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IoT-Based Mountain Climbing Health and GPS Tracker

MID TERM REPORT

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Under the Guidance of

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Abstract

Mountaineering is an adventurous yet risky activity, especially in remote Himalayan regions where health emergencies and connectivity issues can lead to severe consequences. Climbers and trekkers often face altitude sickness, hypothermia, dehydration, or disorientation. In India, such challenges are intensified by limited infrastructure and delayed rescue response times.

This project proposes a **low-cost IoT-based wearable system** that monitors vital health parameters — **heart rate, SpO_2, and body temperature** — while tracking **real-time GPS coordinates**. The system is built using an **ESP32 microcontroller**, **MAX30102 sensor**, **DS18B20 temperature sensor**, and **NEO-6M GPS module**. Data is transmitted to a mobile interface via the **Blynk app**, which displays real-time readings and generates alerts when abnormal conditions are detected.

The project's novelty lies in its **affordability, simplicity, and educational value**, making it ideal for students, trekkers, and low-budget mountaineering use. The final prototype ensures reliable data acquisition, low power consumption, and real-time tracking suitable for Indian mountain terrains.

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CHAPTER 1: INTRODUCTION

1.1 Overview

Mountaineering and trekking are exciting yet dangerous outdoor pursuits, especially in the rugged terrains of India's Himalayan belt. Climbers face unpredictable challenges such as extreme weather, fatigue, altitude sickness, and loss of direction. These risks, combined with poor communication infrastructure, often delay rescue operations, leading to fatalities.

The integration of **Internet of Things (IoT)** with **health monitoring** and **location tracking** presents an innovative solution. This project aims to design a **wearable IoT system** capable of continuously monitoring a climber's **vital signs** — heart rate, oxygen saturation (SpO_2), and body temperature — along with **real-time GPS coordinates**. Data is processed through the **ESP32 microcontroller** and transmitted to a mobile interface via the **Blynk IoT app**.

1.2 Motivation

Despite advancements in technology, most health and GPS tracking devices available for mountaineering are expensive and not optimized for Indian terrains. Imported systems such as Garmin or SPOT trackers cost between ₹25,000–₹60,000, making them inaccessible for students and budget trekkers.

Hence, a **low-cost, efficient, and user-friendly IoT system** is essential for improving safety and enabling early intervention in emergencies. This project bridges the gap between affordability, accessibility, and real-world usability.

1.3 Scope of Work

The project focuses on developing a **portable, cost-effective device** that integrates **health monitoring** and **location tracking** for mountaineers and trekkers. It is designed to operate efficiently even in **low-connectivity environments**. The system also serves as an educational model for IoT learning, combining sensor interfacing, cloud integration, and mobile application development.

1.4 Purpose

The main purpose is to enhance safety and reduce the time required for rescue operations by providing **real-time health and location data**. Alerts are automatically triggered when readings exceed safe thresholds, ensuring immediate response and awareness.

1.5 Organization of the Report

This report is structured into eight chapters, covering background, design, implementation, results, and future prospect

CHAPTER 2: LITERATURE SURVEY

2.1 Background

IoT-based health monitoring systems have been widely developed using microcontrollers such as Arduino, Raspberry Pi, and ESP32. These systems are commonly used in healthcare for monitoring patient vitals remotely. However, most focus on basic parameters like temperature and heart rate.

2.2 Related Work

Baharudin et al. (2025) developed a GPS-based mountain climber tracker achieving 96% accuracy but faced issues with power backup and cost.

Satyanarayana et al. (2013) proposed a GPS and GPRS-based telemonitoring system for emergency patients; however, it required a stable cellular connection.

Garg et al. (2021) designed a low-power wireless network for mountaineers but lacked automated alert mechanisms.

2.3 Research Gaps

Existing models often ignore **SpO_2 monitoring**, a critical indicator of oxygen deficiency at high altitudes. Other limitations include poor network performance in remote areas, short battery life, and high device cost.

CHAPTER 3: PROBLEM FORMULATION

Despite progress in IoT technology, several challenges persist for climbers and trekkers:

Connectivity Issues: GSM and Wi-Fi networks are unstable or unavailable at high altitudes, making continuous monitoring difficult.

Power Constraints: Cold weather rapidly drains batteries, limiting operational duration.

Affordability: Commercial GPS-health trackers are prohibitively expensive for students and local trekkers.

Incomplete Monitoring: Many systems exclude oxygen level measurement, which is crucial for early detection of altitude sickness.

Problem Statement

There is a pressing need for an **affordable, energy-efficient, and user-friendly IoT-based system** capable of providing **continuous health monitoring**, **real-time location tracking**, and **automated emergency alerts** — particularly designed for the **Indian mountaineering context**.

CHAPTER 4: OBJECTIVES

The primary goal of this project is to develop an IoT-based health and safety monitoring system suitable for climbers and trekkers in remote regions.

Specific Objectives:

Design a compact and efficient IoT device for monitoring **heart**

Integrate **GPS functionality** for real-time location detection.

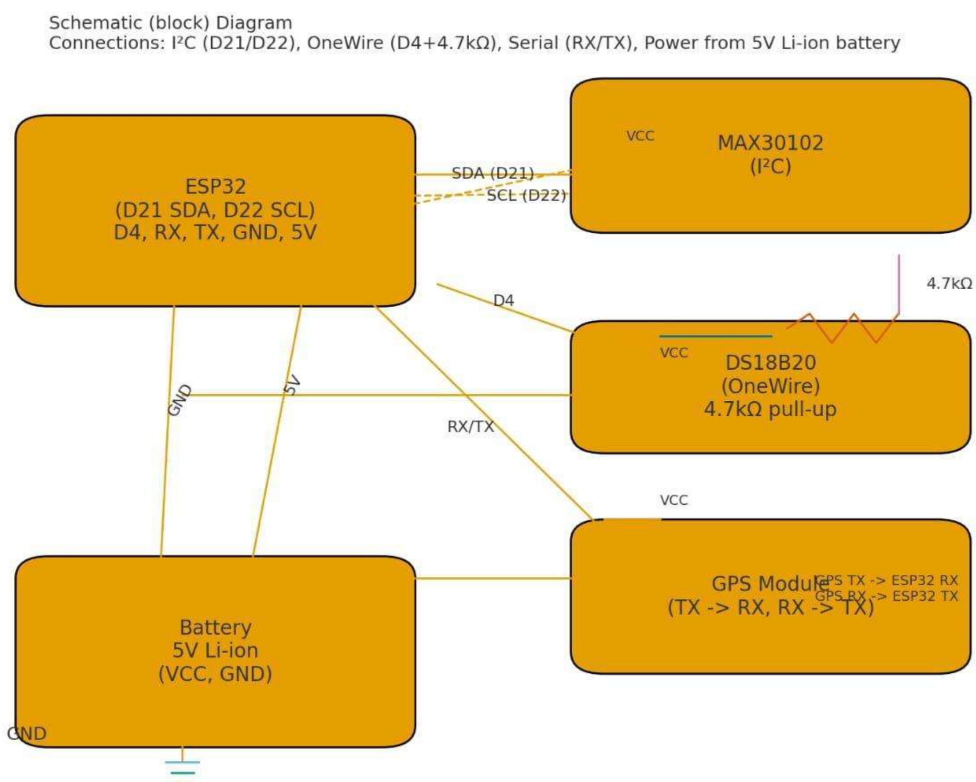
Develop a **mobile-based dashboard** using the **Blynk IoT platform** for data visualization.

Enable **automated alerts** when vitals exceed safety limits.

Ensure **low-cost (<₹2,500)** and **low power consumption** to make it accessible to students and trekkers.

CHAPTER 5: SYSTEM METHODOLOGY & DESIGN

5.1 System Architecture



The system comprises sensors connected to the **ESP32 microcontroller**, which processes and transmits data via Wi-Fi or GSM. It includes:

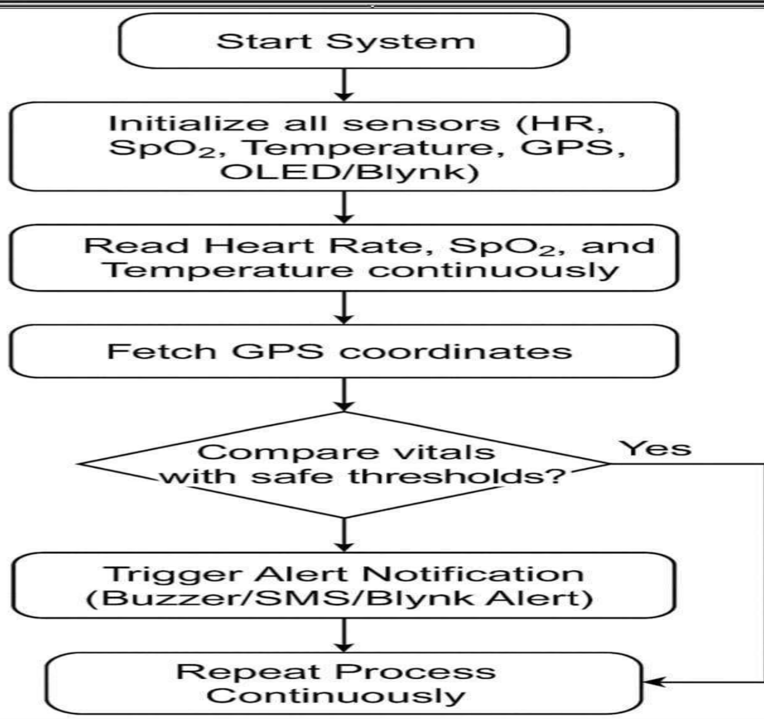
DS18B20 Sensor – Measures body temperature.
NEO-6M GPS Module – Provides latitude and longitude.
Li-ion Battery – Provides portable power supply.

5.2 Circuit Description

The **MAX30102** communicates through the I2C protocol using ESP32 pins D21 and D22.
The **DS18B20** connects via a single digital pin (D4) with a 4.7kΩ pull-up resistor.
The **GPS module** connects through serial pins RX/TX for data transfer.
All components operate at 5V DC, powered by a rechargeable Li-ion battery.

5.3 Data Flow & Working

Sensors collect real-time data (heart rate, SpO_2, temperature).
ESP32 processes the inputs and fetches GPS coordinates.
Data is sent to the **Blynk mobile app** via Wi-Fi.



5.4 Planning of Work

Phase	Duration	Task
I	Week 1 - 2	Study sensors and components
II	Week 3 - 4	Circuit connection and coding

CHAPTER 6: IMPLEMENTATION

The implementation phase converts the planned design into a working prototype. The system was coded in **Arduino IDE**, utilizing libraries for sensor interfacing and Blynk integration.

6.1 Software Implementation

Sensor initialization and calibration.
Data acquisition loop for continuous monitoring.
Threshold-based condition checking.
Real-time updates sent to Blynk via ESP32 Wi-Fi.

6.2 Hardware Integration

All components were mounted on a breadboard and powered by a Li-ion battery. Testing confirmed that the device can operate for up to 12–15 hours per charge.

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