Solar Powered Thermal Sensor for Detecting Bushfires

A prototype thermal sensor was developed that could be used in remote locations to provide early detection of bushfires.

Research Question:
Can a low cost bushfire detection system using renewable energy be designed to provide early warning in remote locations?

Background:
Catastrophic fires have been a feature of Australian spring and summer months for several decades. In 2009 a fire event known as Black Saturday saw 400 separate bushfires in Victoria, Australia take the lives of 173 people.

In Australia many bushfires are started in remote inaccessible areas by lightning strikes. Monitoring of remote areas is difficult and often a large fire front has developed before it has been detected by emergency services. Current approaches to fire detection include fire observation towers, monitoring by light aircraft and increasing use of infra-red satellite technology.

Design Approach:
• Low cost robust unit that can be located outside in remote locations
• Wireless signal sent to paired mobile phone following alarm
• Visual and audio alarm triggered by temperature and smoke thresholds
• Heat sensor and smoke detector
• Solar powered device with rechargeable battery

Materials:
• Power Supply: Solar Panels
• µController: 8051 – V2
• Bluetooth Transmitter: HC-05
• ADC (Analog to Digital Converters): ADD08S9
• Temperature Sensor: LM35 ±0.25°C
• Buzzer: 3V – 20V
• Wires x 20
• Liquid Crystal Display: LCD-016M0020
• Rechargeable Battery: FG20121
• 800mA Low-Dropout Linear Regulator: LM1117
• ATME 8-bit Microcontroller with 8K Bytes: AT 8952
• General Purpose Rectifiers (Glass Passivated): IN5001
• Printed Circuit Board x 3
• Resistors x 5
• Green LED x 1, Red LED x 1, Orange LED x 1

Prototype:

Prototype Construction:
A schematic diagram of the device circuit was drawn using Proteus Schematic Software. The circuit was assembled using the schematic diagram.

Circuit
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Software
The micro-controller was programmed using embedded C code. Download the Bluetooth Terminal application. Pair the Bluetooth-enabled device with the model (HC-05).

Power
Connect all components and the battery wires to the battery and the black power cord to the 8051 (microcontroller) PCB and ensure that all components are powered up. Check that the indicator green LED on Voltage Regulator PCB is on. Ensure the solar panel is exposed to sun light.

Future Work:
• Increase the number of sensors on the device to include smoke and humidity sensors
• Blue tooth mobile linking has limited range and needs to be upgraded to GPS to work in remote locations
• Field testing insitu to ensure durability of prototype

Conclusion:
Overall, this prototype system can successfully detect analogue signals (temperature) and convert them to digital signals. These digital signals can reliably activate visual and audio alarms and transmit information via blue tooth. Improvements in the prototype will hopefully lead to a successful sensing system for bushfire detection in remote locations. This design could help protect people, property and wildlife from bushfires in the future.