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Wild Fire Detection Balloon Using Thermal Camera

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Abstract: There have been many cases about forest burning and wildfires. Climate change, rising temperature, drought condition has been the major factor which led to the incident. Major cases such as forest burning in Australia in January 2020 has shown how disastrous a wildfire can be. The problem with existing forest fire detection is most of them are not continuously reading the same area. A good wild fire detection system should be able to continuously monitor every part of the forest at once. This study is to create a forest fire detection device that has low maintenance cost, safe and can cover a big area. Firefighter are expected to get real time information about any wild fire occurrence. One node from the system made will cover an area of the forest with one thermal camera. There will be several nodes place in the forest that will intercept with each other to cover all area of the forest. Time taken, fire temperature and radius covered are recorded.

Keywords: Wild fire, Disaster, Thermal Camera, Firefighter

1. Introduction

There have been many cases about forest burning and wildfires. Climate change, rising temperature, drought condition has been the major factor which led to the incident. Major cases such as forest burning in Australia in January,2020 has shown how disastrous a wildfire can be. There are numerous combustible elements in the forest that will enable fire to spread faster. Massive damage that has occur could be avoided if early stage of the fire could be prevented effectively before it gets out of hand. Wild fires would not only take over floras and faunas' habitat, it could also cause old virus to resurface. There are various factors that could enable the old virus to make a comeback such as the melting of ice at the Antarctica and Artic. In order to give a perfect early-stage countermeasure, an automated system is better than human power as it is likely to be affected by unavoidable human mistake. The idea is to invent a fire detection system in the forest. This is done by putting a thermal camera or infrared sensor together with a weather balloon. Weather balloon is a balloon filled with helium. This system

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does not just detect fire but after detecting a high change in heat at the forest it will send signal to the nearest fire station.

2. Materials and Methods

The materials and methods section, otherwise known as methodology, describes all the necessary information that is required to obtain the results of the study.

2.1 Materials

Specifications and properties of materials, equipment, and other resources used in the current study are chosen to meet the expectation of reducing the cost while still covering large area. A bulleted list of materials involves in inventing this system is shown below:

- ESP 32
- Buzzer
- Relay
- Thermal camera amg8833
- Solar panel 12V 100W
- Solar charge controller
- Li-on rechargeable battery 12 v
- Buck converter LM2596
- DC female power jack connector
- Arduino IDE
- Blynk Application

The block diagram in Figure 1 shows the connection of the project and it power and data signal flow. From the block diagram, it shows that power source for this project is solar panel. It is then connected to solar charge converter in order to be able to charge 12V battery. The solar charge converter is also connected to step-down buck converter and relay. Step-down buck converter is used to lower the input voltage coming from the solar panel before the voltage enter ESP32. This is because the ESP32 cannot handle high voltage and can only receive 5V. If ESP32 receive direct DC voltage from solar panel, it will burn. The ESP32 function as the brain of this circuit. It connects to relay and thermal camera. Thermal camera work as a sensor. It detects heat in an area and send data to ESP32. Relay receive power and data signal from ESP32. Relay will complete the circuit when thermal camera sense extreme heat in an area which then will ring the buzzer. When thermal camera detects extreme heat in an area, ESP32 will also send signal to developer's phone.

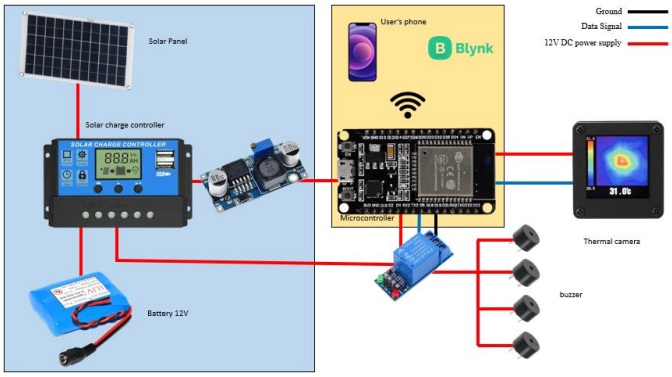

Figure 1: Block diagram of the system

2.2 Methods

Procedures can be described using flowcharts and algorithms, in which case the flowchart will be considered as a figure.

First, the thermal camera will detect heat of the area covered by its lenses. If the thermal camera detects extreme heat, the ESP32 will send signal to developers' mobile phone saying that there's a forest fire occurring. The ESP32 will also send signal to relay. Relay then complete the circuit and ring all the buzzers around the forest. If the thermal camera does not detect any extreme heat, it will loop back and continue detecting if there is any part of the forest temperature that exceed normal heat. The system will also loop back to thermal camera detecting heat after buzzers start to ring.

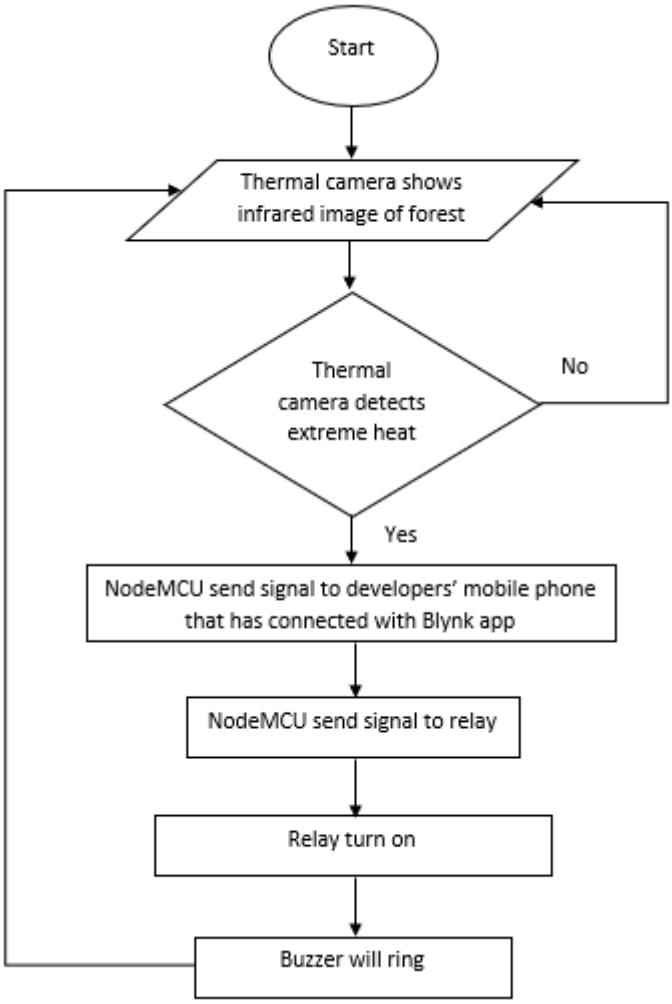

Figure 2: Flowchart of the system

3. Results and Discussion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

3.1 Results

Figure 3.1: Thermal Camera AMG8833 detecting heat

Figure 3.1 above shows it detecting heat from a hot water. Temperature that was set in the coding is only 45 degrees Celsius as that is the highest temperature item I could get to do the demo. The thermal camera will then trigger relay that connect with 4 buzzers to represent siren. Sadly, it did not send message to Blynk and could not represent the value of the temperature.

Figure 4.5: View of radius covered by AMG8833 measurement from above

When measuring at the height of 33 cm it could cover almost 17 cm which represent half of its length. If it were to be use in real time and not prototype 1 node of it may cover up to 30-meter diameter.

3.2 Discussions

The thermal camera seems to work well in detecting heat and the relay works well too as a switch from ESP32 to buzzer. Theoretically, the system could send message to Blynk to notify about the wildfire. The ESP32 does not seem to receive interrupt input from the AMG8833 thermal camera. When there is no input, the system could not run its program. Various coding was use to design the program starting from the complex one but it did not seem to work. The coding can be compiled but the output somehow did not come out as what were stated in the objective. Then, the complex coding was changed to a much simpler and 'straight to the point' coding. Nothing much has change except the relay starting to work. Possible problem is that there might be commands in this program that is intercepting with each other. Another possible problem might be related to the wiring to the AMG 8833 thermal camera. Its interrupt pin which is related to the temperature sensing is already soldered to its PCB. Even though USB to I2C cable is use to separate its pin, none of all the 6 pins provide interrupt pin. Blynk use user or hotspot provided by developer to connect with ESP32. Weak hotspot is considered the problem that prohibit the output from displaying in Blynk user interface.

4. Conclusion

The findings done in this project shows its capability of detecting wild fire occurrence efficiently. The problem makes by previous wild fire detection findings was they doesn't take reading continuously in order to save energy, unlike the findings made in this project. Several nodes are place to cover the whole area of the forest to make sure the thermal camera able to run continuously without missing any part of the forest. Having low maintenance cost than previous findings is what makes this finding really good. Previous findings mostly use complex robotic body for their system but still not that robust. This finding made have low building cost which also result in low maintenance cost. With this finding, a wildfire detection balloon using thermal camera were made to allow local fire department to keep track of data from the built system in real time.

Regarding all this achievement, there are several improvements that could be implement in this finding. For the real product, light material should be prioritized to make sure weather balloon are not being drag down by the components and sensor weight. For future upgrade, we can make the sensor from one balloon connect with another sensor from another balloon. This way a more precise location can be update to the Firefighter on which parameter they could take to prevent fire from spreading. I have one idea which is to make the weather balloon double layer same like tubeless tyre. A secondary balloon will be blown inside the weather balloon itself. This act as a measure if the outer balloon pop, then it will still take time before reaching the ground without damaging the components and sensor. ESP can also be made to notify for maintenance in case this situation happens. Lastly, I have learned that there is sound to repel birds. This can be great addition to this product as we can reduce the number of situations that would led to the balloon popping.

Acknowledgement

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