



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com



Zigbee Based Analysis of Solar Powered Forest Fire Detection and Control System

Hrutika Tanpure¹, Nupur Talekar², Anushka Shelke³, Prathmesh Galande⁴, Mrs.S.S.Gite⁵

U.G. Student, Department of Electronics and Telecommunication Engineering, Amrutvahini College Of Engineering, Sangamner, Maharashtra, India^{1,2,3,4}

Assistant Professor, Department of Electronics and Telecommunication Engineering, Amrutvahini College Of Engineering, Sangamner, Maharashtra, India⁵

ABSTRACT: Forest fires are significant disasters that can cause severe environmental impacts making their early detection vital. To address the limitations of existing technologies such as MODIS and basic wireless sensor network-based forest fire detection systems, an advanced system has been developed. The project consists of two main modules, the monitoring area module and the forest area module, which are subdivided into five sub-modules for systematic development and implementation. These sub-modules include the sensors module, serial communication module that utilizes the Zigbee, an Optimized Solar Energy Harvester using Maximum Power Point Tracking(MPPT), a PC-based web server and mechanical modeling. The forest area module's first three sub-modules are integrated and mechanically modeled for placement within the forest, while the PC-based Web Server is developed for the monitoring area.

The system's outcome reveals that incorporating various sensors in addition to the temperature sensor enhances the security level of the areas close to the forest. The optimized solar energy harvester, utilizing MPPT increases the efficiency by approximately 85%, which is crucial for systems operating in remote areas with limited power access. The PC-based webserver decreases the bulkiness of the system and cost making it more practical and cost-effective. Overall, this system presents a well-designed solution to address the challenges of detecting forest fires early and its outcomes demonstrate its effectiveness.

KEYWORDS: ZigBee, Pic18f4520, Fire Sensor, Gas Sensor, LM35 Sensor.

I. INTRODUCTION

Forests are essential resources for human survival and social development, preserving the ecological balance of the earth. However, human activities and abnormal natural conditions have resulted in frequent, uncontrolled forest fires. These fires pose a serious threat to forest resources and the environment. The incidence of forest fires has increased significantly in recent years, primarily due to climate change and human activities. Prevention and monitoring of forest fires have become a global concern for forest fire prevention organizations. Currently, forest fire prevention methods mainly involve patrols, observations from watch-towers, Satellite monitoring and wireless sensor network. Observation from watch towers is an easy and feasible method, but it has several shortcomings. Firstly, it requires a substantial amount of financial and material resources as well as trained labor. Secondly, there are several issues with fire protection personnel such as carelessness, absence from the post, inability to real-time monitoring and limited area coverage.

II. RELATED WORK

The forest fires have become a significant problem in recent times and various methods have been proposed for their detection. However, most existing methods suffer from limitations such as inadequate monitoring of dynamic changes in temperature and smoke concentration, resulting in real-time performance. Forest fires can be caused by natural factors such as lightning and extreme weather conditions or human factors such as carelessness or deliberate act of the person. The frequency of forest fires has increased considerably in recent years, attributed to various factors including climate change and human activities[1]. Based on forecasts, wildfires which also include intentional fires in tropical



rainforests are projected to reduce the global forest stand by half by 2030 [2]. Europe experiences the destruction of up to 10,000 km² of vegetation annually due to fires while North America and Russia face losses of up to 100,000 km². Wildfires contribute to around 20% of CO₂ emissions in the atmosphere. By Ref[3], Samants suggests a forest fire detection system using a mesh sensor network. The system includes temperature, humidity, light and CO₂ sensors and communication occurs with Zigbee technology. Moving nodes are deployed on the belts of forest animals and when they come in the range of stationery Zigbee wireless nodes data is collected and sent to the cloud for analysis.

III. METHODOLOGY

An installed fire sensor can identify forest fires. The sensor has three terminals and is located in a transmitting module within the forest. Two of these terminals are for power supply, with one serving as a ground connection and the other as a voltage source of +5V. The final terminal is an output pin, and when a fire is detected, it will go high. This pin is connected to a digital input pin on an Arduino UNO board that has been configured to read the signal from the sensor. If a fire occurs, the fire sensor's digital output pin will become a logic HIGH signal, which the Arduino UNO will detect. When the Arduino UNO detects a fire, it sends a fire message over a ZigBee wireless sensor network. The ZigBee module on the Arduino UNO is configured as a transmitter and will send the message through its serial communication Rx and Tx pins. The message will be transmitted to a remote ZigBee module, located in the forest office surroundings, which is far away from the transmitter ZigBee module.

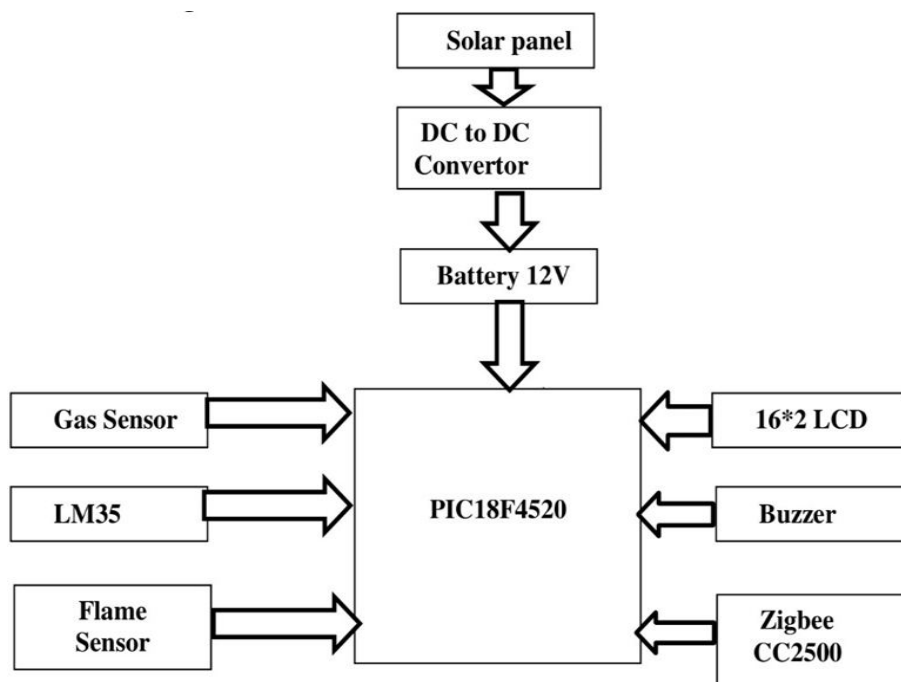


Fig1. TRANSMITTER END MODULE

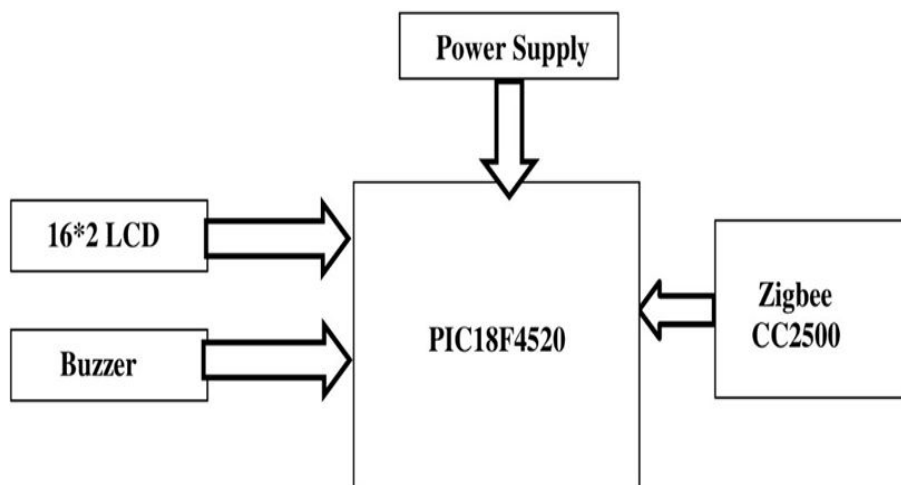


Fig. 2:RECEIVER END MODULE

A solar panel powers the distant ZigBee receiver, which is amplified via a boost converter. Solar photovoltaic modules absorb sunlight as a source of energy to generate electricity, with their DC output power rated under standard test conditions ranging from 100 to 365 W. Capacitor filters are employed on the output and input sides of the boost converter to reduce voltage ripples. The boost converter functions as a charge or battery regulator, regulating the rate at which electricity is added to or extracted from batteries. A lead-acid battery is used to prevent overcharging and deep draining, which can degrade battery performance and longevity and constitute a safety issue. This battery type has a greater cell voltage and is less expensive. The remote ZigBee receiver is connected to an Arduino Nano and will receive messages from a ZigBee transmitter. The received message will be transmitted to the Arduino Nano through serial communication pins via the ZigBee receiver. The control system will activate after receiving the message, and the water in the lake will be sprinkled on the forest fire using all available control arrangements.

Software Development:

SOFTWARE REQUIREMENT:

- MPLAB IDE 8.91
- EMBEDDED C LANGUAGE
- PIC KIT3 PROGRAMMER
- PCB WIZARD (LAYOUT)
- PROTEL SE 99 (CIRCUIT DIA.)

PIC is a family of microcontrollers manufactured by Microchip Technology Inc. PIC stands for Peripheral Interface Controller. It is also referred to as Programmable Interface Controller or Programmable Intelligent Computer.



Microchip Technology Inc. produces a range of microcontrollers known as PIC, which stands for Peripheral Interface Controller, Programmable Interface Controller, or Programmable Intelligent Computer. While it is possible to program PIC Microcontrollers using Assembly Language, High Level Languages are preferred due to their ease of use. Several high level language compilers are available for PIC Microcontroller programming, including MikroC, MPLAB XC8, Hi-Tech C, and CCS C. For this tutorial, CCS C Compiler will be used. CCS C is a tool solutions company for Microchip PIC Microcontrollers. MikroC and CCS C are highly recommended for beginners as they include numerous built-in libraries that simplify PIC Microcontroller programming without in-depth knowledge of its internal architecture. CCS C is the best High Level Language Compiler for PIC Microcontroller since it is almost hardware independent.

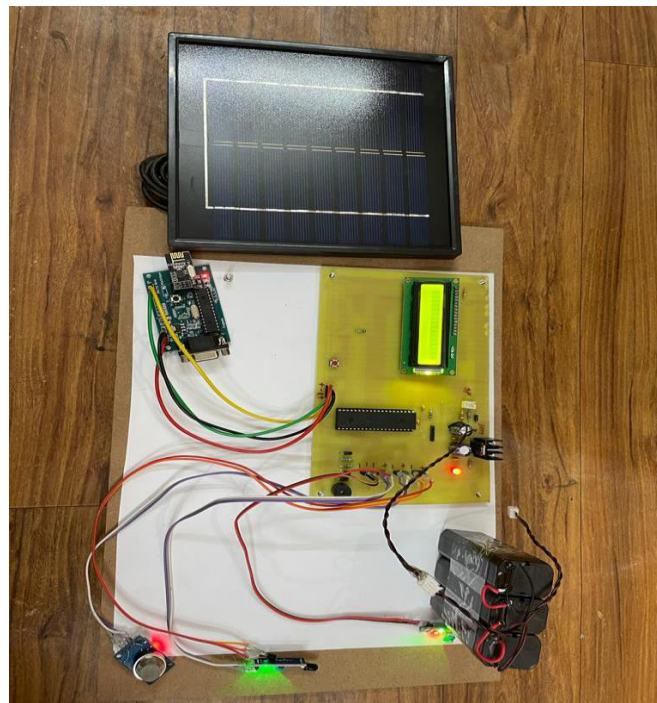


Fig 3. TRANSMITTER END MODULE

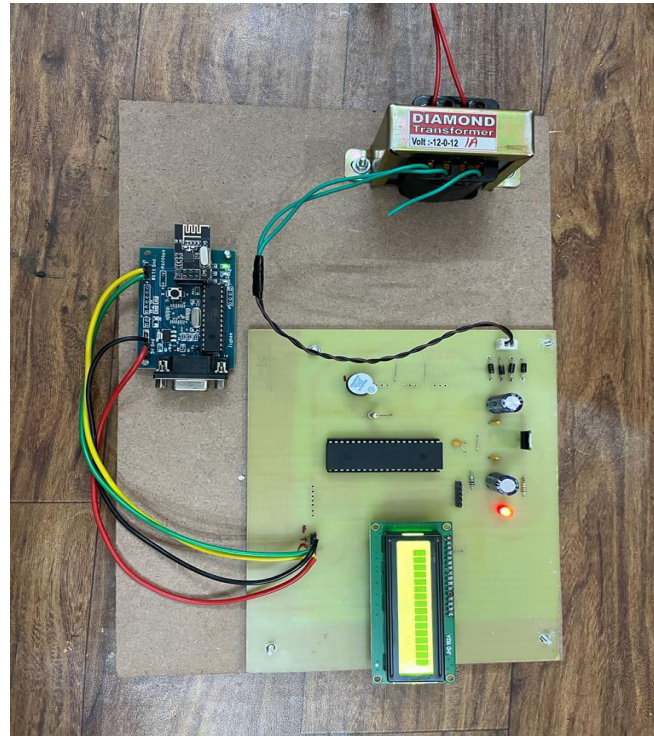


Fig 4. RECEIVER ENDMODULE

IV. EXPERIMENTAL RESULT

RESULT TABLE

Sr.no	Sensors	Normal Condition	After Fire Detection
1	Fire Sensor	Logical 0	Logical 1
2	Humidity Sensor	30%	56%-58%
3	Temperature sensor	35 C	50 C
4	Gas Sensor	25%	43%



V. CONCLUSION

This project outlines the development and implementation of a forest fire detection system that utilizes ZigBee wireless sensor networks and Arduino. The system's design can be applied to various other scenarios such as smart waste management, hospitals, malls, and theaters. Its purpose is to address the drawbacks of existing forest fire protection systems. Due to its accuracy, the system can be scaled up and further enhanced. Incorporating higher versions of ZigBee and solar modules can boost the system's efficiency.

REFERENCES

- [1] Forest Fire Detection Using Optimized Solar – Powered Zigbee Wireless Sensor Networks U. Arun Ganesh, M. Anand, S. Arun, M. Dinesh, P. Gunaseelan and R. Karthik. International Journal of Scientific & Engineering Research, Volume 4, Issue 6, June-2013 586 ISSN 2229-5518
- [2] Forest Fire Detection Using Optimized Solar Powered Wireless Sensor Networks Pallavi C. Jamdhade¹, Ashwini D. Kawate², Shital S. Lachake³, Abdal A. Shaikh⁴, Prof. S. M. More⁵, Ms. Rajashree S. Kadam⁶ Department Of Electrical Engineering, Organization Name: Guru Gobind Singh Polytechnic, Nashik (India)- 2018
- [3] Forest Fire Monitoring System Based On ZIG-BEE Wireless Sensor Network P.S. Jadhav¹, V.U. Deshmukh² 1PG Student, 2Assistant Professor, Vidya Pratishthans College of Engineering, Baramati, Pune University. International Journal of Emerging Technology and Advanced Engineering – Dec 2012 Yassin M. Y. Hasan and Lina J. Karam, "Morphological Text Extraction from Images", IEEE Transactions On Image Processing, vol. 9, No. 11, 2000
- [4] Samantha S. An architecture of future forest fire detection system. International Journal on Recent and Innovation Trends in Computing and Communication. 2016; 4(8), 139-140.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details