

# Pillola

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## Executive Summary

### Medication Management and Pill Security

Medication management and pill security are prevalent issues in senior health today. Unfortunately, seniors are one of the greatest victims of medication theft in independent living facilities. They are often targeted by caregivers, nurses, or other staff who swap out vital medication either for self-use or to sell to others for profit. This results in residents taking the wrong medication or receiving their medication in inadequate amounts, both of which are very detrimental to their well-being. According to a recent review of state reports of drug thefts from the School of Nursing at the University of Minnesota, "the average resident lost 45 doses of medication due to theft," which can put countless individuals in harm's way (Mir).

Furthermore, many seniors take several medications at once, and managing these different medication regimens can often be confusing. As a result, they may forget to take their medication, lose track of their medication schedule, or accidentally take the wrong dosage. Consequently, irregularities in their pill consumption occur, increasing the risk of serious medical ailments such as accelerated organ failure, uncontrolled bleeding, and hallucinations, which can all be fatal. In fact, "medication non-adherence is responsible for 30 percent of hospital readmissions" (The Danger of Forgetting or Taking the Wrong Medication). So far, the only solution to this problem has been 24/7 monitoring of patients by the caregivers in the facilities. However, a study of the State Regulatory Review conducted by the National Center for Assisted Living in 2013 reported that "63% of the staff at [Assisted Living Facilities] offer help and administration of prescription medications to residents", indicating that while there are many staff members actively tailoring to seniors' medical needs, such requirements are still not being sufficiently met (Medication Management).

In our interview with Kristofer Munch, the executive director of the Alura by Inspired Living senior living facility in Rockledge, Florida, our team gained insight into how caregivers administer medication to patients. While caregivers go to the senior's room at the designated times to deliver their medication, they may often find themselves overwhelmed when helping seniors with their medication, throwing pill delivery timings into jeopardy. To mitigate this issue, the state of Florida allows caregivers to administer medication within a two-hour time frame of the prescribed dosage time; however, this results in a frequent pattern of inconsistent medication consumption.

## **Introducing Pillola**

Pillola is the reinvention of the pill bottle that aims to tackle these two issues of pill security and medication management. It reminds the user (senior) to take their medication with audio alerts and mobile notifications, dispenses the correct doses at scheduled times, and provides secure access with fingerprint identification. To gain access to the pill chambers for refilling (or emergency use), the senior or respective caregiver must enter a four-digit passcode on the keypad [Appendix 1]. This reduces the risk of pills being swapped or tampered with by others.

In addition, Pillola highly prioritizes the automated monitoring and analysis of pill consumption by users. With the Pillola app, both seniors and their loved ones will be able to track every aspect of pill usage, including but not limited to whether the pill was taken and at what time [Appendix 4]. The app records this information in detail by tracking user input from the keypad sent through the NodeMCU. These features make the process by which seniors take their medications as prescribed easier, relieve caregivers and family members that seniors are doing so, and reassure independent senior living facilities that their residents' medications are safe and secure.

Other automatic pill dispensers exist in the pharmaceutical manufacturing industry and pill bottle markets, such as the Hero pill dispenser, MedaCube, and MedMinder; however, none of these dispensers are compact, connects seniors and their loved ones with an easy-to-use interface, or maintain high-level security to protect a user's pills. Pillola is the only dispenser that maintains the familiarity of a pill bottle while incorporating the previously listed features. Its small size [Appendix 6] allows for product storage in various locations, from the user's purse to their kitchen countertop. Pillola is also equipped with a unique dispensing mechanism that operates a 180-degree custom dial indexer to accept one pill at a time from an overhead container. Such a method enables Pillola to avoid the need to presort pills as conventional pill organizers do [Appendix 3]. In addition, this unique mechanism allows Pillola to mitigate the possibility of dispensing too many pills and makes it easier to keep track of exact pill outtake.

## **Who is Pillola for?**

Pillola specifically targets senior citizens who want better ways to track their medication and family members (sons, daughters, caregivers) that are concerned about their loved ones following their medication schedule. According to an analysis by the National Center for Health Statistics, "...the number of Americans using five or more prescription drugs increased 70 percent over the past 10 years" (Prescription drug use on the rise in the United States).

Additionally, the greatest percentage of consumers of prescription medication are those over the age of 65, where "40 percent of the nation's seniors used five or more prescription drugs in a one-month period" (Prescription drug use on the rise in the United States). Thus, at a time when prescription drug use is rising, and the population of Americans 65 and older has increased by 34.2% in the last decade - according to 2019 population estimates published by the United States Census Bureau in June 2020 - the future of consumer demand for Pillola is very opportunistic (65 and Older Population Grows Rapidly as Baby Boomers Age).

## **The Pillola App and Hardware Configuration**

Pillola's software user interface is designed to be simple enough for both seniors and their loved ones or caregivers to use. When a senior (user) receives their Pillola, they will configure fingerprint authentication settings, set a four-digit passcode, and download the app on their phone to receive notifications [Appendix 5]. Once they receive their pills, they can open the pill bottle using the fingerprint scanner and pour their pills into the top of the bottle [Appendix 2].

The dispensing mechanism handles distributing the designated dose using our custom dial indexer [Appendix 3]. The setup process is complete once the time at which the senior needs to take their pills and the dosage is inputted using the keypad. For seniors who are not comfortable with mobile phone technology or do not have their phone with them, the Pillola device emits a sound using a piezo buzzer. In addition, the user can customize the number of pill types dispensed by Pillola and colors for the outer shell [Appendix 1].

## **Reaching Seniors, Caregivers, and Families**

To reach our intended consumer base, Pillola will advertise using search engine optimization (SEO), cost-per-click, and targeted promotions through social networking platforms. SEO will be customized to appeal to seniors, assisted living facility caregivers, and concerned family members whose web searches indicate a proactive interest in senior medication assistance. Ideally, our product will appear on the user's screen after searching for something to do with the issues we are solving. Additionally, with a well-designed price per-click advertising model, we will be able to effectively promote our product on sites whose content lines up with similar issues (i.e., a blog about pill consumption or an article with steps to help one remember to

take one's medication), and lead people to our website. Our target market predominantly uses Facebook, and many advertisements can be launched on this platform. Once users are directed to our website, they can easily explore our features and order directly online.

Our target market predominantly uses Facebook, and many advertisements can be launched on this platform. Once users are directed to our website, they can easily explore our features and order directly online. Our team will also reach out to the heads of several senior living facilities and make deals with them to have Pillola be a standard product used by their residents. The next step would be to get Pillola approved by public health officials from government institutions like the Food and Drug Administration (FDA) so that consumer confidence is achieved and federal safety requirements are met. Lastly, once a stable customer base is acquired, we plan to mass-produce and sell the product in-store chains such as CVS, Walmart, and Walgreens.

## Scalability and Revenue with Living Facilities and Domestic Purchases

To sustain the competitive advantage of Pillola's product development and distribution operations over time, sample Pillola bottles would be dispersed to senior facility homes through customer feedback loops that will receive and value user input. Such streamlined insights from seniors and caregivers would inform Pillola about how different degrees of consumer satisfaction can improve its business model and competitive strategy over time. The value of the pill bottle would also be calculated through factoring in key predictor variables, including but not limited to product sales data, customer reviews, and competitive analytics to gauge the strength of other companies with slightly differentiated products.

Pillola's business model is centered around the proposed pill bottle's mass production and third-party retail distribution. This would be done with a steadfast approach that commits toward ensuring both a frequent usage of the product and increased market share from existing Pillola users influencing new users to purchase the products through word-of-mouth and reviews. We can reflect the unit economics of this model by implementing the following equation:

$$\begin{aligned} \text{Gross Profit} = & ((\# \text{ seniors}) \cdot ((\# \text{ bottles per senior}) - (\text{COGS per senior})) \cdot (\text{revenue split})) \\ & - ((\# \text{ ads}) \cdot (\text{ad click-through rate}) \cdot (\text{cost-per-click of ad})) \\ & - (\text{marketing expenses}) \end{aligned}$$

We categorize the user of a Pillola product as a senior in an independent living facility. While they or a facility may pay for the product, the seniors who are using the product are the fundamental revenue drivers. Revenue is calculated by the number of pill bottles purchased per senior, multiplied by the number of seniors that use Pillola. A revenue split is included in our model since third-party retailers will eventually

distribute Pillola; any online purchases, however, will allow Pillola to benefit from the entire selling profit of the product. The cost of goods sold initially plays a role in our model's unit costs. However, as adoption of the Pillola pill bottle increases and the bottle nears mass production, it will eventually decrease, increasing the ratio of revenue to costs. This is because Pillola bottles are 3D-printed, and 3D-printing technology has reduced economies of scale because of reliance on the availability of printers and filaments, which are not entirely expended per individual bottle production.

Pillola will also be advertised through prominent search engines such as Google and marketing representatives who discuss the benefits of Pillola with caregivers who are taking care of seniors. Costs associated with marketing and promotional efforts contribute to the customer acquisition value because they are incurred after taking actions such as meeting with caregivers to promote the product to new users. As Pillola becomes more widespread, we expect that new customers will be attracted by our effective advertising models in addition to word of mouth and successful usage at senior assisted-living facilities, thereby decreasing the costs contributed by the customer acquisition values and increasing its potential to scale into a widely profitable business.

## References

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- [5] "65 and Older Population Grows Rapidly as Baby Boomers Age." United States Census Bureau, 25 June 2020, [www.census.gov/newsroom/press-releases/2020/65-older-population-grows.html](http://www.census.gov/newsroom/press-releases/2020/65-older-population-grows.html). Accessed 29 July 2021.

# Appendix 1

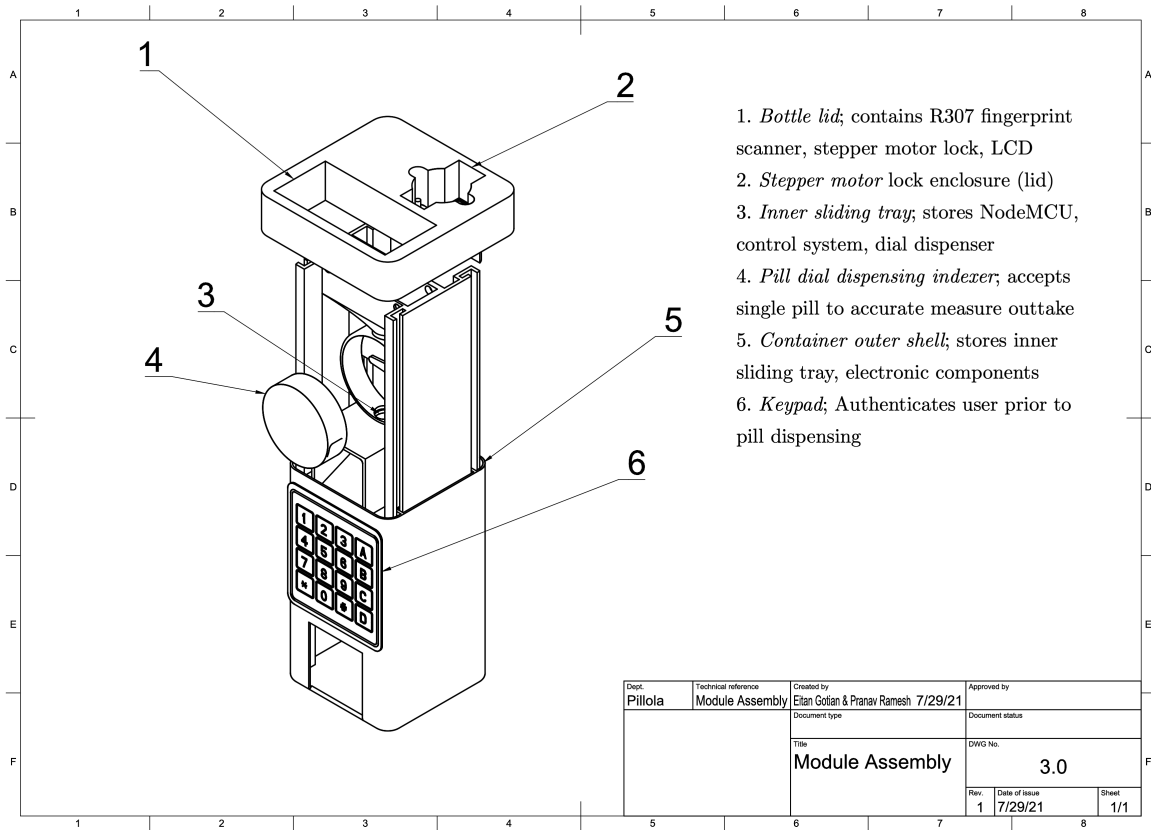


Figure 1: Line drawing of the key components of the module highlighting the feature and mechanisms for pill dispensing and the shelling mechanism. Created by Pranav Ramesh and Eitan Gotlan with Autodesk Fusion 360.

## Appendix 2

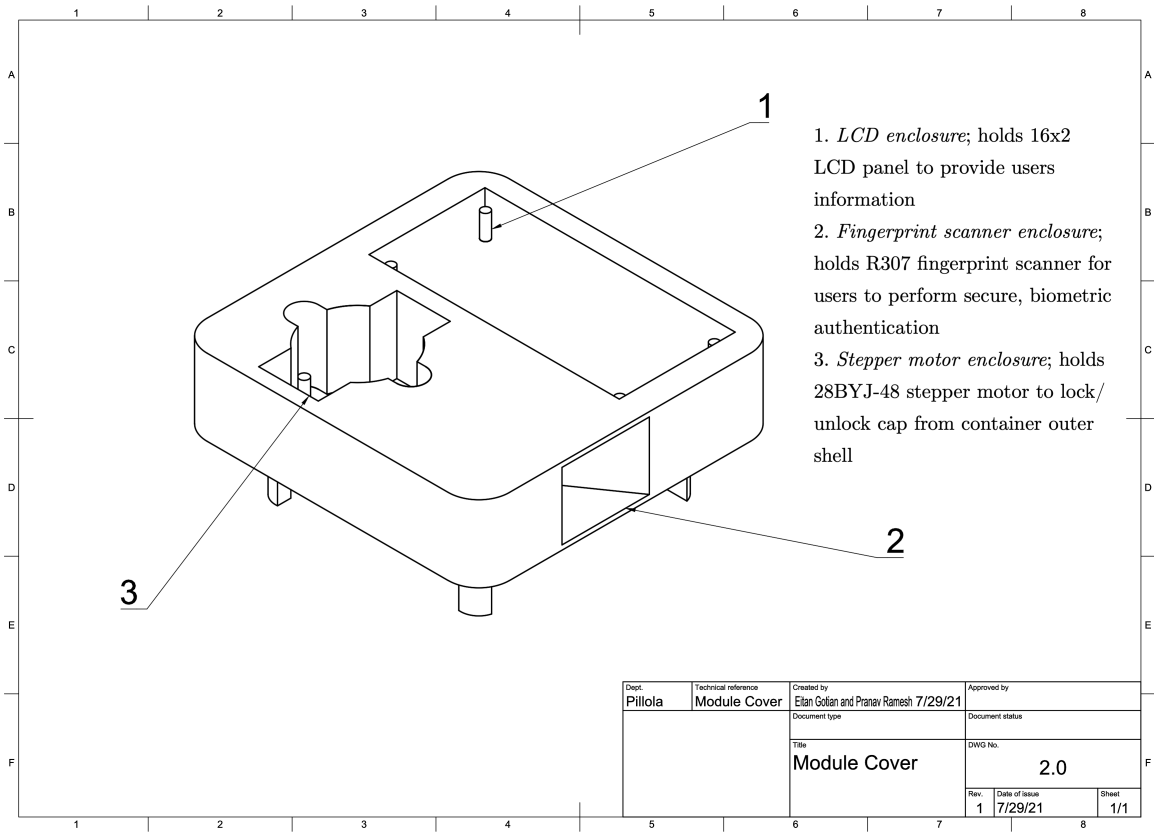


Figure 2: Line drawing of the module cover highlighting the cavities for the embedded electronic components. Created by Pranav Ramesh and Eitan Gotian with Autodesk Fusion 360.



## Appendix 3

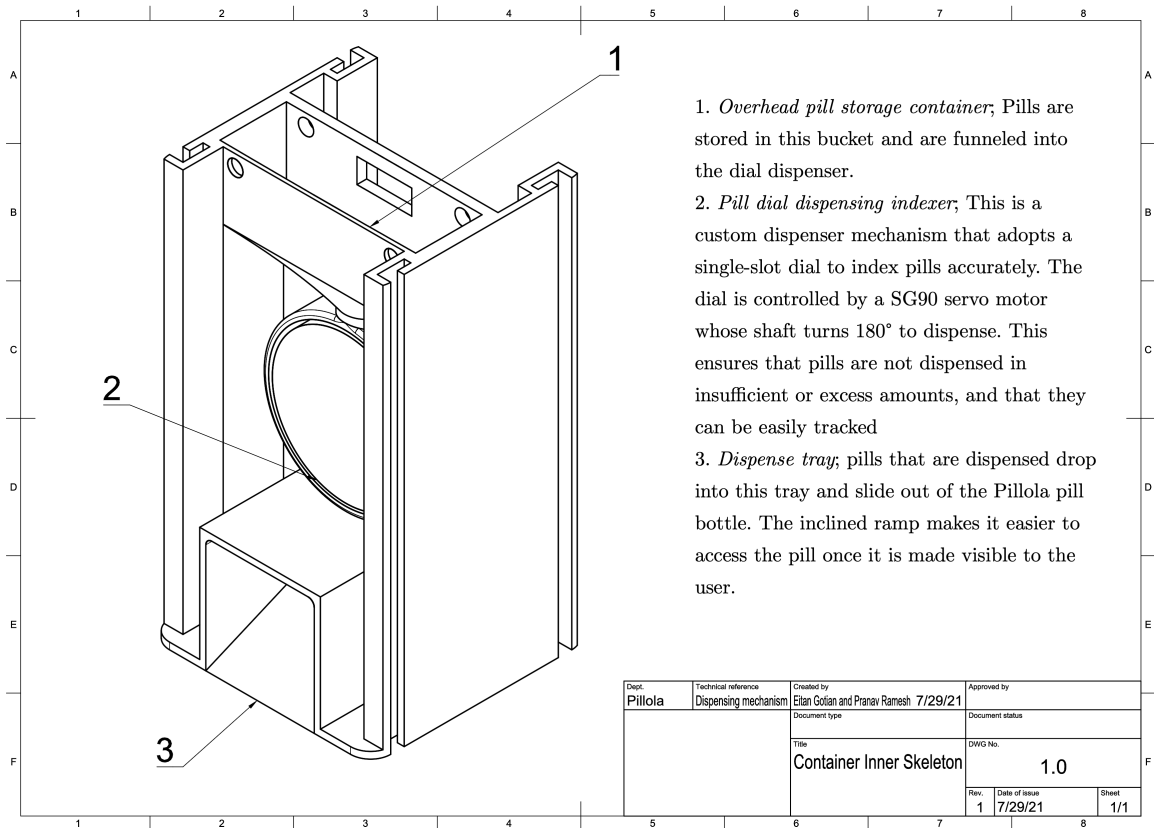


Figure 3: Line drawing of the dispensing mechanism highlighting the dial indexer and pill storage container. Container Inner Skeleton. Created by Pranav Ramesh and Eitan Gotian with Autodesk Fusion 360.

## Appendix 4

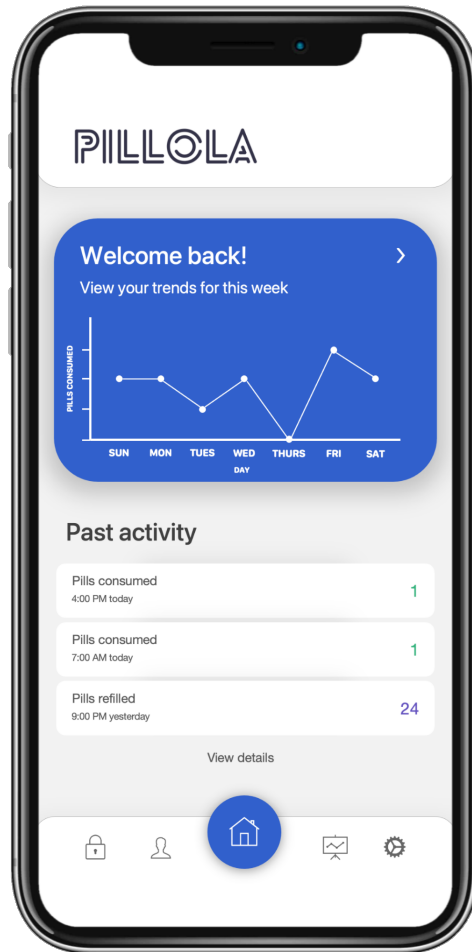


Figure 4: Screenshot of the home screen interface for the Pillola client iOS app. Includes consumption trends and past activity.

## Appendix 5

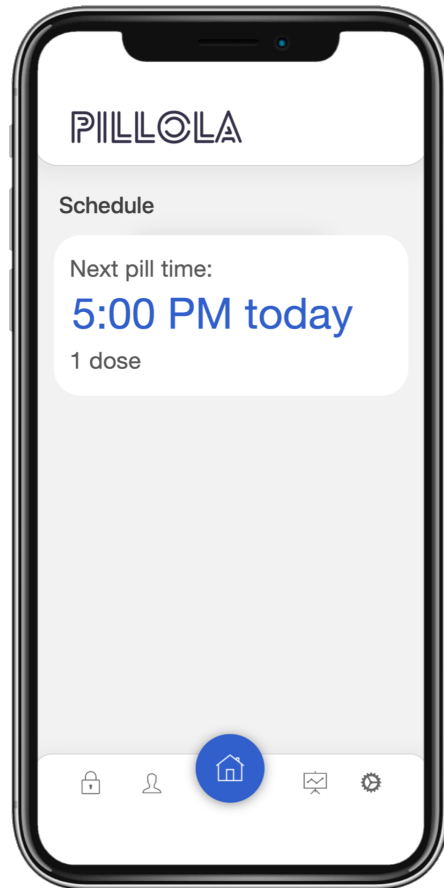


Figure 5: Screenshot of the schedule notification interface for the Pillola client iOS app. Includes upcoming pill consumption times in the day.

## Appendix 6



Figure 6: Side-by-side comparison of a 16-oz. bottle to the Pillola pill bottle. The comparison is indicative of Pillola's small form factor.

## Appendix 7

Item	Accuracy	Description
Sensor Accuracy	97.5%	Based on testing and recording data.
Alarm accuracy	100%	As long as the NodeMUC maintains a network connection.
App notification accuracy	100%	As long as the NodeMCU maintains a network connection and the user enables notification settings.
Proposed Battery Life	N/A	In the future we plan to use a lithium rechargeable battery that will power the model for 3-5 days. We arrived at this number by determining the average voltage the module needs.
Proposed motor life	N/A	Servo motor will last approximately 5 years. This number was calculated based on the average number of dispenses per day and consumption schedule length.