SMART BACKPACK

Higher National Diploma In Software Engineering

IOT Project Proposal

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Chapter 1: Introduction

1.1 Introduction

Backpacks are now crucial to travel, business and education in today's world**. But issues about their effects on health and safety have grown, particularly regarding excessive weight and improper usage. Research shows that people of all ages might have long-term discomfort, bad posture and muscle strain from carrying heavy backpacks**. These issues indicate the requirement for creative fixes to improve user safety and comfort.

The smart backpack integrates modern IOT capabilities like fall detection, water leak monitoring, item tracking, weight monitoring, lost item reminder and inside pressure check to tackle these issues. These are managed by a smart phone application the provides users with safe, well organized, and health-conscious features. This project defines a typical backpack and introduces higher standards for smart and useful accessories.

2. Problem Statement

While backpacks are required for everyday living, carrying too much weight can lead to pain in the muscles. Particularly in younger people, carrying too much weight can lead to bad posture, pain and strained muscles. Long use of heavy backpacks has been related with long-term health problems such as muscular ailments and changed posture, according to studies These challenges highlight the need for creative solutions that put user organization, simplicity and wellness.

3. Proposed Solution

The smart backpack uses IOT technology to tackle organizational and health problems. Fall detection, water leak monitoring, weight monitoring, item tracking for lost item reminder and inside pressure check are some of the key features. These capabilities, paired with a smartphone application, improve user comfort, safety and convenience while redefining backpack utility for modern lifestyles.

Chapter 2: Objectives

Objectives

- Design a smart backpack with IOT capabilities that improve user convenience, safety and health.

- Implement capabilities for inside pressure checks and weight tracking to protect user health

- Reminders for lost items and item tracking could enhance organization.

- integrate features for water leak monitoring and fall detection to provide real-time protection.

- Provides for easy control of backpack capabilities with a smartphone application.

Chapter 3: Methodology

Our project goal is to improve backpack function through using IOT based monitoring systems that capture sensor data for improved usability and safety.

We encourage the use of the following sensors:

- Load cell Sensor - To avoid overloading the load cell sensor weighs the backpack.
- Accelerometer & Gyroscope - Detect the sudden motions and falls.
- RFID Module - Monitors items to avoid losing.
- Moisture Sensor - Identifies water leaks inside the backpack.
- Pressure Sensor - Monitor on the inside and detect the unusual alterations in pressure.

An NodeMCU ESP32 microcontroller is implemented to process and transfer data from sensors. It captures readings and wirelessly transmits the data to a cloud database. The firebase is used to store data, offering secure access and continuous monitoring. After that a mobile application displays the data users to:

- Monitor updates from sensors in real time.
- Receive notifications for water leaks, weight monitoring, item tracking and fall detection.
- Set up personalized alerts based on user preferences
  - Pressure warning - Avoids too much pressure buildup by allowing adjustments for sensitive objects.

This system improves backpack safety and usability by providing users with real-time updates and automated monitoring.

Chapter 4: Project Plan

4.1 Timeline

Task	Week 1	Week 2	Week 3	Week 4
Planning & Research	X			
- Requirements Gathering	X			
- Market & Tech Research	X			
- Component Selection & Initial Design Sketch	X			
Hardware & Circuit Design		X		
- Order & Procure Components		X		
- Circuit Design & Breadboarding		X		
- Hardware Testing		X		
Software Development			X	
- Microcontroller Setup & Firmware			X	
- IoT Integration			X	
- Testing and Debugging			X	
Assembly & Finalization				X
- Assemble Backpack				X
- Final Testing				X
- Documentation & Report				X

Chapter 5: Budget

Items	Quantity	Unit Cost	Total
NodeMCU ESP32S	1	RS.1,340.00	RS.1,340.00
MPU9250 3-Axis Acceleration Gyroscope	1	RS.1,200.00	RS.1,200.00
7.2V 2500mAh Battery Pack	1	RS.1,200.00	RS.1,200.00
YL-83 Moisture Sensor	1	RS.250.00	RS.250.00
RFID Module	1	RS.260.00	RS.260.00
RFID tags	3	RS.80.00	RS.240.00
50Kg Load Cell Weighing Scale Sensor	1	RS.180.00	RS.180.00
HX711 AD Conversion Weighing Sensor	1	RS.230.00	RS.230.00
BMP280 Digital Barometric Pressure Sensor	1	RS.330.00	RS.330.00
GRANT TOTAL			**RS.5230.00**

Chapter 6: Challenges and Limitations

- Difficulties in pressure sensitivity - When the BME280 sensor is has to respond to sudden changes in air pressure, as happens in high altitude situations or quickly changing environments can change.

- Proper sensor placement - To ensure proper data gathering, environmental sensors include the sensors that need to be positioned properly inside the backpack. incorrect measurements from poor location can be messed with real-time monitoring and decision-making.

- High power consumption - Many of parts, such as the RFID module, ESP32 and MPU9250 need constant power, which causes the battery to run out more quickly. In a lack of effective power management strategies, the system usability may be limited by lower operating hours.

Chapter 7: Conclusion

The smart backpack which easily integrates modern IOT features, is an innovative advance that defines usual backpack usage. With capabilities like fall detection, water leak, missing item reminders, weight monitoring and internal pressure checks the smart backpack tackles key issues like health, safety and organization. An simple to use mobile application for manages these features, ensuring an effective and user friendly experience.

This initiative supports for a safety and health conscious design in addition to increasing the usefulness of a standard backpack. The smart backpack change the modern accessories by integrating IOT technology with useful functionality the evolving requirements of modern lifestyles.

Chapter 8: Appendices

8.1 References

1. Genitrini, M., Dotti, F., Bianca, E., & Ferri, A. (2022). *Impact of Backpacks on Ergonomics: Biomechanical and Physiological Effects*. International Journal of Environmental Research and Public Health, 19(11), p.6737. Available at: https://www.mdpi.com/1660-4601/19/11/6737 [Accessed 11 Apr. 2025].

2. Aqlan, F. & Basily, B. (2017). *Ergonomic Assessment of Backpack Carriage Among High School Students*. Available at: https://www.researchgate.net/publication/317231385_Ergonomic_Assessment_of_Backpack_Carriage_among_High_School_Students [Accessed 11 Apr. 2025].