

Preventing and Monitoring of Framework for Forest Fire Detection and Data Analysis Using Internet of Things (IoT)

V.Parthipan, D.Dhanasekaran

Abstract: The most common hazard in forest fires are as accident as the forest themselves which destroy the forests and can be great threat to wildlife and peoples. The internet of things is the physical device which is used to connect, store the data and enable the objects to collect information for exchanging the data through the internet based system. In the advancement of technology platform can be used to build a real time application systems based on data collections through the sensors and network connectivity using cloud services in IoT. The concept of this research is to detect the fire in various locations to identify the forest fire accidents to monitor and prevent before attempting any forest fire on the location. Fire disaster is an extinguishing strategy which provides the real time monitoring and identifies the accidents to secure forest and control the fire. In this proposed work, the smoke detector, temperature, humidity and Ultra sonic sensors is used to sense the fire detection and collects the data using cloud for the prevention for immediate action to take place also to increase the system in advanced level of GSM is provided to send an immediate message to fire fighters to prevent an accident. In this proposed work it is mainly used to prevent the forest fire for saving nature and monitor to check the threshold value of each sensor to validate the data and take initiative to prevent the requirement of achieve with high reliability prevention using this technology.

KEYWORDS: Sensors, GSM, node, IoT, GSM, FFDA.

I. INTRODUCTION

Forest Fires are uncontrolled fires occurring in wild areas and cause significant damage to natural and human resources are the extensive phenomenon in Indian forests. Most forest fires are atmospheric temperature and occasional humidity which provide auspicious environments for fire to begin. Common causes of forest fire include lightning, human carelessness and exposure of fuel to extreme heat and aridity.

The forests and the biodiversity of the India are at a greater chance and underneath tremendous pressure. Suppression of wildfires that arise in wooded area demands huge quantity of federal assets, costing up to 1.48 billion in

line with year, alongside the lives of ten to twenty fire fighters [1].

It is significant to detect that if you want to manipulate woodland fire, early caution schemes are essential. In India there are normally conventional behaviors to reduce the impact of wooded area fire. Combating forest fires are normally performed in usual way like fire lines and beating with branches. New technological know-how like fire extinguisher from water planes and demarcation to reduce the spread of fire isn't always usually typically accompanied in India [2].

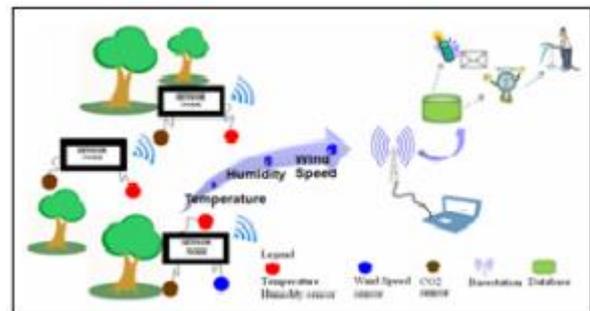


Fig 1. Structure of Forest fire Sensor Network

In order to protect these huge stretches of land and biodiversity, there is an important want to have a tremendous surveillance and early caution structures for the forest fire whilst in its establishing diploma of spreading shall be managed which will save you its unfold. Usually so that you can prevent fire in forest vicinity there may additionally be a massive dependency on man power. Tracing true area, communiqué troubles, transportation ciliates, climate situations, environmental and natural world nation of affairs which can be one of the exclusive elements stopping the officials and responsible authority to behave while woodland fire arise. Proper mechanism to forestall wooded area fire may also be laid down in a greater way for it should be beneficial to officials and woodland involved authority. Through this lookup paper we create a machine if you desire to assist the woodland fire protection people to manipulate undesirable results on forest ecosystem and natural world. For this purpose, a sensing surroundings can be deployed with a large vast range of wireless sensor nodes. [3].

Manuscript published on 28 February 2019.

* Correspondence Author (s)

V. Parthipan, Research Scholar, Professor, Computer Science and Engineering, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu India. (E-mail: parthipansp@gmail.com)

D. Dhanasekaran, Professor, Computer Science and Engineering, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu India. (E-mail: nddsekar@gmail.com)

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <https://creativecommons.org/licenses/by-nc-nd/4.0/>

A wooded area hearth is a natural disaster consisting of a hearth which destroys a forested location, and can be a splendid risk to those who live in forests as well as natural world. Forest fires are usually started out by using lightning, however additionally by way of human negligence or arson, and might burn hundreds of square kilometers.

Forest fires, additionally known as wildfires, flowers fireplace, grass fireplace, brush fireplace or bush hearth, is common in vegetated regions of Australia, South Africa, United States and Canada, wherein climates are sufficiently moist to allow the increase of trees, but function prolonged hot and dry intervals. [4]

Forest fires are due to the drying out of branches, leaves and therefore turns into fairly flammable.

Fires can do weird things including:

- Crawling - spreads from bush to bush
- Crown - unfold at an super tempo via the top of the woodland. These are dangerous as it may deprive humans underneath the fire of oxygen to feed the hearth.
- Jumping / Spotting - Burning branches and leaves carried away through wind.[5]

To prevent fires, there are big firefighter offerings which include planes, hearth trucks, in addition to small extinguishers depending on the severity of the fire. Assume a very popularly It is also large investment by both on private and government agencies. On the development of our work is based on frame work data analysis and easy to monitor and preventing to detect forest fire towards in cloud environment using IoT.[6]

II. RELATED WORK

The concept of this research is to build a network through distributed wireless sensors, which is randomly spread in the forest and to create a self-organized robust network between the sensors to cover all the large areas in the forests that may used to avoid the fire damage at any time. The function of the sensor network is to detect fire in the coverage area between the time intervals of every 10-15 minutes and it will send a warning signal to a main server. When the fire is detected all of the sensor in the area of vicinity will be active and command to stop the routine task. [7]. That the sensors are provided a small wireless range transmission. The data will be transmitted from one sensor to another until the signal reaches the sink. When the sink receives the data it will start doing process to routine and check if the fire clearly represents danger zone through the measure rate of the fire spreads. If the result of processing is conformed then the sink determine the position of the fire .Next the sink will send an alarm signal to the fire department and give information about the exact location of the fire and also notify the temperature and speed of the fire[8][9].

Based on the received information , the fire department will be able to assess the extent and gravity of the situation to arrive at an optimal decision and also they take approximate action before the fire becomes uncontrollable..



Fig.2 Forest fire in kurangani tamilnadu

The forest fire is not only destroy the forest wealth (trees) but also to the entire regine to flora and fauna seriously disturbing the bio diversity. During summer season there is no raining the forest become littered with dry senescent leaves and twings which could burst in to flames Ignitiated by the slightly sparks. [10]

2.1 PROBLEM DESCRIPTION

The forest furnace is in many instances located by the spreading of largest location making its control and stoppage and it is impossible. The end result of devastating loss of lives and forsest naturals.

In addition, to irreparable-damage to the ecology among unique serious significance of woodland furnace are such long-term disastrous consequences as the affect on the neighborhood weather pattern, world warming, extinction of unusual species of the plants and fauna; etc.

The problems two of the forest fires are generally typically unfavourable planes. trees, wild animals etc. This will act as a fuel sources. These factors form a quite flammable fabric and symbolize the perfect context for fire explosion tiers of the fire. The furnace explosion brought on by means of human beings like smoking or barbeque parties and high temperature in a hot summer season day, or a damaged glass working as a collective lens focusing the sun light on a small spot for a length of time as a consequence leading to fireplace ignition. Once ignition begins then the flammable fabric may also without problems fuel to feed the hearth central spot. The spot then will become bigger and wider. two The preliminary stage of ignition is generally referred to as 'surface fire' stage. This may also then lead to feed on adjoining bushes and the fire flame will become higher and greater accordingly turning into 'crown fire'. Mostly at this stage the hearth turns into uncontrollable and injury to the panorama might also turn out to be immoderate that could remaining for a very long time relying on prevailing climate conditions and the terrain.

It is a large region and it produces more carbon monoxide than the standard vehicle traffic. Monitoring of the plausible danger areas and an early detection of fireplace can appreciably shorten the response time and additionally decrease the practicable injury as nicely as the fee of firefighting. Known rule applies here: 1 minute – 1 cup of water, 2 minutes - 100 liters of water, 10 minutes - 1000 liters of water. The goal is to notice the fireplace as quicker as possible, its actual localization and early notification to the fire devices [12].

III. IMPLEMENTATION MODEL & RESULT

Forest fire detection and hindrance is another actual downside confronted in big variety of nations. totally different techniques for observance the emergence of fires are initiated. The first methods were based on manned observation towers but this system accustomed be inefficient and conditionally effective. afterward, camera police work structures and satellite imaging technologies were tried however this to boot established ineffective at having the ability to with efficiency monitor the initial begin of the ground fireplace. as an example, camera networks is connected in specific positions within the forests but these offer entirely line of sight pix and these could also be plagued by mistreatment climate state of affairs and/or bodily obstacles. Satellite photos have established further economical than camera police work, the place photos gathered through 2 satellites, the advanced terribly excessive resolution meter AVHRR), MODIS, are used [13]. The satellites can grant pics of the areas of the earth each two days and that is a long time for fireplace scanning, barring the high-quality of satellite photos can be affected with the aid of the climate condition.. [14]

In this working model we introduced the remote monitoring method for preventing forest fire based on FFDA (Forest Fire Detection Algorithm) sensing the threshold value is identified automatically intimate to the authorized person to take action and prevent the forest fire. The architecture diagram shows below for forest fire monitoring and preventing system over Internet of Things.

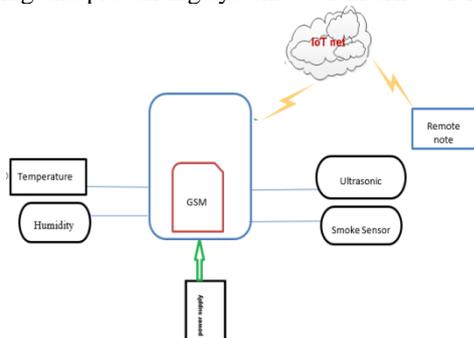


Fig 3. Monitoring forest fire using IoT

Working of this model can be described in following steps. They are:

Sensors serving as Data Centre, Temperature sensor and smoke sensor are working for the requirement of certain distances. The certain forest place in order to notice the temperature and the threshold value of carbon dioxide gas (CO₂). These sensors will send the signal to the microcontroller. These sequence are helpful for adjustments in the surroundings and react automatically in the occurrence of an emergency. The innovation in computerized initiating devices using ultrasonic to analyze the visible effect of fire happens in the forest. The flame sensors are to be recognized in realistic state of affairs that are wanted to be placed at measure distances so that a seem can be saved on the complete forest area.

Transmission of the data by means of the transmitter:

On accepting the records from the controller, transmitter transmits the statistics to a unique vary where the collector station is superior to be utilized. Microcontroller is the focal piece of the tools circuit; it controls and empowers the working of the complete circuit, right here transmitter circuit

for this situation. receiving of the facts by means of the receiving station:

On receiving the records from the transmitter circuit, the receiver sends the data to the controller IC of the attached arduino embedded in the receiver circuit in digital form making the controller feasible to do the programmed moves for the monitoring of temperature level and CO₂ degree for fire detection.

Display of the ranges of temperature and CO₂ level in accessible through domestically created network:

When the records involving the temperature and the CO₂ degree are processed in the IC of the receiver circuits Arduino which is programmed with one-of-a-kind library features of the Ethernet protect interfacing making it viable to create message in the domestically created community naming -Fire Security model via the help of router.. The network gives a framework (IP) stack organized for both TCP and UDP. Arduino Ethernet Shield to accesses arduino to the internet . When the degrees of the temperature will go the preset value(threshold) the sensor with GSM will supplied the information.

Stages of Designing:- The whole designing of this IoT enabled forest fire detection and monitoring system has been mainly detection using FFDA algorithm.

Algorithm FDPA(Forest Fire detection algorithm):

```

Start with t check the parameter t & h;
Start with t check the parameter s & u;
if (t == th)
{
  if t has reached v3
    check ( u && s)
    send the information to l1 through g
  else if check v2 && u if satisfied
    send information to l2 through g
  else check v3 && u
    send information to l3 through g
}

```

using the FFDA algorithm we can easy identify the fire is going to happen based on the parameter value, take prevent action based on the value the automatic sends the generated message through GSM to authorized person to take prevent action to stop fire in the forest. Each and every information about the forest weather identification and monitor the forest using the four parameter continuously for prevent forest fire in the real time environment. Humidity is identifying how for fire can spread over the forest, for calculating speed of fire we are using humidity sensor to identify the air quality and humidity measure for reach fire over the areas.

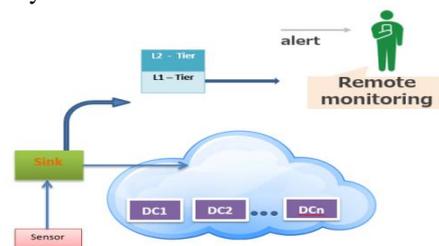


Fig 4. Frame work for prevent and monitoring

Preventing And Monitoring Of Framework For Forest Fire Detection And Data Analysis Using Internet Of Things (Iot)

The frame work diagram for sending a data through sensor node to sink node is shown in the above fig.3.This also depicted the path between the client node to IoT . The accrued statistics from the sensor node is analyzed and detect of forest fire. If the analyzed data reached the threshold value, then the intimation will be dispatch to take action for prevent the forest fire. The action taken will be based on different tiers. If the threshold value is between 80% to 85% it is considered to be level 3. If the threshold value is between 86% to 90% it is considered to be level 2. If the threshold value reaches 100% it is considered to level 1. Based on levels the intimation will be sent to the appropriate person to take the necessary action to prevent the fire.

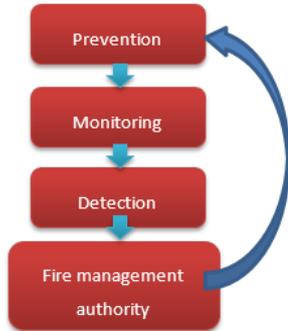


Fig.5: Forest fire prevention and monitoring

The forest fire detection monitoring and prevention life cycle mechanism to analyze the data with some delay and to check their parameter data value compared with the threshold value. If it reach it manage and prevention action based on the forest fire management and its methodology to prevent the fire.

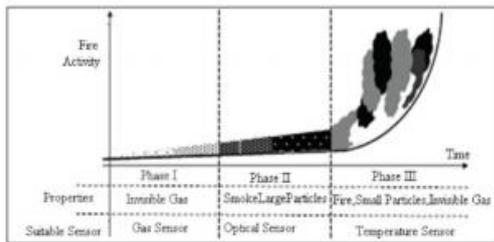


Figure 6: Fire formation phase digram

Phase i: smoke sensor for sensing Invisible Gases

Phase ii: smoke and ultrasonic sensor sensing for large carbon particals and measuring distance.

Phase iii: Temperature and humidity sensor

Table1. Showing the status state over the last ten years' forest fire effected and estimated cost in year wise as shown below.

Year	No. of Fire Cases Reported	Total Area Effected (in ha)	Estimated Loss (Rs.)
2008-09	571	6,583.12	60,04,705
2009-10	1806	24,849.52	2,55,13,928
2010-11	872	7,847.63	97,29,363
2011-12	164	1,558.15	43,00,078
2012-13	1768	20,752.65	2,76,71,583
2013-14	397	3,237.52	52,11,021
2014-15	722	6,726.40	1,13,26,522
2015-16	662	5,963.95	1,25,62,872
2016-17	1749	19,162.69	3,27,76,325
2017-18	676	4,686.67	55,21,092

The below graph is showing the state over last ten years due to forest fire report in all over the India to loss of Estimated cost.

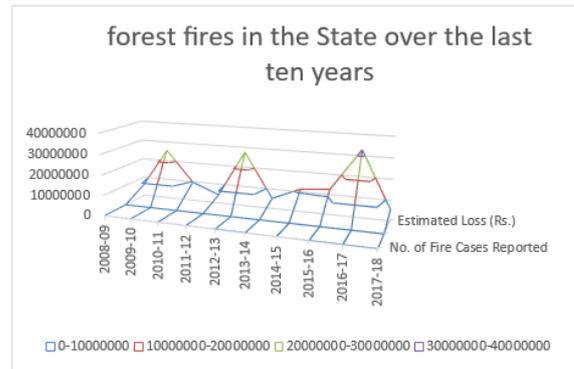


Fig.5 state over forest fire report

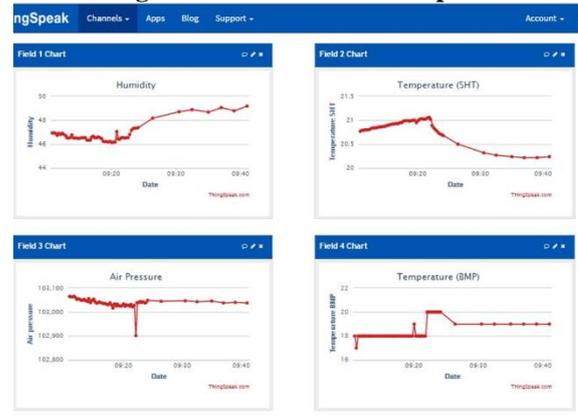


Fig 6. Monitoring humidity and temperature in IoT

IV. CONCLUSION

The work is to design the model to predict and monitoring the forest fire at the time of disaster. In this proposed design, we had designed a framework for data processing and authorizing the level for taking the prevention measure as shown in architecture model fig.3. This framework model gets the data and controlled using system. Then the data is monitored through IoT cloud center. Further if the sensor data reaches the threshold value it send the information to the authorized person to take prevention Of fire. The proposed algorithm called FFDA monitor the threshold value and intimate the authorized person. The developed system has many scope that can be improved to take performance analysis of different strategy viz. temperature, humidity, smoke and ultrasonic. The result obtained helps us in making the decision by differentiating between peaceful fire and potential dangerous fire which require immediate reaction.

REFERENCE

- Zhou, Gouqing,. "Unmanned aerial vehicle (UAV) real-time video registration for forest fire monitoring." Geoscience and Remote Sensing Symposium,2005. IGARSS'05. Proceedings. 2005 IEEE International. Vol. 3. IEEE, 2005.
- Li Da Xu, Senior Member, IEEE, Wu He, and Shancang Li, "Internet of Things in Industries: A Survey", IEEE Transactions On Industrial Informatics, Vol. 10, No. 4, November 2014



3. Liao, Wen-Hwa, Yucheng Kao, and Ying-Shan Li. "A sensor deployment approach using glow worm swarm optimization algorithm in wireless sensor networks." *Expert Systems with Applications* 38.10 (2011): 12180–12188.
4. Doolin, D., M., Sitar, N., *Wireless Sensor Nodes for Wildfire Monitoring in SPIE Symposium on Smart Structures and Materials*. 2006: San Diego.
5. Buratti, C., et al., *An Overview on Wireless Sensor Networks Technology and Evolution*. *Sensors*, 2009. 9(9): p. 6869.
6. V.Parthipan, D.Dhanasekaran "A framework for IoT analytics based on visualization in cloud environments towards forest fire detection and prevention" *international journal of pure and applied mathematics* volume 116 no. 23 2017, 161-167
7. Den breejen, E., breuers, M., Cremer, F., kemp, R.,Roos, M., Schutte, K. and De vries, J.S. (1998) *Autonomous forest fire detection*. In *Proceedings of the Third International Conference on Forest Fire Research and the Fourteenth Conference on Fire and Forest Meteorology*, Luso, Portugal, 16–20 November 1998, 2003–2012.
8. Hartung, C., Han, R., *Fire WxNet: A Multi Environments*, in *4th International Conference of Mobile Systems, Applications and Services*. 2006. p. 28
9. Viegas, D.). "Fire Behaviour and Fire line Safety." *Annual Mediterranean Burns Club*6(3).
10. Scott, J. H. (2012). *Introduction to Wildfire Behaviour Modeling*. National Interagency Fuels, Fire, &Vegetation Technology Wild Fire Management RD&A: 7-15.
11. https://himachal.nic.in/WriteReadData/1892s/172_1892s/5-54447247.pdf
12. R. Chandrasekharan, Ashiq M.I, Dr. V. Prakash " Forest Fire Detection using Temperature Sensors Powered by Tree and Auto Alarming using GSM "Volume II , March 2015
13. "Email Statistics Report, 2015-2019" The Radicati Group, Inc. A Technology Market Research Firm Palo Alto, Ca, USA.
14. The Advanced Very High Resolution Radiometer (AVHRR) [cited jul/ 2011]; Available from:
15. Son, B., A Design and Implementation of forest fires surveillance System Based on Wireless Sensor Network *International Journal of Computer Science and Network Security*, 2006. 6: p. 124
16. Fabrice Anon, Vijith Navarathinasah, Chung-Hornq "Building a Framework for Internet of Things and Cloud Computing", 2014 IEEE International Conference on Internet of Things .
17. Julien Mineraud, Oleksiy Mazhelis, Xiang Su, Sasu Tarkoma,"A gap analysis of Internet-of-Things platforms",2015
18. "Big Data Analytics in Future Internet of Things", White paper Internet of Things 2015.
19. Lihong Jiang, Li Da Xu, Senior Member, IEEE, , "An IoT-Oriented Data Storage Framework in Cloud Computing Platform", *IEEE Transactions On Industrial Informatics*, Vol. 10, No. 2, May 2014.