A System to Detect Forest Fire using Optimized Solar Energy

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***Abstract*—Forests are considered to be one amongst the most supreme and indispensable resource. Although the world is advancing day by day, it is not possible to sustain in a world without a balanced environment. For a balanced environment, forests play a vital role. Therefore, the aim of this project is to detect forest fires and alert the forest officials whenever there is an outbreak of fire. IOT devices along with sensors help to monitor environment parameters like smoke, temperature, humidity and flame. A forest fire detecting system is formed by interfacing Arduino UNO with a DHT sensor, a smoke sensor and a flame sensor. DHT11 sensor, smoke sensor, flame sensor and buzzer are given as input to the arduino and output of the arduino is connected to the LCD display. Whenever the environmental parameters exceed the threshold values in the sensors, fire is detected and temperature, humidity and smoke values are displayed on LCD and a buzzer is rung. When fire is detected, a caution message is sent to the concerned officials through the registered mobile number using GSM. The whole system works using solar energy as it is a vast source of energy in the forests. This solar energy is stored in the battery and used for the operation of the whole system. This system detects forest fire as early as possible and is energy efficient in a distributed environment and also efficient in performance.**

Keywords: Arduino, GSM module, Sensors, Solar energy

I. INTRODUCTION

Forests are essential to all life forms on earth. Approximately 30% of the world's land is covered by forests. The importance of forests can never be underestimated. Many life forms depend on forests for survival. Forests provide shelter for animals and livelihoods for humans, forests also offer watershed protection, prevent soil erosion and mitigate climate change.

Forest fire can be described as any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra which consumes the natural fuels and spreads based on environmental conditions, owns big risk not just to the wealth of forest but also destroys forests and its surrounding areas. Forest fires destroy the natural habitat of animals and birds and also results in the death of animals due to fire thus diversely affecting the biodiversity. These forest fires results in the destruction of vegetation, on atmospheric pollution, and directly on human lives. The number of forest fires and its impacts are expected to grow as a result of global warming.

Early detection helps minimize the damages of forest fire hazards. Satellite based remote sensing technology is more frequently used method for detecting fire but the disadvantage of satellite based fire detection is its long duration of scanning and also low resolution whereas WSNs can detect fire in real time and instantly as compared to the satellite based technique.

Wireless sensor networks refer to sensor networks that are used in recording and monitoring the physical conditions of the environment. WSNs can measure environmental conditions such as temperature, sound, pollution level, smoke and humidity.

II. LITERATURE REVIEW

[1] This paper reviews on the various aspects of security, range of application, characteristics of the wireless sensor network. At present, with the advancement of internet of things, there is rapid development of wireless sensor network in the area of communication technology and sensor technology. Therefore the range of application in wireless sensors will also increases deeply. As a result of basic service of security, the security management will seek more importance. The key technology used in the security of wireless sensor network like Node security optimization technology and Data security fusion technology is briefed.

[2] The idea is to develop a model that includes combination of multiple sensors for the detection of fire and also communicate with the nearest authorized centre regarding the crisis. This system also includes the connection to nearest pond and water pipelines around the forest to extract

water to minimize the further destruction. Another part of approach is to carry water to the area where fire is initiated using unmanned aerial vehicles. The aim of the ideology is the early determination of forest fire in order to avoid property loss and protect the rare species, also to determine the fire locations with the help of particular sensor data.

[3] To prevent fault data injection attacks in wireless sensor networks, this paper proposed an idea based on correlation theory to identify the malicious nodes present. Firstly, based on time correlation the similar sensor data type is used. Secondly, using spatial correlation infected nodes are identified. Lastly, based on event correlation, the verification of recognized malicious node is done. The paper focuses false data injection attacks, where attackers change node detection and system by injecting inappropriate information. Hence it can be said that it is very important to detect such type of attacks in wireless sensor network.

[4] The paper is based on wireless sensor network framework in order to continuously monitor and for the fire detection in real time by using various types of sensors. Various sensors include temperature, humidity sensors integrated with the infrared camera sensor for surveillance. This proposed system aims to notify fire detection faster than any other conventional approaches by using specification like temperature, gaseous contents in the atmosphere.

[5] A system to detect forest fires, by use of a network of wireless sensors and info fusion methods. The older detection system contained satellite based systems. But these systems not efficient due to different reasons, such as high infrastructure and high expenses, real-time monitoring systems are required, when the fire is detected, the speed it spreads is uncontrollable and levels of loss is high. a fire detection system for forest fires is proposed in the paper where in its base stage, using a sensor network. The main part of this work is the implement a low-computational and low complexity algorithm, which has the capability to detect fire using only the data from two sensors like temperature and humidity.

[6] A method for managing and detecting fire with combined technology. Forest fires are very common that could be a very big disaster to the surroundings and life. So as to guard these and measures have to be taken early to regulate the spreading fire. Typically it needs huge dependency of man power, transportation facility and insulating material to trace true space can results in delay. Through this search gave answer for this by implementation the IOT sensor technology. Fluctuation is detected by sensors where it observed within the temperature and wetness by using Node MCU small controller that is additionally a Wi-Fi module sending these values to the information to cloud.

[7] A style to develop a Arduino based IOT enabled fire detecting and observation system for solution to the forest fire. In this project, fire detector by Arduino that is interfaced with few sensors. GSM is employed to produce the send message to the user through a particular range. The sensing element values area unit showed within the display.

[8] A system that is depending on different sensors together to that and therefore the information from these wireless transmission, to fulfill the of fire detection. The paper tells the important features of wireless sensing element networks as a probable answer to the early detection of forest fires challenge. The system mentioned uses varied sensors hooked up and information transmission through wireless means, to satisfy the activity. These information that are gathered are unit sent to the tiny satellite that keeps on transmitting them to the ground station and that they are unit analyze.

[9] An article about working of a system based on far infrared sensor having narrow beam. This infrared sensor can identify fire and its location. Therefore it can detect forest fires. This system can be externally connected to sprinklers to extinguish forest fire. The main motive of this project was to design a system which can protect outlying hamlets, camping grounds etc.

[10] An IOT based system which detects forest fires and sends the exact place of forest fire to the officials using GSM. Thus knowing the exact location of fire helps in early extinguishing of forest fire and saving the rest of the forest part from forest fire. By these large destruction in forests can be reduced and ecosystem can be maintained.

III. METHODOLOGY

Usually temperature and humidity values exhibit a cyclic conduct during the different stages of the day but during fire, temperature increases rapidly thus decreasing humidity. This system therefore helps in monitoring such variations in the environment and alerting the officials in case of forest fire.

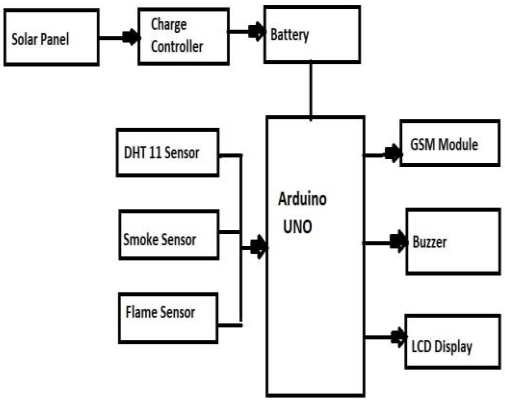

Fig 1: Block diagram

As shown in the block diagram, this system consist of GSM module, flame sensor, smoke sensor, DHT sensor, buzzer, solar panel, charge controller, 12V battery, LCD and display. In this project we are using Arduino program in

which we predefine the rated values of sensors and this project uses sensors for monitoring the weather conditions [4]. This system works in different phases. In the initial phase analog data is converted to digital data using sensors. The sensors continuously read the variables like temperature, humidity, flame intensity and air quality [5]. In case forest fire occurs, the starting stage of fire is temperature increase and humidity decrease. When temperature increases beyond threshold value, it is displayed on the LCD. Also flame and smoke are created and when smoke and flame value exceeds the rated value, it will be displayed on LCD and buzzer will automatically becomes on. Arduino contrasts the sensor values with the predefined threshold values at regular time period . On comparing, if the input value of sensors exceeds the threshold, then information is transmitted which is the next phase of operation. In the next phase, an alert message saying forest fire detected will be sent to registered phone numbers of forest officials through GSM. In this way the message flow is regulated in this model. Solar panels are used to harvest solar energy. This system works using electrical energy obtained from solar energy [11]. Excess solar energy converted to electrical energy is stored in battery which is utilized during night time for the system to operate. Excess solar energy harvested is converted to electrical energy and stored in battery which is utilized during night time for the system to operate.

IV. RESULT

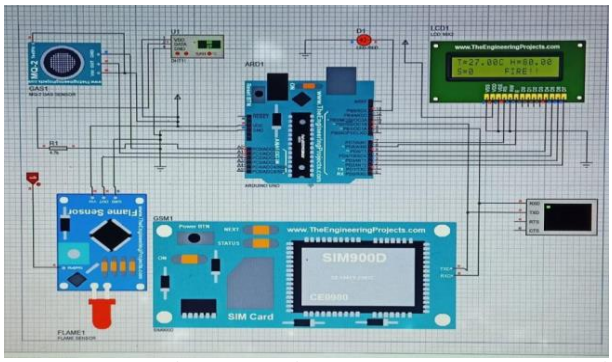

Fig 2: Simulation of sensors interfaced with Arduino in the absence of forest fire.

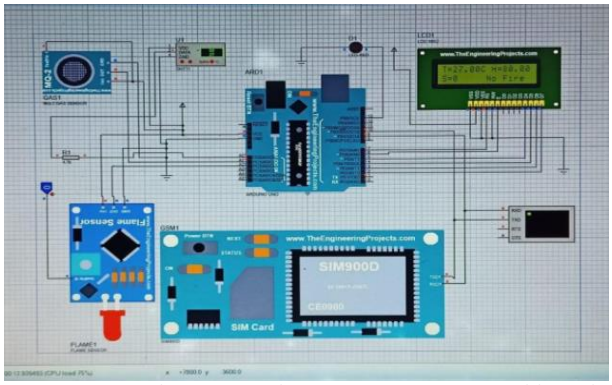

Fig 3: Simulation of sensors interfaced with Arduino in case of forest fire.

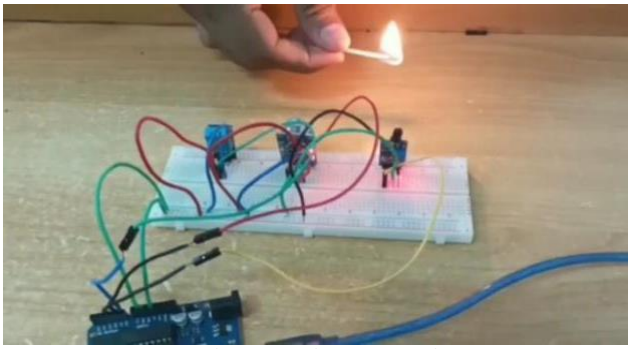

Fig 4: Demonstration of working of sensors interfaced with Arduino in case of fire.

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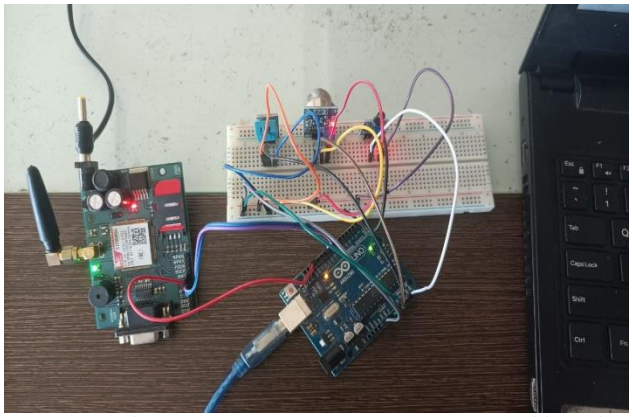

Fig 5: Output of hardware setup in the absence and presence of forest fire.

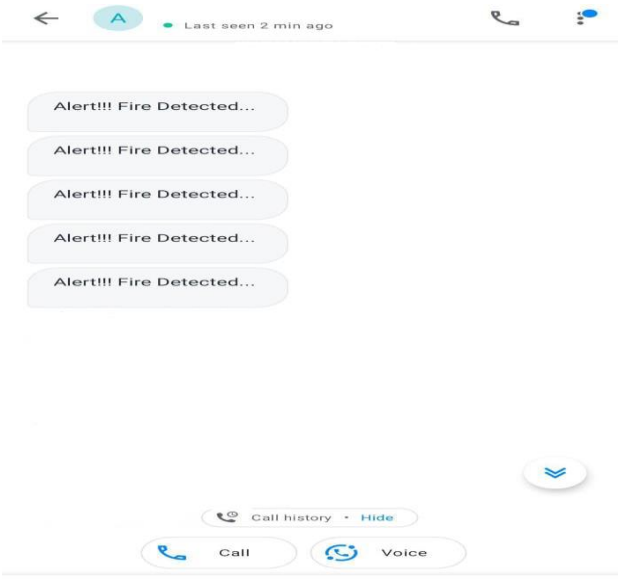

Fig 6: Hardware setup of arduino interfaced with sensors and GSM.

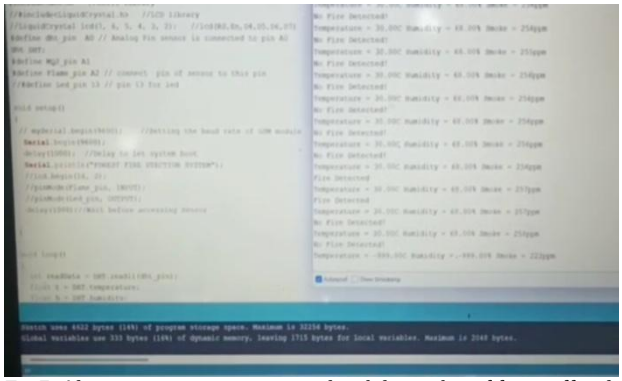

Fig 7: Alert message sent to registered mobile number of forest official.

V. CONCLUSION

This project aims on providing early fire detection based on several parameters like temperature, smoke contents, humidity using wireless sensors and also alert the forest authorities. The implementation of this system in areas where the fire occurrence is high will significantly reduce the reaction time and also minimize the damage which may occur. This system is energy efficient in distributed environment and also efficient in performance. By controlling the fire we can also protect the rare species of flora and fauna. Continuous monitoring of forest by this system will surely reduce manual work by obtaining the required information. Cost of setting up the proposed methodology is negligible when compared with the loss of forests. Hence it can be concluded that using this system we can detect the fire early which will be helpful in avoiding further destruction in order to save the forest and maintain balanced environment.

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REFERENCES

[1] Zhang Huanan, Xing Suping and Wang Jiannan," Security and application of wireless sensor network, "Procedia Computer Science, Volume 183,2021, Pages 486-492, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2021.02.088.

[2] V. r. Karumanchi, S. H. Raju, S. Kavitha, V. L. Lalitha and S. V. Krishna, "Fully Smart fire detection and prevention in the authorized forests," 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), 2021, pp. 573-579, doi: 10.1109/ICAIS50930.2021.9395969.

[3] Yingxu Lai, Liyao Tong, Jing Liu, Yipeng Wang, Tong Tang, Zijian Zhao and Hua Qin, "Identifying malicious nodes in wireless sensor networks based on correlation detection," Computers & Security, Volume 113, 2022,102540, ISSN 0167-4048.

[4] D. Arjun and A. Hanumanthaiah, "Wireless Sensor Network Framework for Early Detection and Warning of Forest Fire," 2020 International Conference on Inventive Computation Technologies, 2020, pp. 186-191, doi: 10.1109/ICICT48043.2020.9112389.

[5] Noel Varela, Díaz -Martinez Jorge L, Adalberto Ospino and Nelson Alberto Lizardo Zelaya, "Wireless sensor network for forest fire detection", Procedia Computer Science, Volume 175, 2020, Pages 435-440, ISSN 1877-0509,https://doi.org/10.1016/j.procs.2020.07.061.

[6] Deepthi S, Shushma G Krishna, Sahana K B, Vandana H R and Latha M, "IOT Enabled Forest Fire Detection and Management," International Journal of Engineering Research & Technology (IJERT) IETE, 2020.

[7] P .Malarvizhi, G. Gajendran, R .Mahalakshmi, S Sarathkumar and K .Vigneshwaran," Smart forest fire detection system based on optimized solar energy using Arduino with source of tank water," International Journal of Research in Electrical Engineering (IJREE),ISSN No: 2349-2503, Volume 07, Issue 01, 2020.

[8] A. Divya, T. Kavithanjali and P. Dharshini, "IoT Enabled Forest Fire Detection and Early Warning System," 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN),2019,pp.15,doi:10.1109/ICSCAN.2019.8878808.
Dept. of ECE, MITE, Moodabidri 2021-22

[9] M. Antunes, L. M. Ferreira, C. Viegas, A. P. Coimbra and A. T. de Almeida, "Low-Cost System for Early Detection and Deployment of Countermeasures Against Wild Fires," 2019 IEEE 5th World Forum on Internet of Things (WF-IoT), 2019, pp. 418-423,doi: 10.1109/WF-IoT.2019.8767331.

[10] K. Jayaram, K. Janani, R. Jeyaguru, R. Kumaresh and N. Muralidharan, "Forest Fire Alerting System With GPS Co-ordinates Using IoT," 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), 2019, pp. 488-491, doi: 10.1109/ICACCS.2019.8728383.

[11] T. Saikumar and P. Sriramya, "IOT Enabled Forest Fire Detection and Altering the Authorities," International Journal of Recent Technology and Engineering (IJRTE), ISSN: *2277*-3878, Volume-7, Issue-6S4, April 2019.

[12] Vinod Channappa Sajjan, Lavanya B, Premsagar G, Rashmi S Hugar and Dr. L. Sanjeev Kumar, "Solar Powered Forest Fire Detection and Mitigation," International Journal of Innovations in Engineering and Technology (IJIET), ISSN: 2319-1058, Volume 12, Issue 4, March 2019.

[13] Rupali Mahajan, Akanksha Yadav, Divya Priya Baghel, Neha Chauhan, Kajal Sharma and Anuj Sharma, "Forest Fire Detection System using GSM Module," International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, Volume 06, Issue 08, Aug 2019.

[14] Chaitali Tikhe, Nimisha Rail, "Solar powered wireless forest fire detection", April 2018. International Journal of Advanced Research in Computer and Communication Engineering, ISSN: 2278-1021, Volume 7, Issue 4.

[15] A. S. Chand, K. S. Bhargavi, R. S. Kiran, M. K. Kaushik, D. R. Prashanthi and S. S. Kumar, "SAMRAKSHA : Developing a real-time and automatic early warning system for forest fire," 2018 International Conference on Circuits and Systems in Digital Enterprise Technology (ICCSDET), 2018, pp. 1-4, doi: 10.1109/ICCSDET.2018.8821124.