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ECE 198

# Project Proposal

Remindicine

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# Customer Problem

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## WHO

It's common to have diseases as ages grow. Remindicine aims to serve for those patients who need to take various medications several times in a day. For instance, patients with uremia are usually required to take more than six types of medications daily [1]. However, many elderly people have difficulty taking pills due to impairments in memory and the large amounts of medication issued [2].

48.6% of the U.S. population, approximately 328 million people [3] in 2015-2018 have had at least one prescription drug in the recent 30 days when they were surveyed [4] and more than 80% of patients usually miss their prescription [5] which amounts to approximately 262 million people that could be our target audience.

However, we will primarily focus on patients in Waterloo Ontario at the age 65+, which is the 91,295 people in the most recent population census [6].

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## THE PROBLEM

Inconsistent medication intake among the elderly population can have critical implications, including the risk of potentially fatal overdoses [2].

Many elderly individuals lack a reliable reminder system, resulting in irregularities in medication adherence—whether it's regarding timing, dosage, or specific medications. However, professional caretaker services is not a privilege everyone can afford [5].

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[1] S. Brown, P. Lascarides, S. Stickevers, "Treating Pain in Patients With Chronic Kidney Disease: A Review of the Literature." Practical Pain Management. <https://www.practicalpainmanagement.com/treatments/pharmacological/treating-pain-patients-chronic-kidney-disease-review-literature> (accessed Sep. 19, 2023).

[2] "the Danger of Forgetting or Taking the Wrong Medication." Assisting Hands. <https://assistinghands.com/8/illinois/chicagoland-naperville/blog/forgetting-or-taking-the-wrong-medication/> (accessed Sep. 19, 2023).

[3] "U.S. Population 1950-2023." macrotrends. <https://www.macrotrends.net/countries/USA/united-states/population> (accessed Sep. 19, 2023).

[4] "Data Finder." Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/hus/data-finder.htm?year=2019&table=Table%20039> (accessed Sep. 26, 2023).

[5] A. Gilbert, L. Roughhead, L. Sansom, "I've Missed a Dose; What Should I Do?" Medsafe. <https://www.medsafe.govt.nz/profs/PUarticles/missed.htm#:~:text=More%20than%2080%25%20of%20patients,a%20dose%20of%20their%20medication> (accessed Sep. 19, 2023).

[6] "Focus on Geography Series, 2021 Census of Population." Statistics Canada. <https://www12.statcan.gc.ca/census-recensement/2021/as-sa/fogs-spg/Page.cfm?lang=E&topic=2&dguid=2021A00033530> (accessed Sep. 26, 2023).

# Solution

Introducing Remindicine, an affordable and accessible smart pill box. It serves as a dependable solution to bolster the health and safety of the elderly, ensuring consistent and accurate medication intake. With Remindicine, individuals can enjoy peace of mind knowing they have a reliable ally in their healthcare journey.

## Stakeholder Considerations

### ASSIGNED GRADUATE TA

--A GRADUATE STUDENT ENROLLED IN A UNIVERSITY WHO ALSO TEACHES UNDERGRADUATE STUDENTS AT THAT UNIVERSITY

- Ensuring that the project provides valuable learning experiences for students, aligns with the course objectives, and meets academic standards.
- Their parents/grandparents are part of our target audience.

### SUPPLIERS TO THE CLIENT

--THE PERSON OR ORGANISATION THAT PROVIDES A PRODUCT OR SERVICE TO ANOTHER BUSINESS

- Clear communication of material requirements, timely payments, adherence to quality standards.
- Reasonable volume to cost ratio.

### CUSTOMERS OF THE CLIENT

--PEOPLE WHO PURCHASE PROFESSIONAL SERVICES FROM A BUSINESS OR COMPANY TO SATISFY A NEED OR SOLVE A PROBLEM

- Having access to a reliable, user-friendly, and cost-effective solution that helps them or their loved ones adhere to prescribed medication regimens, ensuring optimal health outcomes.

### GOVERNMENTAL OR REGULATORY BODIES

--FEDERAL COMMUNICATIONS COMMISSION, ANY STATEWIDE REGULATORY BODY, OR ANY BODY WITH LESS THAN STATEWIDE JURISDICTION WHEN OPERATING UNDER THE STATE AUTHORITY

- Ensuring that the Smart Pill Box complies with all relevant healthcare, privacy, and safety standards, thereby ensuring legal operation and safeguarding public health.
- Include in hospital items to increase profit.

### THE PUBLIC

--THE COMMUNITY

- The aging population has high demand for Remindicine
- Being informed about the benefits and safety of Remindicine, as well as understanding its potential impact on public health and well-being.

### SPECIAL INTEREST GROUPS

--A GROUP OF PEOPLE OR AN ORGANIZATION SEEKING OR RECEIVING SPECIAL ADVANTAGES

- Ages 65+ people with medical prescriptions to take

# Initial Requirements

## FUNCTIONAL

- Audio and visual alerts
- Center LED display screen: reminder of the type and dosage of appropriate medicine
- Schedule customization: users can customize the time of doses, prescriptions
- Confirmation of pill retrieval using light sensors

## TECHNICAL

- Audio speaker releasing 80-110db of sound [1]
- Optic-yellow/safety green LED light for visual alerts [2]
- 10,000 lux of bright light [3]
- Light sensor for pill detection
- 9V external power source (battery) [4]

## SAFETY

- The design should not exceed a power consumption, transfer, discharge, or expenditure of 30 watts at any given moment.
- The design should not retain or hold more than 500 millijoules of energy at any given moment.
- All design components directly connected to a building electrical supply outlet (110V AC outlet) must possess CSA approval.
- Medication Integrity: protects pills from dust, moisture, light
- Abide by ISO standards [5]

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[1] "Assistive Listening Devices." hear4life.com. <https://www.hear4life.com/hearing-aids/accessories/assistive-listening-devices/#:~:text=But%20those%20with%20a%20moderate,up%20when%20you%20want%20to> (accessed Sep. 19, 2023).

[2] D. Keisler, "MEDICAL INSIGHTS: The most visible colors." postandcourier.com. [https://www.postandcourier.com/aikenstandard/lifestyle/medical-insights-the-most-visible-colors/article\\_e031d15b-973a-5289-8f88-e014afab0a81.html#:~:text=Structures%20in%20the%20eye%20called,color%20between%20green%20and%20yellow](https://www.postandcourier.com/aikenstandard/lifestyle/medical-insights-the-most-visible-colors/article_e031d15b-973a-5289-8f88-e014afab0a81.html#:~:text=Structures%20in%20the%20eye%20called,color%20between%20green%20and%20yellow) (accessed Sep. 19, 2023).

[3] L. Daugherty, "Still Waking Up to an Alarm? Here's Why You Should Use Light Instead." cnet.com. <https://www.cnet.com/health/sleep/still-waking-up-to-an-alarm-heres-why-you-should-use-light-instead/#:~:text=These%20are%20most%20effective%20for,hit%20the%20pillow%20at%20night> (accessed Sep. 19, 2023).

[4] C. Cox, "How to Power an Arduino with a Battery." circuitbasics.com. <https://www.circuitbasics.com/how-to-choose-the-right-battery-to-power-up-your-arduino/#:~:text=Primary%20Cells,utilized%20in%20an%20Arduino%20project> (accessed Sep 26, 2023).

[5] T. Rish, "Ultimate List of ISO Standards for Medical Devices." greenlight.guru. <https://www.greenlight.guru/blog/iso-standards> (accessed Sep. 19, 2023).

# Principles

## PRINCIPLE #1: LUMINANCE [1]

- **Description:** Luminance is a measure of the intensity of light emitted or reflected from a surface in a particular direction.
- **Equation:**  $L = (d\Phi) / (d\Omega \cdot dA \cdot \cos\theta)$ , where  $L$  is luminance,  $\Phi$  is luminous flux,  $\Omega$  is solid angle,  $A$  is area, and  $\theta$  is angle.
- **Contribution:** Incorporating luminance measurements through a light sensor will enable the system to detect whether a pill has been taken from the box. This principle ensures accurate monitoring and adherence to the medication schedule.

## PRINCIPLE #2: SPEED OF SOUND EQUATION [2] EQUATION [2]

- **Description:** Sound propagation refers to the way sound waves travel through different mediums. It involves concepts like waveforms, frequency ( $f$ ), amplitude ( $A$ ), wavelength ( $\lambda$ ), and the speed of sound ( $c$ ).
- **Equation:**  $c = f\lambda$ , where  $c$  is the speed of sound,  $f$  is the frequency, and  $\lambda$  is the wavelength. The sound intensity ( $I$ ) is proportional to the square of the amplitude ( $A^2$ ).
- **Contribution:** Understanding sound propagation helps in optimizing the design of alarms. This principle enable us to determine the most appropriate decibels of volume for customers (through the amplitude).

## PRINCIPLE #3: OHM'S LAW [3]

- **Description:** Ohm's Law describes the fundamental relationship between voltage ( $V$ ), current ( $I$ ), and resistance ( $R$ ) in an electrical circuit. It states that the current flowing through a conductor between two points is directly proportional to the voltage across the two points and inversely proportional to the resistance between them.
- **Equation:**  $V = IR$ , where  $V$  is voltage (in volts),  $I$  is current (in amperes), and  $R$  is resistance (in ohms).
- **Contribution:** Ohm's law can be used in calculating power consumption and energy efficiency of our product to make sure it doesn't surpass the project requirements. In the context of voltage and current measurements, it helps quantify the power usage of electronic components and systems.

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[1] "Luminance." Wikipedia. <https://en.wikipedia.org/wiki/Luminance> (accessed Sep. 27, 2023).

[2] C. Deziel, "How to Calculate the Speed of Light." sciencing.com. <https://sciencing.com/calculate-speed-light-5157189.html> (accessed Sep. 27, 2023).

[3] "Ohm's Law." Wikipedia. [https://en.wikipedia.org/wiki/Ohm%27s\\_law](https://en.wikipedia.org/wiki/Ohm%27s_law) (accessed Sep. 27, 2023).

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