Healthfull

Code Snippet that runs the medication compartments motor telling it to turn a certain amount to dispense the proper medications on command.

```
void setup() {
 Serial.begin(9600);
 dispense.attach(3);  // attaches the servo on pin 9 to the servo object
 lock.attach(2);

 pinMode(greenLEDPin, OUTPUT);
 pinMode(redLEDPin, OUTPUT);
}

void loop() {
 if(Serial.available() > 0){ // Checks whether data is comming from the serial port
    state = Serial.read(); // Reads the data from the serial port
  }

 if(state == 'D' && roundcount == 0) {
  for(int roundone = 0; roundone <= 2;roundone +=1) {
    for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
      dispense.write(pos);              // tell servo to go to position in variable 'pos'
      delay(10);                        // waits 15ms for the servo to reach the position
    }
    for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
      dispense.write(pos);              // tell servo to go to position in variable 'pos'
      delay(10);                        // waits 15ms for the servo to reach the position
    }
    digitalWrite(10,HIGH);
    for (pos = 1; pos <= 25; pos += 1) { //45 degree movement
      myStepper.step(1);               //One step
      stepCount++;                     // Update Step count
      delay(20);
    }
    digitalWrite(10,LOW);
  }
  roundcount++;
  state = 0;
  digitalWrite(greenLEDPin,LOW);
 } else if(state == 'D' && roundcount == 1) {

  for(int roundtwo = 0; roundtwo <= 3;roundtwo +=1) {
    for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
      dispense.write(pos);              // tell servo to go to position in variable 'pos'
```

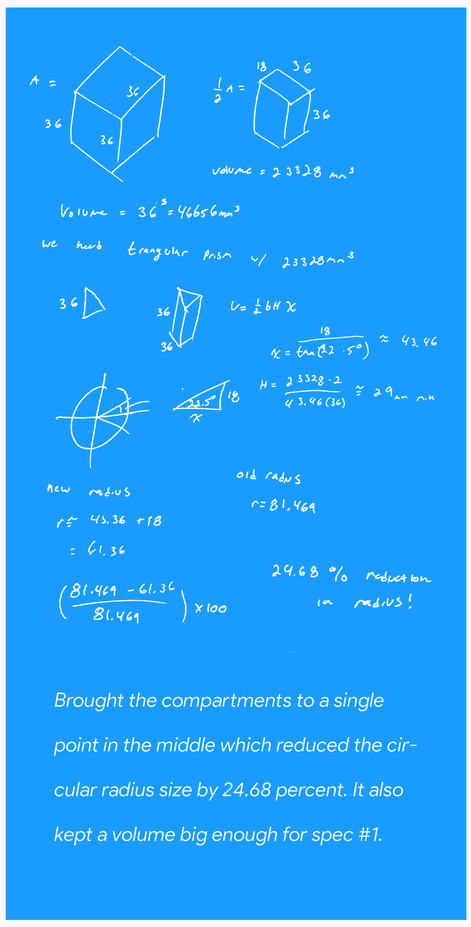
The Problem

We created a smart medicine dispenser that stores medication and alerts users via their phones when their next dose is ready. It locks the meds until the correct time and then dispenses the pills, which reduces improper medicine consumption among the elderly.

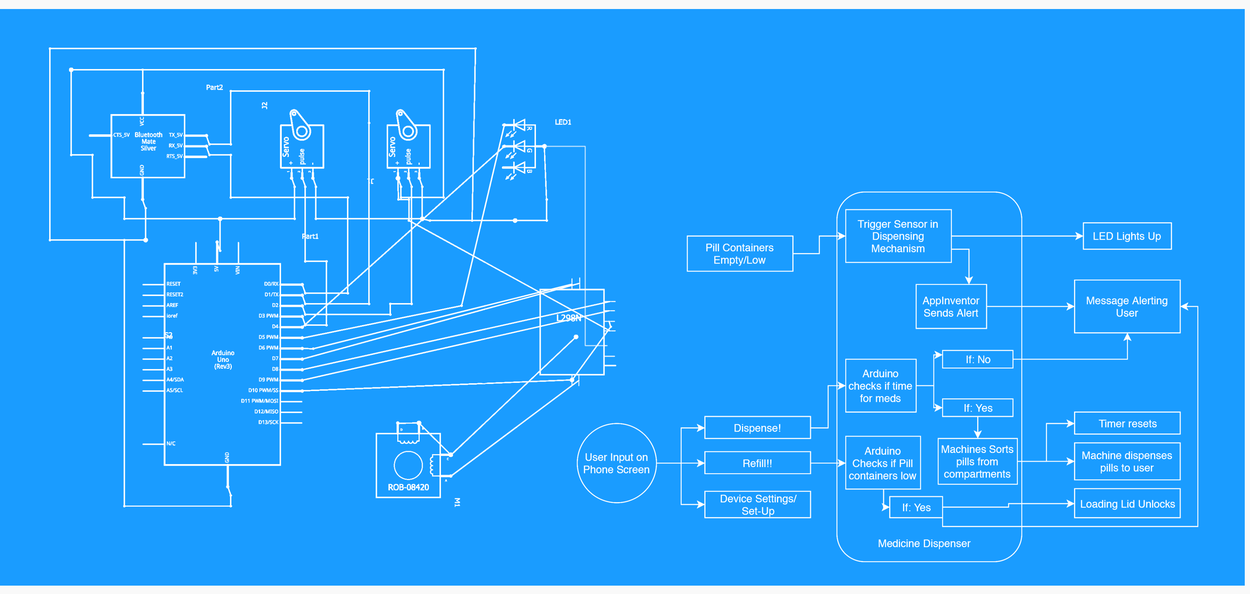
Stakeholders include the elderly and their concerned family members because 60% take meds wrong and approx. 140,000 related deaths occur each year. [1]

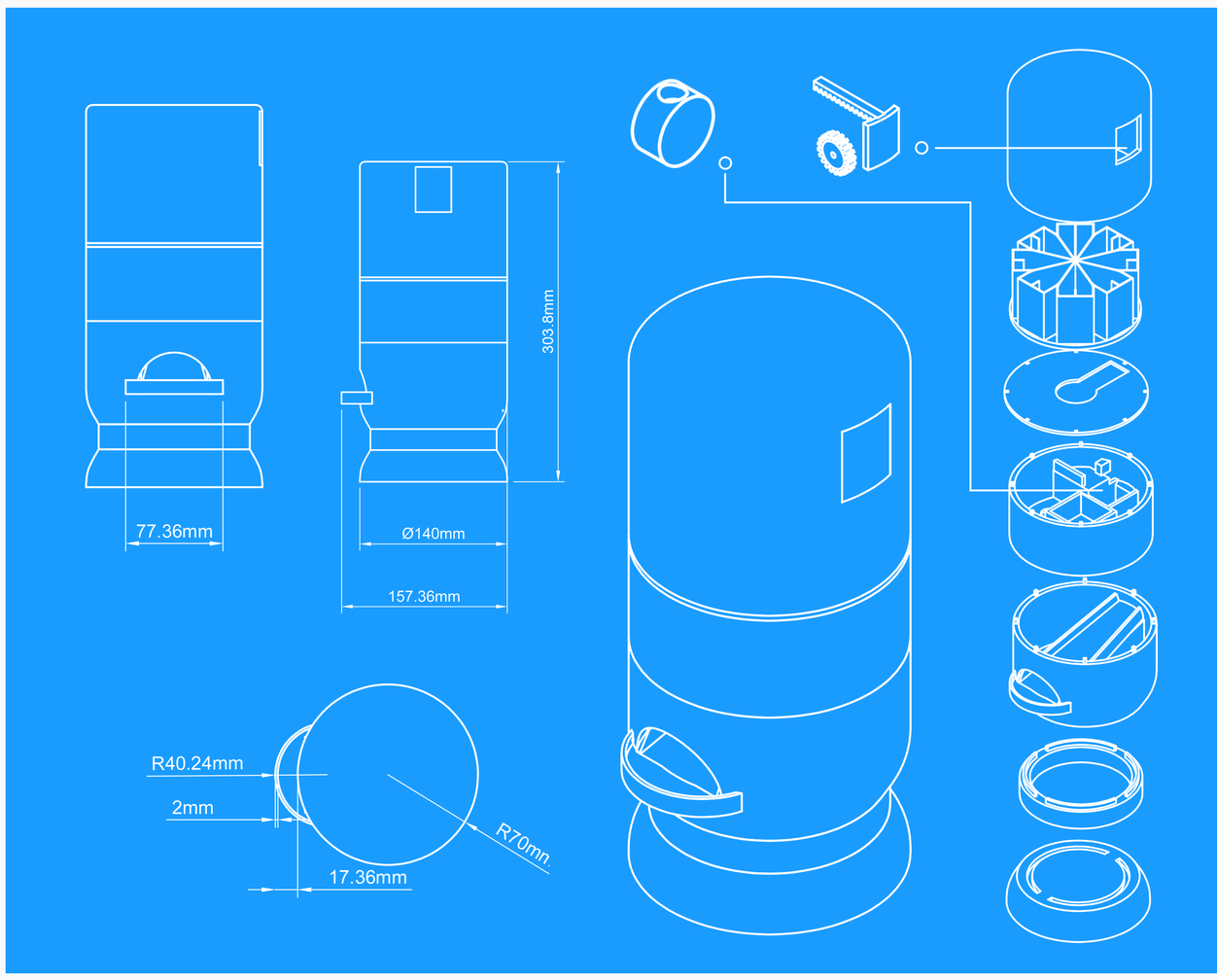
1. Hold 210 pills, for seven prescription medications.
2. 100% accuracy of pills dispensed at the right time.
3. Signal via LED when compartment has 12 pills left.
4. Send various reminder alerts to the user's phone

The elderly will be using the machine daily to improve health, therefore the system must be easy to use and reliable. Family members will use the app to check on the health of loved ones and assist easily in the setup.



Brought the compartments to a single point in the middle which reduced the circular radius size by 24.68 percent. It also kept a volume big enough for spec #1.





Design Considerations

A Bluetooth app controls 3 main functions: dispensing, refilling, and managing settings. The app is ideal because the upcoming generation of elderly is well versed with smartphones, secondly, they and linked users can receive alerts and check medication anywhere. The machine itself is straightforward, It dispenses the medicine into a tray and an led signals when refilling is needed. When the refill button is clicked a locked compartment opens where the user is prompted to seamlessly pour the new medicine in.

The dispenser is a household item, which means it must fit on countertops and tables. We intend to have it sit on a kitchen countertop thus it was designed to be relatively small and aesthetically pleasing.

2 major design considerations were: Incorporating a locking mechanism to stop unauthorized users from accessing the medication and secondly having a machine that could hold up to 210 pills, for seven medications. Elderly adults take 5-7 meds and pill bottles hold 30 pills each, 7×30=210 pills need to be held. [1]

Experimental Results

Based on the engineering specifications stated in the problem section we tested our machines functions. Spec 1: We were able to hold more than the min. amount. Spec 2: We had a 99.5% accuracy - Test #1 was performed with 1 pill in each compartment, Test #2: 3 pills, Test #4: 12 pills. Spec 3: The led turned on each time when compartments hit 12 pills. Finally, for Spec 4, a notification appeared on the phone 100% of the time that the medicine was ready to dispense. The results were very promising, we achieved all of our goals, with only one minor issue where 2 of the 96 pills in Spec 2: Test #4 failed. The issue was caused by the rotating disk moving off axis on the last two spins.

	Spec #1	Spec #2	Spec #3	Spec #4
Test #1	Holds 360 pills in 8 separate sections - 45 pills in each one	100 %	Yes	100 %
Test #2		100 %	Yes	100 %
Test #3		100 %	Yes	100 %
Test #4		98%	Yes	100 %

Build Process

Consisted of 3 stages: 1. Prototyping, 2. Refining, and 3. Final Build. In prototyping paper plates, cardboard and skittles were used to conceptualize ideas. We then refined volume and shape and 3D printed. In the final, we accounted for electronics and made changes.

The electronics included 2 servo motors, a stepper motor, a Bluetooth module, an RGB LED, and an Arduino. The final 3D printed build used PLA, the electronics and components were housed inside and the body pieces were glued together at the matching grooves.

Conclusion

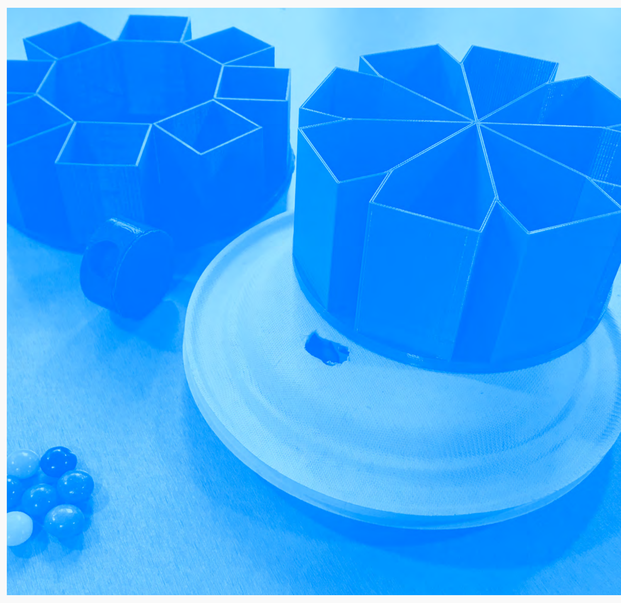
Currently able to dispense medication accurately, holds 45 pills in 8 compartments, and signals via led when 12 remain. The locking refill works and the Bluetooth app controls the functions, we met all of our big goals.

A challenge was sending alerts to users via text message from the SIM 900. We overcame this issue by finding a new solution. Using MIT App Inventor we were able to successfully send multiple alerts.

A second challenge that we faced was that the meds were getting caught in the holes because the weight was distributed equally. We overcame this by adding in a small wall and having the stepper motor shake.

In the up-scale of this project, we would create a fully developed app that could control more features like a to-go feature. Competing products like Hero Health and Pillo do not currently utilize one, and it would also allow the user more freedom. Furthermore, we would look into how to differentiate between pill sizes by creating a sorting mechanism to ensure safety and versatility in dispensing. We would conduct many more tests to ensure 100% accuracy in all conditions and lastly limiting our environmental impact would be a major consideration in upscaling this specific project.

Acknowledgements

[1] "Fact Sheet: Prescription Medication Use by Older Adults," Medscape. [Online]. At: https://wwwmedscape.com/viewarticle/501879. [Accessed: 16-Apr-2019].

[2] "Stepper - One Step At A Time," Arduino. [Online]. Available: https://www.arduino.cc/en/Tutorial/StepperOneStepAtATime. [Accessed: 12-Jun-2019].