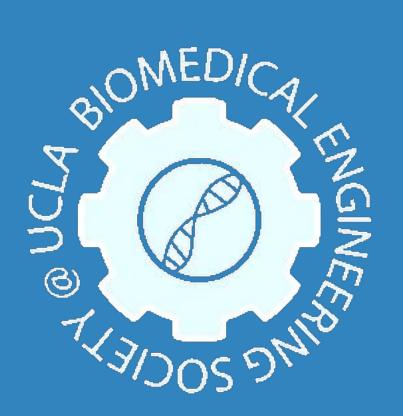
Automated Pill Dispenser for Medication Management



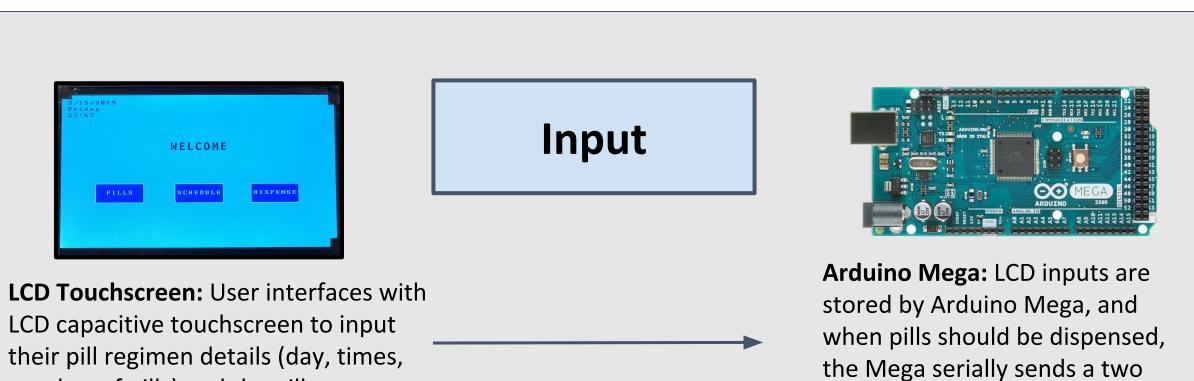
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Motivation

Often times, an overlooked aspect of treating an illness occurs on the patient end in medication management. About 1 in 3 medication non-adherence cases are caused by forgetfulness, and the monetary effect of non-adherence reaches \$100 billion per year in the US alone (Stawarz 2014). The term "stressed adherence" refers to emotional pressure resulting from the perceived danger of forgetting to take medication, and patients in one study have reported the difficulties in dealing with this pressure and lack of guidance or help from healthcare professionals (Haslbeck 2009). In order to address this issue, we have developed an automated device to match the individual's medication regimen and eliminate medication non-adherence through a built-in notification system.

Design

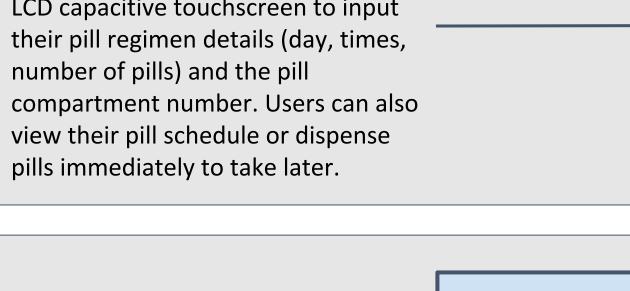


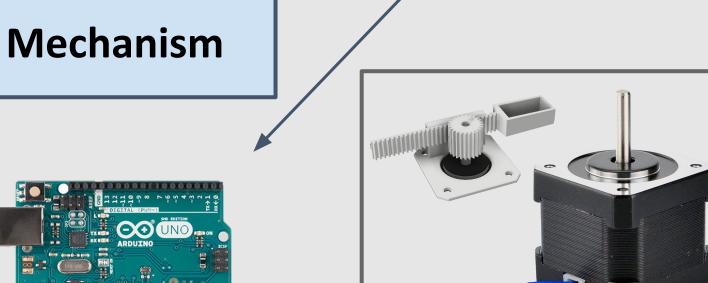
2. Select correct

3. Insert pill box to retrieve

4. Sense whether pill is

compartment





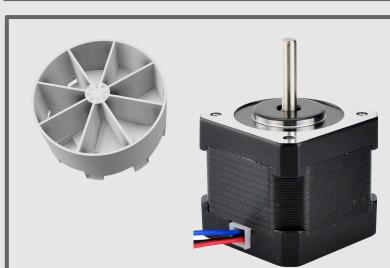
digit number to the Arduino

compartment and number of

Uno, designating the pill

pills to dispense.

The pill compartments rotates until the infrared (IR) sensor module detects a block attached to the compartment. The signal stops the compartments such that the first compartment is aligned with the pill



2. Select Correct Compartment The pill compartments rotate the correct number of steps in either direction, as determined in the code through an optimizing function.

3. Insert Pill Box to Retrieve Pill The rack-and-pinion with the pill Arduino Uno: Take in data box attachment is powered by a from Arduino Mega and bipolar stepper motor. controls pill dispensing Extension speed and distance mechanism. for pill retrieval are defined in the code. L. Compartment calibration



through its 15° cone of view

Output LED: Visual component of alarm system, blinks on and off to alert users that pills have been dispensed.

Buzzer: Audio component of the

Outlet: When dispensed, pills alarm system, beeps follow the slide down and end on and off to alert into the collection area within users that pills have the semicircle enclosure. been dispensed.

Auxiliary Components

into the outlet.

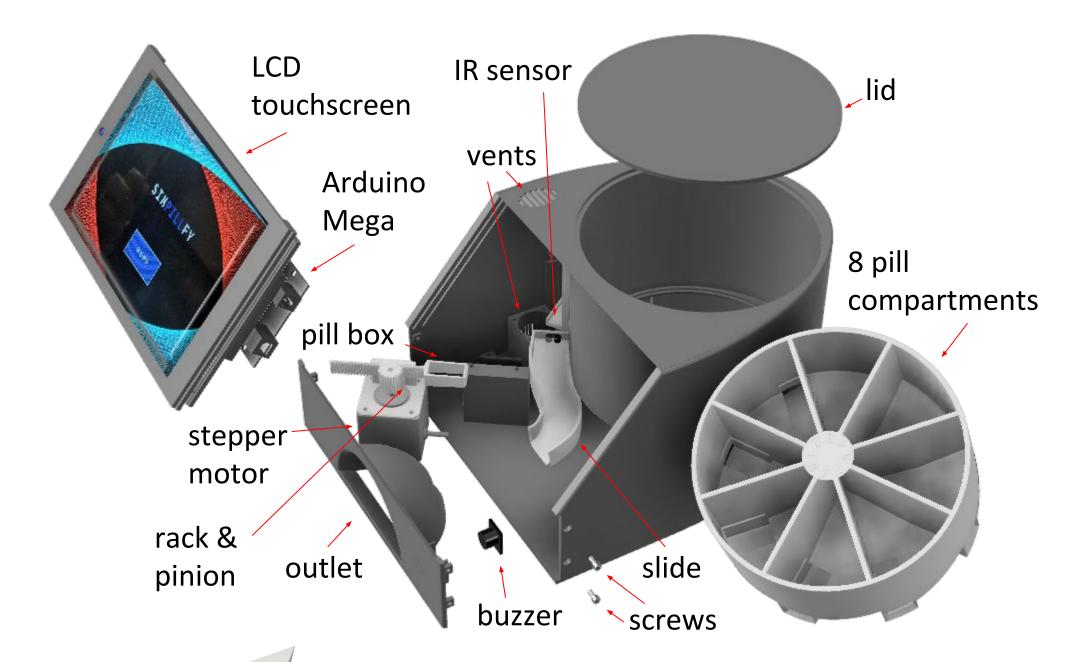
Spring-loaded Compartment Block: Designed to prevent uncontrolled dispensing of pills. The block is compressed by the pill box and decompresses to block the opening in the capture zone



Establishes an **USB Hub:** Commercial 5 port electronic USB power strip to provide 5V connection to LCD touchscreen, Arduino between Arduino Mega, Arduino Uno, and both Uno and each stepper motors. stepper motor.

Motor Driver:

Exploded view of computer aided design (CAD) model

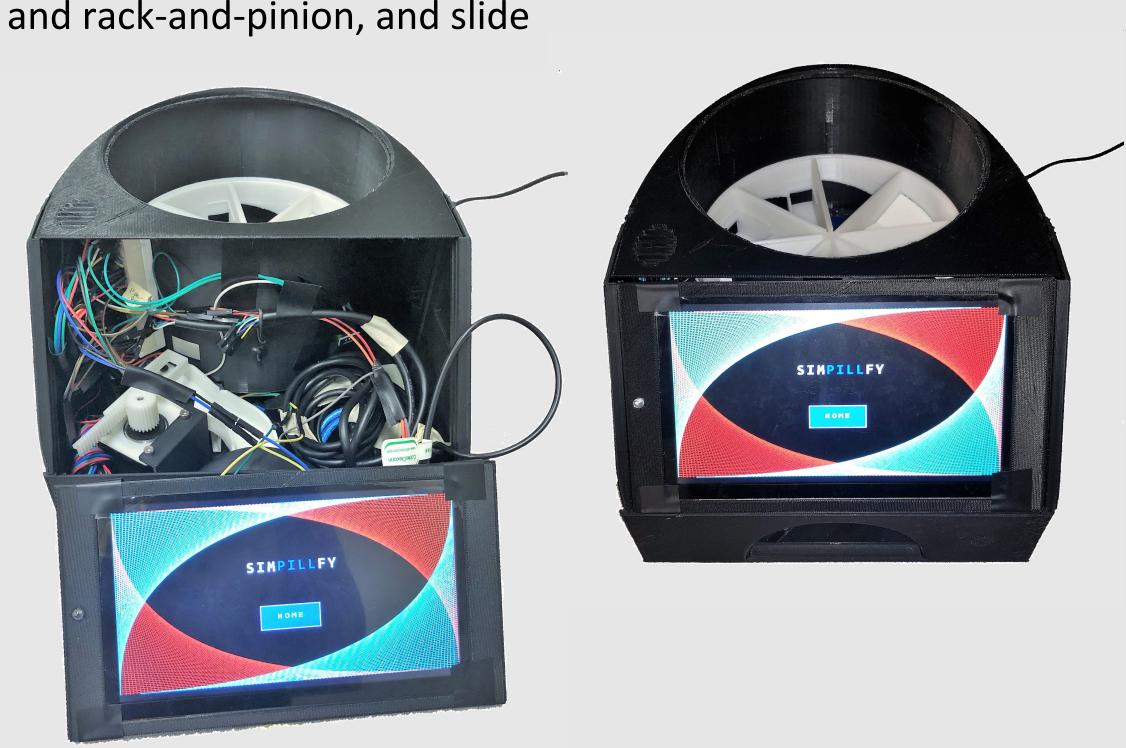


Isolated Individual Pill Compartment View Each compartment has sloped interior surfaces to funnel pills towards the opening. Controlled delivery of pills is controlled by a spring-loaded box.

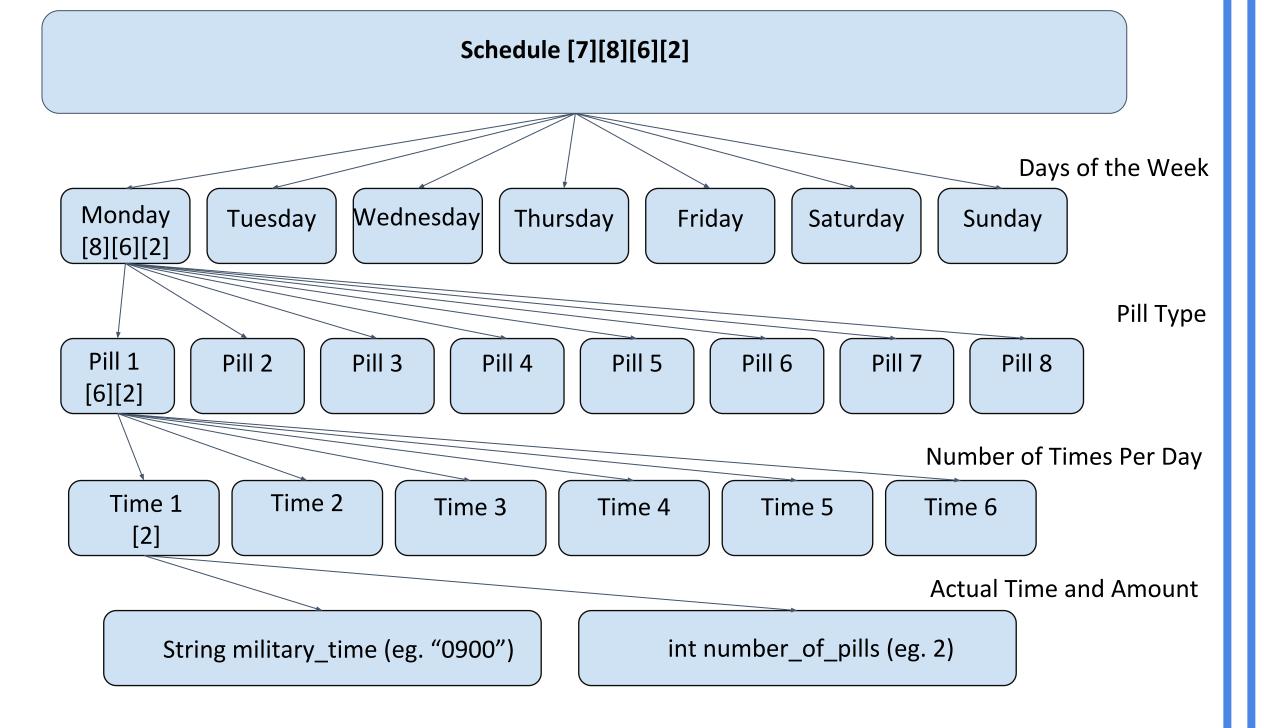
Final Product

Assembled pill dispenser with LCD display and lid removed to demonstrate wiring, pill box and rack-and-pinion, and slide

Pill dispenser with LCD display in place



LCD/Arduino Mega Pill Schedule



This chart shows the format of the pill schedule coded within the LCD/Mega unit. User inputted times and numbers of pills are stored in this 4D array. For daily usage, this large array is accessed to make a simple schedule for the current day, which can be altered if need be to dispense early - in case one will not be near the machine at the expected time.

The LCD inputs all of the data from the user's interactions with the touchscreen graphical user interface. The Mega stores this information and takes care of all time-related duties, delegating hardware control to the Uno at the appropriate times.

Obstacles

Issue	Solution
Pill box and pill compartment opening would often become misaligned during and after dispensing	Incorporate IR sensor to sense a block attached to bottom of pill compartments, allowing location calibration
Despite the pill compartment's overall slope towards the capture zone, sometimes pills would not fall into the capture box	Implement function in code to quickly rotate pill compartments back and forth prior to dispensing to shake pills into capture zone
Even with pill compartment shaking before dispensing, sometimes pills would not fall into capture box	Incorporate IR sensor in pill slide to sense when a pill is successfully dispensed. Repeat dispensing if no pill is dispensed
Motor driver H-bridge quickly heated and became too hot to touch	Affix aluminium heat sinks and add fan with inlet and outlet vents

Future Directions

Bluetooth App

We plan to implement a bluetooth-based phone application as an added feature in the notification system. Because smartphone usage is becoming increasingly more common and widespread, including this functionality should help to further reduce medication non-adherence due to forgetfulness.

Patient Feedback System

One feature to improve healthcare by providing doctors with more information would be a system where patients are prompted for comments such as any noticeable side effects or irregularities associated with the medication. This feedback would be relayed back to healthcare professionals so that there can be a more direct line of patient-provider communication.

References

- 1. Stawarz K, Cox A, Blandford A, Don't Forget Your Pill! **Designing Effective Medication Reminder Apps That Supports** Users' Daily Routines. CHI 2014, pg 2269 - 2278.
- 2. Haslbeck J, Schaeffer D, Routines in Medical Management: the Perspective of People with Chronic Conditions. *Chronic* Illness, vol 5, pg 184 - 196.

Acknowledgments

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