International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 05 | May 2026 www.irjet.net p-ISSN: 2395-0072

DESIGN AND FABRICATION OF GPS INTEGRATED TRACKING SMART SAFETY BAND FOR PERSONAL SAFETY PROTECTION DURING ON BOARD

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ABSTRACT-*Maritime Guardian is an innovative GPS-enabled smart band designed to enhance maritime safety and personal tracking for a crew members and passengers at sea. It integrates several safety features to prevent accidents, locate individuals in emergencies, and enhance communication during maritime travel. This wearable device integrates multiple sensors and technologies to provide real time monitoring of individuals' vital signs, location, and environmental conditions. In emergency situations, such as man-overboard incidents or entrapment in enclosed spaces, the smart band sends distress signals to nearby vessels and shore-based authorities, facilitating rapid response and rescue operations. This project aims to improve maritime safety, reduce response time, and enhance overall well-being for individuals at sea.*

Keywords: Maritime safety, Personal tracking, GPS, Wearable technology, Smart band, Emergency response, Man-overboard, Enclosed space entry.

1. INTRODUCTION

The maritime industry is a vital component of global trade and commerce, with millions of people employed on ships and vessels worldwide. However, the maritime environment poses unique safety risks, including man-overboard incidents, entrapment in enclosed spaces, and exposure to hazardous environmental conditions. Existing safety measures, such as personal locator beacons (PLBs) and emergency position-indicating radio beacons (EPIRBs), have limitations in terms of accuracy, response time, and functionality.

To address these challenges, this project aims to design, develop, and test a GPS-enabled smart band which is specifically designed for maritime safety and personal tracking. The Maritime Guardian smart band integrates multiple sensors and technologies.

This project seeks to contribute to the improvement of maritime safety and reduce the risk of accidents and injuries by providing a reliable, accurate, and user-friendly safety solution.

1.1 Working of Maritime Guardian

1.1.1 System Workflow

Data Acquisition: The smart band collects data from various sensors and transmits it to the central monitoring system. The central monitoring system processes the received data, analyzes it, and identifies potential safety risks. In emergency situations, the central monitoring system sends alerts and notifications to authorities, emergency responders, and designated contacts. The central monitoring system provides real-time tracking and monitoring of the smart band's location and vital signs. In emergency situations, the central monitoring system dispatches emergency responders and provides critical information to facilitate rapid response and rescue operations.

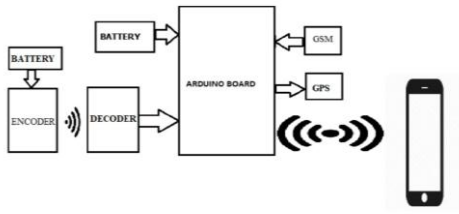

Figure 1- worinking principle of the GPS integrated tracking smart safety band

1.1.2 Control Interface on Ship

A high-resolution display screen that shows real-time data from the GPS-enabled smart bands, including location, vital signs, and safety status. Alert and Notification System alerts and notifies crew members and emergency responders in case of an emergency or safety risk. Tracking and Monitoring System allows crew members to track and monitor the location and safety status of other crew members and passengers in real-time. Emergency Response Button that crew members can press to initiate an emergency response in case of a safety risk or emergency. Communication System allows crew members to communicate with each other and with emergency responders in case of an emergency.

1.1.3 Command and data transmission

The GPS module collects location data, including latitude, longitude, altitude, and velocity. The smart band's sensors collect data on vital signs, such as heart rate, blood oxygen levels, and body temperature. The microcontroller processes the collected data and prepares it for transmission. The communication module transmits the processed data to the central monitoring system via cellular, satellite, or Wi-Fi connectivity. The central monitoring system receives the transmitted data and processes it for real-time tracking, monitoring, and emergency response. The central monitoring system transmits commands to the smart band, such as configuration updates or emergency response instructions. The smart band receives the transmitted commands and executes them accordingly.

1.1.4 Real-Time Monitoring and Feedback Workflow

The GPS module, sensors, and environmental sensors collect data in real-time.The microcontroller processes the collected data and analyzes it for potential safety risks.If a potential safety risk is detected, the microcontroller triggers an alert and notification to the wearer and the central monitoring system.The display screen, vibration motor, audio speaker, and LED indicators provide real-time feedback to the wearer.

2. COMPONENTS NEEDED

2.1 Hardware Components

- GPS Module: Provides location information and tracking data.
- Microcontroller: Controls the smart band's functions and processes data.
- Accelerometer and Gyroscope: Detects movement, orientation, and impact.
- Heart Rate and Blood Oxygen Sensors: Monitors vital signs.
- EnvironmentalSensors: Tracks temperature, humidity, and air quality.
- Communication Module: Enables wireless communication with the central monitoring system.
- Battery and Power Management: Provides power to the smart band and manages power consumption.
- Waterproof and Durable Housing: Protects the smart band from harsh maritime environments.

2.2 Software Components

- Firmware: Controls the smart band's hardware components and data acquisition.
- Maritime Guardian App: Provides a user-friendly interface for device configuration, data visualization, and emergency response.
- Central Monitoring System: Receives and processes data from the smart band, alerts authorities in emergency situations, and provides real-time tracking and monitoring.
- Data Analytics and Machine Learning Algorithms: Analyzes data from the smart band and provides insights on maritime safety and personal tracking.

2.3 Connectivity and Communication Components

- Cellular Connectivity: Enables communication with the central monitoring system via cellular networks.
- Satellite Connectivity: Enables communication with the central monitoring system via satellite networks in areas with limited or no cellular coverage.
- Bluetooth and Wi-Fi Connectivity: Enables communication with nearby devices and the central monitoring system via Bluetooth and Wi-Fi networks.

2.4 Power and Battery Components

- Battery: Provides power to the smart band.
- Power Management Unit: Manages power consumption and optimizes battery life.
- Solar Charging: Recharges the battery using solar power.

2.5 Durability and Waterproofing Components

- Waterproof Housing: Protects the smart band from water and moisture.
- Durable Materials: Ensures the smart band can withstand harsh maritime environments.
- Shock and Vibration Resistance: Ensures the smart band can withstand physical stress and impacts.

3. CYBER SECURITY MEASURES

3.1 Hardware Security Measures

Utilize a secure microcontroller that incorporates hardware-based security features, such as encryption and secure boot mechanisms. Design the smart band with tamper-proof features to prevent unauthorized physical access to the device. Implement secure communication interfaces, such as encrypted Bluetooth or Wi-Fi, to protect data transmitted between the smart band and the central monitoring system.

3.2 Software Security Measures

Developing secure firmware that incorporates encryption, secure boot mechanisms, and secure software updates. Encrypt all data transmitted between the smart band and the central monitoring system, as well as data stored on the device. Implementation of secure authentication

mechanisms, such as multi-factor authentication, to prevent unauthorized access to the smart band and the central monitoring system. Regularly update the smart band's firmware and software to ensure that any known vulnerabilities are patched.

3.3 Network Security Measures

Utilization of secure communication protocols, such as Transport Layer Security (TLS) or Secure Sockets Layer (SSL), to protect data transmitted between the smart band and the central monitoring system and Configure firewalls to restrict incoming and outgoing traffic to only necessary ports and IP addresses. Implementation of intrusion detection and prevention systems to detect and prevent potential cyber threats.

3.4 Data Security Measures

Encryption of all data stored on the smart band and the central monitoring system. Regularly backup data and implement a disaster recovery plan to ensure business continuity in the event of a cyber-attack or data loss.

3.5 User Security Measures

Implementation of secure user authentication mechanisms, such as multi-factor authentication, to prevent unauthorized access to the smart band and the central monitoring system and role-based access control, to restrict access to sensitive data and features.

4. SAFETY FEATURES AND BENEFITS OF MARITIME GUARDIAN

4.1 Safety Features

The smart band detects if the wearer has fallen overboard and sends an alert to the central monitoring system. It has an integrated Emergency Position Indicating Radio Beacon (EPIRB) that sends a distress signal to emergency responders in the event of an emergency. It also has an SOS button that allows the wearer to send a distress signal to the central monitoring system in emergency situations.

4.2 Benefits

The smart band enhances maritime safety by providing real-time tracking and monitoring of crew members and passengers. it facilitates rapid response and rescue operations in emergency situations and automates many tasks, such as tracking and monitoring, freeing up crew members to focus on other critical tasks.

5. SECURITY CONSIDERATION

5.1 Physical Security

This device ensuring that is designed to prevent tampering and unauthorized access and withstand harsh maritime environments. It also stores sensitive data, such as encryption keys and personal identifiable information, securely within the device.

5.2 Data Security

This device encrypt all data transmitted between the device and the central monitoring system by using secure communication protocols, such as TLS or SSL, to protect data transmitted between the device and the central monitoring system. It access control mechanisms, such as role-based access control, to restrict access to sensitive data.

5.3 Network Security

This device Configure firewalls to restrict incoming and outgoing traffic to only necessary ports and IP addresses by using secure network protocols, such as HTTPS or SFTP. It also implements intrusion detection and prevention systems to detect and prevent potential cyber threats.

5.4 Software Security

Ensure the device's firmware is secure and up-to-date. By implementing secure software update mechanisms, prevent unauthorized access or malicious code execution.

5.5 User Security

By implementing secure user authentication mechanisms, such as multi-factor authentication and role-based access control, prevent unauthorized access to the device and restrict access to sensitive data and features.

6. CONCLUSION

The GPS-enabled smart band designed specifically for maritime safety and personal tracking has the potential to revolutionize the way we approach maritime safety. By providing real-time tracking, monitoring, and emergency response capabilities, this device can help prevent accidents, reduce response times, and improve overall safety for maritime personnel and passengers. The device's ability to detect falls, impacts, and other safety risks, and to automatically send alerts to emergency responders, can help ensure that help arrives quickly in emergency situations. Additionally, the device's ability to track vital signs, such as heart rate and blood oxygen levels, can help identify potential health risks before they become major issues.

While there are potential challenges and limitations to the adoption of this technology, including cost, user acceptance, and regulatory compliance, the benefits of improved maritime safety and personal tracking make it an important innovation worth exploring further. Ultimately, the GPS-enabled smart band designed specifically for maritime safety and personal tracking has the potential to save lives, reduce injuries, and improve overall safety for maritime personnel and passengers. As the maritime industry continues to evolve and grow, innovations like this will play an increasingly important role in ensuring the safety and well-being of those who work and travel at sea.

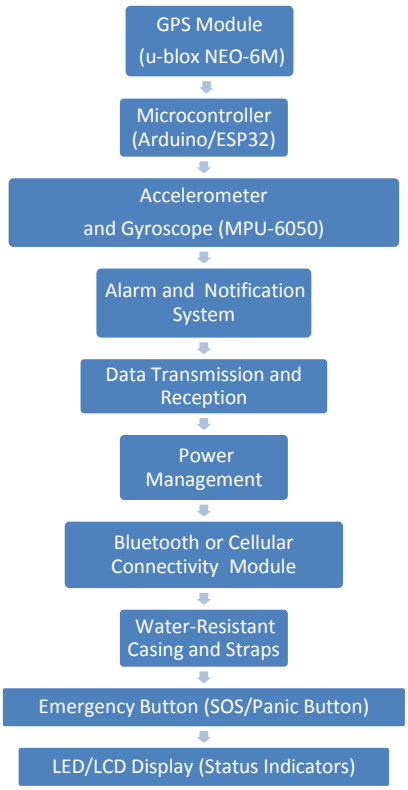

Figure 2- flowchart of GPS integrated tracking smart safety band

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