Design for Independent Living ENGINEERING INC.

# Remi The Reminding Device

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Engineering for Social Innovation

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# Background and Motivation

D4IL's Mission is to improve our users' quality of life by designing devices to help keep task organization simple. In the United States, according to the New England Health Care Institute in the U.S., approximately 75% of the population struggles with medication adherence. Every year, 125,000 of these people die from medication non-adherence. Remi is a specialized device designed to function and look like a watch to be discrete. Remi will keep track of medication instructions and medication use and alert our users to take their medication. When alerted to take their medicine, users will be prompted to scan the associated Task Tag to turn off the alarm. Task tags are specialized stickers set and placed by the user.

## The Problem

234.6 million people across the United States struggle to adhere to their medication (National Institute of Health). This leads to 125,000 people dying yearly just in the United States from not adhering to their medication. There are many reasons for this, such as being forgetful, not understanding the dosage or purpose of the medication, not knowing the side effects, and having mental capabilities (National Library of Medicine).

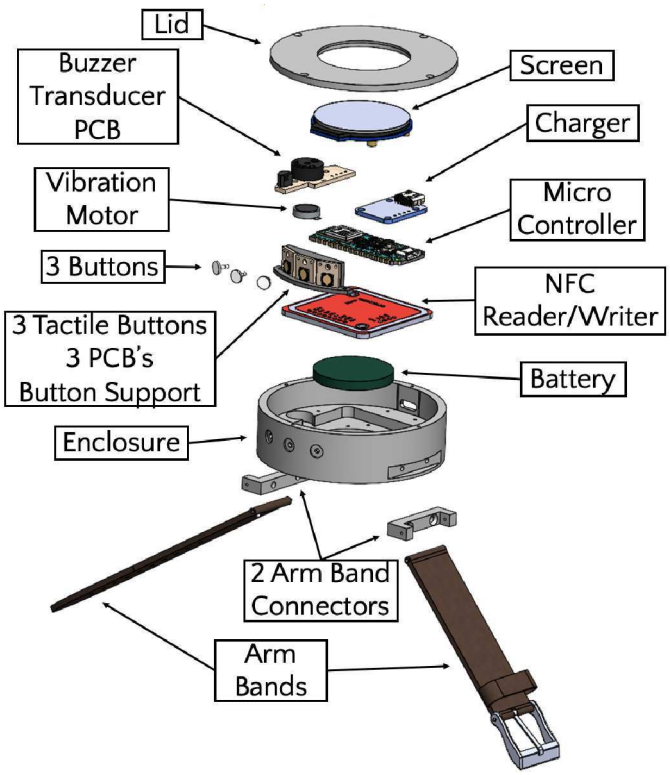
## The Solution

Remi is a specialized smartwatch that helps people take their medication as directed and needed. Users will also need Task Tags, which are specialized stickers set and placed by the users. Users will start by downloading Remi, the app. On there, they will make an account and input all medications they need to take, the dosage, and how often they need to take it. From there, they will connect their watch to their phone. This will allow them to set the stickers for each medication and place them where needed. When it is time to take their medicine, Remi will alert them to take their medication. Remi will continue to remind them until they do so or tell Remi they cannot take the medication or tap a task tag. However, if they can take their medication and tap the corresponding Task Tag, Remi will mark down that medication as taken. Users can always go on the app and see which medications they have and have not taken to adjust their schedule.

# Design Overview

Remi is designed to be a wearable piece of technology that mirrors a standard watch aesthetically, contains the necessary functionality of a smartwatch, and keeps the product cost substantially lower. These were the considerations taken with our design process, from functional prototypes to our projected moonshot product.

Remi has two central areas of design; mechanical and electronic. Due to the product's design timeline, our team had to develop the software, hardware, and enclosure simultaneously, which resulted in the product's constant development, function, and integration.




# Priorities and Requirements

Since the original intent was to design a wearable device and minimize the overall footprint of the entire product while also maintaining prototype functionality, having to first focus on developing the technology to read and write NFC tags portably, our prototype design prioritized functionality over aesthetics and wearability. However, we have maintained our desire to achieve a minimal footprint throughout the process.

The housing for the wearable device is to enclose the electronic components with protection from the external environment. The housing design incorporates features and materials to thwart all these unwanted intrusions. The material is made from Delrin, which provides good durability, structure, and permeability for the NFC frequency to travel to and from electronic components.

# Manufacturing Considerations

## Manufacturing

Considering D4IL's experience with software development, the decision was made to utilize off-the-shelf hardware components to develop a working prototype. Doing this required the size of the enclosure to be considerably larger than the average watch. The dimensions for the current prototype of Remi are 2.75" in diameter with a height of 0.75". Currently, the design is not intended for mass production and can be manufactured utilizing a CNC Mill or multi-axis CNC, a lathe, and a 3-D printer.


Remi's manufactured components include an enclosure, lid, two armband mounting brackets, four printed circuit boards (PCB), three buttons, and one button support. Delrin manufactures the enclosure, lid, and armband mounts. The buttons were machined from aluminum, and the button support was 3-D printed with ABS.

## Future: Cost, Material, Time

A market-ready design would utilize a custom PCB where all the required processors for Remi to function would be mounted. Doing this greatly reduces the size of the enclosure needed and allows for a normal-sized watch to be manufactured. Future manufacturing would be done with an Aluminum enclosure and manufactured on a multi-axis CNC. The manufacturing at a scale of 10000 units is estimated to be $26.45 per unit, with an estimated 3-6 weeks time. This is due to utilizing established manufacturing companies for the enclosure and PCB.

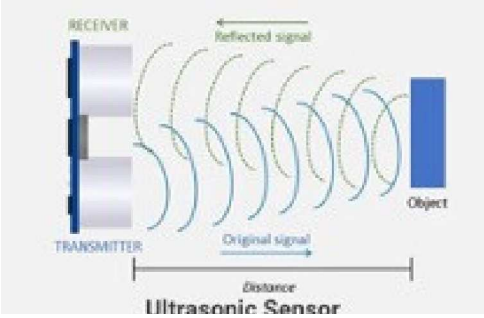
# Testing Results

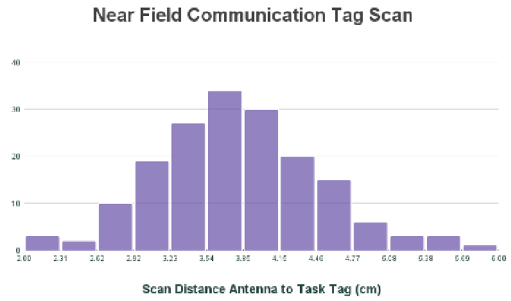
## NFC Test

Arguably the most critical piece of technology on Remi is the Near Field Communication Reader and Writer. The main functional purpose of the device is to recognize when a scheduled activity is complete, and this is done by registering a scan of a task tag with the NFC component. Therefore, ensuring its reliability and success a distance and reliability test of the NFC communication was conducted.

This test was conducted by using the NFC components mounted on our enclosure to scan NFC tags. When a scan was successful an ultrasonic sensor registered the distance from the central cylindrical axis of Remi and the Tag. When a scan was unsuccessful it was documented accordingly.

| MEDIAN | STD | MEAN | 1 sigma range 68% | 2 sigma range 95% | Failure Rate % |
|---|---|---|---|---|---|
| 3.76 | 0.6477345051 | 3.769216867 | 3.121482362 | 2.473747857 | 1.744186047 |
| | | | 4.416951373 | 5.064685878 | |




This test was considered successful. The enclosure provides desired permittivity. The device functions efficiently with a distance range that provides ease of use in proximity as well as protection and privacy from long range detection.

## Water Test

This test verified that Remi met the Ingress Protection number 4 (IPX4) for water splash resistance. IPX4 test must be conducted at a water pressure range of 11 to 14 psi for at least 5 minutes. During the test, water is constantly sprayed at Remi at varying angles. test results indicated that the buttons were a source of water intrusion. This was verified by gluing the buttonholes completely and performing the test again. The test successfully proved the sealant selected would provide water protection and determine what feature needed to be modified to meet the IPX4 standard.

# Business and Market Consideration

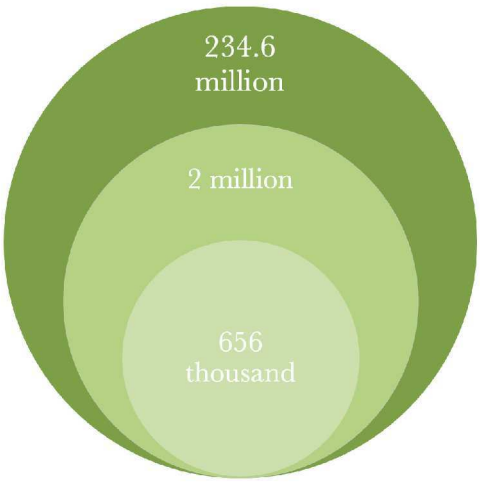
## Market Opportunity

D4IL plans to tap local independent pharmacies to market Remi to patients in exchange for access to data which can demonstrate the efficacy with which patients are taking their medication. Direct and Indirect Remuneration (DIR) fees represent a major pain point for pharmacies. DIR fees are assessed against pharmacies by insurance companies, with the aim of incentivizing pharmacies to achieve good patient outcomes. However, with few effective ways of assessing pharmacy patient outcomes, DIR fees are known to be arbitrary and ineffective. Remi offers a method for pharmacies to provide proof of patient outcomes and lower DIR fees assessed against themselves.

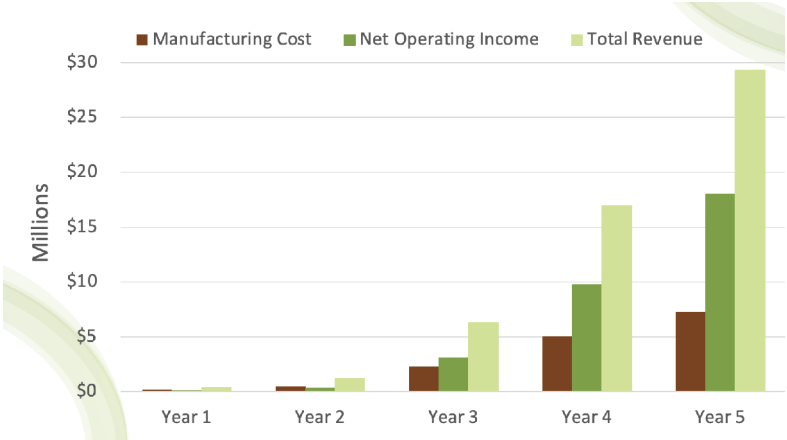
## Users and User Cases

D4IL has designed Remi for students and working adults between the ages of 16 and 40. While countertop pill dispenser designs appeal to older users who spend an overwhelming amount of time within their homes, these designs don't work for students or young professionals because they lack portability. Remi is easy to travel with and discreet in various social settings. Remi is affordable for young users growing their net worth.

## Addressable Market




## Project Revenue



# Meet The Team

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Larry Tieman
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Dan Riffell
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# Special Thanks !

Paul Ibanez
Larry Tieman
Daniel Riffell
Karen Crofton
Eric Bogatin
Greg Potts
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