FOREST FIRE DETECTION SYSTEM

Quad Core Crew

Version 1.0

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User Manual

Version 1.0

Contents

A. Introduction

1. Purpose Document

The User Guide will provide information regarding the Forest Fire Detection System. The Forest Fire Detection System is a system that will detect wildfires before they spread significantly. The system will have various sensors that will be used whenever a fire is detected. These sensors include photoelectric and ionization sensors, temperature and humidity sensors, wind vane, camera, GPS, and GSM. This guide will include a product description and installation, step-by-step usage, a quick start guide, and FAQs.

2. Scope

The Forest Fire Detection System will have two main audiences. The primary audience will be system administrators that will be responsible to onlook all systems deployed. This will be known as Command Control. The secondary audience will include staff, fire departments, and individuals that will be using the website.

B. Product Description

1. Key Features

Some key features that the Forest Fire Detection System has are sensors that will be used to detect the presence of wildfire nearby.

- Photoelectric and Ionization sensor: The Forest Fire Detection System will have two smoke alarm sensors that will be able to detect if a wildfire is nearby. Some key features that these sensors have are:
    - Triggered only when it detects combustion particles.
    - Detecting combustion particles
    - Sending alert when combustion particles are detected.
- Temperature and Humidity sensor: The Forest Fire Detection System will have a temperature and humidity sensor. Some key features that these sensors have are:
    - Threshold of 58 degrees
    - Triggered only when there is a spike in temperature.
    - Detects a change in humidity.
    - Alerts Command Control when sensor is triggered.
- GPS: The Forest Fire Detection System will include a GPS. Some key features the GPS has are:
    - Will locate where the wildfire is.
    - Triangulation for a better location

    - Send location to Command Control when location is detected.
- GSM: The Forest Fire Detection System will include a GSM Module. Some key features that the GSM module has are:
    - Return the fire's location and send to Command Control if GPS failed.
    - Triangulation for a better location
    - Transmit sensor data to the wildfire website.
- Wind Vanes: The Forest Fire Detection System will include wind vanes. Some key features that the wind vanes have are:
    - Determine the direction of the wind.
    - Determine the speed of the wind.
- Camera: The Forest Fire Detection System will have a camera that will be able to record a video of a possible wildfire outbreak. Some key features that the camera has are:
    - Recording up to 50 seconds
    - Saving video onto an SD card
    - Sending video through the cloud
    - Deleting videos when 20 video max is reached.

With all these sensors, Command Control has a better chance of stopping a fire from increasing. The data from these sensors will be sent to a website, so users can better locate where a fire might be coming from. A few key features that the website provides are:

- Query and observe sensor data from a cloud database.
- Display sensor issues on the Wildfire System Website
- Receive push notifications for important events.
- Responsive website design for easy access on various devices

2. Product Dimensions

The product dimensions of the enclosure are 16.1'' x 12.2'' x 7.1'' inches or 410 x 310 x 180 mm. For the internal dimensions of the enclosure, they are going to be 15.11'' x 11.18'' x 5.04'' inches or 384 x 284 x 128 mm. The weight of the enclosure is 6.74 pounds and the material of it is acrylonitrile butadiene styrene plastic. This enclosure will follow the standard IP67, and it is waterproof. Inside of the enclosure, it will contain the PCB with its sensors which will add an additional weight to the enclosure.

3. Packaging

The primary components that come in the Forest Fire Detection System are the photoelectric and ionization sensor, temperature and humidity sensor, GPS, GSM, wind vanes, and a camera. These primary components will be used to detect wildfire. There are other components that will also be inside of the enclosure that will be used. This includes a PCB, cooling fan, insect mesh, and a solar panel.

4. Environment

The Forest Fire Detection System will be placed in an open environment. This includes forests, wilderness, open land, and any outdoor environment that a massive fire could happen in. As for the hardware of the system, the fire would need to cause activation of all the fire sensing sensors. Both the photoelectric and ionization sensors will need to be activated when it detects combustion ions/smoke particles. Once these sensors are activated, it will turn on the camera and it will begin recording its surrounding areas. This video will then be saved onto an SD card and will be sent to Command Control. Along with these sensors, the temperature and humidity sensors will alert Command Control that there has either been a spike in temperature or a change in humidity. When Command Control is alerted of a fire present, they will want to get the coordinates of where the fire has begun and will use the GPS and GSM module to get to approximate location. To prevent the fire from spreading, the wind vane will be used to determine in which direction the fire could go.

Once the data is passed to Soracom, it is sent to the appropriate table and storage container within AWS services. The database receives the uploaded data, triggering a Lambda function that checks the alert value. If it identifies a potential or active fire, the system notifies subscribed users about the detecting device. Meanwhile, the website updates every 60 seconds to provide the latest information on the home page and validate sensor data for the admin page.

5. Normal System Operation

The Forest Fire Detection System will periodically gather all the sensor values, send the data to the cloud, and update the website will real-time data. To indicate the hardware device is working in normal operation, a solid blinking LED light will allow users to know it is working. As for the website, normal operations should allow users to view data, subscribe, and use Authorization features.

C. Product Installation

1. First-Time Users

For first time users, the Forest Fire Detection System will need time to configure settings. Here are some instructions that will help:

1. Power on the device at the location where it will be used.
2. Once powered, the device will connect to the GSM network.

3. Location coordinates will be detected and attained by the GPS and GSM module.
4. The status LED will blink when the device is configuring.
5. Finally, the status LED will stop blinking and stay on when the device is operating.

2. Access Controls

The Forest Fire Detection System will require some access controls. Since the system is composed of various sensors, most of these sensors require additional installation. For the camera, there will need to be an installation of libraries. Download the code for the camera and make sure to include the extra files. When all the files are downloaded, run the main code and check if the camera is detected. These code files should be able to detect the camera, SPI, and SD card. If it fails or there is an error, make sure to check if all modifications were made to the code.

For the other sensors that are on the system, download their respective codes. Once they are downloaded, make sure to test it. Some might need to have modifications made to them, such as downloading extra libraries. Once all the sensors are working correctly, download the final code file. Make sure that all the components are plugged in correctly and run the final code to see if access has been given. If it runs with no errors, then the system is ready to be deployed.

3. Installation

For the installation of the Forest Fire Detection System, follow these instructions for a successful installation.

1. Find a location for the system that will get direct sunlight.
2. When found, place the system at that location and mount it on a pole or tree.
3. Make sure when mounted with the provided mounting parts, to make sure that the wind vane is facing north.
4. Next, turn on the ON switch on the device to initialize it.
5. The LED on the device will blink for 5-10 minutes.
6. When the LED stops blinking, the device is operational and ready to detect fires.

4. Configuration

For the configuration of the Forest Fire Detection System, internal default configuration is done on the device when it is powered on. This includes:

- Attaining the location of the device
- Connecting to the GSM network

As for the configuration of the device, the device does not need custom configurations. It only has two modes which are functioning and troubleshooting mode. Apart from this make sure that the wind vane is facing north.

5. Starting the System

To start the Forest Fire Detection System, you must first place the device in the area where it will be used. Next, flip the "ON" switch to begin operation. The status LED will blink while the device is configuring and booting up.

6. Stopping the System

To properly stop the Forest Fire Detection System, the switch that was used to turn on the device can be flipped to turn off the device. This cuts the power to the system and completely stops it, disconnecting it from the GSM network. Command control will be notified that the system is off.

7. Suspending the System

To suspend the Forest Fire Detection System, a troubleshooter must be on site. The troubleshooter will plug in their computer into the serial port of the device, enter a command to suspend, and then the device will be suspended. The suspended device can be troubleshooted, as it will not be connected to any networks.

D. Step-by-Step Usage

1. Instructions

1. Mount and install on a tree or pole with access to adequate sunlight.
2. Turn ON the system and wait for about 5 to 10 minutes to do its internal configuration. The LED light will blink while it is configuring and booting up.
3. Make sure the wind vane is facing towards the north direction for accurate readings.
4. After blinking for 5 to 10 minutes, the status LED should stop blinking and stay on. This means that the device has found its' location, sensors have been configured and it is ready to operate.
5. The device can now be accessed by command control, and readings by the device can be attained.

2. Conventions

- Make sure to have a cell signal in the environment of your choosing.
- Make sure that the wind vane is facing the north direction.
- The system will need to be evaluated on the first try, so accurate readings can happen.
- There will need to be sunlight that will directly hit the system for power.

3. Errors, Malfunctions, and Emergencies

Error: the LED will not stop slowly flashing after a 10-minute wait

Meaning: the device cannot find the current location. Power the device off, then on to restart the system. The device should find coordinates after a reset.

Error: the LED is flashing rapidly

Meaning: the device cannot connect to the GSM network.

Error: The camera is not detected.

Meaning: When wanting to capture video, the camera is not detected. Power off the device, then restart the system. If this does not fix it, then there might be a problem with the code. Contact the troubleshooting team so they can look at the code file.

Error: The SD card is not detected.

Meaning: When the camera is turned on, it sees if the SD card is connected. If it fails, the SD card might need formatting. Make sure that the SD card format is FAT32 and not exFAT32. If it is correct, contact the troubleshooting team to see if the pin location is set and open on the system.

4. Messages

Messages are visible whenever a troubleshooter powers off the device, connects their computer to the serial port on the device and opens the Arduino serial console. The following are messages seen on the serial console when troubleshooting the device.

When the camera begins recording, it will display a set of messages that will let the user know that the camera, SD card, and SPI are detected and working properly. The following messages are if it is working properly:

- “OV5642 detected.”
- “SPI interface OK.”
- “SD Card detected.”

If there is an error with any of these functions, these are the messages it will display:

- “Can’t find OV5642 module!”
- “SPI interface Error!”
- “SD Card Error!”

To test the ionization sensor and see if the output is correct, then the following message will be displayed:

- A jump from “0.00V” to “0.03” will display.

If there is an error with the ionization sensor, then the voltage will remain constant:

- “0.00V” will be shown when triggered.

When the GPS finds valid coordinates, the console will display the coordinates attained. If not, then the message “GPS coordinates not found” will display.

E. Quick Start Guide

A quick start-up guide for the Forest Fire Detection System will be available at the end of this manual.

F. FAQs

Q: Do videos get deleted from the SD card or will there be a need for a replacement?

A: Videos will get deleted from the SD card after 20 recordings are detected. There is no need to get a SD card replacement.

Q: Can there be false alarms?

A: False alarms can happen. But, with all the sensors that are in the system it can be prevented. Running a quick test to see if any other sensors have been alerted can show if there is a wildfire nearby.

Q: How long can the device be powered by a fully charged battery with no sunlight?

A: The device can operate for 48 hours with the battery without any sunlight.

Q: There is a problem with the wind readings, what should I do?

A: Turn off the system and face the wind vane towards the north. Turn the system back on and check if the wind readings are correct.

Q: Why is my system not getting enough power?

A: There can be issues with the system failing to get enough power and that might happen because it is running on its batteries instead of recharging through the solar panel. Make sure that there is enough sunlight hitting the solar panels.

Q: Why is my system not getting signal?

A: In some environments, the issue of cell signal is present. Make sure that when the environment is chosen, to run a test on it and see if cell signal is present.

Appendixes

1. Reference Documents

These are the reference documents that could help with the system.

For issues regarding the cloud services, feel free to use this resource link below:

- https://docs.aws.amazon.com/awssupport/latest/user/troubleshooting.html

For development issues or contributing to project code, please use these resource links below:

- https://nextjs.org/docs/getting-started
- https://docs.amplify.aws/

If issues arise with the camera, then the data sheet of the ArduCam can be helpful. It will provide information about the pins and any other additional information that will be needed.

Camera:

- https://www.uctronics.com/download/Amazon/B0068.pdf

2. Glossary

- GSM module: A GSM module is a device that uses GSM mobile telephone technology that will provide a wireless data link to a network. They are usually used in mobiles and other devices that communicate with cell networks.
- Triangulation: Triangulation is the tracing and measurement of a series of networks when three devices are placed in a triangle form. This will determine the distance across a territory and pinpoint the area where a potential fire could be happening from.
- FAT32: This is a version of the FAT file system that is a format for an SD card.

- IoT: IoT (internet of things) are physical objects that are embedded sensors, software, and other technologies that connect and exchange data with other devices through the internet.

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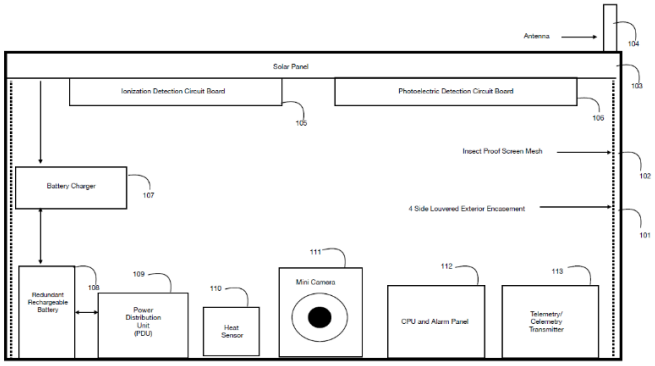
Forest Fire Detection System Quick Start-Up Guide



System Contents

The Forest Fire Detection System will include the following components: photoelectric and ionization smoke sensors, temperature and humidity sensors, GPS and a GSM module, a camera, and wind vanes.

Instructions

1. Mount and install the system in the environment of your choosing.

Make sure to place it where there is sunlight.

2. Turn ON the system and wait 5 to 10 minutes for internal configuration.

The LED light will blink continuously while it is configuring and booting up.

3. Face the wind vane towards the North.

This will allow for accurate wind readings.

4. After blinking for 5 to 10 minutes, the LED will stop blinking and stay on.

The system has found its location, sensors have been configured and it is ready to operate.

5. The system can now be accessed by Command Control and readings can be obtained.

Run a test on the system.