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RE: ENSC 405W/440 Requirements Specification for e-minder

This document has been prepared by purple mango to clearly list the requirements specifications for the product “e-minder” for our ENSC 405W and ENSC 440 capstone design course. e-minder is a solution that reminds people of their items as they leave their homes. This product can be used for anyone that has difficulty remembering to bring their items with them - be it daily everyday items or special one-off items. The target demographic for the product has been narrowed down to specifically target the elderly population, people with adult attention-deficit/hyperactivity disorder (ADHD), and children (administered by their parents).

e-minder will compose of a hardware based system that will be mounted near the user’s exit accompanied by a mobile app that can control & customize the hardware’s functionality, giving full control to the user over their experience. The user can be reminded of specific items that they are missing and/or receive customizable notifications when they leave their home.

This document has been broken up into the following sections: general requirements, hardware requirements, software requirements, electrical requirements, sustainability, safety, and engineering standards. Each section will specify the features necessary to solve the problem of forgetting items when leaving one’s home.

Thank-you for taking the time to read this document reviewing the specifications for e-minder.

Sincerely,

Team purple mango



Requirements Specification: purple mango

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Glossary

TABLE I

Glossary

Term	Definition
ADHD	Adult attention-deficit/hyperactivity disorder
EM	Electromagnetic
PLA	Polylactic acid
POC	Proof of Concept
RFID	Radio-Frequency Identification
UHF	Ultra High Frequency
UI	User Interface



Abstract:

This report outlines the Hardware and Software requirements that need to be met by e-minder. A block diagram is provided to explain the basic principles on which e-minder is based and show a general overview of the solution's structure. This report highlights the technological approach we will take in order to realize e-minder as a product. The sustainability and electrical standards will be discussed in detail. To be most effective, the location and setting of the product placement is crucial for its use. For these reasons, it will have to be used indoors and be at a precise distance from the exit.



1 Introduction

Have you ever walked into your car, started it up and drove halfway to work just to remember that you left your phone at home? Or you consciously thought of bringing your grocery bag only to leave it behind in the heat of the moment? Fret no more, e-mider will be an electronic system which reminds users of forgotten items before they exit their home. The system will consist of a hardware component (embedded system) and a software competent (mobile application). Users will be able to tag important items that they do not wish to forget, and as the user exits their home items will be scanned ensuring that they are not being forgotten by the user. In addition, the user is also able to add items that do not contain tags to the system and will also be reminded of these items as they exit the home.

Purple mango intends to create an easy to use system that prevents users from forgetting key items needed for their day. The system must be cost effective, and will be an excellent addition to a smart home.

1.1 Background

RFID as a technology has potential to improve smart environments as it allows users to capture digital information in smart tags via radio waves that are transmitted in the electromagnetic field. e-mider will incorporate RFID tags, antennas and an RFID reader within its system to allow users to physically track tagged objects that are with them as they exit their home. The system will allow the user to fully customize the reminder item list; they will be able to register newly tagged items, remove old ones, or reassign registered tags to different items, all done remotely through an application on the user's smartphone. e-minder will be usable by



multiple users and will be capable of distinguishing between its users, meeting every users' individual reminding needs before they leave the house. Therefore, e-minder will be information oriented as it will function according to the needs of its users.

With variable ranges that RFID can operate on, e-minder will be useful for all types of items that will be reminded of resulting in less stress for the user when attempting to remember to take all their items. e-minder is especially useful in a setting with seniors or people with ADHD as even trivial tasks can be reminded of via this device.

Purple mango is aware of the importance of data security and will construct e-minder in a way that is secure and that protects user data. Data breaches in recent years have made it paramount to take data safety into account. e-minder will secure its data by not allowing third parties to view its data. Further, users of the product will only have access to their data, even if they share the product with other users in the same home.

1.2 Intended Audience

This requirements specification document is intended to be reviewed by the instructor and teaching assistants in Simon Fraser University's ENSC 405W and ENSC 440. The document is the first step to creating the e-minder product and will be used to build a future project proposal document.



1.3 Block Diagram

Below is a diagram describing the mechanism of RFID and its environment

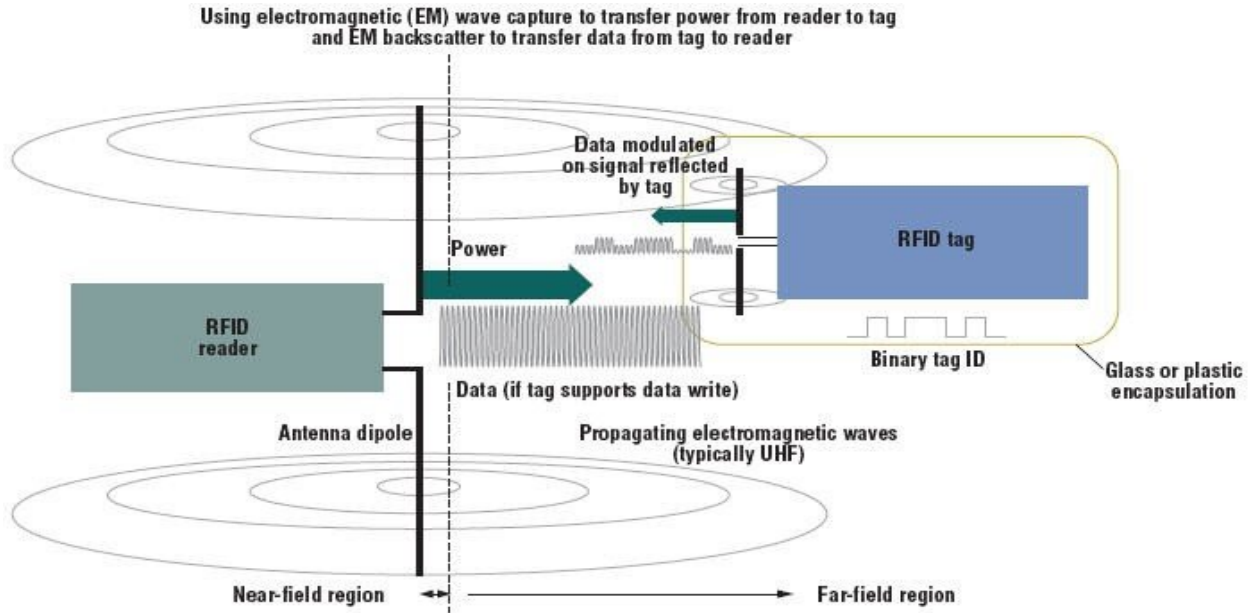


Fig. 1.1: RFID mechanism [3]

As seen in figure 1.1, RFID reader uses electromagnetic waves to transmit Ultra High Frequency (UHF) signals that activate the RFID tag (which is encapsulated in glass or plastic). The tag must be in a specified range in order to be activated by the signal. Once received, the tag reflects a modulated wave back to the antenna, where it is translated into data and identified.



2 General Requirements

The general system requirements for e-minder are listed below. These requirements cover the scope of the entire system on a high level and capture its overarching goals. These may not be specific to the software and system hardware requirements which are defined separately.

TABLE II
General Requirements

Requirement ID	Description
REQ.G.1	Must actively remind user of important daily items
REQ.G.2	Should not remind user of important daily items already on person
REQ.G.3	Reminded items must be easily adjustable for a senior
REQ.G.4	Interface must have scalable text size for people with poor vision
REQ.G.5	UI must be easily navigable
REQ.G.6	Should be accessible over remotely by family/caretaker
REQ.G.7	Should access user's calendar events to be displayed
REQ.G.8	Must distinguish between multiple users
REQ.G.9	Must be capable of maintaining several user profiles
REQ.G.10	User profiles must be customizable



3 Hardware Requirements

The hardware requirements are based on the outer box system that will detect the RFID tags at the door. The hardware components involved with this system includes a raspberry pie, RFID reader, RFID tags, wifi router/antenna, and the enclosing box for these components.

TABLE III
Hardware Requirements

Requirement ID	Description
REQ.HW.1	The system must consist of hardware panel with all electrical components embedded in it
REQ.HW.2	The system must have compact and portable power management
REQ.HW.3	The system must be smaller than 15 cm by 15 cm
REQ.HW.4	The system should have adjustable height
REQ.HW.5	The system must cost less than 200\$
REQ.HW.6	The system should cost less than 100\$
REQ.HW.7	The system must be operable in 0-50C degrees
REQ.HW.8	The system's hardware must be capable to perform all tasks in < 0.5s
REQ.HW.9	The system must identify items while in user's pockets
REQ.HW.10	The system must identify objects through a thin backpack and purse within 1m
REQ.HW.11	The system should identify objects as far as 2m
REQ.HW.12	The system should identify objects at-least within a 45 degree range



4 Software Requirements

The following are the software system requirements for e-minder. The software component consists of a mobile app [App] and an embedded system [System]. The App and the System will communicate wirelessly and will share the necessary data to provide the desired functionality.

TABLE IV
Software Requirements

Requirement ID	Description
REQ.SW.1	App must access & control the system remotely from inside the home
REQ.SW.2	System must be able to work if internet is down
REQ.SW.3	System must be able to correctly identify users at the door
REQ.SW.4	App must know when user is at the door
REQ.SW.5	System must store separate profiles for separate users with separate item lists
REQ.SW.5	Item lists must be accessible via the App
REQ.SW.6	Item lists must be customizable by each user via the App
REQ.SW.7	Items must be able to be added, removed, and modified via the App
REQ.SW.8	Items should be able to be inputted based off weekly patterns
REQ.SW.9	Added items should be classified as 'regular' or 'special' (one-off items)
REQ.SW.10	Regular items must be checked on every exit
REQ.SW.11	Special items must be checked only on the next exit and then removed from the list
REQ.SW.12	Items can be marked as having an RFID tag or not
REQ.SW.13	System should not remind the user of tagged items they are already carrying
REQ.SW.14	The user must always be reminded of untagged items when leaving the door via the App



REQ.SW.15	Item classification must be customizable (tagged vs untagged)
REQ.SW.16	Reminder notifications should be distinct & clearly heard (perhaps customizable)
REQ.SW.17	Items must be assignable through the app
REQ.SW.18	Item assignment must be customizable
REQ.SW.19	App must keep user information and location confidential to the public
REQ.SW.20	App must be able to run on IOS 10+
REQ.SW.21	App must be able to run on android 4.4+
REQ.SW.22	App must be able to start up in 3 seconds or less
REQ.SW.23	App must recover from an idle state in 2 seconds or less
REQ.SW.24	App must not crash without recovering
REQ.SW.25	System should alert when the battery level is low



5 Electrical Requirements

The electrical requirements of e-minder are based on the need to be used globally. This means it should be able to handle any standard main power supply. At the same time it must not consume excessive power during idle modes in order to follow our ecological rules. These two requirements help us meet our goals of a widely accessible and environmentally friendly product.

TABLE V
Electrical Requirements

Requirement ID	Description
REQ.EL.1	Must run on 110V mains
REQ.EL.2	Should run on 220V mains
REQ.EL.3	Must consume < 2W on stand by



6 Sustainability + Safety

At purple mango we are committed to minimizing our impact on the environment. There are many different business models and strategies that companies can follow to increase financial growth, with sustainability and the environment in mind. We chose to adopt the cradle-to-cradle design approach for our products. The nature of e-minder does not allow for the return of most materials to the environment, however we aim to use all biodegradable material where possible, such as PLA plastic and wooden structures. Using such materials allow the bulky non technical components to be ecologically disposed of. PLA plastic is non-toxic and fully degradable or can be melted back into usable material. Wooden structures will be used where possible because of their low CO2 production output and biodegradability.

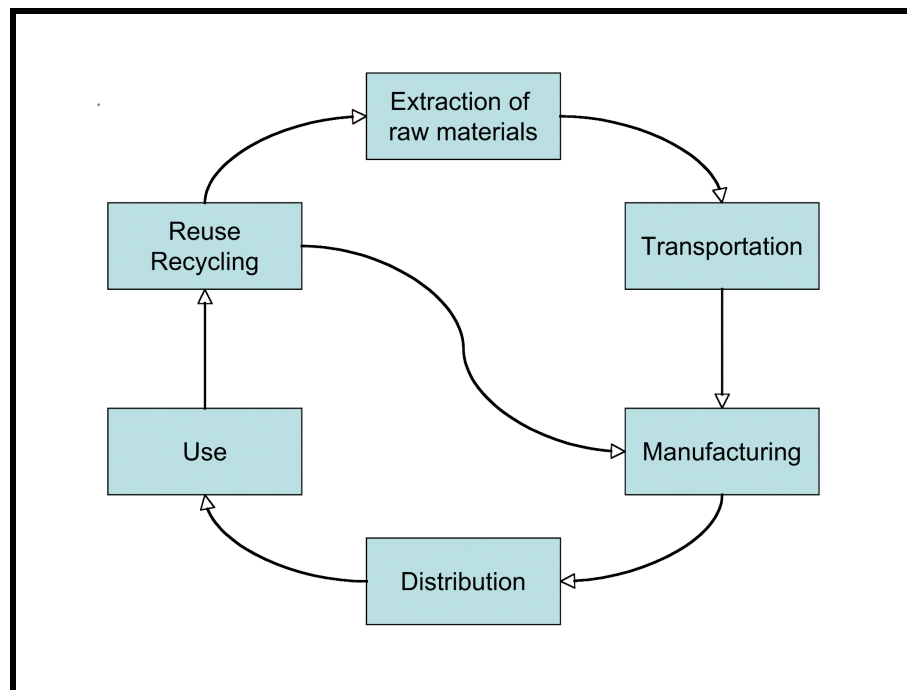


Fig. 6.1: A visual model of the cradle-to-cradle approach [2]

Where components are not degradable such as technical components, we facilitate the reuse and recycling of all possible materials used in e-minder by incorporating a modular design.



This allows easy upgradability and maintenance by the user or technician. Damaged or unusable parts will be easy to replace. Technical help will be freely accessible to those who wish to perform such tasks without shipping the unit back to a technician.

Sustainable production and packaging methods will be first priority in the purple mango ecosystem. Local manufacturers and national resources will be sourced to reduce logistics emissions.

“According to research through the Ellen MacArthur Foundation, businesses in the European Union could save up to US\$630 billion a year by switching to a cradle-to-cradle model and operating through a circular production system” [1]. Through these mentioned methods and goals we may apply to obtain the Cradle-to-Cradle certification that was established in 2005.

TABLE VI
Sustainability + Safety Requirements

Requirement ID	Description
REQ.SS.1	Some components can be sourced from recycled materials
REQ.SS.2	The product shall not have sharp edges that might hurt the users
REQ.SS.3	Small products must display warning for choking hazards
REQ.SS.4	The circuitry shall not pose a fire or explosion hazard under normal environmental conditions
REQ.SS.5	Any material in contact with the user shall not be made using materials toxic to human and/or the environment
REQ.SS.6	The system must contain swappable modules



7 Engineering Standards

TABLE VII
Engineering Standards Requirements

Requirement ID	Description
REQ.ES.1	UL 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use — Part 1: General Requirements [1]
REQ.ES.2	IEC 60950-1 Information technology equipment - Safety - Part 1: General requirements [2]
REQ.ES.3	IEC 60335-1:2020 Household and similar electrical appliances - Safety - Part 1: General requirements [3]



8 POC Acceptance Test Plan

We developed the following acceptance test plan to ensure that the POC we build towards the end of the term functions as is desired and handles all the requirements presented in this document. This test plan verifies all the generic, high-level, features of the system and is not concerned with the specific design/implementation details.

8.1 Scenario 1: All Registered RFID Items are Present

Setup: A registered user opens the door while being within a 2 meter range of the mounted system. The user has all their registered RFID items on their person; their phone & keys are in their jean pocket and their wallet is in their cloth purse/bag.

Result: The system alarm doesn't sound when the door is opened and stays silent after the door shuts.

8.2 Scenario 2: One or More Registered RFID Items Missing

Setup: A registered user opens the door while being within a 2 meter range of the mounted system. The user has all their registered RFID items on their person but one; their phone is in their jean pocket and their wallet is in their cloth purse/bag, but their keys are missing.

Result: The system correctly identifies the user, determines that their keys are missing, and sounds the alarm upon opening the door. The systems alert the user of the missing items.



8.3 Scenario 3: Customizable non-RFID Item List Empty

Setup: A registered user opens the door while being within a 2 meter range of the mounted system. The user's non-RFID item list is empty.

Result: The system correctly identifies the user at the door, checks their non-RFID list, and the user doesn't receive any notifications.

8.4 Scenario 4: Customizable non-RFID Item List Not Empty

Setup: A registered user opens the door while being within a 2 meter range of the mounted system. The user's non-RFID item list is not empty.

Result: The system correctly identifies the user at the door, checks their non-RFID list, and pushes a notification to the user via the mobile app on their phone reminding them of the items in their customizable non-RFID item list before the door is closed.



9 Conclusion

This document provides the requirements specification for the e-minder, which defines a first-of-its-kind automated hardware and software system that detects and reminds users to carry user specified items when exiting the home. Additionally, the document contains safety and sustainability, along with the engineering standards to ensure the developed product is both safe and optimal for the client and the environment. The successful creation of e-minder will result in an exemplary solution to the market for forgetful individuals such as the elderly population, children, and individuals with ADHD who frequently forget to bring necessary items with them as they exit the home.

The following summarizes the key requirements of e-minder:

1. Item Detection

- a. The device must detect whether the user specified items are on them in a way that is not damaging to their health.

2. Item reminder

- a. The device must notify the user if any of their specified items are missing before they leave the house, but it must not notify the user if all of their belongings are present on them.

3. User Interface

- a. The user interface must be customizable for users to input necessary items and frequently alter that list when needed.
- b. The user interface must be able to detect and differentiate between multiple users

4. Safety



- a. Under normal circumstances, the device must not harm users, the environment, or nearby objects.

To develop Purple Mango's e-minder, several components are combined, including detection devices, software systems, hardware construction, and electrical and power systems. The preceding requirements will define a successful industrial application system to bring accessibility gains in the fast growing smart home technology market through the components and phases described in this paper.



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