

Integrated Tactical Patrolling Stick

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Abstract: *The Integrated Tactical Patrol Stick (ITPS) is an innovative multifunctional device developed to assist security personnel operating in critical and high-risk environments. The system combines several technologies to provide real-time tracking, communication, and emergency support within a single portable unit. The core of the design is based on the ESP32 microcontroller, which coordinates the operation of various modules including the NEO-6M GPS for location tracking, the SIM800L GSM module for mobile communication, and a battery management system for power monitoring. The device also integrates functional utilities such as a high-intensity LED torch, laser signaling unit, and emergency buzzer to ensure quick response during field operations. Power is supplied through a 3S 18650 lithium battery pack supported by both solar and DC charging options to enhance reliability in remote locations. The ITPS communicates with a control room dashboard, allowing operators to monitor the guard's location, receive emergency alerts, and send commands or instructions remotely. This integration of hardware and communication technology ensures continuous connectivity, improved situational awareness, and better coordination between patrol teams and control units. The proposed ITPS system provides a cost-effective, compact, and energy-efficient solution for modern security and surveillance applications.*

Keywords: Integrated Tactical Patrol Stick

I. INTRODUCTION

Security personnel often operate in unpredictable and high-risk environments where quick communication, location awareness, and access to emergency support are essential. Conventional patrol equipment such as torches, communication radios, and batons function as standalone tools, which limits their overall efficiency and response capability. In modern security systems, there is a growing need for an integrated device that combines multiple functionalities into a single, compact, and reliable unit.

The Integrated Tactical Patrol Stick (ITPS) is developed to address this requirement by merging several technologies including GPS tracking, GSM communication, emergency alert systems, and power management into one portable device. By integrating these modules, ITPS enhances the situational awareness of security guards and enables seamless coordination with control room operators. The system is designed around the ESP32 microcontroller, which acts as the central processing unit and manages all connected components such as the NEO-6M GPS module, SIM800L GSM module, and battery management circuitry.

In addition to providing real-time tracking and communication, the ITPS also incorporates practical field tools like a high-intensity LED torch, laser indicator, and emergency buzzer, ensuring both functionality and safety during patrol operations. The inclusion of solar and DC charging options further extends operational reliability, especially in remote areas with limited access to conventional power sources.

Overall, the ITPS aims to improve efficiency, safety, and coordination in security and surveillance operations by providing a smart, multifunctional, and energy-efficient solution tailored for modern field requirements.



II. LITERATURE REVIEW

Supriya Sarker et al. [1] proposed an IoT-based multifunctional patrol device designed to enhance the safety of security personnel in high-risk areas. The system integrated GPS modules to continuously track the real-time location of guards and GSM communication to relay alerts and status updates to a central control room. By automating the monitoring process, the system reduced the dependency on manual reporting, ensuring that any unusual activity or emergencies were immediately communicated. The authors emphasized that the device could be scaled to integrate multiple patrol units into a centralized dashboard, enabling coordinated responses during incidents and enhancing overall operational efficiency. Additionally, the study highlighted the potential for cloud-based storage of patrol logs, which could be used for performance monitoring, route optimization, and post-incident analysis. The researchers also suggested integrating predictive analytics to anticipate high-risk zones, which could allow proactive interventions and reduce threats to personnel.

R. Thamizharasi et al. [2] developed a wearable alert system for patrolling officers that incorporated real-time monitoring of environmental hazards and human factors. The device utilized accelerometers and motion sensors to detect falls, unusual movements, or prolonged inactivity, which may indicate distress. Upon detecting such anomalies, the system instantly triggered visual and audio alarms while simultaneously sending an emergency notification via GSM to the control room. The study also discussed the challenges of sensor accuracy in dynamic environments, such as interference from strong sunlight or vibrations from rough terrain. To overcome these issues, the authors proposed a hybrid approach combining sensor data with periodic GPS updates and control-room verification, improving detection reliability and reducing false alarms. This research underscored the importance of automated monitoring for personnel working in isolated or high-risk locations.

R. Krishnan et al. [3] introduced a high-voltage deterrent module for personal safety integrated into a portable patrol stick. The system employed a compact high-voltage generator capable of delivering controlled pulses to deter aggressors while maintaining safety for the user. Coupled with ESP32-based control and battery management systems, the module allowed secure activation and ensured optimal energy utilization. The study highlighted that combining this deterrent with GPS tracking and GSM communication enabled both real-time response and documentation of incidents. Limitations included the need for robust insulation and periodic battery monitoring, which the authors addressed by recommending integrated 3S Li-ion packs with voltage regulation circuits. The research demonstrated that high-voltage modules could be safely incorporated into multifunctional security devices without compromising portability or user safety.

A. Kumar et al. [4] designed an integrated patrol device that combined GPS tracking, GSM alerts, LED torches, and a laser signaling module into a single unit controlled via ESP32 microcontroller. The device continuously monitored battery status using a 3S Li-ion pack and provided on-device visual indicators for remaining charge, ensuring operational readiness during extended patrols. The authors validated the system in simulated patrol scenarios, demonstrating rapid communication of location and emergency alerts, as well as the effective activation of deterrent and signaling modules. Challenges such as power optimization and sensor calibration were addressed through adaptive programming, which dynamically regulated high-voltage pulse output and laser intensity to conserve battery life. The research highlighted that multifunctional integration, combined with real-time monitoring, significantly improves field safety for personnel in high-risk operations.

P. Singh et al. [5] proposed a holistic security management framework through a multifunctional patrol stick that combined GPS geofencing, GSM communication, high-voltage deterrent, LED torch, laser signaling, and real-time control-room monitoring. The system utilized ESP32 for centralized processing, coordinating between sensors, battery management, and communication modules. Alerts generated from unusual movements, emergency button activation, or low battery conditions were transmitted instantly to the control room, allowing proactive intervention. The authors further emphasized cloud integration for logging patrol routes, incident history, and battery usage, which could support operational planning and performance analysis. This comprehensive approach demonstrated the feasibility of merging multiple functionalities into a portable device while maintaining reliability, security, and ease of use for personnel operating in remote or hazardous locations.



Battery

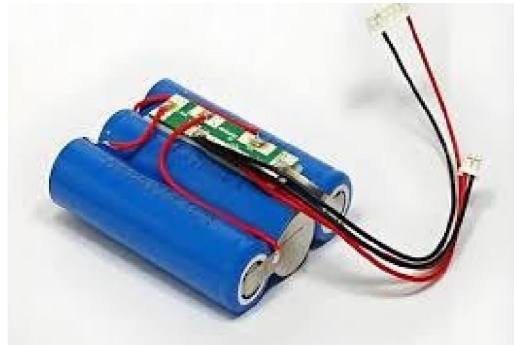


Fig3. Battery

The power source of the Integrated Tactical Patrol Stick (ITPS) is a 3S 18650 lithium-ion battery pack designed to provide stable and reliable power to all modules of the system. The term “3S” indicates that three 18650 cells are connected in series, which increases the total voltage output while maintaining the same current capacity. Each 18650 cell typically provides a nominal voltage of 3.7 V, and when connected in series, the pack delivers a combined voltage of approximately 11.1 V (3×3.7 V). This voltage is then regulated down to 4 V (or 3.7–4.2 V range) using a DC-DC buck converter to safely power sensitive components such as the ESP32 microcontroller, SIM800L GSM module, and NEO-6M GPS module. The pack is equipped with a Battery Management System (BMS) that ensures overcharge, over-discharge, and short-circuit protection, extending the lifespan and safety of the cells. To monitor the charge status, a Robu-in/Havoc 3S 18650 battery indicator board is integrated into the system, providing real-time visual feedback of battery levels through LEDs. The battery pack also supports dual charging options—solar panel input and DC adapter charging—to ensure uninterrupted operation in remote or outdoor environments.

GSM Module:



Fig5. SIM800L

The GSM module used in the Integrated Tactical Patrol Stick (ITPS) is the SIM800L, a compact and cost-effective GSM/GPRS module that enables wireless communication through mobile networks. It operates on quad-band frequencies (850 MHz, 900 MHz, 1800 MHz, and 1900 MHz), making it suitable for use in most regions. The module supports SMS, voice call, and GPRS data transmission functionalities, which are essential for real-time communication and alert systems. In the ITPS system, the SIM800L module is interfaced with the ESP32 microcontroller through serial communication (UART). It is responsible for sending location updates, emergency alerts, and status messages to the control room or registered mobile numbers. The module receives AT commands from the ESP32 to perform operations such as sending SMS, initiating calls, or receiving messages.



GPS Module:



Fig6. GPS Module

The GPS (Global Positioning System) module, such as the NEO-6M, is used to determine the real-time geographic location of the vehicle. It receives signals from satellites and provides precise latitude and longitude coordinates to the microcontroller. In this project, the GPS module helps in tracking the vehicle's position and sending the location details to emergency contacts during an accident. The data from the GPS is processed by the ESP32 and transmitted through the GSM/A9G module for alert messaging. It offers high accuracy, low power consumption, and continuous location updates. This feature enables quick response and rescue operations, enhancing the system's efficiency in accident reporting and safety monitoring.

LCD Display:

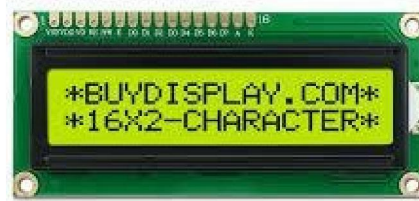


Fig7. LCD Display

The L298N motor driver is a dual H-bridge driver module used to control the direction and speed of DC motors. It acts as an interface between the ESP32 microcontroller and the vehicle's motor by amplifying the control signals to drive high-current motors. In this project, the motor driver is utilized for vehicle movement control, such as stopping the motor when drowsiness or an accident is detected. It can control two DC motors independently and supports both forward and reverse motion. The L298N module is efficient, reliable, and easy to interface, making it ideal for embedded and automation applications.

High vtg generator:



Fig8: High Vtg Generator



The Integrated Tactical Patrol Stick (ITPS) includes a high voltage generator designed to provide a safe and controlled output for applications such as the stun functionality or signaling devices. The module is based on a compact DC-DC boost converter circuit, which steps up the battery voltage from the 3S 18650 pack (nominal 11.1 V) to a high voltage output suitable for operational use. The generator incorporates protective components such as resistors, capacitors, and diodes to ensure stable voltage delivery and prevent damage to the connected circuitry. The output voltage and current are carefully limited to meet safety standards while providing sufficient effectiveness for defensive or signaling purposes.

IV. RESULT

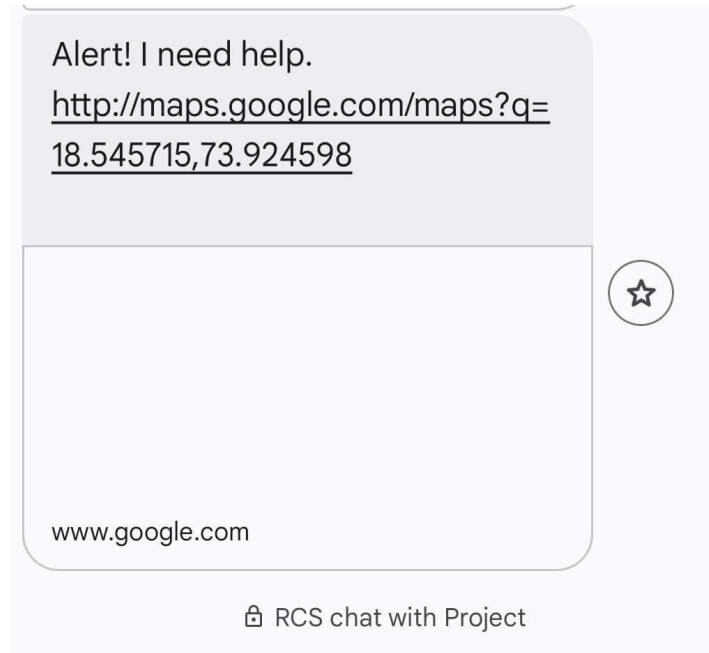


Fig9. Result1 SMS

V. DISCUSSIONS

The development of the Integrated Tactical Patrol Stick (ITPS) demonstrates the effectiveness of combining multiple functionalities into a single, compact device for security applications. By integrating GPS tracking, GSM communication, battery monitoring, and field tools such as an LED torch, laser indicator, buzzer, and high voltage generator, the ITPS provides enhanced situational awareness and rapid response capabilities for security personnel operating in high-risk environments. Testing and evaluation of the prototype indicate that the system can reliably transmit location updates and emergency alerts to the control room through the SIM800L GSM module, even in areas with moderate network coverage. The NEO-6M GPS module provides accurate positioning, which allows the control room to monitor patrol routes and ensure guard safety in real-time. The inclusion of a Robu-in/Havoc 3S 18650 battery indicator board, along with solar and DC charging options, ensures uninterrupted operation and energy efficiency during extended field deployment. The modular design of ITPS allows easy integration of additional features in the future, such as biometric authentication, environmental sensors, or remote data logging. Moreover, the multifunctionality of the device reduces the need for multiple standalone tools, thereby increasing portability and operational convenience. Overall, the ITPS prototype validates the concept of a multifunctional, energy-efficient, and reliable security device. Its performance demonstrates the potential for wider adoption in modern security and surveillance operations, improving both the safety of personnel and the efficiency of monitoring systems.



VI. CONCLUSION

The Integrated Tactical Patrol Stick (ITPS) successfully demonstrates a multifunctional approach to enhancing the safety and operational efficiency of security personnel. By combining GPS tracking, GSM communication, battery monitoring, and practical field tools such as an LED torch, laser indicator, emergency buzzer, and high voltage generator into a single portable device, ITPS provides a compact and reliable solution for modern security challenges. The prototype testing confirms that the system can deliver accurate real-time location tracking, reliable two-way communication, and quick emergency alert responses, ensuring better coordination between field personnel and the control room. The integration of a 3S 18650 battery pack with monitoring and dual charging options allows uninterrupted operation, while the modular design supports future expansion of features. Overall, ITPS addresses the limitations of conventional patrol equipment by providing a unified, energy-efficient, and user-friendly device. The project demonstrates the potential for significant improvements in security operations, reducing response times, enhancing situational awareness, and ensuring personnel safety in high-risk environments.

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