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Wildfire Surveillance System for Peat Soil Area

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Abstract: The purpose of this project is to develop a Wildfire surveillance system for peat soil areas using Internet of Things (IoT) and smart systems. The system will use microcontrollers and sensors to collect and evaluate data such as temperature and smoke presence, and a GSM module will be used to transmit this data to the user. The Blynk application will serve as the main interface for the user to access this information and take action to respond to the wildfire. The goal is to commercialize the prototype and use it as a tool for wildfire prevention and conservation.

Keywords: Wildfire, Internet of Things (IoT), Blynk, Peat Soil, Microcontroller.

1. Introduction

This project aimed at developing a surveillance system to prevent wildfires, specifically in peat soil forests. Wildfires in peat soil forests are a significant problem, particularly in Southeast Asian countries, and are often caused by transmission line faults. These fires can be particularly difficult to control and can lead to significant losses of valuable flora and fauna. Peatlands are the most high-risk wildfire area since the fire will be long-lasting and require a lot of time and cost to put out the fire.

The proposed surveillance system would consist of 18 watts solar panel as a main energy source, heat,humidity,flame and smoke sensors that are attached to collect the real-time data of the soil and the data will be processed by the microcontroller. The microcontroller is responsible for processing the data and sending it to the user via a GSM module, which uses GPRS technology, and linked with a mobile application. By having a surveillance system in place, the risk of wildfires can be reduced, as the source of the fire can be detected early, and the fire department can act more quickly. This can help to reduce the loss of valuable flora and fauna in the forest.

Overall, the project is focused on the surveillance system to prevent wildfire, especially in peat soil forests. The project can be implemented in the reserved forest which contains a lot of valuable flora and fauna. By placing a surveillance system in the forest, wildfire risk can be reduced since the source of the fire can be detected early and the fire department can take an action way faster, thus reducing the valuable losses. This is the ultimate goal of this project is to develop a system that can detect early signs

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of a wildfire, alert the fire department, and help them put out the fire quickly and minimize damage to the forest and its inhabitants.3 objectives has been set as a goal of the project.

1.1 To investigate the real-time data of smoke and temperature of the peat soil as a preventative measure from wildfire.

The goal of investigating the real-time data of smoke and temperature of the peat soil is to gather information that can be used as a preventative measure against wildfires. By monitoring the temperature and smoke levels in the peat soil, the surveillance system can detect early signs of a wildfire, even before it becomes visible to the naked eye.

1.2 To develop a Wildfire detection system for peat soil forest area

The proposed wildfire detection system would be made up of a variety of components, including a 10V solar panel for power, heat and smoke sensors for data collection, a microcontroller for processing data, and a GSM module for sending data to the user.The heat and smoke sensors would be placed in strategic locations within the peat soil forest.

These sensors would collect data on the temperature and smoke levels in real-time, which would then be processed by the microcontroller. The microcontroller would analyze the data and determine if there are any signs of a wildfire, such as an abnormal increase in temperature or smoke levels. If a potential wildfire is detected, the microcontroller would send an alert to the user via the GSM module and mobile application.

1.3 To verify the performance of the proposed system in a real situation via experimental setup.

In order to determine the effectiveness of the proposed wildfire detection system, it is important to verify its performance in real-world situations. This can be done by setting up an experimental setup that simulates a wildfire scenario and testing the system under these conditions

2. Materials and Methods

There are 2 major discussions in the methodology of Wildfire Surveillance system development which are the Method of Hardware and the method of Software. In this part, the materials and the software used will be discussed.

2.1 Materials

The prototype for a wildfire detection system for peat soil areas using IoT technology is a highly sophisticated and advanced system that utilizes various technologies to detect and mitigate the risk of a wildfire. The system is designed to be used in peat soil areas, where fires are a common occurrence, and can cause significant damage to the environment and communities.

The system consists of a combination of hardware and software components that work together to detect and alert the authorities about the wildfire. The GSM module, which is a key component of the system, is used to transmit real-time data to the firefighting authorities, allowing them to respond promptly and effectively.

The MQ-2 sensor and the smoke and heat sensor are used to detect the presence of fire in the peat soil area. These sensors work by monitoring the levels of smoke and heat in the air, and sending a signal to the microcontroller when a fire is detected. The microcontroller, which acts as the central processing unit of the system, collects data from the sensors and executes instructions to control various other components of the system.

The solar panel and batteries serve as the power source for the system, providing a green and sustainable energy source. This helps to reduce the carbon footprint of the system, and also ensures that it can operate even in remote areas where there is no access to grid power.

In addition to the components listed above, the prototype also includes a DHT22 sensor, a GPRS Neo6M module, a flame sensor, a servo motor, a relay module, a pilot lamp, and a PWM solar charge controller. All of these components work together to provide a comprehensive and effective solution for detecting and mitigating the risk of a wildfire in peat soil areas.

2.2 System Block Diagram

The prototype uses heat and smoke sensors to detect the presence of wildfire. The MQ 2 sensor is used to detect the concentration of carbon monoxide to identify smoke and the flame sensor is used to detect fire. The DHT 22 sensor is used to detect the temperature and humidity of the air. These four indicators work together to indicate the presence of a wildfire. The data collected by these sensors is transferred to the microcontroller and processed by the ESP8266. If the inputs exceed normal values, a signal is sent via GSM module to the Blynk app, which can be monitored from a phone. As an early countermeasure, a servo-controlled water pump can be activated to extinguish the fire.Figure 1 shows the Block diagram of the prototype.

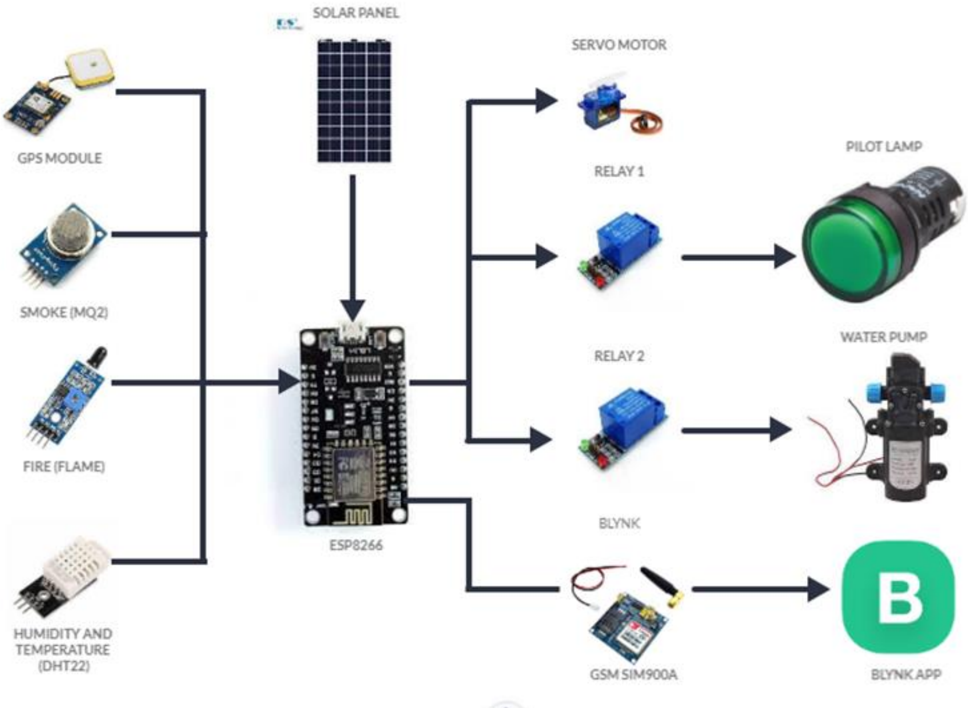

Figure 1: Block Diagram of the system

2.3 Flowchart

A flowchart is a diagram that represents a set of instructions, showing the sequence of steps and the decision points that are used in a process or program. In coding, a flowchart is a visual representation of the algorithm that is used to solve a problem. It is used to plan and organize the logic of a program before any actual coding takes place. Figure 2 shows the flowchart of the system.

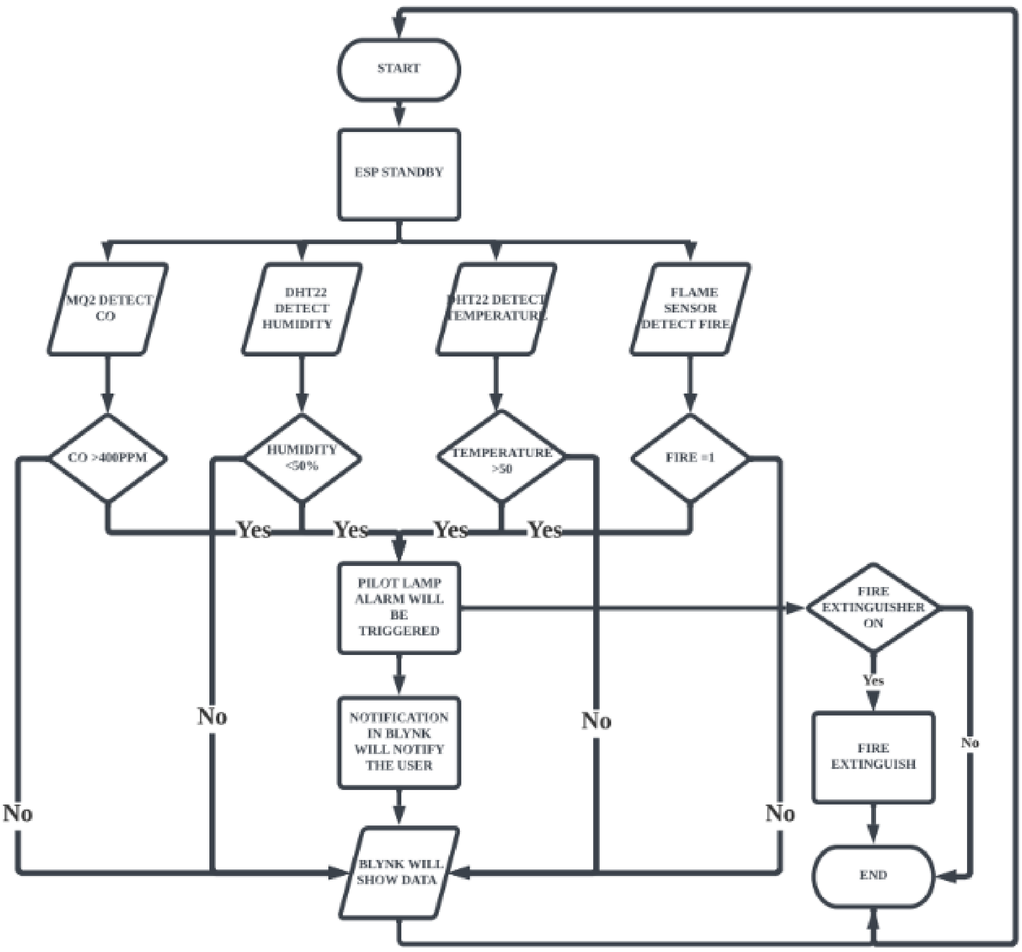

Figure 2: Flowchart of the system

3. Results and Discussion

The Wildfire Surveillance System is an innovative technology that is designed to help detect and monitor the spread of wildfires. By monitoring air quality, the system can detect changes in the environment that may indicate the presence of a fire. This information is then transmitted to a microcontroller, which processes the data and sends it to a central monitoring station or database.

The performance of the prototype was tested in a real-world experimental setup to evaluate its workability, durability, and accuracy of data collection. This testing is crucial to ensure that the system will function effectively in a real-world setting and provide accurate and reliable information to those who need it. The testing process involved setting up the system in a simulated wildfire environment and monitoring its performance over time.

The results of the testing can be used to make improvements to the system, if necessary, and to ensure that it will perform effectively when it is deployed in the field. Overall, the development and testing of the Wildfire Surveillance System is a crucial step in ensuring that this technology can help protect communities and the environment from the devastating effects of wildfires.

3.1 Project development

The dimension and specification of the project was planned from the early development.

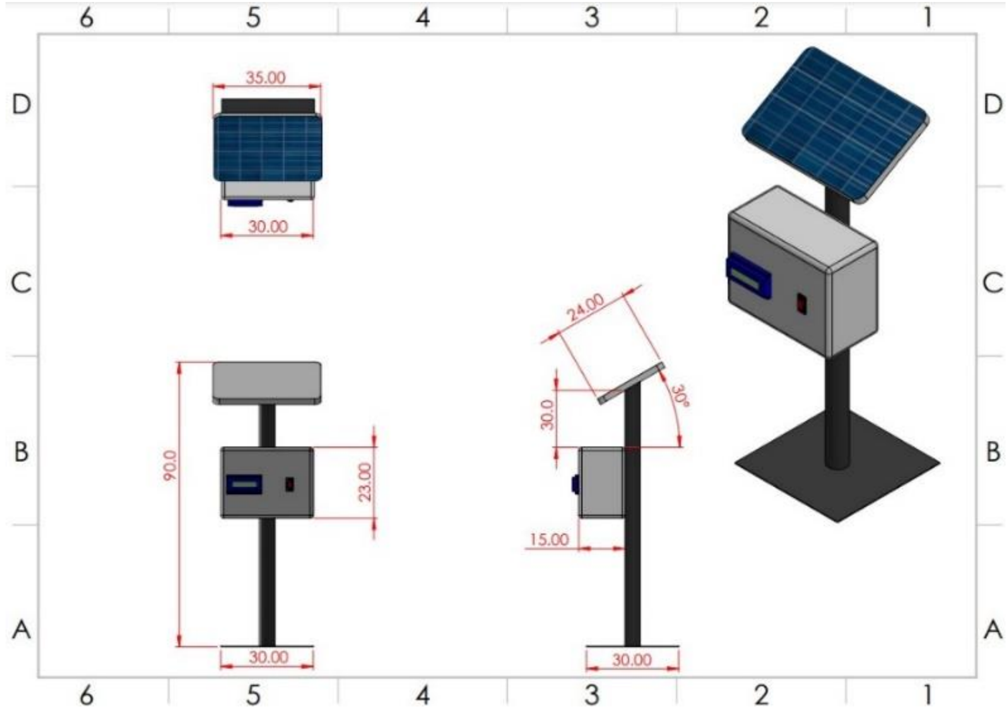

Figure 2: Block Diagram of the system

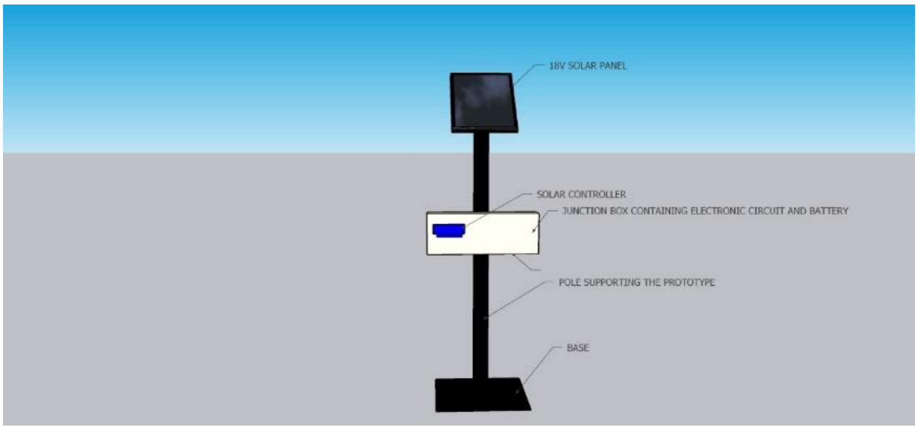

Figure 3: 3D view of the prototype using SketchUp.

The system is housed in a junction box, which is mounted on a metal pole and powered by a solar panel. This allows the system to be deployed in remote areas where power is not readily available. The metal pole used in the wildfire surveillance system serves as the structural support for the junction box and the sensors. The pole is typically made of steel or aluminum and is designed to withstand harsh weather conditions and high winds. It also provides the necessary height for the sensors to detect fires and smoke at a distance. The junction box is a weather-resistant enclosure that houses the microcontroller, sensors, and other electronic components. It is made of plastic and has a hinged or removable cover to allow access to the internal components. The box is designed to protect the electronics from moisture, dust, and other environmental factors. It also contains the necessary wiring and connections for the sensors and the microcontroller.

Figure 4: Final Product.

The hardware and equipment used in a project to develop a surveillance system for wildfires in peat soil areas using IoT technology. The system includes a solar panel to collect energy from the sun, a charge controller to monitor the battery state, a lead-acid battery to power the electronics, and an ESP8266 microcontroller, along with three types of sensors to collect data on wildfires. The system also includes a GSM SIM 900 A to enable IoT connectivity, and a metal pole to support the solar panel and other components. The pole is made of metal because it provides durability in extreme weather. The IoT part of the prototype uses BLYNK IoT and 2G connectivity from SIM 900 A to send data collected from the sensors.

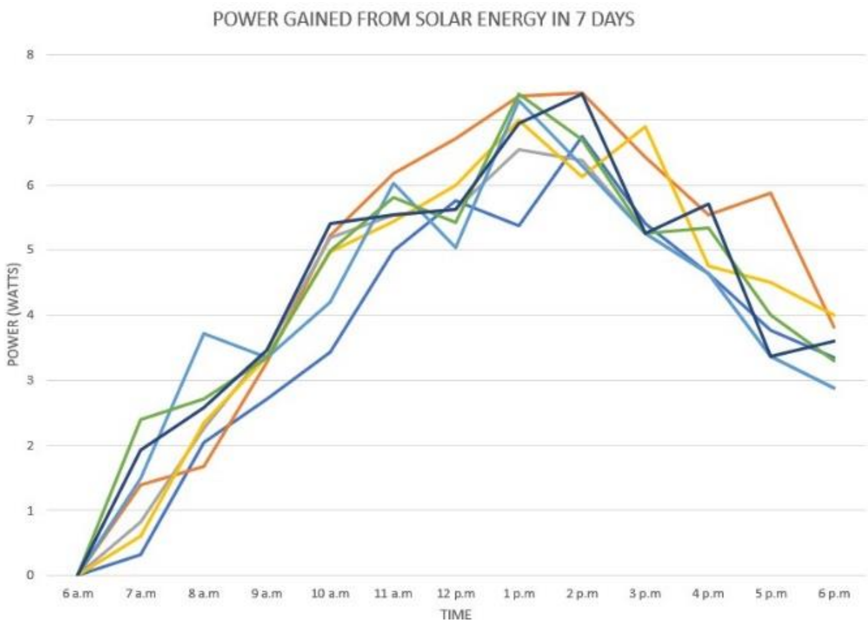

Figure 5: Graph of Power against time for the project in 7 days(Solar Panel).

Table 1: Table of Average Power for Solar Panel in 7 days.

DAY	AVERAGE POWER (W)
1	4.05
2	5.08
3	4.33
4	4.05
5	4.46
6	4.72
7	4.73

Data shows that solar power generation is low in the morning and increases to a peak in the afternoon, reaching a maximum of 6.75 W to 7.42 W at around 2 p.m. across a 5 days' period. Factors such as cloud conditions, sun angle, temperature, and other environmental factors may impact the power generated by solar panels, and the pattern observed. Also, a decreasing trend can be observed in the peak power generated during the 5 days' period and a decrease in the minimum power generated.

The system is designed to be independent and track possible wildfires in an area. It is noted that early detection and rapid response are critical for minimizing wildfire damage. The prototype system's sensor is reliable in detecting wildfires on a small scale but there is room for improvement to increase the detection scale. It also states that good power consumption and energy management is needed since the system will be located in the Malaysian forest, where there's a large canopy.

Table 2: Table of sensors and flame distance.

Number	Distance between sensor and flame (ft)	Output in the serial monitor
1	1	HIGH
2	2	HIGH
3	3	HIGH
4	4	HIGH/LOW
5	5	LOW

Based on Table 2 Wildfire surveillance systems rely on a combination of sensor technology and wireless communication to detect and transmit data on wildfire conditions to remote monitoring stations. Common components include microcontrollers, sensors for measuring temperature, humidity, and gas levels, and wireless communication modules. These systems can be effective in detecting small fires at an early stage, transmitting data and alerts, and controlling and extinguishing fires before they grow larger. Studies suggest that machine learning algorithms and multiple sensor types can improve the accuracy of fire detection and there is a need for continued research and development to improve the effectiveness and efficiency of these systems and protect human lives and natural resources from the devastating effects of wildfires.

The Wildfire Surveillance prototype has three main inputs: a heat sensor (DHT 22), a smoke sensor (MQ 2), and a flame sensor. The heat sensor detects the temperature and humidity of the air in the surrounding area to identify any abnormal changes that could indicate a wildfire. The smoke sensor detects the presence of carbon monoxide in the air, which is a byproduct of burning and a key indicator of smoke. The flame sensor detects the presence of fire in the surrounding area.

When these sensors detect a change in their input readings that exceeds normal values, the data is transmitted to a microcontroller (ESP8266) for processing. If the readings indicate the presence of a wildfire, the microcontroller sends a signal to a GSM module, which then sends an alert to the BLYNK app on a phone. The BLYNK app can be used to monitor the readings in real-time and take appropriate action.

As an early countermeasure, the system is equipped with a water pump that can be activated by a servo motor to extinguish the fire. This helps to quickly respond to the fire before it spreads, reducing the potential damage to the surrounding area and infrastructure.

Overall, the Wildfire Surveillance prototype is designed to detect early signs of a wildfire, process the data, and provide real-time information to authorities, who can take appropriate action to contain the fire. The system aims to improve the effectiveness and efficiency of wildfire response efforts, helping to reduce the impact of these destructive events.

4. Conclusion

A prototype for a wildfire surveillance system for peat soil areas has been developed, with a problem statement and objectives that have been achieved throughout the project's progress. Research was conducted using internet and journal resources. The system is dependable, reliable and functional, as it is a standalone device that can monitor wildfires in the forest using IoT technology and powered by renewable solar energy. A solar charge controller is also installed to control charging from the solar panel.

Acknowledgment

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