IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, January 2026
Impact Factor: 7.67

Intelligent Backpack : A Smart Companion for Personal Safety and Security

Prof. Naveenkumar H[1], Ms. Affifah H[2], Ms. Aishwarya S Raibagi[3], Ms. Kavyashree E[4]
[1] Professor, CS&E Dept, Proudhadevaraya Institute of Technology, Hosapete
[2345] Students, CS&E Dept, Proudhadevaraya Institute of Technology, Hosapete

Abstract: *Personal safety has become a significant concern in today's society, especially for students, women, and daily commuters. Technological advancements in the Internet of Things (IoT) provide effective solutions for enhancing personal security through smart wearable systems. This project presents the design and development of an* ***Intelligent Backpack****, a smart companion aimed at improving personal safety and security. The proposed system integrates a microcontroller with multiple sensors, a GPS module, and a communication module to detect emergency situations such as distress, unauthorized bag removal, or suspicious activity.*

Keywords*:* Intelligent Backpack, Personal Safety, IoT, GPS Tracking, Emergency Alert System, Smart Wearable Device, Sensors, GSM Communication, Security System

I. INTRODUCTION

In today's world, personal safety and security have become major concerns due to increasing incidents of theft, emergencies, and health-related risks in public and private spaces. To address these challenges, the proposed project—Intelligent Backpack for Personal Safety and Security—is developed as an IoT-based smart safety system that integrates multiple sensors and communication technologies to protect individuals and their belongings. This backpack acts as an intelligent companion that not only safeguards the user's possessions but also ensures continuous monitoring of the user's well-being.

By integrating security, health monitoring, live streaming, and emergency communication into a single portable unit, the Intelligent Backpack provides a comprehensive solution for personal safety. It aims to act as a smart, reliable, and user-friendly companion that ensures convenience, enhances protection, and promotes confidence in everyday activities.

II. LITERATURE SURVEY

Recent research and student-driven prototypes on smart bags and intelligent backpacks highlight the growing importance of personal safety and security using Internet of Things (IoT) technologies. Several studies have proposed smart backpacks integrated with GPS and GSM modules to enable real-time location tracking and emergency alert systems, primarily targeting the safety of school children, women, and daily commuters. These systems typically use microcontrollers such as Arduino or NodeMCU along with panic buttons to send distress messages containing location details to predefined contacts. Some works extend functionality by incorporating sensors such as accelerometers, vibration sensors, infrared or ultrasonic sensors to detect abnormal movements, forced bag removal, or proximity threats, thereby enhancing immediate threat awareness. A few prototypes also include audible alarms, LEDs, or vibration motors to deter attackers and alert nearby people. Recent literature on wearable and near-sensor architectures emphasizes the need for low-power sensor integration, efficient data processing, and compact system design, which are critical for backpack-based wearable devices.

DOI: 10.48175/IJARSCT-31016

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, January 2026
Impact Factor: 7.67

III. OBJECTIVES

The detailed objectives of this project are as follows:

1. To design and implement a smart backpack using Arduino Mega and ESP32-CAM:

The main goal is to create an embedded system-based intelligent backpack that integrates multiple modules such as sensors, cameras, and alarms for enhanced security and usability.

2. To provide secure access through fingerprint and password authentication:

The project aims to prevent unauthorized access by incorporating biometric (fingerprint) and password-based authentication systems, ensuring that only the rightful owner can open or use the backpack.

3. To monitor vital health parameters using sensors:

Heartbeat and temperature sensors are included to continuously monitor the user's health status. These readings can be displayed on an LCD and transmitted to connected devices for tracking and emergency alerts.

IV. METHODOLOGY

The development of the intelligent backpack follows a structured methodology to ensure accuracy, reliability, and efficiency at every stage.

1. Hardware Integration:

All electronic components such as sensors, GSM module, ESP32-CAM, relay, and LCD display are interfaced with Arduino Mega 2560. Proper circuit design and wiring are carried out to ensure stable operation and avoid interference.

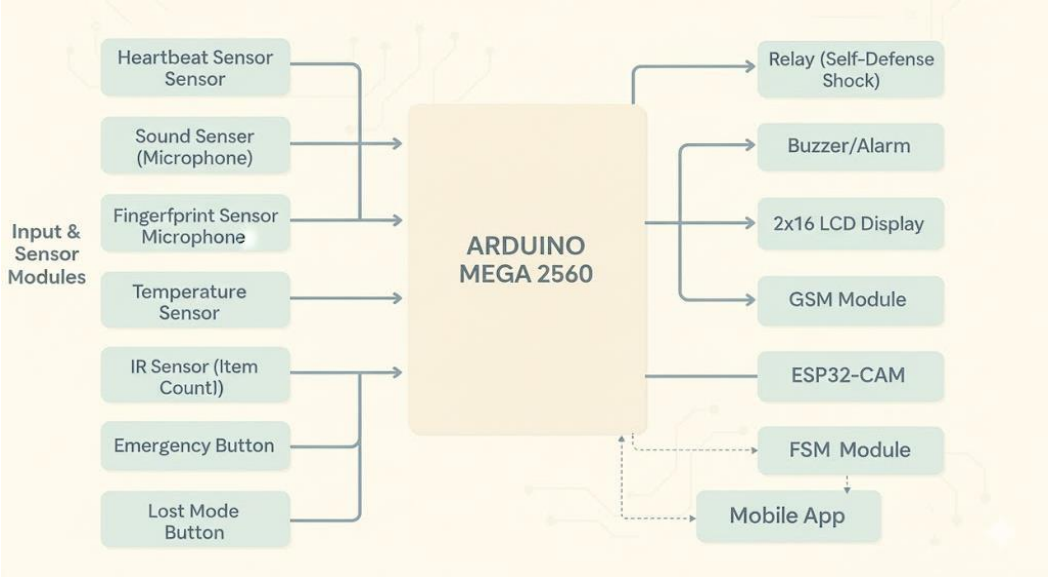
2. Software Development:

Embedded C/C++ code is developed using the Arduino IDE to control sensors, handle authentication, monitor physiological data, and manage communication with other modules. Separate firmware is programmed for ESP32-CAM for live streaming functionality.

3. Communication Setup:

The GSM and GPS modules are configured for sending SMS alerts and real-time location data. The ESP32-CAM is connected over Wi-Fi for video transmission to the mobile app, while serial communication is established between the camera and Arduino Mega.

V. BLOCK DIAGRAM



IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, January 2026
Impact Factor: 7.67

VI. RESULTS AND DISCUSSION

The main objective of the testing phase was to verify the performance of all hardware and software components, ensure accurate sensor readings, and validate the communication between modules such as Arduino Mega, ESP32-CAM, GPS, and GSM. Each feature was tested individually and then integrated to evaluate the system's overall functionality.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, January 2026
Impact Factor: 7.67

VII. CONCLUSION

The Intelligent Backpack for Personal Safety and Security successfully integrates multiple technologies to ensure enhanced safety, real-time monitoring, and convenience for users. By combining hardware components such as the Arduino Mega and ESP32-CAM with smart sensors and IoT functionalities, the system provides a reliable solution for both personal and professional use. The incorporation of fingerprint and password authentication ensures restricted access, while the GPS module and alert message system enhance tracking and communication during emergencies.

VIII. FUTURE SCOPE

The intelligent backpack has significant potential for further improvement and real-world application. In the future, the system can be enhanced by integrating advanced IoT and AI-based features to make it more autonomous and efficient. Machine learning algorithms can be incorporated to analyze the user's behavioural patterns, automatically detect unusual activities, and adapt the system's response accordingly.

REFERENCES

[1]. S. K. Anisha, S. Chandana, J. J. Teresa, S. Varma and M. N. Thippeswamy, "Women's Wearable Security and Safety Device," Int. J. of Recent Technology & Engineering (IJRTE), Vol.9,Issue 4, Nov. 2020. [Online]. Available:https://www.researchgate.net/publication/363565504_Women%27s_Wearable_Security_and_Safety_Device ResearchGate

[2]. N. Penchalaiah, M. Susmitha, C. Vinay Kumar Reddy, D. V. Pavan Kalyan Rao and D. Sreelekha, "An IoT Based Smart Wearable Device for Women Safety," Int. Research Journal on Advanced Science Hub (IRJASH), Vol. 3, Special Issue, May 2021. [Online]. https://www.researchgate.net/publication/354701713_An_IoT_Based_Smart_Wearable_Device_for_Women_Safety ResearchGate

[3]. K. B. Sk, "Intelligent Travel Companion: The IoT-Enabled Smart Bag," Int. J. of Modern Technology & Science (IJMTST), Vol. 10, Issue 2, Feb. 2024. [Online]. Available: https://ijmtst.com/volume10/issue02/10zIJMTST1002030.pdf ijmtst.com