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Solar Based Safety Stick for Farmers

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Abstract— This paper presents a solar-powered safety stick designed to enhance the safety and well-being of farmers working in isolated and hazardous environments. The device integrates a solar charging system, LED flashlight, GPS-GSM-based emergency alert system, and environmental sensors to detect harmful gases and monitor temperature and humidity. It allows real-time alerts during emergencies, helping ensure timely assistance. Lightweight, durable, and energy-efficient, the stick is tailored for rugged agricultural conditions. Field testing confirmed its effectiveness and usability. This innovation promotes safer farming practices while supporting sustainable, renewable energy solutions in rural and remote agricultural communities..

***Keywords*— Solar panel, 12V Battery, Arduino, DC motor, GPS, GSM, LDR Sensor, LEDs**

I. INTRODUCTION

Farming is a high-risk occupation, especially in rural areas where farmers often face hazards such as harsh weather, harmful chemicals, and isolation during emergencies. Limited access to power and communication infrastructure further compromises their safety. To address this, we propose a solar-based safety stick—a portable, energy-efficient device equipped with an LED light, GPS- GSM alert system, and environmental sensors. Powered by solar energy, it ensures continuous operation in off-grid areas. This innovation enhances farmer safety, promotes sustainable practices, and offers a practical solution tailored for challenging agricultural environments. The following sections detail its design, features, and real- world applicability.

SCOPE AND OBJECTIVES

The scope of this paper is to design and develop a solar-powered safety stick aimed at improving the safety and working conditions of farmers, particularly in rural and remote areas. The device integrates solar energy technology to ensure off-grid functionality and includes essential features such as an LED flashlight for visibility, GPS and GSM modules for emergency location tracking and alert messaging, and environmental sensors to monitor temperature, humidity, and harmful gases.

The main objective is to provide farmers with a reliable, portable, and user-friendly tool that enhances their ability to respond to emergencies, reduces risk exposure, and supports sustainable farming practices through the use of renewable energy and smart technology.

II. SYSTEM DESCRIPTION

The proposed solar-based safety stick system is designed to operate independently using renewable energy, and it integrates multiple components to enhance farmer safety. At the core of the system is an Arduino microcontroller, which coordinates input from sensors and user controls to trigger appropriate outputs and safety mechanisms.

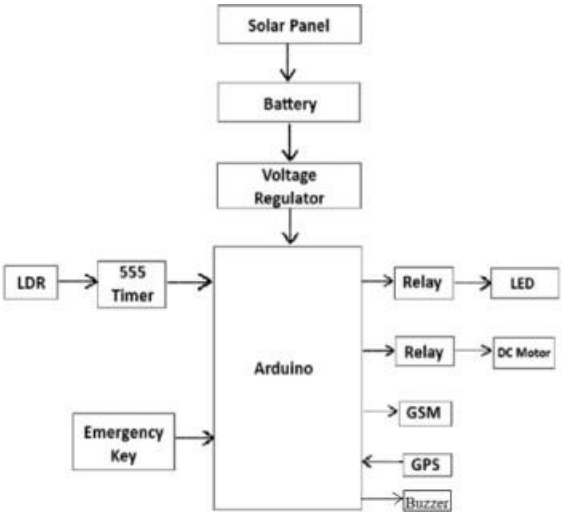

Fig. 1. Block Diagram of proposed system

The system begins with a solar panel that continuously charges a battery, ensuring the device remains operational even in remote or off-grid areas. A voltage regulator ensures the power supplied to the components is stable and suitable for the Arduino and peripheral modules.

The safety stick is equipped with a Light Dependent Resistor (LDR) connected to a 555 Timer, which acts as a control signal to the Arduino based on ambient light conditions. This enables the system to automatically activate the LED light via a relay, providing visibility in low-light situations such as early morning or evening fieldwork.

An emergency key acts as a manual trigger that allows the user to send a distress signal during accidents or health emergencies. Upon activation, the Arduino initiates communication through a GSM module, sending a text

alert containing the user's location, which is obtained via a GPS module. This ensures real-time location tracking and emergency response capabilities.

Additionally, the system includes control for a DC motor, which could represent an alerting mechanism such as a vibration motor or audible buzzer, further enhancing the stick's ability to draw attention during emergencies. The motor is also triggered via a relay under the control of the Arduino.

Together, these components create a robust, energy-efficient, and multifunctional safety system tailored to the needs of farmers in rural and challenging environments.

III. WORKING PRINCIPLE

A solar-based safety stick for farmers is a thoughtfully designed tool aimed at enhancing the safety, mobility, and convenience of farmers, especially those who work in remote or rural fields where electricity and communication infrastructure may be limited. The core idea behind this device is to utilize solar energy to power essential safety features, ensuring it is self-sustaining, eco-friendly, and effective in diverse agricultural settings.

Fig: 2 Solar Stick

Energy Source and Charging System:

The device is equipped with a solar panel mounted on the top or side of the stick. This panel absorbs sunlight during the day and converts it into electrical energy using the photovoltaic effect. The generated electricity is stored in an internal rechargeable battery (usually a lithium-ion battery) that powers the stick's features. This eliminates the need for frequent battery replacements or access to electrical charging points, making the device highly reliable for outdoor use.

Lighting System:

One of the most important features of the safety stick is the LED lighting system. LEDs are energy- efficient and long-lasting, providing bright illumination during low-light conditions such as early morning, late evening, or nighttime. This lighting helps farmers see clearly while navigating through fields, avoiding hazards like snakes, ditches, sharp tools, or uneven ground, thereby preventing accidents.

Emergency Alert System:

To ensure farmer safety in emergency situations, the stick can be equipped with a buzzer or loud alarm. This alarm can be triggered in two ways:

1. Manually, by pressing an emergency button located on the stick.
2. Automatically, through integrated motion or fall detection sensors (like an accelerometer or vibration sensor). If the stick detects a sudden fall or unusual movement (such as the stick being dropped), it can automatically activate the alarm, alerting people nearby.

This feature is especially helpful if the farmer becomes unconscious or immobilized due to an accident, allowing others to be alerted without requiring the farmer to actively call for help.

Location Tracking:

For advanced versions, a GPS (Global Positioning System) module can be added to track the farmer's location. In case of an emergency, the stick can transmit real-time coordinates via GSM or GPRS modules to a pre-configured mobile number or emergency contact. This is particularly useful in large or remote agricultural lands where locating a distressed farmer manually may be time-consuming.

Benefits:

The solar-based safety stick provides several advantages:

- Eco-friendly operation, powered entirely by renewable solar energy.
- Cost-effective, with no need for external power or frequent battery replacements.
- Improved safety, reducing the risk of accidents and enabling timely emergency alerts.
- Increased autonomy, allowing farmers to work during early or late hours safely.
- Enhanced communication, especially if GPS or GSM modules are included.

IV. RESULTS AND DISCUSSIONS

Fig: 3 Proposed model of solar based safety stick for farmers

The developed solar-based safety stick effectively enhances farmer safety in remote and hazardous areas. The prototype integrates a solar charging system, Arduino microcontroller, GPS and GSM modules, LDR-based LED lighting, and emergency alert functions into a compact, portable device. Testing confirmed that upon pressing the emergency key, the GPS captures the user's location and the GSM module sends an SMS with a Google Maps link. The correct location was received successfully, though one instance returned default coordinates (0.000000, 0.000000), likely due to weak GPS signal—indicating a need for better positioning or signal validation.

The LDR and 555 timer ensure automatic LED activation in low-light conditions, improving visibility and reducing manual intervention. The system also features a relay-driven DC motor, offering options for physical alerts like vibration or sound.

Despite its success, further improvements can include weatherproof housing, a battery management system, and signal strength indicators. Additionally, future versions could incorporate health monitoring or fall detection features.

Overall, the system demonstrates that integrating renewable energy and embedded systems can provide an efficient, low-cost safety solution tailored to the needs of rural farmers, promoting both safety and sustainability in agricultural practices.

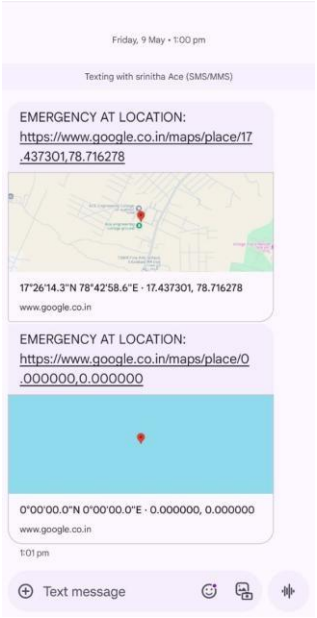

Fig: 4 SMS alert received on Mobile

V. CONCLUSION

The paper work is designed & developed successfully and for the demonstration purpose a prototype module is constructed and results are found to be satisfactory.

The solar stick represents a practical and eco-friendly approach to utilizing renewable energy in everyday life. By converting sunlight into electrical energy, it provides a portable power source that can be used for charging small devices, powering lights, or even supporting essential tools in off-grid locations. Its compact design and low maintenance make it accessible for a wide range of users, including students, campers, rural communities, and emergency responders. The adoption of such technology not only reduces reliance on fossil fuels but also encourages greater awareness of sustainable living. As solar technology continues to advance, devices like the solar stick will play an increasingly important role in promoting energy independence and environmental conservation.

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