International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

FIRE ALARM SYSTEM FOR SMART CITIES USING EDGE COMPUTING

N Ranga Reddy, Manoj Kumar G, Narayan, Sheshi Kumar, H Srinivasa Murthy

[1]*Student, Dept. of CSE, S J C Institute of Technology, Chickballapur, Karnataka, India*
[2]*Student, Dept. of CSE, S J C Institute of Technology, Chickballapur, Karnataka, India*
[3]*Student, Dept. of CSE, S J C Institute of Technology, Chickballapur, Karnataka, India*
[4]*Student, Dept. of CSE, S J C Institute of Technology, Chickballapur, Karnataka, India*
[5]*Associate Professor ,Dept. of CSE, S J C Institute of Technology, Chickballapur, Karnataka, India*

Abstract - *The present urban planning trend is to build smart cities that are advanced, safe and sustainable. To build these cities several technologies are used including the Internet of Things (IOT) and edge computing. This made us to develop an IoT-based fire alarm system that uses edge computing. The system that is built would be suitable in smart cities, as it solve the issues faced by the existing fire alarm systems the prevailing fire alarm systems like installation overhead and lack of remote warning.Our system is an ad-hoc network which have several sensing nodes and a one central node. Each of those sensing nodes consists of an ESP8266-nodeMCU connected to differing types of sensors, like smoke, temperature, humidity, flame, Methane and carbon monoxide gas (CO) sensors. These nodes are used for sensing the environment and detecting the fire which suggests that they're smart end nodes and hence satisfying one among the characteristics of edge computing. The nodes dispatch the collected data to a centralized node that was employed with a Raspberry Pi computer. Communication between the sensing node and therefore the central node will takes place in Message Queuing Telemetry Transport (MQTT) protocol which is carried via a bridge node. When a node detects fire, it signals the centralized node to alert the user and therefore the local department using the attached 4G module. An SMS is shipped to them and therefore the user is named. Users can look into the status of their home by sending an SMS. A prototype for the system performed the specified functionalities successfully with a mean delay of 30 seconds and node coverage of 1400m^2.*

Key Words: Raspberry Pi, Message Queuing Telemetry Transport, ESP8266-nodeMCU, Internet of Things, Ad-hoc, Fire alarm system.

1. INTRODUCTION

Nowadays we are reading in newspapers that several buildings and other places are set to fire and several human loss, property loss took place.One of the crucial systems that need to be considered when building smart cities is a fire alarm system. Having a fire alarm system is essential to ensure the safety of the people's lives and reduce the amount of losses as much as possible. However, the conventional fire alarm systems have some limitations including the inability to warn owners when they are outside their home. Not only human loss but also property damage and surrounding loss also plays vital role in fire accidents. Even if we kept existing systems in home but, If fire accident occurs when no one at home then so much damage occurs. Keeping in mind the above problems we can solve mentioned problem by proposing a fire alarm system that can communicate with the owner remotely to warn them if there is a fire at their homes. In addition to that, it can communicate with the firefighting department to speed up the process of rescuing lives and properties. Human Life is a god's gift we can't let any one loose their lives in such fire accidents. So the proposed system "Fire Alarm System For Smart City" will Save Lives.

2. SIGNIFICANCE& RELEVANCE OF WORK

Our system is an ad-hoc network of several sensing nodes and one central node. Each of these sensing nodes consists of anESP8266-nodeMCU connected to different types of sensors such as smoke, temperature, humidity, flame, Methane and Carbon Monoxide Gas (CO) sensors. These nodes are liable for sensing the environment and detecting fire which suggests that they're smart end nodes and hence satisfying one among the characteristics of edge computing. The nodes dispatch the collected data to a centralized node that was employed with a Raspberry Pi computer.Communication between the sensing node and therefore the central node is thru Message Queuing Telemetry Transport (MQTT) protocol which is carried via abridge node. When a node detects fire, it signals the centralized node to alert the user and the fire department using the attached4G module. An SMS is shipped to them and therefore the user is named. Users can look into the status of their home by sending an SMS. Whole process will takes place with an average delay of less than 30 seconds and node coverage of 1400m2.

3. OBJECTIVES & METHODOLOGY

The main objective of this project is to develop such a system which can prevent fire accidents and save lives. Cultural property management is the most trusted one with the responsibility of protecting and preserving an institution's buildings, collections, operations and occupants. Constant attention is required to attenuate adverse impact hanks to climate, pollution, theft,

vandalism, insects, mold and fire. Because of the speed and totality of the destructive forces of fire side , it constitutes one the most serious threats. Defaced or environmentally damaged structures are often repaired and stolen objects recovered. Things destroyed by fire, however, are gone forever. Generally fire can spread in no time. It can spread a whole room within minutes and have high chances of destroying the whole building within few days.

4. SYSTEM ANALYSIS

4.1Existing System:

In this system some sensors for detecting fire and a Wifi based system is used to distinguish the fire accidents and to inform owners through the buzzers and flashes. In this system the information is not transferred to fire station and also user mobile is not linked up.

Limitations:

a) It is limited to certain space but not for whole big buildings.

b) Information can't be send to fire fighters.

4.2 Proposed System:

The main idea presented in this project is to design a wireless sensor node which will be a part of a sensor network .This suggested system is of three parts front-side, middle-side, back-side. Front-side will be near user that is alarms, buzzers and all. Middle-side will be the sensing nodes ,node esp 8266, bridge node , raspberry pi. Back-side will be at the operation occurs at 4g module. Advantages :

a) Get notified immediately

b) High Accuracy

c) Low power consumption

d) Accessible all over world

e) Reduced cost.

5. SYSTEM DESIGN

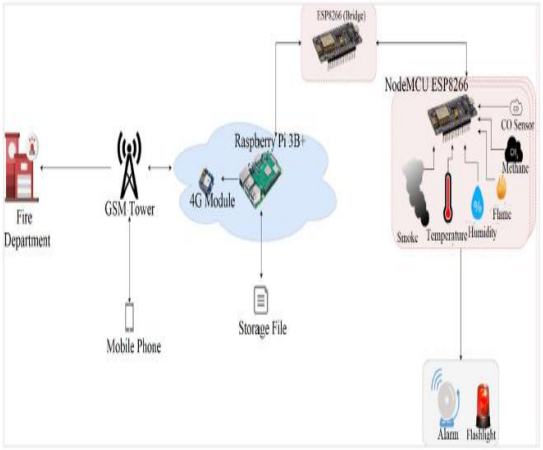

Fig -1: System Design

5.1 RASPBERRY PI

The Raspberry Pi is a small sized computer that can be used as computer, and we can use keyboard and mouse to give inputs. It is used for computing, and we can also learn how to program in different languages. Raspberry Pi is well capable of doing everything that computer can do, it can be used for browsing and playing video and many more.

5.2 NODE MCU

Node MCU is firmware which is used to connect to wifi. It is used as a module to connect the devices.

5.3 GSM

GSM (Global System for Mobile communication) is a mobile network that is used by mobile phone users all around the world. GSM will digitalize and compresses data, and after that sends it to a channel with two other streams of user data, each in one time.

5.4 TEMPERATURE & HUMDITY SENSOR

Temperature and humidity sensors are commonly used sensors used to identify the temperature and Humidity. Humidity sensors are also called hygrometers. Humidity sensors are used to provide the humidity at any given point or in any given place.

5.5 FIRE SENSOR

A flame is a sensor used to detect the presence of a flame or fire, which allows to detect flame. Detection of fire is done and the alert is sent to respective GSM.

5.6 CO2 SENSOR

A carbon dioxide sensor or CO_2 sensor is used to measure carbon dioxide gas. It gives the carbon dioxide level in the atmosphere.

6. IMPLEMENTATION

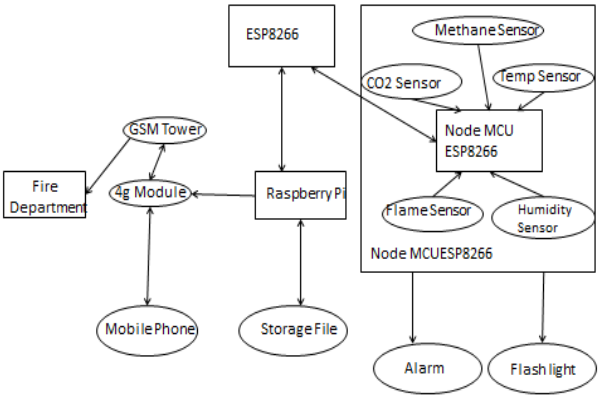

Fig -2: Data Flow Diagram

Node MCUESP8266 will collect the data from Temperature, Humidity, Smoke, Flame and CO2 sensors and sends the alarm signals and turns the Flash light on. After this all the data collected data will be sent to the Raspberry Pi through the ESP8266 which will act as the bridge. The data collected in Raspberry Pi is stored in a file and sends the data to the nearest GSM tower through the 4G Module which is used to transfer the data. The GSM tower sends the signals to the Fire Department and the respective mobile phone.

7. TESTING

Testing is the final step in the system where verification and validation happens within the organization itself. The following goals are tried to achieve:-

a) To affirm the quality of the project.

b) To find and eliminate any residual errors from previous stages.

c) To validate the software as the solution to the original problem.

d) To provide operational reliability of the system.

At first, the user will be prompted to fill the login details as shown in figure. After logged on, the user will be redirected to the display webpage as shown in figure which will display the image captured later.

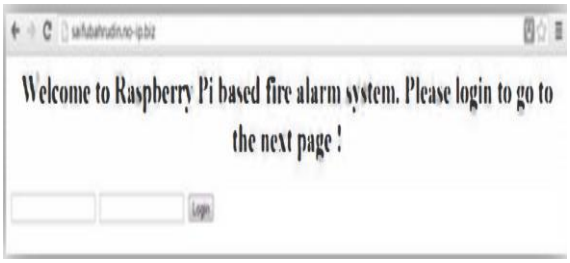

Fig 3: Login Page

A. True warning as the sensor detects the increase of coal gas in the air and the value of the measurements surpassed the threshold value, the camera captured an image and it was displayed on the webpage. Figure shows the display of the image in the webpage. After the submit button was clicked, the PHP programming modified the content of the Logger file by writing a word "send" in it. The user will be redirected to the report webpage as shown in the figure. The Python programming read the content of the Logger file and a HIGH output was sent through Port 25 of the Raspberry Pi. The Arduino Uno reads the signal as a confirmation for sending SMS to the Firefighter and activates the GSM shield and sends the address of the scene in the form of SMS by using AT Commands. Figure shows the screenshot of the message.

Fig 4: The image displayed on the webpage

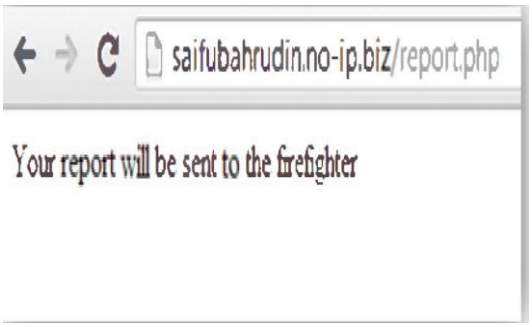

Fig 5 : The webpage redirected from the display webpage

Fig 6: The screenshot of the message sent

B. A false warning test was made to show what happened when any error occurs during the operation of the system. The source of error can vary. The reason may be due to sensor failure or gas leakage.

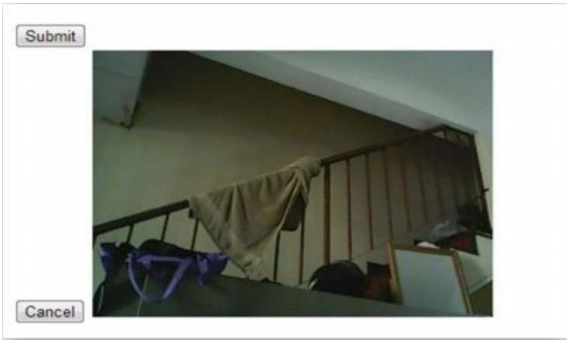

Fig 7 : The false warning image displayed on the webpage

8. PERFORMANCE ANALYSIS

Performance analysis is the technique of studying or comparing the performance of a specific situation in contrast to the aim and yet executed. In human Resources, Performance analysis can help to review an employee contribution towards a project .Three basic data collection techniques Data collection, Data Transformation, Data Visualization.

9. CONCLUSIONS

Science and technology is panacea for all our growing problems. Predicting the natural processes are more complex and our system needs to be tested against real time conditions. Though our system is self- sustaining and standalone, other factors which would affect the hardware were tested against time. This will be implemented in small forest areas where chances of occurrence of forest fires are high. The system needs to be robust to withstand all the climate changes which may affect its functioning. However, our system will play a crucial role in curbing the forest fires which would prevent loss of huge resources and financial losses. We have tested in forest like conditions, but real hardship which we may face is during implementation in large area in real time.

REFERENCES

[1] A. A. Radhi, “Design and Implementation of a Smart Fire Alarm System Based of Wi-Fi over Long Distance (WiLD),” Al-Ma’mon Coll. J., no. 27, pp. 374–389, 2016.

[2] A. Ashwitha, K. Arjun, and H. L. Prashanth, “GSM Enabled Smart Fire Alarm Controlling System with SMS Alert,” Int. J. Comput. Appl., vol. 147, no. 11, pp. 975–8887, 2016.

[3] R. H. Eltom, E. A. Hamood, A. A. Mohammed, and A. A. Osman, “Early Warning Firefighting System Using Internet of Things,” in 2018 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE), Aug. 2018, pp. 1–7. [4] R. K. Kodali and A. Valdas, “MQTT Implementation of IoT based Fire Alarm Network,” in 2018 International Conference on Communication, Computing and Internet of Things (IC3IoT), Feb. 2018, pp. 143–146.

[5] M. U. Harun Al Rasyid, D. Enda, and F. A. Saputra, “Smart Home System for Fire Detection Monitoring Based on Wireless Sensor Network,” in 2019 International Electronics Symposium (IES), Sept. 2019, pp. 189–194.

[6] R. A. Dziyauddin et al., “Smart Fire Emergency System for Buildings: A Review,” in 2018 2nd International Conference on Telematics and Future Generation Networks (TAFGEN), July 2018, pp. 125–130.

[7] I. Shoker, IoT Can Help Save Lives, Oct. 26, 2017. Accessed on: Oct. 13, 2018. [Online]. Available: https://www.instmc.org/Portals/0/IoT%20Can%20Help%20Save%20 Lives.pdf.

[8] Nest Labs, Installation and Tech Specs, Nest Labs. Accessed on: Oct. 24, 2018. [Online]. Available: https://nest.com/smoke-co-alarm/techspecs/.

[9] L. U. Khan, I. Yaqoob, N. H. Tran, S. M. A. Kazmi, T. N. Dang and C. S. Hong, "Edge Computing Enabled Smart Cities: A Comprehensive Survey," arXiv:1909.08747 [cs], Sept. 2019.

[10] W. Yu, F. Liang, X. He, W. G. Hatcher, C. Lu, J. Lin and X. Yang, "A Survey on the Edge Computing for the Internet of Things," IEEE Access, vol. 6, pp. 6900-6919, Nov. 2017. [11] "PainlessMesh," Gitlab, 2018. Accessed on: Nov. 24,2018.Available:https://gitlab.com/painlessMesh/painlessMesh/wikis/home.