

Design Documen tation

By

COVALI ~ group A

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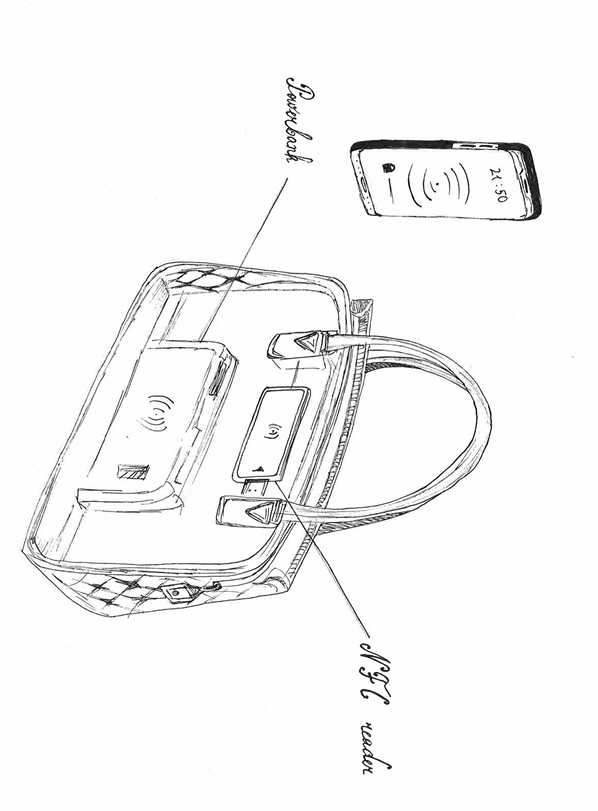
**Introduction**

Nowadays, the emphasis on efficiency and convenience is crucial in product design, particularly for items that are carried daily. Covali addresses the prevalent problem of forgotten personal belongings by introducing Project "Smart Bag". The bag will be a top-notch design (see *Figure 1*) that combines both fashion and functionality, ensuring that users can carry their belongings in a style that will compete on the fashion market. This innovative bag (see *Figure 2)* utilizes advanced sensor technology to detect and track its contents, guaranteeing that you never leave home or workplace without your essential items. The Smart Bag takes a proactive approach to personal organization by alerting users if any necessary item is not present before they leave their household.

This document will outline the upcoming stages of development for the Smart Bag, from initial idea to implementation. It covers in-depth talks on the Smart Bag’s design, technical specifications, and features, as well as potential enhancements for future iterations that are not essential but could be beneficial. Moreover, it includes financial plans and a diagram that will give an overview of the whole project, making the team follow it step by step and ensure that everything will be up to standard.

**\*Notice: If the approach with the Project Smart Bag is not successful, it may be necessary to reevaluate the design and consider alternative solutions to meet the project’s goals. \***

Below here you will find an overview diagram of the project and the illustration of the first prototype:

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*Figure 1. Illustration of the First Prototype*

A diagram of a device

Description automatically generated

*Figure 2. Project Overview Diagram*

**Chapter 1: Requirements**

In this document, we outline the functionalities and performance expectations for our Smart Bag with sensors and the accompanying custom application. We categorize our requirements into two main types: functional and non-functional.

* Functional requirements define the specific tasks and features that our Smart Bag with sensors and custom application should perform. These are the actions users anticipate from our system, such as detecting items in the Smart Bag, sending notifications, and providing user-friendly interfaces.
* Non-functional requirements, however, focus on the quality and performance aspects of our system. These include factors like durability, battery life, security, and usability. These requirements ensure that our product not only functions correctly but also deliver an effective and satisfactory user experience.

By comprehensively documenting these requirements, we ensure that our Smart Bag with sensors and custom application meet the needs of our users and operate as intended.

1.1 Functional Requirements

**Registration and Configuration of Items**

* Through the accompanying smartphone app, customers will be able to connect and add items in the Smart bag system.
* The goods that users often carry in the bag have to be added on the app and be scanned by the bag, and each item must have an NFC tag attached for identification.

**Monitoring and Detection in Real Time**

* Using integrated sensors that connect with NFC tags, the Smart Bag will check every time to see if any registered things are in or out of the bag.
* It will update the Smart Bag's inventory in real-time upon detecting changes in the item's state (presence or absence).

**Bag Alarm System**

* The Smart Bag will sound an alarm if it finds a missing item that is part of the user's list of necessities.

**Phone Application Alarm System**

* Through Bluetooth or Wi-Fi connectivity, the accompanying mobile app will send the alarm to the user's associated smartphone.

**Speaker Implementation**

* For better usage of the bag, there could be implemented a feature for a speaker with the purpose of announcing with a short sound when an item was scanned while introduced and with another one when the item was taken out.
* With this option the customer will be ensured that the app will complete its scope for monitoring the presence or the absence of the items.

**Power Management**

* To enable the ongoing functioning of the sensors and networking functionalities, the Smart Bag must have a dependable power supply (such as inbuilt power banks or rechargeable batteries).
* It will maximize power consumption to guarantee longer battery life and reduce the frequency of recharging.
* For an easier way of charging, there could be implemented a wireless charging stand for the user does not have to check anymore the life of the battery and to easily put the bag in the specific spot when arriving home, for example.

**Compatibility and Integration**

* The accompanying mobile app and the Smart Bag's sensors and connection functions must work together flawlessly.
* To provide wide accessibility and usage, the system must be interoperable with popular smartphone platforms (Android).

**LED System**

* A nice to have feature that can substitute the speaker option, can be the implementation of a mini led inside the bag that can indicate with green light when all tagged items are inside of the bag, and with a red light when a least one item is missing.

**User Interface (UI) Design**

* The mobile application must have an easy-to-use interface that makes it simple to set up, customize, and keep track of the contents of the Smart Bag.
* It will give concise alerts and status reports about the inventory of the Smart Bag and any anomalies found.

**GPS Shared Location**

* The accompanying mobile app of the Smart Bag will be able, once allowed by the customer, to recognize the safe space chosen (for example home or the office) and to send notification about an item missing while the customer left the so-called safe space.

1.2 Non-Functional Requirements

In this part, we talk about the things that make our project work well, even though they are not directly about what it does. These include how strong and long-lasting the Smart Bag is, how accurate the sensors are, and how easy it is to use the app. We also look at things like keeping your info safe and making sure the app runs smoothly. These are all important to make sure our project is reliable and easy to use.

* 1. Smart Bag/ Mobile App

**Design**   
Simply to make the Smart Bag look appealing and modern so it attracts people to use it.

**Durability and build**  
Make sure the Smart Bag is strong and will not break easily, so it lasts a long time.

**Size and weight**  
The Smart Bag should not be too heavy or big, so it is easy to carry around.

**Sensor Technology**  
Sensors need to provide accurate information and work well, so they can keep track of the tagged items.

**Battery Life**  
The battery needs to last for a long time, so the client does not have to charge it often.

**Compatibility**  
Make sure the Smart Bag hardware works well with several types of phones and systems, so anyone can use it.

**User Interface Design**  
Making the application user-friendly and nice to look at, so that anyone can use it without difficulties.

**Mobile application compatibility**  
Making sure the application works on different systems, so everyone can use it.

**Notification system**  
The user should know based on the notification system the status of the tracked items that can be either in the Smart Bag or not.

**Integration:**  
Making sure the app works well with the Smart Bag sensors so it can tell you what is inside and what is missing.  
  
 **Security**  
 Keeping users’ personal information secure from external sources.

**Performance**  
Make sure the application runs smoothly and does not freeze or crash.

**Customization Options**  
The user can add and remove various Smart Bags and for each Smart Bag different tagged items.

1.4 Priority Levels

For our project, we have established clear priority levels tailored to each stage of development. These priorities are based on the specific needs of the bag with sensors and the custom application. By understanding these priority levels, the team can focus on the most important tasks and optimize their time and effort accordingly. This approach ensures that we meet key objectives and deliver a successful product that meets user needs effectively.

**Functional Requirements**

|  |  |  |
| --- | --- | --- |
| **Title** | **Value** | **Complexity** |
| Registration and configuration of item | High | High |
| Monitoring and detection while adding and removing items | High | High |
| Bag Alarm System | Low | Low |
| Phone Application Alarm System | High | High |
| Power Management | Medium | Medium |
| Compatibility and integration | High | High |
| User Interface (UI) design | High | High |
| GPS Shared Location | Medium | Medium |
| Wireless Charging Stand | Low | Low |
| Speaker Implementation | Medium | Low |
| LED system | Low | Low |

**Non–Functional Requirements**

|  |  |  |
| --- | --- | --- |
| **Title** | **Value** | **Complexity** |
| Design | Medium | Medium |
| Durability and build | High | Medium |
| Size and weight | Low | Low |
| Sensor technology | High | High |
| Battery life | Medium | Medium |
| Compatibility | High | High |
| User Interface Design | Medium | Medium |
| Mobile application compatibility | High | High |
| Notification System | High | High |
| Integration | High | Medium |
| Security | High | High |
| Performance | High | High |
| Customization options | Low | Medium |
| Offline functionality | Medium | Medium |

**Chapter 2:** **Description/Objectives**

**Smart Bag: Item Tracking System**

**2.1 Objective**

The primary objective for the Item Tracking System is to ensure the Smart Bag can effectively monitor and keep track of essential items tagged with NFC (Near Field Communication) technology. The Smart Bag should seamlessly interact with an embedded reader, powered by a rechargeable power bank, to detect the presence or absence of these tagged items.

**Specific Goals**

* *NFC Integration and Reliability*
  + Implement NFC reader system within the Smart Bag to reliably read tags attached to personal items.
  + Ensure the system’s functionality in tracking when the items, after registering them in the app, are being added inside or be taken out of the bag.
* *Power Management*
  + Design and integrate a power management system that efficiently uses the rechargeable power bank to ensure long-lasting operation.

**2.2 App: User Notification System**

**Objective**

Develop a comprehensive notification system within the app that alerts the user in real-time about the status of their items, including notifications for items that are removed, potentially stolen or forgotten in the spaces chosen by the customer.

**Specific Goals**

* *Real-Time Monitoring*
  + Implement real-time tracking capabilities in the app to monitor the status of each tagged item, indicating whether items are in the Smart Bag or have been removed.
  + Provide immediate alerts to the user if an item is taken out of the bag when the bag is outside the chosen area.
* *Security Alerts*
  + Design the system to detect unauthorized access or potential theft scenarios, sending prompt alerts to the user's mobile device.

**2.3. Application: User Interface and Experience**

**Objective**

To create a user-friendly application interface that allows customers to easily register their Smart Bag, manage tagged items, and receive updates on their item's status (if it is in the Smart Bag or not) effectively.

**Specific Goals**

* *Application Setup and Registration*
  + Provide a seamless method for users to attach and register NFC tags to their items through the application.
  + Easily link your phone Android system with the Smart Bag via Bluetooth recognition of near devices.
* *User Interaction and Accessibility*
  + Ensure the app's interface is clear and easily navigable for users of all tech levels.
  + Incorporate easy use of the features for adding and removing objects, filling in the information required when needed.

This structured approach ensures that the Smart Bag project is developed with a clear understanding of its technical requirements and user-centric goals, facilitating a comprehensive and effective item-tracking solution.

**Chapter 3: Budget and Components of the Bag**

To design a bag that detects objects using NFC (Near Field Communication) chips, we'll need a few components:

1. Microcontroller: This is the brain of the bag. It will read the data from the NFC chips and process it. Popular options include Arduino or Raspberry Pi.

* [Raspberry Pi Zero WH - Pre-soldered Header | Kiwi Electronics (kiwi-electronics.com)](https://www.kiwi-electronics.com/en/raspberry-pi-zero-wh-pre-soldered-header-3328?search=raspberry&page=2)

***Approximate price: 18.95€***

1. NFC Reader/Writer Module: This module will interact with the NFC chips on your objects. We’ll need an NFC reader/writer compatible with your chosen microcontroller. Common options include PN532 or RC522 modules.

* [PN532 NFC/RFID Breakout Board | Kiwi Electronics (kiwi-electronics.com)](https://www.kiwi-electronics.com/en/pn532-nfc-rfid-breakout-board-3622?search=PN532)

***Approximate price: 17.95€***

1. NFC Tags or Chips: Each object will need an NFC tag or chip embedded in it. These tags will contain unique identifiers that the NFC reader can detect.

* [13.56MHz RFID/NFC Keychain | Kiwi Electronics (kiwi-electronics.com)](https://www.kiwi-electronics.com/en/13-56mhz-rfid-nfc-keychain-3711?search=nfc)

***Approximate price: 0.95€ x5***

1. Power Supply: Depending on our setup, we’ll need a power supply to power the microcontroller and NFC reader. This could be a battery pack or a USB power adapter.

* [OKAPHONE - Powerbank (UPBKPD10000BK Nedis)](https://www.okaphone.com/artikel.asp?id=496349)

***Approximate price:19.95€***

1. Enclosure: we’ll need a box or enclosure to house all the components. This could be made from wood, plastic, or any other material of your choice, 3d printed option sounds like the best choice for a prototype.

***Approximate price: unknown***

1. Wiring and Connectors: we will need wires and connectors to connect the microcontroller to the NFC reader and other components.

* [Silicone Jumperwires - 40-pack - M/F - 20cm | Kiwi Electronics (kiwi-electronics.com)](https://www.kiwi-electronics.com/en/electronics-parts-components-113/wires-jumperwires-120/silicone-jumperwires-40-pack-m-f-20cm-10752)

***Approximate price: 4.95€***

1. Speaker: a speaker to alert you along with a notification when an object is missing in a bag.

* [Stereo Enclosed Speaker Set - 3W 4 Ohm | Kiwi Electronics (kiwi-electronics.com)](https://www.kiwi-electronics.com/en/stereo-enclosed-speaker-set-3w-4-ohm-2913?search=speaker)

***Approximate price: 7.50€***

1. Actual Bag: the bag itself that will contain all the above components.

***Approximate price: 20-50€***

***\*Total estimated price: 124***

**Chapter 4: Risk Analysis**

1. **Technical Difficulty**

**Description:**

Complex technical knowledge is needed to integrate sensors, connections, and a companion mobile app. It might be difficult to ensure smooth connection between bag sensors, RFID/NFC tags, and the mobile app because of software synchronization and hardware compatibility issues.

**Solution:**

To guarantee the smooth integration of hardware (RFID/NFC tags, sensors) and software (mobile app, connection), make significant investments in research and development. To find and fix compatibility problems early in the development cycle, do thorough testing.

1. **Reliability of sensor technology**

**Description:**

Interference or restrictions on the detection range may impact the precision and dependability of RFID/NFC technology in identifying objects within the bag. For the bag to be effective, item tracking must be precise and consistent.

**Solution:**

Select high-quality sensors and RFID/NFC tags that have dependable detecting powers. To guarantee accurate and consistent item tracking, do thorough testing in a variety of settings. Put error-handling procedures in place to handle detection failures with compassion.

1. **Privacy and data security**

**Description:**

Data security and privacy are issues when using Bluetooth or Wi-Fi to gather and send information about the contents of the bag. It is crucial to protect user data from illegal access or interception, particularly when handling information about personal items.

**Solution:**

Follow strict guidelines for data privacy (such as the CCPA and GDPR) and use encryption techniques when sending data from the bag to the mobile app. Give people choices to manage data sharing and clear privacy regulations.

1. **Power management**

**Description:**

A dependable power supply is necessary for the continuous operation of sensors and networking functionalities. The utility of the backpack may be impacted by difficult integration of rechargeable batteries or efficient power management to extend battery life.

**Solution:**

Reduce power usage by putting in place effective user-interactive sensor activation and deactivation procedures. Make use of low-power parts and think about including energy-saving functions in the app, such as power management settings or automated sleep modes.

1. **User experience and adoption**

**Description:**

User happiness and adoption are key factors in a smart bag's success. Enhancing user experience and promoting adoption requires thoughtfully designing a mobile app's UI, offering simple customization choices, and guaranteeing reliable performance.

**Solution:**

When developing an app, give user-centered design concepts top priority. To improve the app's user interface and make it more intuitive, assess its usefulness. Provide possibilities for individualized customization and continuously collect customer input to enhance features and functionality.

1. **Integration with daily routines**

**Description:**

The efficacy of the smart bag depends on how well it fits into users' regular schedules. Should notifications or monitoring functionalities turn obtrusive or cumbersome, users could not completely use or value the bag's potential.

**Solution:**

Create a smart bag and app that fit into consumers' daily activities without interfering. To accommodate varying usage patterns and preferences, offer customizable choices and flexible notification settings.

1. **Maintenance and assistance**

**Description:**

Over time, maintaining product performance and user happiness requires timely resolution of any maintenance issues (such as software upgrades, sensor calibration), as well as dependable customer assistance.

**Solution:**

Provide a dependable customer service system to respond to questions from users, fix problems, and provide software upgrades on schedule. Use over-the-air updates and remote diagnostics to guarantee ongoing bug fixes and performance enhancements.