

ABSTRACT

Sugarcane field fires cause serious economic, environmental, and public health impacts. This study aims to design and implement a solar-powered early fire detection system capable of operating independently in sugarcane plantations. The methodology includes a literature review, hardware and software design consisting of a 20 Wp solar panel, a 12 V 7.2 Ah battery, a PWM charge controller, temperature and smoke sensors, and a communication module, followed by component-level and integrated system testing, and field performance analysis.

The results indicate that the solar panel produced an average voltage of 21.66 V under partly cloudy conditions, sufficient to charge the battery and support system operation. The system successfully powered the sensors, microcontroller, and communication module, and transmitted real-time fire notifications to mobile devices. Despite using a simple PWM configuration, the system operated stably and efficiently.

This research demonstrates that a solar-powered real-time fire monitoring and warning system is feasible for sugarcane plantations, as it is energy-independent, effective, and capable of providing early notifications. Limitations include a restricted implementation scale, modest energy capacity, and the absence of an economic analysis. Future research is recommended to employ MPPT controllers, expand multipoint IoT-based sensor networks, and conduct long-term testing under varying weather conditions.

Keywords: Solar Panel, Monitoring System, Sugarcane Fire, Renewable Energy, Plantation.