IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, April 2024

IoT Based Mountain Climber Health and Position Tracker

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Abstract: *In extreme and remote environments like mountain climbing, safeguarding climbers' safety and health is of utmost importance. This project proposes an innovative IoT-based system designed specifically for monitoring mountain climbers' health and tracking their positions. The system utilizes a combination of sensors including the MAX30102 Pulse Oximeter for continuous health monitoring, the Neo6M GPS Module for accurate location tracking, and the MPU6050 Accelerometer and Gyroscope for motion sensing.The central processing unit of this system is the Node MCU ESP8266, which efficiently collects data from these sensors and transmits it to a designated server or cloud platform. In the event of emergencies or critical health conditions, the system is capable of automatically initiating distress signals or alerts to designated contacts via popular online messaging platforms like Telegram.The primary objective of this IoT-based mountain climber health and position tracker system is to provide real-time monitoring and data analysis, thereby significantly enhancing the safety, performance, and overall experience of mountain climbers. By continuously monitoring vital health parameters and tracking precise geographical locations, the system ensures timely intervention in case of emergencies, facilitating prompt rescue operations and improving overall risk management in challenging mountainous environments.This project represents a crucial advancement in leveraging IoT technologies to address safety concerns in mountain climbing, offering a comprehensive solution that integrates sensor data with cloud-based communication to optimize climbers' safety and well-being during their expeditions.*

Keywords: Mountain, Oximeter, GPS, Telegram, IoT

I. INTRODUCTION

Our research titled "IOT BASED MOUNTAIN CLIMBER HEALTH AND POSITION TRACKER" integrates cutting-edge technologies to create a sophisticated system in remote and extreme environments such as mountain climbing, ensuring the safety and well-being of climbers remains a primary concern. The challenges posed by such environments necessitate innovative solutions that leverage technology to mitigate risks and enhance overall safety. In response to this imperative, we propose the development of an IoT-based mountain climber health and position tracking system.The objective of this project is to design and implement a comprehensive system that integrates advanced sensor technologies with IoT capabilities. This system will utilize specialized sensors tailored for mountainous conditions, including the MAX30102 Pulse Oximeter for continuous health monitoring, the Neo6M GPS Module for precise location tracking, and the MPU6050 Accelerometer and Gyroscope for motion detection and orientation sensing. These sensors will be integrated into a cohesive framework facilitated by the Node MCU ESP8266, which will act as the central processing unit responsible for data aggregation and transmission. The primary functionality of the system revolves around real-time monitoring and analysis of critical health parameters and positional data of climbers. By collecting and processing data from the integrated sensors, the system will provide valuable insights into the climber's physiological state and their geographical location throughout their ascent. Moreover, the system will be equipped with automated alert mechanisms designed to respond to emergencies promptly. In the event of critical health conditions or distress situations, the system will trigger immediate alerts to designated contacts via online messaging platforms like

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Telegram. This rapid communication capability ensures timely intervention and assistance, potentially mitigating severe outcomes in challenging circumstances.

II. PROPOSED BLOCK DIAGRAM

Our idea titled "IoT-based mountain climber health and position tracker" proposed for remote and challenging environments like mountain climbing is designed with a focus on ensuring the safety and well-being of climbers. This innovative system integrates several essential components to provide comprehensive monitoring and emergency response capabilities.

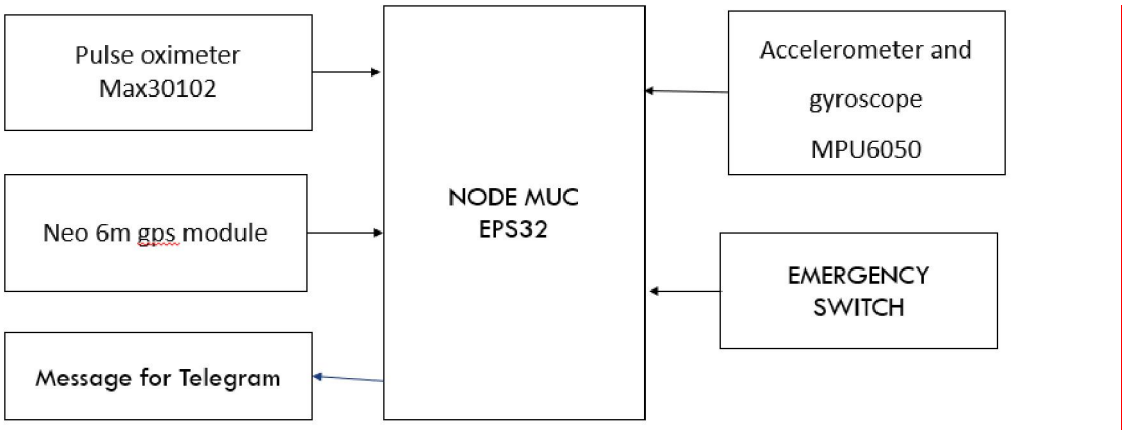

Fig. 1. Proposed Block Diagram

At the core of this system is the Node MCU ESP8266, which acts as the central processing unit responsible for collecting and processing data from a range of integrated sensors. These sensors include the MAX30102 Pulse Oximeter for continuous health monitoring, enabling real-time measurement of vital signs such as blood oxygen saturation levels and heart rate. Additionally, the system incorporates the Neo6M GPS Module to accurately track the climber's location throughout their journey, crucial for providing precise positioning information especially in emergency situations. To enhance motion sensing and activity monitoring, the system integrates the MPU6050 Accelerometer and Gyroscope. These sensors detect movements, orientation changes, and acceleration, contributing to a comprehensive understanding of the climber's physical activities and conditions. The collected data from these sensors is processed and transmitted by the Node MCU ESP8266 to a designated server or cloud platform. This data transmission enables real-time monitoring and analysis, empowering remote observers or designated contacts to track the climber's progress and receive immediate alerts in case of emergencies or critical health conditions. A key feature of this system is its ability to automatically trigger distress signals or alerts via online messaging platforms like Telegram when predefined thresholds or abnormal conditions are detected. This proactive alerting mechanism ensures timely response and assistance, significantly improving the safety, performance, and overall experience of mountain climbers operating in challenging and unpredictable environments.

III. METHODOLOGY USED

Our methodology described below, outlines a systematic approach to developing and implementing an IoT-based mountain climber health and position tracker system. Through this method, the system aims to enhance safety, performance, and overall experience for mountain climbers operating in remote and challenging environments.

1. Sensor Integration and Data Collection

Sensor Selection: Careful consideration was given to selecting sensors suitable for mountain climbing conditions, including the MAX30102 Pulse Oximeter for health monitoring, Neo6M GPS Module for location tracking, and MPU6050 Accelerometer and Gyroscope for motion sensing.

Hardware Configuration: These sensors were integrated with the Node MCU ESP8266 microcontroller for data collection and processing.

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Data Collection Protocol: The Node MCU ESP8266 continuously gathers sensor data, including vital signs (heart rate, blood oxygen levels), geographical coordinates, and motion metrics.

2. Data Transmission and Connectivity

IoT Connectivity: Utilizing Wi-Fi connectivity, the Node MCU ESP8266 securely transmits the collected data to a designated server or cloud platform.

Data Encryption: To ensure data security and integrity during transmission, encrypted protocols are employed.

3. Real-Time Monitoring and Analysis

Cloud Integration: Data is stored and processed on a cloud-based platform, facilitating real-time monitoring.

Dashboard Development: A user-friendly dashboard interface was developed to display live data streams and historical trends.

Alert Mechanisms: Customized algorithms detect anomalies or emergencies based on sensor data, triggering immediate alerts.

4. Emergency Response System

Distress Signal Generation: In critical situations such as sudden health issues or distress, the system automatically initiates distress signals.

Messaging Integration: Integration with online messaging platforms like Telegram enables instant notifications to designated contacts and emergency services.

5. System Testing and Validation

Field Testing: The system underwent rigorous testing in simulated and real mountain environments.

Performance Evaluation: Comprehensive performance tests were conducted to assess reliability, accuracy, and responsiveness.

User Feedback Incorporation: Feedback from mountain climbers and experts was used to refine the system's functionality and user interface.

6. Continuous Improvement and Updates

Iterative Development: Ongoing updates and improvements are implemented based on feedback and emerging technologies.

Scalability Considerations: The system is designed to accommodate future enhancements and scalability to support larger deployments or additional functionalities.

IV. SYSTEM OVERVIEW

The proposed system i.e."IOT BASED MOUNTAIN CLIMBER HEALTH AND POSITION TRACKER" consists of several sensors and controller which are listed below with the overview of their specification–

- ESP32(Microcontroller)
- GPS NEO-6M
- Accelerometer

ESP 32 WIFI -

The ESP 32 is a versatile and widely-used development board renowned for its compact size and powerful features. It serves as an essential tool in the IoT (Internet of Things) and embedded systems development.

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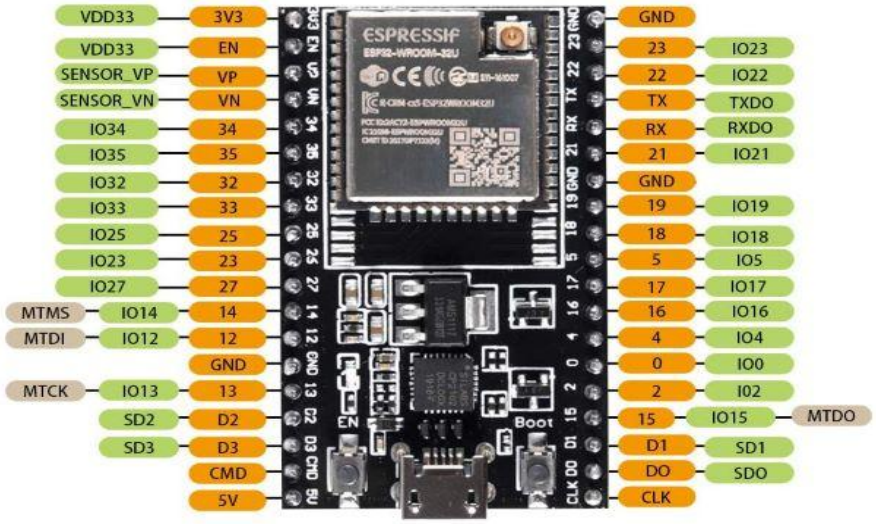

Fig.2. System component – ESP 32 Wifi

It is an integrated development board built around the microcontroller module, designed to facilitate the rapid prototyping of IoT projects and embedded systems. At its core, the microcontroller boasts a 32-bit Tensilica Xtensa LX106 processor, clocked at speeds of up to 80MHz (with the possibility of overclocking to 160MHz), rendering it capable of handling a wide range of tasks with remarkable efficiency.

One of the most notable features of the is its built-in Wi-Fi connectivity, which enables seamless communication with local networks and the internet. This functionality allows devices built with the to interact with online services, exchange data with remote servers, and participate in IoT ecosystems. The board supports the 802.11 b/g/n Wi-Fi standards, ensuring compatibility with most modern wireless networks.

In terms of connectivity, the provides a plethora of GPIO (General Purpose Input/Output) pins, offering flexibility for interfacing with various sensors, actuators, and peripheral devices. These GPIO pins support digital input/output operations, analog input measurements, and PWM (Pulse Width Modulation) output control, enabling a widerange of applications.

GPS NEO-6M -

One of the global positioning system (GPS) devices utilizes data from satellites to locate a specific point on the Earth in a process named trilateration.

Meanwhile, a GPS receiver measures the distances to satellites using radio signals to trilateration. And trilateration is similar to triangulation, which measures angles, depicted in this illustration (Tim Gunther, 2020). GPS modules contain tiny processors and antennas that directly receive data sent by satellites through dedicated RF frequencies.

From there, it'll receive timestamp from each visible satellites, along with other pieces of data. If the module's antenna can spot 4 or more satellites, it's able to accurately calculate its position and time.

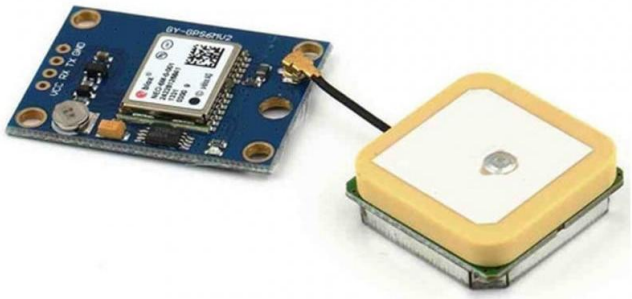

Fig.3. System component – GPS NEO 6M

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The four well-known Global Navigation Satellite System include GPS, BDS(Beidou), GLONASS and GALILEO four satellite navigation systems.

The earliest appeared in the United States is GPS (Global Positioning System), which is the most complete technology at this stage. BDS, GLONASS and GALILEO have become the other largest satellite navigation systems in the world and are currently in the process of modernization.

Accelerometer MPU6050

The MPU6050 is a highly versatile motion tracking device that combines a 3-axis accelerometer and a 3-axis gyroscope in a single chip. This compact and efficient sensor module is widely used in various applications, ranging from consumer electronics to industrial systems and robotics. The accelerometer component of the MPU6050 measures static acceleration due to gravity and dynamic acceleration caused by motion or vibration. It provides precise information about the orientation and inclination of an object in real-time. Additionally, the integrated gyroscope detects angular velocity and rotational movements with exceptional accuracy, making it invaluable for applications requiring motion sensing and stabilization. One key feature of the MPU6050 is its ability to perform sensor fusion using an onboard Digital Motion Processor (DMP). This DMP seamlessly combines data from the accelerometer and gyroscope to provide accurate motion tracking and orientation estimation, reducing the computational load on the main microcontroller. This sensor fusion technique enables precise motion sensing in complex environments, enhancing the stability and responsiveness of systems that rely on motion control.

Moreover, the MPU6050 offers flexible communication interfaces, supporting both I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface) protocols for seamless integration with various microcontrollers and systems. This versatility simplifies the integration process and enhances compatibility across different platforms. The MPU6050 is also equipped with configurable settings for sensitivity and sampling rate, allowing users to optimize performance based on specific application requirements.

In practical terms, the MPU6050 is employed in diverse applications such as inertial navigation systems, gesture recognition interfaces, virtual reality devices, and motion-controlled gaming consoles. Its compact size, low power consumption, and robust performance make it an ideal choice for projects where accurate motion tracking and orientation sensing are essential. Overall, the MPU6050 accelerometer and gyroscope module continues to be a popular solution for motion-based applications, offering exceptional reliability and performance in a compact and cost-effective package.

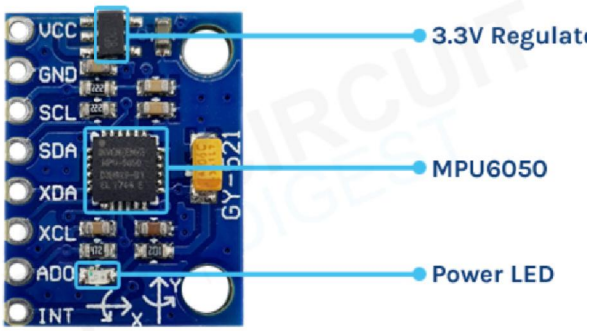

Fig.4. System component – MPU6050

V. CONCLUSION

In conclusion, the proposed IoT-based mountain climber health and position tracker system represents a significant advancement in addressing safety concerns for climbers in remote and challenging environments. By integrating cutting-edge sensor technologies such as the MAX30102 Pulse Oximeter, Neo6M GPS Module, and MPU6050 Accelerometer and Gyroscope with the Node MCU ESP8266, we have developed a comprehensive solution for real-time health monitoring and location tracking. This system not only ensures continuous monitoring of climbers' vital signs and positions but also leverages advanced data processing capabilities to detect and respond to emergencies

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promptly. The integration with online messaging platforms like Telegram enables immediate alerts to designated contacts in critical situations, enhancing response times and potentially saving lives. By harnessing IoT technologies, our system aims to enhance the safety, performance, and overall experience of mountain climbers by providing valuable insights into their health and whereabouts. The real-time data analysis capability opens new avenues for proactive intervention and personalized support, ultimately contributing to a safer and more enjoyable climbing experience in remote environments. In summary, the IoT-based mountain climber health and position tracker system represents a vital step forward in leveraging technology to mitigate risks and ensure the well-being of climbers. This innovative solution has the potential to revolutionize safety practices in mountain climbing, setting a new standard for expedition monitoring and emergency response in challenging terrains.

VI. ACKNOWLEDGMENT

With great pleasure, I am indebted, especially to my project guide Prof. Dipanjali Padhi, for her long-lasting encouragement, close supervision, enlightening and valuable guidance. It would have not been attainable to bring out this project without his valuable timely guidance and constant encouragement. I would like to express my deep thanks to Dr. B.E. Shinde, Professor and Head of the Department of E&TC Engineering for their valuable suggestions for this project work. I would like to express my deep gratitude to Dr. Omprakash Rajankar, Principal of Dhole Patil College of Engineering, Pune for their continued support for this project work. I would like to express special thanks to the Management of Dhole Patil College of Engineering Pune for providing the required infrastructure and facilities during this project work.

I would like to thank all Teaching and Non-Teaching Staff members of the E&TC Engineering department and my friends for helping me directly or indirectly during the completion of my Project.

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