as a method for interlinking objects – and thus, propose ways in which IOT could be subsequently interlinked and analyzed through social network analysis approach - which provides possibilities for linking of the objects, while extends it into real-world domain. They present few applications and key characteristics of disaster management and the social networking analysis approach, as well as, foreseen benefits of its application in the IOT domain.
Luca Filipponi et.al [6], have proposed system based on the ARTEMIS JU SP3 SOFIA project. It is an Event Driven Architecture that allows the management and cooperation of heterogeneous sensors for monitoring public spaces. The main components of the architecture are implemented in a tested on a subway scenario with the objective to demonstrate that our proposed solution, can enhance the detection of anomalous events and simplify both the operators tasks and the communications to passengers in case of emergency.
Arduino UNO: https://www.arduino.cc [7] gives information on ARDUINO UNO IDE
software and its installation. The required library files of the following sensors are obtained from the above website:
(1) DHT11 sensor
(2) Gyroscope and Accelerometer sensor
NodeMCU: http://nodemcu.com [8] gives the pin configuration and architecture of NodeMCU firmware.
IFTTT: https://ifttt.com [9] website provides devices talking to each other using the software as services for sending text messages.
ThingSpeak website: https://thingspeak.com [10] has been used to store the data read by the sensors and analyzed in this project work.

III. SYSTEM OVERVIEW

The Figure 1 shows the proposed disaster management system using internet of things in smart cities, the block diagram gives details of NodeMCU board along with Esp8266 wifi-module collects the data from the various sensors – DTH11 module, MQ-2 sensor, GY521 module, Ultrasonic HC-SR04. Sensors give input to the module by sensing the atmospheric conditions. The Arduino programming environment facilitates the developer to manage, compile, upload, and simulate programs in a user friendly environment. A Wifi-module ESP8266 is low-code MCU supports Wi-Fi and the HTTP protocol, thus enabling to connect the board to the Internet without a gateway solution and merge it into complex device networks made up of smart sensors. The sensed data is stored in cloud. "ThingSpeak is an open source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications. Modules switch to the disaster management mode when they receive the alert signal and information is sent to rescue agencies via Gmail, and people of that particular region the module is operating through telegram application, messages of information is sent in specified group. Monitor is used to observe the readings from the sensed data of module. ThingView is the mobile application used view the sensors data stored in ThingSpeak. During extreme temperature, Fan is switched on automatically, and in case of fire disaster sprinklers are made on. But some of the natural disaster like flood and earthquake are analyzed prior and informed via mail and sms.

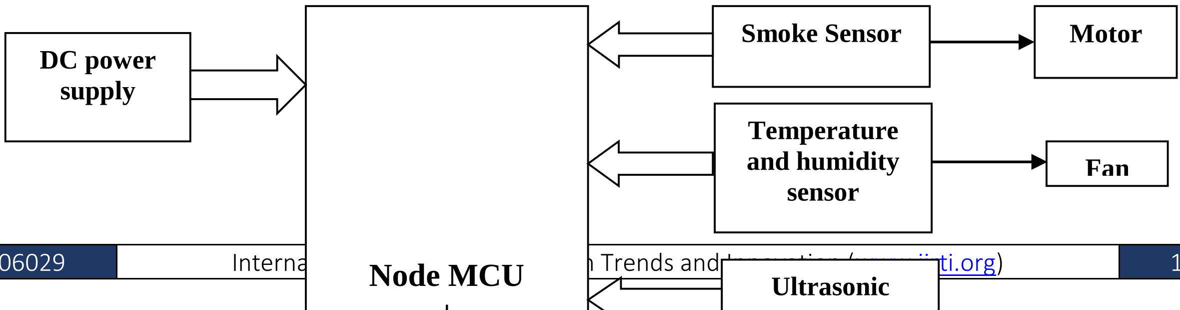

Fig 1. Block diagram of the disaster management system

The following Figure 2, flowchart describes the DHT11 sensor temperature and humidity measurements. When the temperature is detected above the threshold value of 35^0C then the mail is sent to rescue team and message is sent to both rescue team and the users. If the temperature is above the threshold value then the fan is ON.

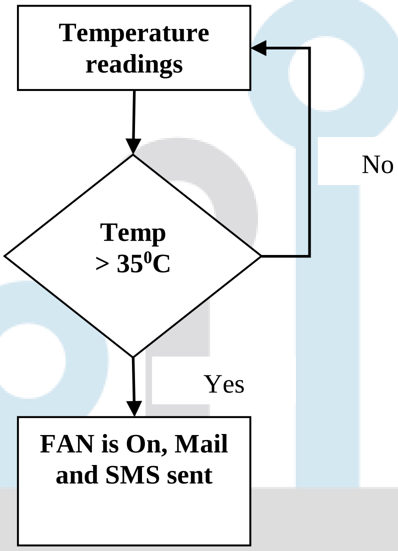

Fig 2. Operational Flow Diagram of the DHT11 Sensor

The Figure 3, flowchart describes the Ultrasonic sensor distance measurements. When the water level is detected above the threshold value between 80cm - 149cm then the alert mail of flood occurrence is sent to rescue team and message is sent to both rescue team and the users.

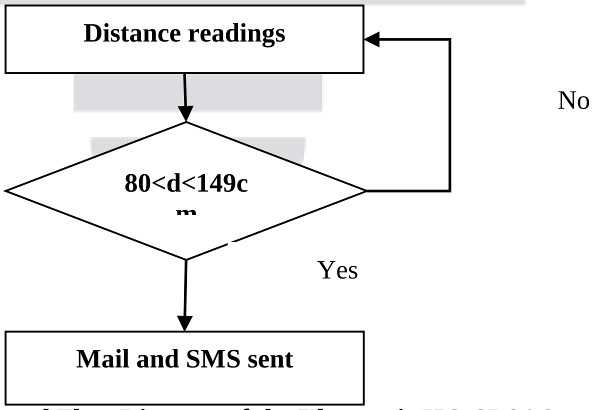

Fig 3. Operational Flow Diagram of the Ultrasonic HC-SR04 Sensor

The figure 4, flowchart describes the Gyroscope sensor distance measurements of 3 Axis. When the changes occurs in the axis of sensor it's detected then the alert mail of earthquake occurrence is sent to rescue team and message is sent to both rescue team and the users.

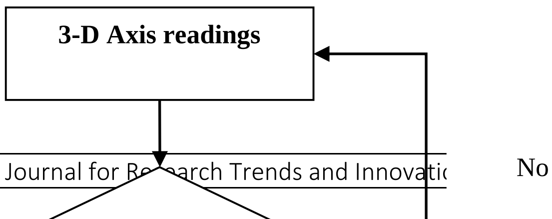

Fig 4. Operational Flow Diagram of the Gyroscope GY-521 Sensor

The Figure 5, flowchart describes the smoke detection MQ-2 sensor. When the smoke is detected referring the threshold value above 1000 ppm then the alert mail is sent to rescue team and message is sent to both rescue team and the users. Sprinklers are switched on.

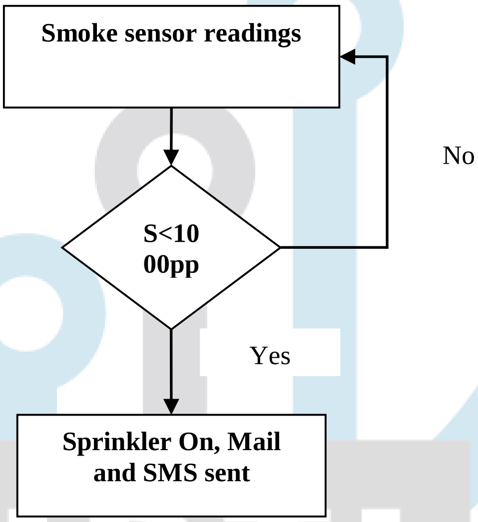

Fig 5. Operational Flow Diagram of the Smoke detection MQ-2 Sensor

IV. Results and Discussion

The following Figure 6 represents the Disaster management system model. The values of the atmosphere parameters are read by sensors,Figure 7 lists the sensors readings on serial monitor, when the temperature is above 35 degree fan is switched on, or smoke is detected (> 1000 ppm) sprinkler is switched on, or change in earth axis measurements or increase in water level results in prior intimation. Disaster intimations are sent to rescue team via Gmail Figure 8 shows the inbox of Gmail of rescue team or user and for people in surrounding place is sent in a group via Telegram application those results are shown in Figure 9.

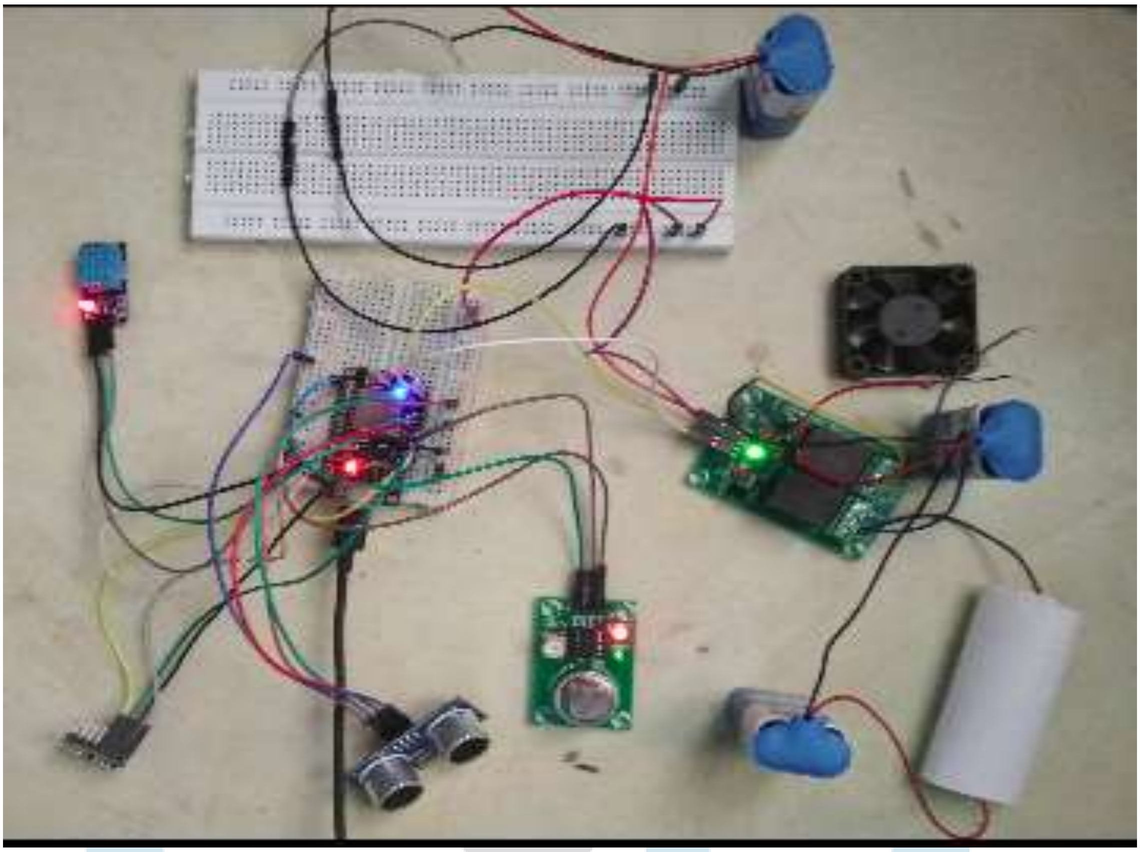

Fig 6. Disaster Management System Model

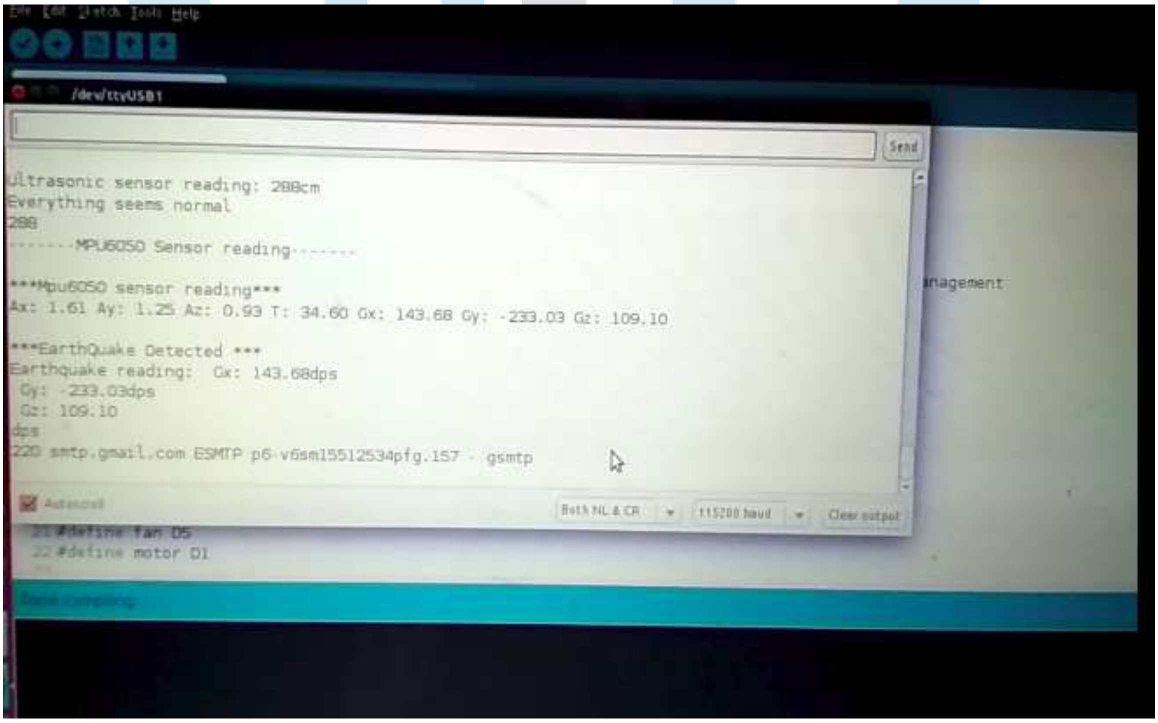

Fig 7. Sensor Readings on Serial Monitor

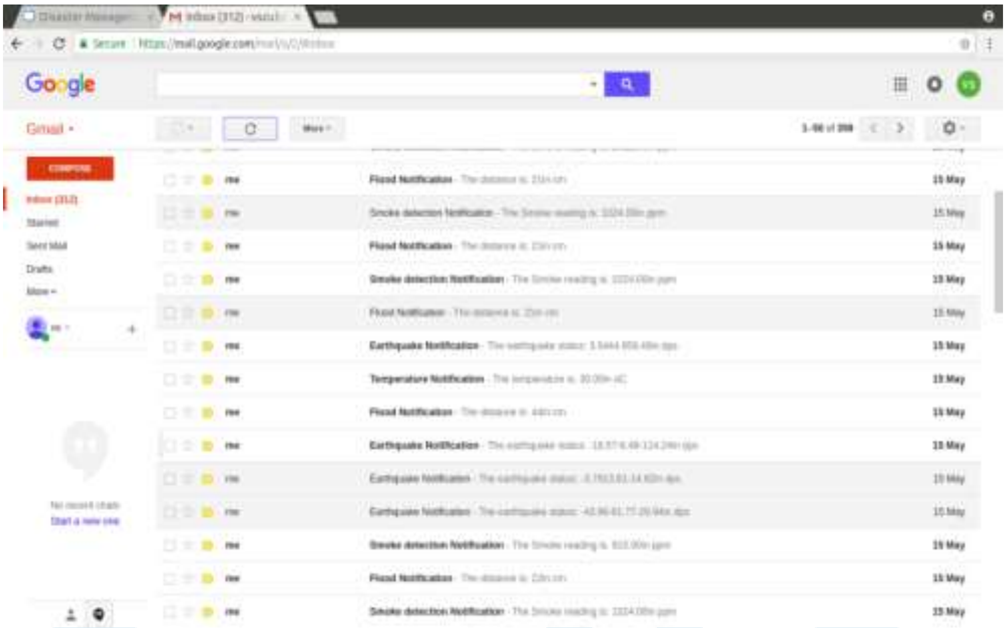

Fig 8. Snapshot of Mail Inbox

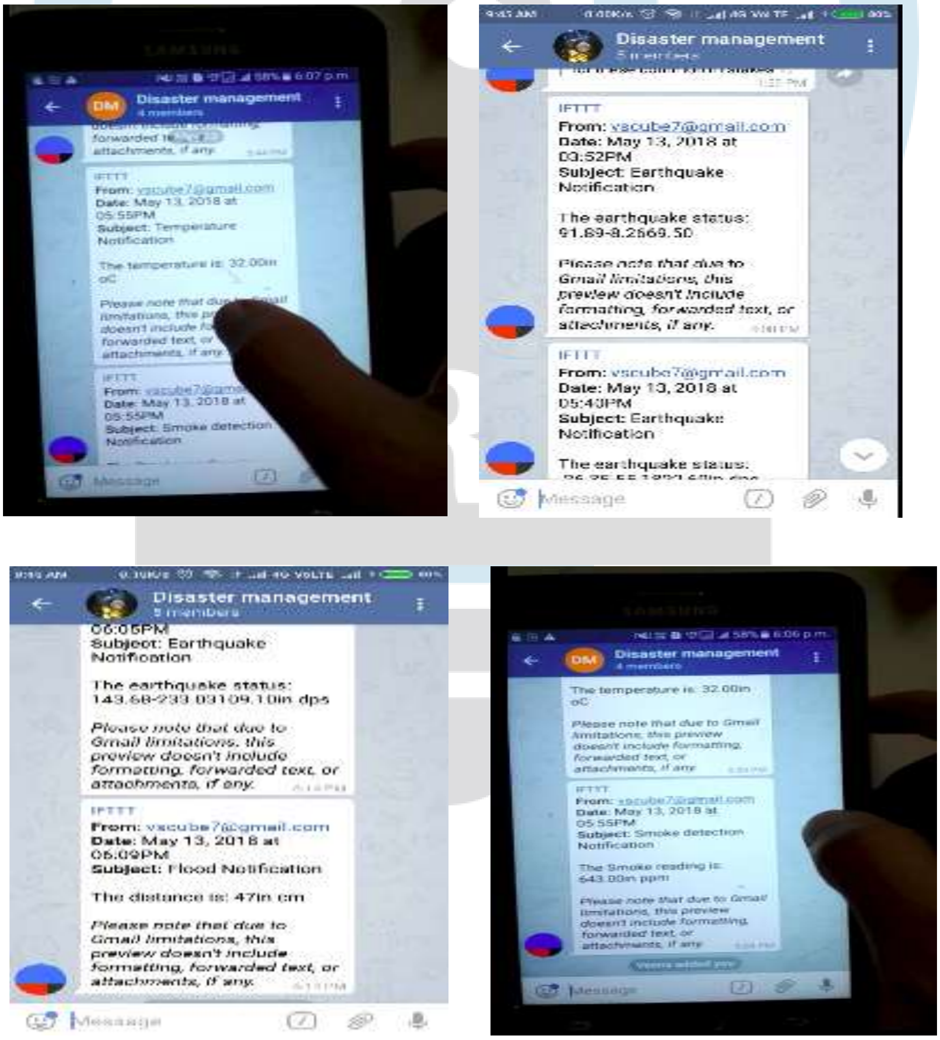

Fig 9. Snapshot of Telegram Group Alert

V. Conclusion and Future Work

An IOT based disaster management system has been proposed in this work to endorse the concept of smart cities. The proposed system involves NodeMCU and four sensors. The parameters monitoring is done using four sensors. The readings of sensors are successfully uploaded to ThingSpeak. Hence, before the occurrence of disaster, alert is sent to rescue team or users via Gmail and SMS in the group of Telegram app. Disasters like extreme temperature and fire detected can be controlled using actuators like Fan and Sprinkler respectively.

The proposed work proves to be a breakthrough in disaster management as it can be deployed in the smart cities with less budget requirements. Future work includes improving dynamic adaptation of modules to changing conditions, development of a dedicated protocol for disaster management, big data analysis on the obtained set of results. These results could be used for the prediction of occurrence of disastrous events.

VI. Acknowledgment

We would like to acknowledge the Department of Electronics and Communication Engineering, GMIT, Davangere for the support extended for the completion of this work. We would also like to thank our parents and friends for their encouragement in completing this work.

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