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Cell Phone Detector

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Abstract

This project presents a Solar-Powered Cell Phone Detector, an innovative and eco-friendly system designed to detect active mobile phones using renewable energy. The primary goal is to offer a sustainable, off-grid solution for environments where mobile phone usage must be restricted, such as examination halls, confidential meeting rooms, and high-security zones. Traditional detectors typically rely on conventional power sources, making them less practical during outages or in remote areas. This system addresses such limitations by incorporating solar power, ensuring continuous operation and aligning with green technology goals. The system comprises a 12 V solar panel that charges a 3.7 V lithium-ion battery through a regulated charging circuit. The battery serves as the primary power source for the RF detection module. At its core is a high-gain RF detector circuit capable of identifying radio frequency (RF) signals emitted by mobile phones during activities such as calling, messaging, or internet use. An NPN transistor functions as a switch that activates a buzzer and LED when an RF signal is detected. Testing and calibration demonstrate successful detection within a limited range of a few meters. Although minor interference from nearby wireless devices was observed, the system offers promising performance in enclosed settings. This project highlights the potential of renewable-powered sensing technologies for modern surveillance applications and underscores the feasibility of sustainable mobile detection systems.

Keywords: Solar-powered device, RF detection, mobile phone surveillance, renewable energy system, wireless signal monitoring

INTRODUCTION

The widespread adoption of mobile phones has significantly reshaped modern communication and connectivity. Despite their ubiquity, there are situations where mobile phone usage must be limited or completely prohibited, such as in examination centers, courtrooms, military zones, and confidential meetings [1–5]. Unauthorized mobile activity in these environments can lead to data breaches, cheating, or even security risks.

Conventional mobile phone jammers and detectors often rely on standard electrical grids, which limits their functionality in remote or power-restricted areas. Furthermore, jamming devices may interfere with legal or emergency communications and are restricted or illegal in some regions [6]. Therefore, there is a need for a sustainable, legal, and low-maintenance solution to detect mobile phone activity non-invasively.

This project proposes a solar-powered RF-based mobile phone detector. The detector identifies active phones by sensing their RF emissions during call or data transmission [7]. Unlike jamming systems, RF detectors do not interfere with communication, they merely detect and report the presence of signals. Incorporating solar energy

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enables off-grid deployment and reduces dependence on traditional electricity. This makes the device highly suitable for educational institutions, defense facilities, or rural regions with unstable power supply [8]. The design integrates a solar panel, lithium-ion battery, RF detection circuit, and a response module (LED and buzzer), offering a clean, affordable, and effective mobile monitoring solution.

LITERATURE SURVEY

Several techniques have been proposed to detect the presence of active mobile phones. Among them, Radio Frequency (RF) detection is considered as one of the most effective [9]. RF-based systems monitor the electromagnetic radiation emitted by mobile devices, particularly in the GSM, CDMA, and LTE frequency bands (typically 800 MHz to 2.5 GHz) [10].

Sharma et al. introduced a method using resonant tank circuits to improve detection sensitivity [11]. These circuits selectively filter frequencies associated with mobile transmissions while minimizing false positives. Some research has also explored acoustic and infrared detection methods. Acoustic techniques depend on identifying specific audio patterns or speaker vibrations, while infrared systems rely on thermal signatures. However, both methods are susceptible to environmental noise or limited line-of-sight [12].

Advancements in solar energy have enabled low-power embedded systems to operate independently in outdoor or remote conditions [13]. Modern lithium-ion batteries paired with Battery Management Systems (BMS) ensure stable energy storage and safety [14]. Transistor-based switching, such as using BC547 NPN transistors, allows energy-efficient control of the output indicators in response to detected RF signals [15].

The proposed system combines the strengths of RF detection with solar power to provide a reliable and self-sufficient mobile detection mechanism.

PROPOSED METHODOLOGY

The system is designed using the following modules (Figure 1):

a. *Power generation and storage*: A 12 V solar panel captures sunlight and converts it to electrical energy. This energy charges a 3.7 V lithium-ion battery via a regulated circuit. A Battery Management System ensures safe charging and discharging cycles [16]. This setup allows for day-night operation without reliance on external power.
b. *RF detection circuit*: A copper antenna detects RF signals between 900 and 2100 MHz, corresponding to mobile transmission frequencies [17]. These signals are fed into a high-gain amplifier based on the CA3130 op-amp. A coupling capacitor filters irrelevant signals, enhancing selectivity.
c. *Signal threshold switching*: Once the signal strength crosses a preset threshold, a BC547 NPN transistor is triggered. This transistor acts as a switch that powers a buzzer and an LED, thereby indicating the presence of an active mobile device [18].
d. *Output alert system*: The audio (buzzer) and visual (LED) indicators provide real-time alerts to the user, allowing immediate detection of mobile activity.

Working

The solar panel continuously charges the lithium-ion battery under sunlight. The battery powers the RF detector circuit. The antenna captures electromagnetic emissions from mobile phones. These are amplified and filtered before reaching the signal comparator section. If the signal exceeds the pre-set threshold, the BC547 transistor conducts, activating the LED and buzzer [19].

This mechanism ensures continuous surveillance with minimal power consumption and no human intervention.

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Hardware Description

Antenna

The antenna plays a central role in receiving RF signals (Figure 2). It is designed to operate across a wide range of frequencies, with particular focus on GSM (900/1800 MHz) and LTE bands. Antenna length, orientation, and placement influence detection range and accuracy. A copper coil dipole antenna is preferred for its simplicity, durability, and effectiveness in confined spaces.

CA3130 Operational Amplifier

This op-amp features a high input impedance and low bias current, making it suitable for detecting and amplifying weak RF signals (Figure 3). Its high slew rate ensures rapid signal response, which is crucial for detecting burst transmissions from mobile phones. Proper biasing and feedback configurations are used to optimize gain and bandwidth.

Coupling Capacitor Network (Signal Filtering)

The capacitors in the network not only block DC components but also form a bandpass filter that allows relevant frequency signals while rejecting low-frequency noise (Figure 4). Capacitor values are selected based on cut-off frequency calculations to match the target RF range.

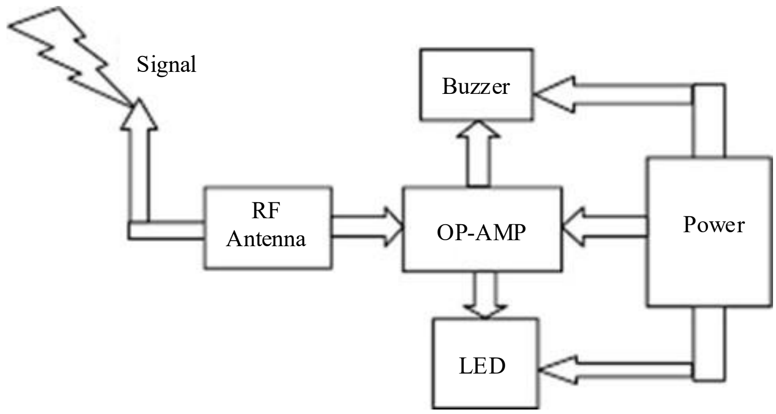


Figure 1. Block diagram.

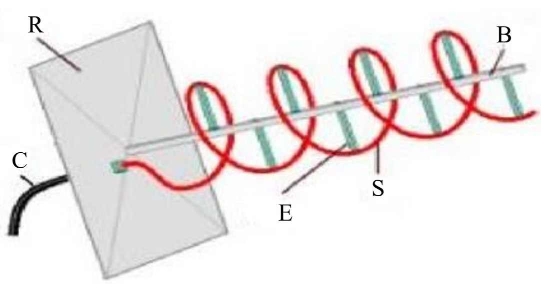
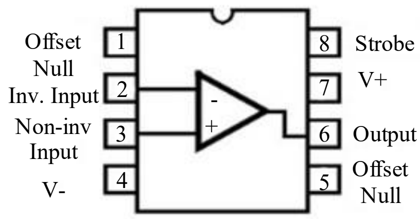


Figure 2. Antenna.



CA3130 MOSFET Op-Amp

CA3130 Pinout

Figure 3. Operational amplifier.

Figure 4. Coupling capacitor network (signal filtering).

Figure 5. LED.

LED

The LED serves as a visual indicator to confirm successful wireless energy transfer (Figure 5). It glows when the receiving coil outputs sufficient voltage, indicating that charging is in progress. LEDs are low-power, efficient components that offer reliable feedback in electronic circuits. In this project, LED represents successful delivery of power to the vehicle. It also helps in troubleshooting by visually showing system status.

Transistor (BC 547)

The BC547 is an NPN bipolar junction transistor used to control the detection threshold in a cell phone detector system (Figure 6). It operates as a switch, when a small current is applied to the base, it allows a larger current to flow from the collector to the emitter, triggering the detection process. In the case of the cell phone detector, the BC547 helps set the threshold level for signal detection. When the electromagnetic signal from an active mobile phone exceeds a certain level, the transistor switches on, enabling the signal to be processed and activating the alert system (LED or buzzer). This threshold detection mechanism improves the detector's sensitivity, ensuring that only signals from active mobile phones trigger the response, thus enhancing the accuracy and efficiency of the detection system.

Amplification of RF Signal

The amplification of the RF signal is a key step in the cell phone detection process (Figure 7). The weak RF signals received by the antenna are amplified using operational amplifiers, such as the CA3130, to boost signal strength. This ensures that even low-power signals from distant or inactive mobile phones are detectable. The amplified signal is then processed further by the detection system, allowing the device to accurately identify the presence of mobile phones. This stage is essential for improving the sensitivity and performance of the cell phone detector.

Power Supply (9 V Battery)

The 9 V battery stores energy and powers the detection circuit during operation (Figure 8). Known for its compact size, reliability, and ease of use, it is ideal for small, portable systems. It ensures consistent power delivery to the circuit even in low-power situations. Its convenience and widespread availability make it a preferred choice for powering mobile detection systems. The 9 V battery provides a practical solution for maintaining system operation in a variety of environments without the need for complex charging or energy storage setups.

RESULTS

The Cell Phone Detector prototype successfully demonstrates the integration of RF signal detection with a portable power source to detect the presence of mobile phones. The 9 V battery effectively powers the detection circuit, which includes an antenna and signal amplification system. When a mobile phone (representing an active device) is brought within range, it emits electromagnetic signals that are captured by the antenna.

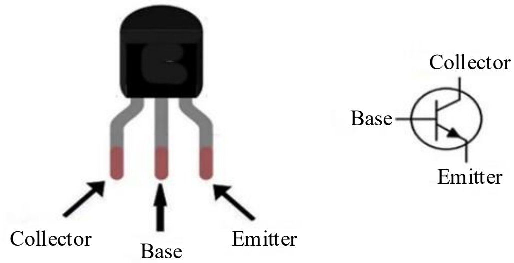


Figure 6. Transistor.

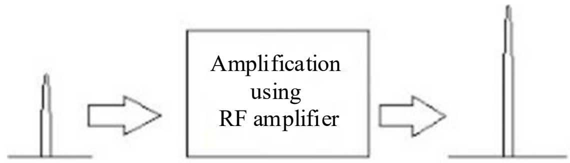


Figure 7. Amplification of RF signal.

Figure 8. Power supply (9 V battery).

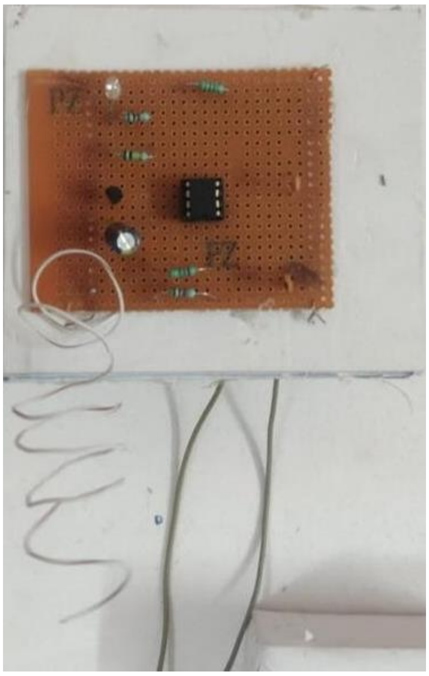


Figure 9. Output of solar wireless EV charging system (LED glows).

The signal is then amplified and processed by the circuit, triggering an LED and buzzer to indicate detection. This validates the concept of wireless mobile phone detection, highlighting its potential as a practical, off-grid solution for secure environments and areas where mobile phone use is restricted. Additionally, Figures 9 and 10 show the final output of the proposed model.

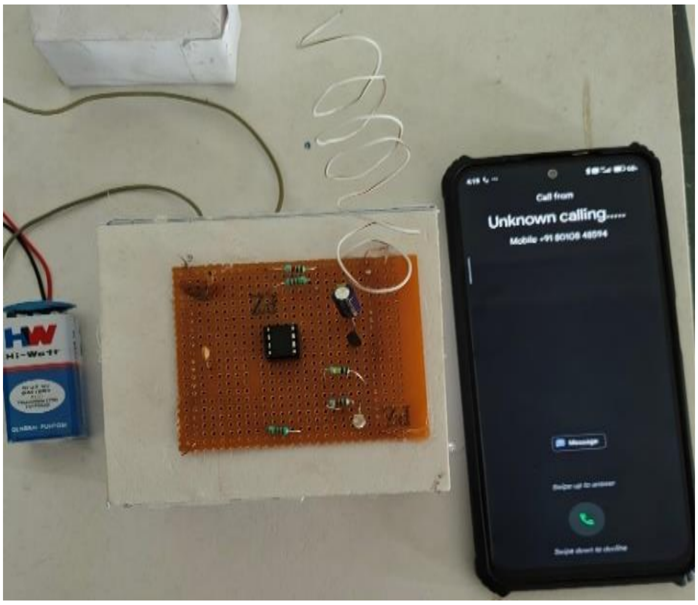


Figure 10. Output of solar wireless EV charging system (LED glows).

CONCLUSION

The Solar-Powered Cell Phone Detector presented in this work is a robust, eco-friendly solution to the growing need for mobile phone regulation in sensitive environments. By leveraging solar energy and an RF-based detection approach, the device eliminates dependency on grid power and enables continuous operation in remote or off-grid locations, such as rural schools, secure installations, and examination centers.

The system effectively detects active mobile phones during calling, messaging, or data transfer by sensing their RF emissions. The use of a high-gain amplifier circuit, tuned antenna, and threshold-based switching mechanism ensures timely alerts via LED and buzzer. Experimental results validate the detector's performance within a 1.5–2 m radius, showing potential for real-world deployment.

In addition to environmental sustainability, the system's design emphasizes simplicity, cost-efficiency, and portability. Its reliance on common and low-power components like the CA3130 op-amp, BC547 transistor, and lithium-ion battery allows for wide-scale implementation, especially in educational institutions with limited infrastructure budgets. Moreover, the absence of jamming or active signal interruption makes the solution compliant with regulatory guidelines in most regions.

However, certain limitations were identified, such as the restricted detection range and possible false positives in RF-dense environments. These can be mitigated in future versions by integrating digital signal processing (DSP), adaptive frequency filtering, and machine learning algorithms for classification of signal types. Incorporating Internet of Things (IoT) connectivity could enable remote monitoring, data logging, and centralized alerting systems. Additionally, expanding detection capabilities to include newer communication bands (such as 5G) will enhance relevance in future deployments.

In conclusion, this work demonstrates the feasibility and effectiveness of a solar-powered mobile phone detection system for enhancing discipline, security, and operational integrity in critical settings. With appropriate refinements and scaling, the technology holds promise for integration into smart surveillance ecosystems that align with global sustainability and digital security goals.

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