

**Technical advisory report​**

By

COVALI ~ group A

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**Summary**

This report is designed to provide a comprehensive technical advisory for the Smart Bag with Sensors project. The purpose of this report is to guide the development and implementation of a smart bag that uses advanced sensor technology to track and monitor personal items.

The primary purpose of this report is to inform readers about the functional and non-functional requirements of the Smart Bag with Sensors project. It aims to analyze the findings based on the project’s design documentation, user feedback, and technical evaluations. The report offers actionable recommendations to ensure the successful completion and adoption of the project. It also highlights potential risks and proposes strategies to mitigate them.

This report is intended for project managers to understand the project scope, allocate resources efficiently, and manage risks effectively. Developers and engineers will gain insights into the technical requirements and integration strategies for the smart bag and its accompanying mobile application. Stakeholders and investors will evaluate the project's feasibility, potential benefits, and overall impact.

## **Introduction**

#### **Project Overview**

The Smart Bag with Sensors project aims to develop a bag that can effectively monitor and keep track of essential items using NFC technology. This involves integrating an NFC reader, sensors, and a mobile application to provide real-time updates and alerts to users.

Recent advancements in NFC technology, as highlighted by Villarino and Girbau (2018), demonstrate the capability of NFC for efficient energy harvesting and data exchange, making it suitable for IoT applications like smart bags.

#### **Project Goal**

The primary goal of the Smart Bag with Sensors project is to create a bag capable of monitoring and tracking essential items tagged with NFC technology. The project involves integrating an NFC reader, a mobile application, and power management solutions to ensure seamless functionality and user experience.

#### **Scope**

The project's scope includes the design, development, and implementation of the Smart Bag and its companion mobile application. This encompasses the integration of hardware components, software development, user interface design, and comprehensive testing.

#### **Purpose of the Report**

This report provides a technical advisory to ensure the successful development and implementation of the Smart Bag with Sensors project, addressing both functional and non-functional requirements.

#### **Scope and Objectives**

The scope of the report includes an analysis of the project's technical requirements, risk assessment, and recommendations for improvement. The objectives are to ensure seamless integration of hardware and software, efficient power management, and user-friendly application features.

#### **Methodology**

The report is based on a thorough review of the project's design documentation and risk analysis. It includes data collection through user feedback, analysis of component compatibility, and evaluation of potential challenges.

## **Chapter 1: System architecture**

This chapter explains how the smart bag tracking system works. The system has several important parts that work together to help you keep track of items in your bag. The main parts are:

* Smart Bag: This is the physical bag that contains sensors and a Raspberry Pi.
* Raspberry Pi: A small computer that controls everything. It has an NFC reader to scan items.
* Mobile App: An app on your phone that shows you what items are in your bag.

**2.1 Connection Structure**

The mobile app connects to the Raspberry Pi using WIFI. The Raspberry Pi has built-in WIFI and special code to connect to the NFC reader and a small database.

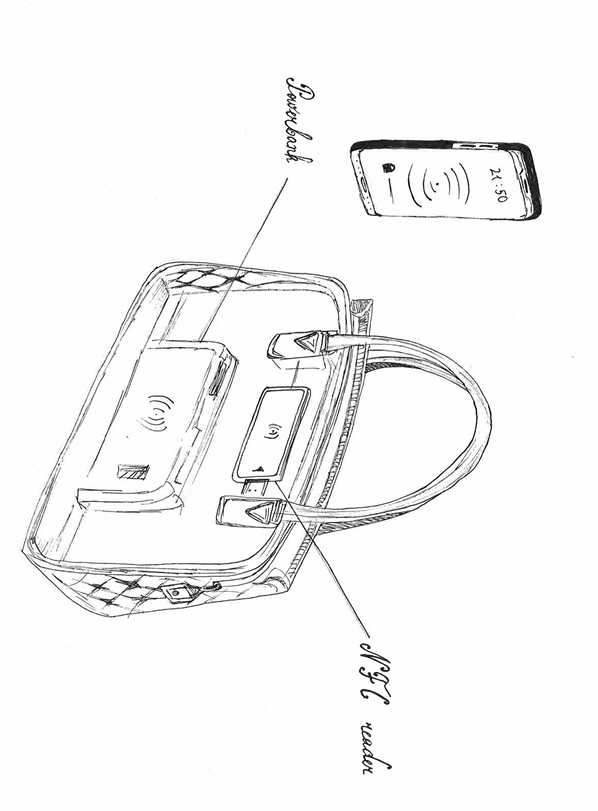
**2.2 How It Works**

Each item in the bag is equipped with an NFC chip. When you place an item in the bag, the NFC reader scans and registers the item. A power bank supplies energy to the Raspberry Pi, ensuring it remains operational. As Sharma et al. (2022) note “In today's world, a bag is only used to carry items from one place to another but imagine what happens when the bag itself can protect your items from being stolen or misused. It is possible using technology, which converts conventional bags into smart bags.”

Refer to **Figure 1** for an illustration of the first prototype, showcasing the physical design of the bag with its hardware components.

The Raspberry Pi continuously checks if the registered items are still inside the bag using the NFC reader. It then sends this information to the mobile app through Wi-Fi. The mobile app processes the received data and sends notifications to your phone. The app displays which items are in the bag, allowing you to see them easily.

Refer to **Figure 2** for a project overview diagram that illustrates how the system components are connected.

**Figure 1.** Illustration of the First Prototype

**A diagram of a device

Description automatically generatedFigure 2***.* Project Overview Diagram

**Figure 3**. Physical overview

*A diagram of a circuit board

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## **Chapter 2: Hardware & Equipment**

In this chapter you will find a complete list of parts contained in the Covali Project as well as their details and specifications.

**2.1 Hardware**

1. **Power bank: Intenso 10000 mAh capacity**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| A rechargeable power bank that provides a stable power supply to the microcontroller and NFC module. | * Supplies continuous power to the Smart Bag's electronic components. * Ensures long-lasting operation without frequent recharging. | - Capacity: 10,000mAh  - Output: 5V/2A |

1. **Raspberry Pi Zero 2017**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| A small, efficient computer that serves as the central processing unit for the Smart Bag. | * Acts as the central processing unit (CPU) of the Smart Bag. * Manages data from sensors and NFC readers. * Communicates with the mobile application via Bluetooth or Wi-Fi. | * CPU: Broadcom BCM2835,1GHz ARM11 core * RAM: 512MB * Ports: 1 micro-USB for power, 1 micro-USB for data, mini-HDMI, GPIO pins |

1. **NFC Reader HW-147**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| A hardware component that scans and registers NFC chips on the items placed in the bag. | * Reads and writes data to NFC tags attached to personal items. * Scans items as they enter and exit the bag, acting as a gate to track item presence. | * Frequency: 13.56 MHz * Communication range: Up to 10cm (about 3.94 in) |

1. **NFC Tags or Chips**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| NFC tags or chips are small, programmable devices that store data and can be read by NFC readers. | * Attached to personal items to allow the NFC reader to identify and track them. * Store unique identifiers that are read by the PN532 module. | * Frequency: 13.56 MHz * Memory: 144 bytes to 8 KB, depending on the type * Various form factors (stickers, keychains, cards) |

1. **Wiring and Connectors**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| A set of silicone jumper wires and connectors for linking the microcontroller with other components. | * Establishes electrical connections between the microcontroller, NFC reader, power supply, and speaker. * Ensures stable and reliable signal transmission. | * Length: up to 5 cm. * Pack: 40-pack with male/female connectors |

**2.2 Hardware Integration:**

The hardware components are carefully integrated into the Smart Bag to make sure the functionality and user experience works. Below is a description of the integration process:

**Power Bank Installation:**The power bank is placed in a easy access location for recharging. It connects to the Raspberry Pi via a micro-USB cable.

**Raspberry Pi and NFC Reader Installation:**The Raspberry Pi and NFC reader are securely inside the bag's main compartment. The NFC reader is positioned near the top opening of the bag to maximize its scanning efficiency.

**NFC Tags Attachment:**NFC tags are attached to frequently carried items such as keys, wallets, and mobile phones. Each tag is programmed with a unique identifier that the NFC reader can recognize.

**2.3 Equipment**

1. **The Bag**

|  |  |  |
| --- | --- | --- |
| **Description** | **Function** | **Specification** |
| A durable, lightweight bag designed to incorporate all the hardware components seamlessly. | * Houses the microcontroller, NFC reader and power supply. * Provides a stylish and functional way to carry and track personal items. | * Material: High-quality, durable fabric * Dimensions: 15x30x36 |

## **Chapter 3: Software**

In this chapter, we will discuss the software we used to implement on this project. Also, more information about the Smart Bag application.

For the mobile application, we utilized the following software:

* **Visual Studio Code:** This served as our primary code editor, providing an efficient and user-friendly environment for writing and editing our code.
* **Expo Go:** An application on mobile phones, Expo Go was essential for displaying the test environment of our application, allowing us to easily preview and debug the app in real-time.
* **Android Studio:** We used Android Studio to create a virtual test environment for our Android application, ensuring compatibility and functionality across different Android devices.

For the hardware setup to connect the Raspberry Pi and NFC reader, we employed:

* **Neovim:** An extensible text editor, Neovim is well-suited for terminal-based text editing tasks, making it ideal for configuring and managing the Raspberry Pi and NFC reader setup.

**3.1 Document Used**

For the Smart Bag hardware and mobile application to perform some functions there is need for the use of the libraries.

The libraries used include:

Mobile application libraries:

* **React and React Native**: Basic dependencies for building the React Native app.
* **React Native Safe Area Context**: For handling safe area views.
* **React Native Flip Card**: For creating flip card animations.
* **Async Storage**: For persisting data locally.

Hardware libraries:

* **asyncio:** Manages asynchronous tasks and events.
* **websockets**: Facilitates real-time communication between clients and servers using WebSockets.
* **json**: Parses and generates JSON data.
* **sqlite3**: Manages SQLite database operations.

**3.2 Smart Bag Application**

Here we have exemplified the mobile application that is linked to the Smart Bag, which the customer must install to use the technology provided by the product. This easy-to-use interface makes it simple to set up, customize, and keep track of the contents of the Smart Bag and it will give concise alerts and status reports about the inventory inside and any anomalies found. Each screen is designed with a cohesive color scheme and layout that supports easy navigation and user interaction, emphasizing functionality and aesthetic appeal in managing and showcasing luxury bags and accessories.

Furthermore, the Covali app is providing a switch mode for their customers, enhancing focus and reading comprehension.

According to user interface design guidelines, it is crucial to maintain a minimalist aesthetic, reducing visual clutter, and ensuring high contrast for readability (Interaction Design Foundation, n.d). Additionally, keeping the navigation intuitive and providing users with clear feedback enhances usability and user satisfaction (Chapman, n.d).

1. **Loading Interface**

For the starting phase of the application, Our logo will starting up the application interface with a gradual animation.

A black background with a black and white logo

Description automatically generated

1. **Main Page**

This interface showcases the customer’s bags, the plus button for adding new ones and the switch light mood. It allows users to view details of the selected bag, which is highlighted against a minimalist, stylish background. Users can browse and choose between different bag options available in the app's inventory.

A brown bag with a logo on it

Description automatically generatedA screenshot of a bag

Description automatically generated

1. **Notifcations**

Notifications help users stay updated about their Smart Bag. They provide alerts and status reports about the bag's contents and any issues.

A screenshot of a phone

Description automatically generatedA screenshot of a phone

Description automatically generated

1. **Items Page**

After pressing a specified bag, with a flip animation the screen will show a list of the items registered for the bag (e.g., keys, wallet, packages) that can be selected or deselected. This feature likely helps users manage and track various items within a bag or across multiple bags. Also, there is always the option for adding to the bag by simply pressing the plus button, and do not forget that when registering the item, the user must place it inside the bag.

A screenshot of a phone

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A brown box with a red and white button

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## **Chapter 4: Testing**

Testing is very important to make sure the Smart Bag with Sensors works correctly. This chapter explains how we tested the mobile app and the hardware parts of the Smart Bag.

**4.1 application testing**We tested the mobile app to make sure it works well for users.

* **Functionality Testing**: We checked all the features of the app to make sure everything works as it should.
* **Usability Testing**: We asked real people to use the app and tell us if it is easy to use. We made changes based on their feedback.
* **Performance Testing**: We tested the app to see if it works quickly and doesn’t crash, even when many people use it at the same time.

**4.2 Hardware Functionality Testing**  
We tested each part of the Smart Bag to make sure they work properly.

* **Power Bank Testing**:
  + We checked how long the power bank can keep the bag working.
  + We tested the battery under different conditions to see how long it lasts.
* **NFC Reader Testing**:
  + We checked if the NFC reader can correctly scan items with NFC tags.
  + We tested the distance and angle to make sure the reader works well.
* **Raspberry Pi Testing**:
  + We tested the Raspberry Pi to see how fast it can process information.
  + We checked the WiFi connection to make sure it sends data to the app quickly.

**4.3 Integration Testing**We tested how well the different parts of the system work together.

* **Hardware and Software Testing**:
  + We checked if the hardware parts (Raspberry Pi, NFC reader, power bank) and the mobile app work well together.
  + We made sure the data from the NFC reader is correctly shown in the app.
* **End-to-End Testing**:
  + We tested the whole system from start to finish to make sure everything works smoothly.
  + We make sure the system gives real-time updates and notifications.

**4.4 User Acceptance Testing (UAT)**  
We asked real users to test the system to see if it meets their needs.

* **Scenario-Based Testing**: Users did common tasks like adding items to the bag and checking notifications to see if the system supports their needs.
* **Feedback Collection**: We collected feedback from users to find any problems or areas for improvement.

These tests help us make sure the Smart Bag with Sensors works well and is ready for people to use. The feedback from these tests helps us make final improvements to the system.

## **Chapter 5: Recommendations and Advice**

**Short-Term Recommendations**

* Conduct extensive testing on NFC readers, sensors, and the power management system.
* Ensuring all hardware components function correctly and reliably under various conditions is critical for project success.
* Develop further the mobile app with a focus on user experience (UX) and user interface (UI) design.
* Engage UX/UI designers, conduct usability testing with potential users, and refine the app based on feedback.
* Implement basic encryption for data transmission between the Smart Bag and the mobile app.
* Protecting user data from unauthorized access is paramount.
* Implementing a speaker for the user to get acknowledged about the status of the items in the bag.
* Implementing led lights for the user to get acknowledged about the status of the items in the bag. (red lights if there are not all the items set in the bag and greed lights if everything is in the bag)
* Implement a wireless charger for the bag.

**Long-Term Recommendations**

* Switch from an NFC reader to an RFID one for more power of reading tags and a bigger range of action.
* Develop and implement advanced power-saving modes and efficient power management algorithms.
* Extending battery life while maintaining functionality is essential for user convenience.
* Research and integrate low-power components, optimize software for power efficiency, and implement adaptive power-saving modes based on usage patterns.
* Enhance security levels between the hardware and software.
* Create a platform for users to provide feedback, such as in-app surveys or a dedicated forum. Schedule regular app updates that incorporate user suggestions and address any issues.
* Continuous development of the hardware components for more efficiency and effectiveness.
* Apply GPS feature to keep track where the item being left.
* Implement Bluetooth function to easily keep track of the items without connecting to WI-FI.

## **Conclusion**

The Smart Bag with Sensors project has faced various technical challenges during its development phase, leading to innovative solutions that enhance the product's functionality and user experience. The initial limitations of the NFC reader in tracking multiple tags prompted a strategic reevaluation, resulting in an improved tracking system that exceeds user expectations.

To maintain the project's success, the focus will be on refining the Smart Bag's technological foundation by conducting thorough testing of NFC readers, sensors, and power management systems. Furthermore, the development of an intuitive mobile app with a user-friendly interface will be prioritized, incorporating feedback from usability testing for continuous improvement.

By following these recommendations, the Smart Bag project is set to establish new standards in the smart luggage industry. Through a commitment to technological advancements and a user-centric approach, the Smart Bag will deliver an exceptional user experience, securing its position as a market leader.

## **APA Referencing**

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