



Accessible Pill Cap Dispensing/Cutting Device

Team Leader: Max Michalski

Communications: Ashley Huth

BSAC : Bryan Fondrie

BWIG: Joe Ferris

Client: John Enderle, Ph.D

Local Client: Mitch Tyler, Ph. D

Advisor: Naomi Chesler, Ph.D



Overview

- Background
 - Problem Statement
 - Design Requirements
 - Design Components
 - Testing
 - Future Work
-



Motivation

- Errors in medication administration
 - Misinterpretation of directions
 - Take wrong pill
- Poor compliance
 - Average adherence rates of 43%-78%
- Pill cutting reduces costs
 - 100mg pill costs same as 50mg pill
- No current pill dispenser has the ability to cut pills in half

RERC- Accessibility

- Accessible Design
 - Adheres ADA Specifications
 - Operable by persons with multiple, varying disabilities
 - Sensory Motor, Physical, & Cognitive
 - Eliminate disability-associated barriers
 - For home & general hospital use
 - FDA Class I Specifications



2



2

Problem Statement

Build a pill cap that dispenses a set dosage of half or whole pills at appropriate time intervals, as scheduled by a pharmacist.

Current Pill Cutters & Dispensers

- Pill dispensers
 - Not enough capabilities or expensive
 - Do not incorporate cutting
- Cutting devices
 - Not automatic
 - Not accurate
 - Not accessible



Design Requirements

- Accurately Dispense Multiple Medications
- Moderately Priced
- Dispense Varying Doses
- Precisely Cut Pills in Half
- Functional for Home or Clinical Environment
- Medication Alarm System
- Record Medication History
- Accessible Device

User Interface

Select Pill (add, modify, or delete)

Frequency of Administration (daily or weekly)

Times Per Day (1-5)

Time of Day (30 minute intervals)

Number of Pills to Administer ($\frac{1}{2}$ to $3 \frac{1}{2}$)



User Interface

- PDA touch screen
- Radio Buttons
- Confirmation screen
- Stores data in XML file

How many times does the patient take the pill per day?

1

2

3

4

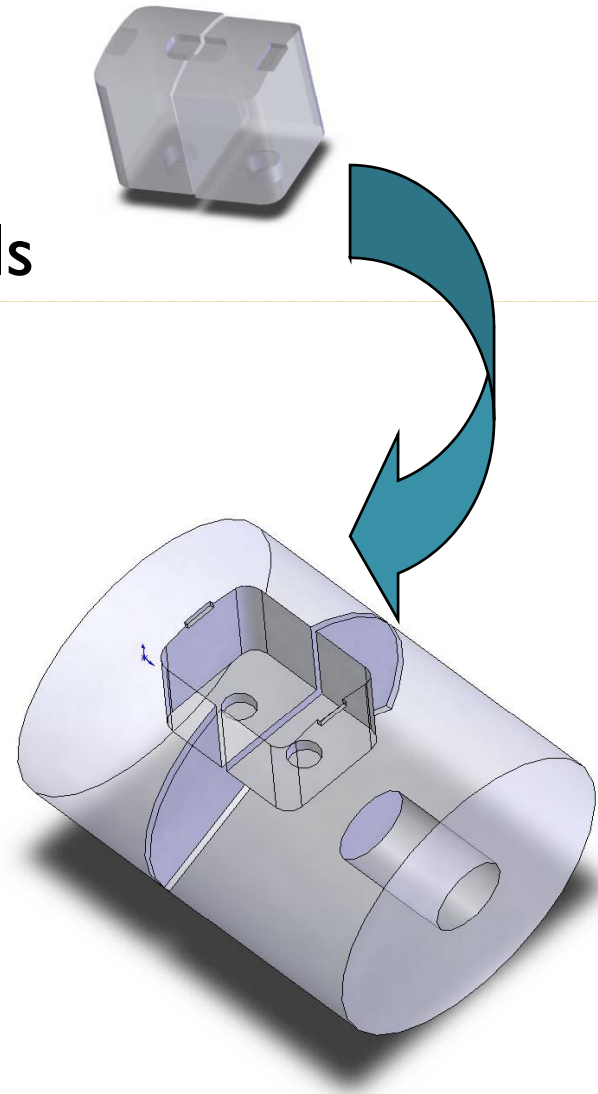
Pill Drum with Inserts

Pill Drum

- “Heart” of dispensing
 - Rotates to cut/deliver pills
- Holes for sensor wires

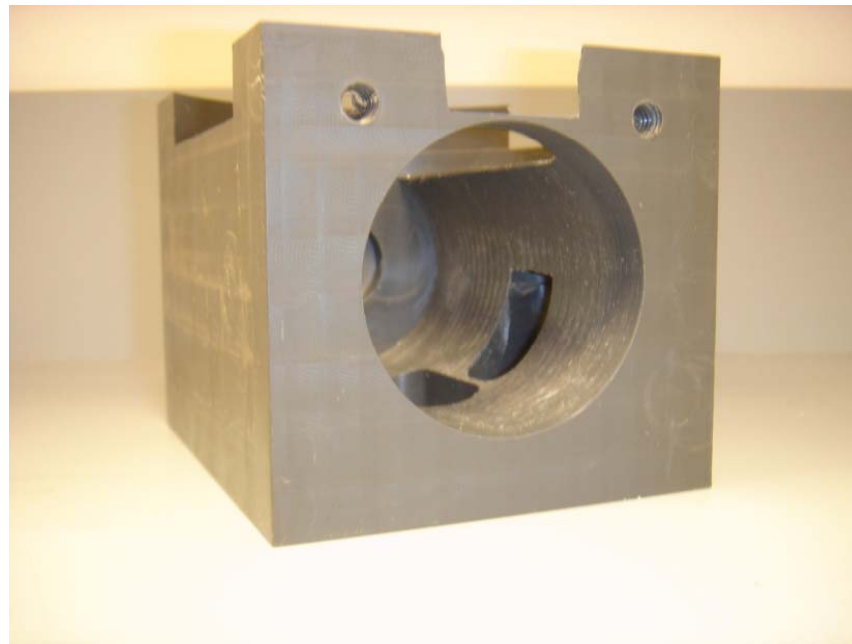
Inserts

- Interchangeable
- Sensors imbedded in inserts

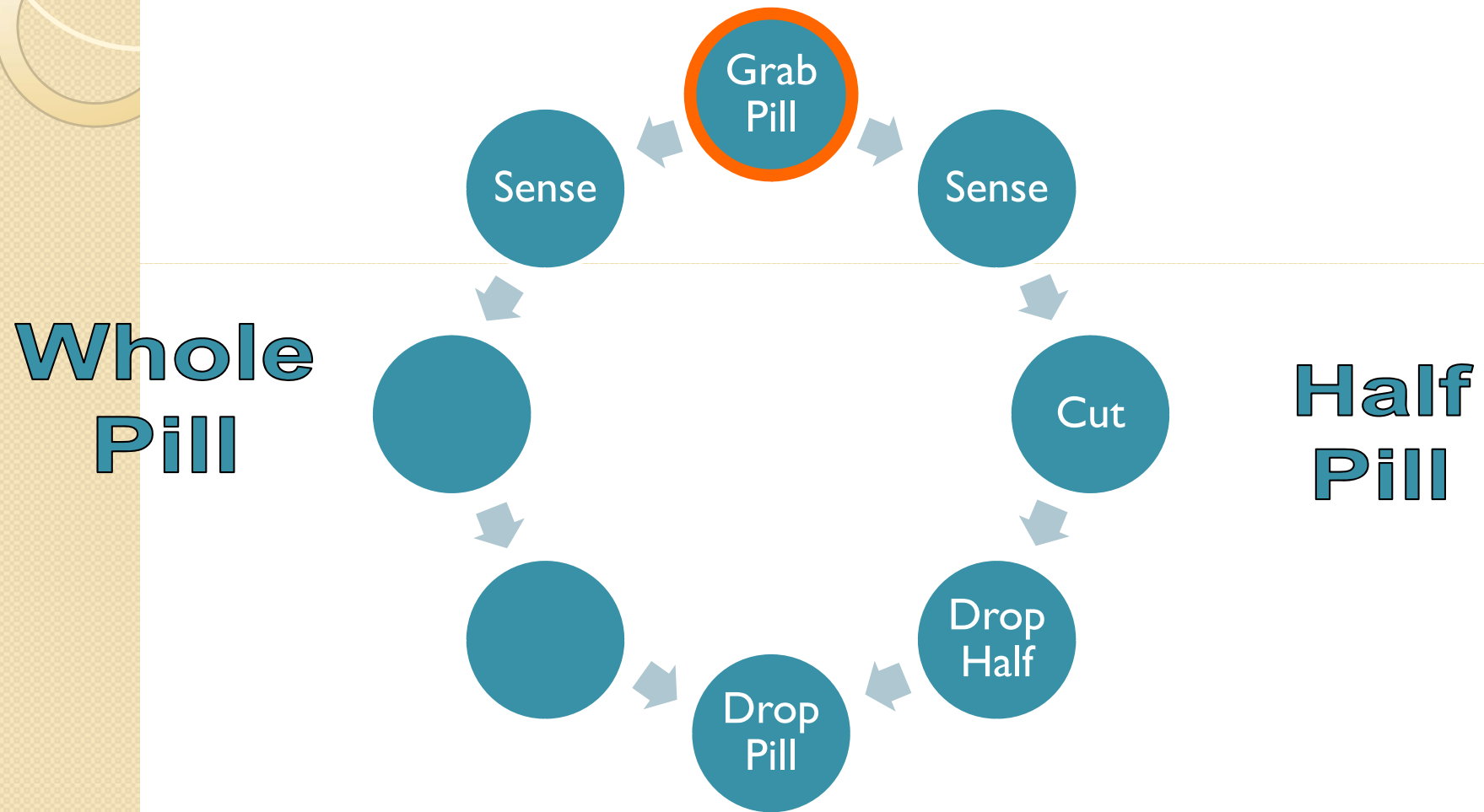


Pill Casing

- Low friction material
- Opaque material
- Block design



Inside the Pill Drum

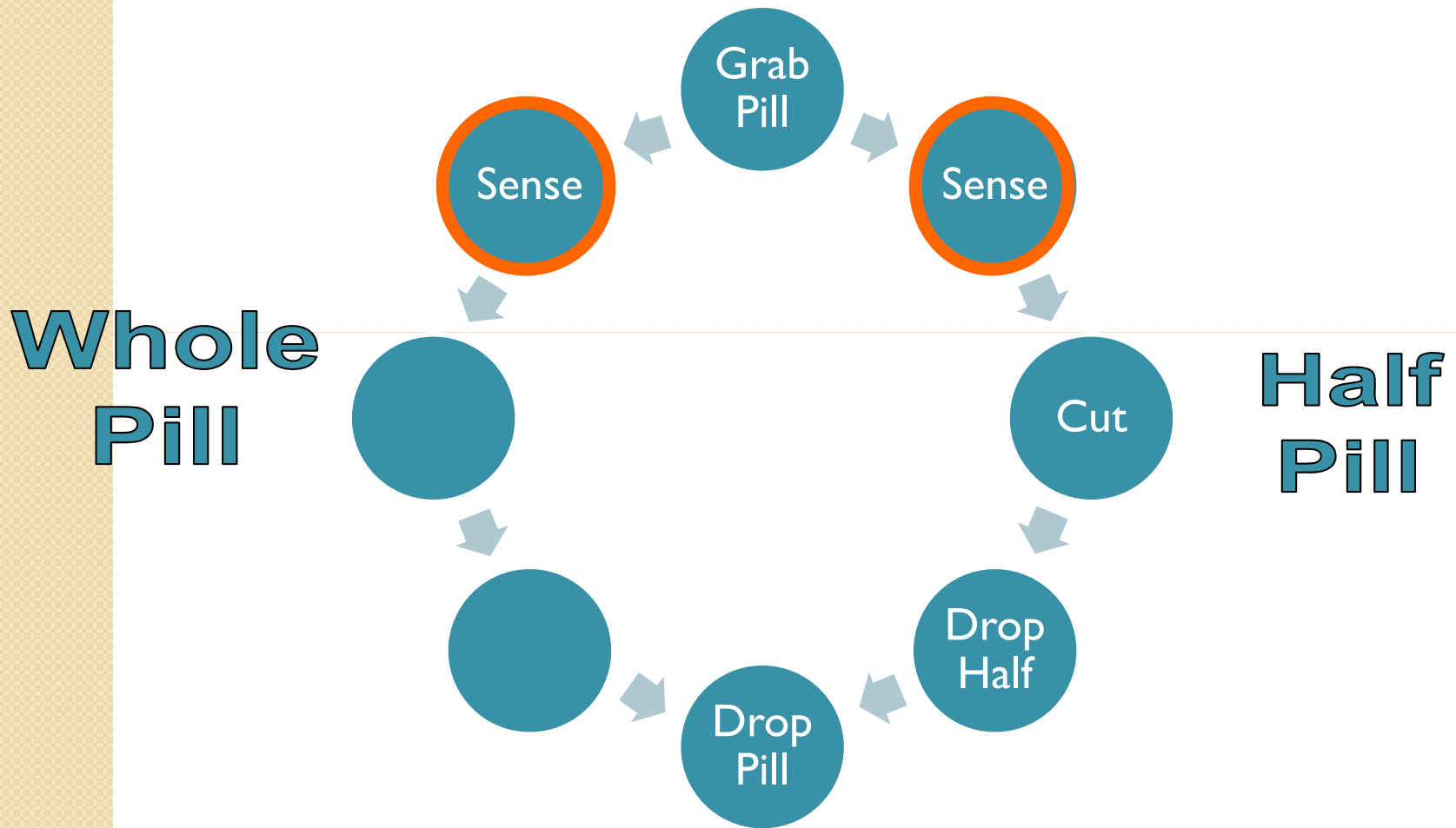




Pill Funnel and Mixing

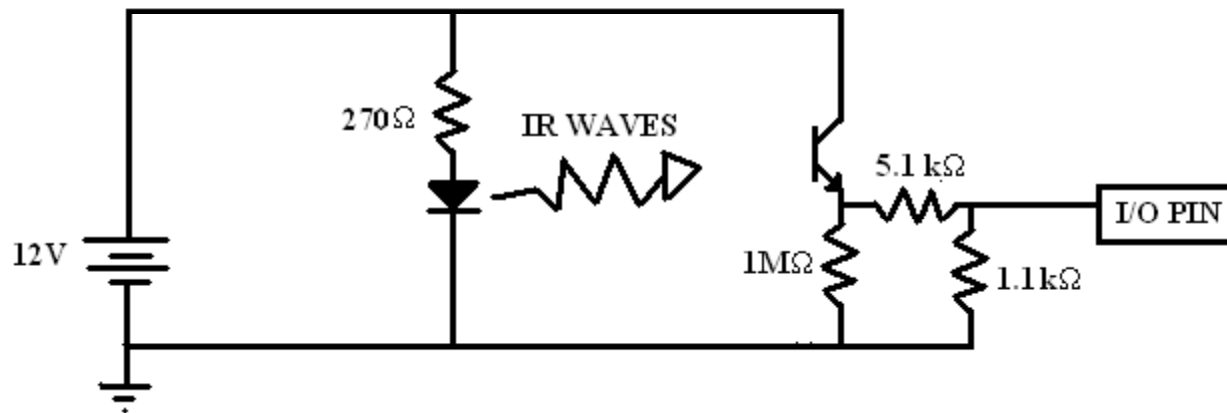
- **Purpose:**
 - Direct pills to pill drum
- **Components:**
 - Servo Motor
 - 4 Soft Brushes
 - Machined PVC Funnel
 - Machined PVC Cap
- **Function:**
 - Funnel directs pills
 - Servo mixer helps orientate pills into inserts

Inside the Pill Drum

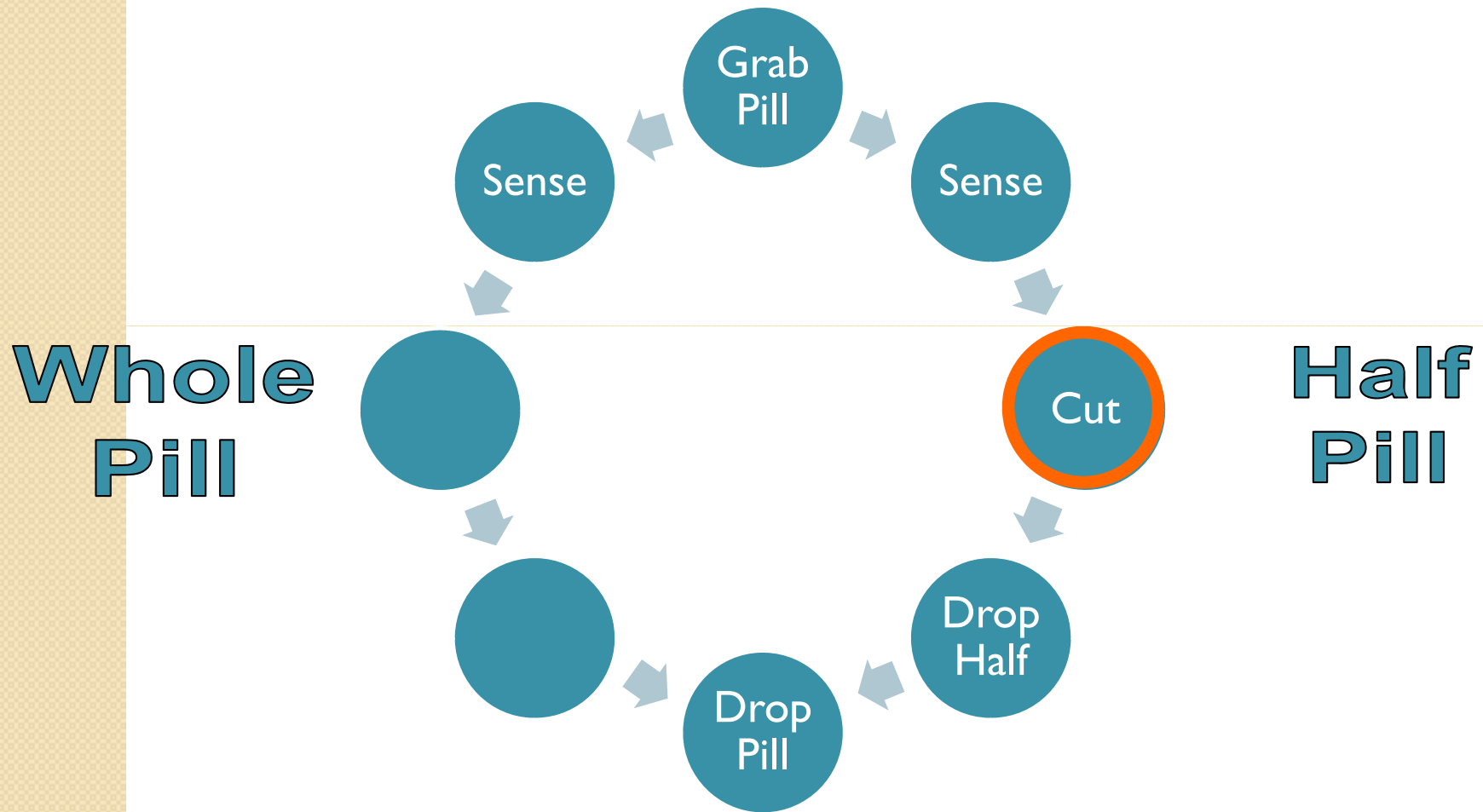


Pill Sensing

- **Purpose:**
 - Determines if pill drum has caught pill (45°)
 - Determines if pill has been administered (180°)
- **Components:**
 - Photodiode emitter and photo transistor detector
 - Embedded in pill inserts
- **Function:**
 - Circuit
 - Programmed through BASIC Stamp microcontroller



Inside the Pill Drum



Pill Cutting

- **Purpose:**

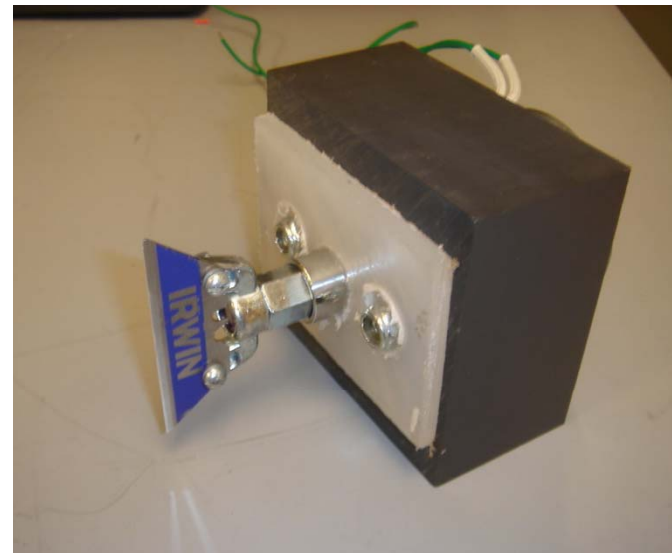
- Accurately cut pills in half

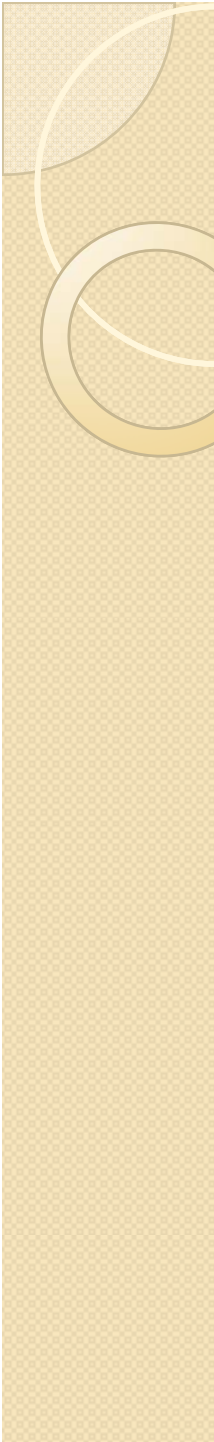
- **Components:**

- Solenoid
- Blade
- Guiders on pill casing
- Spring

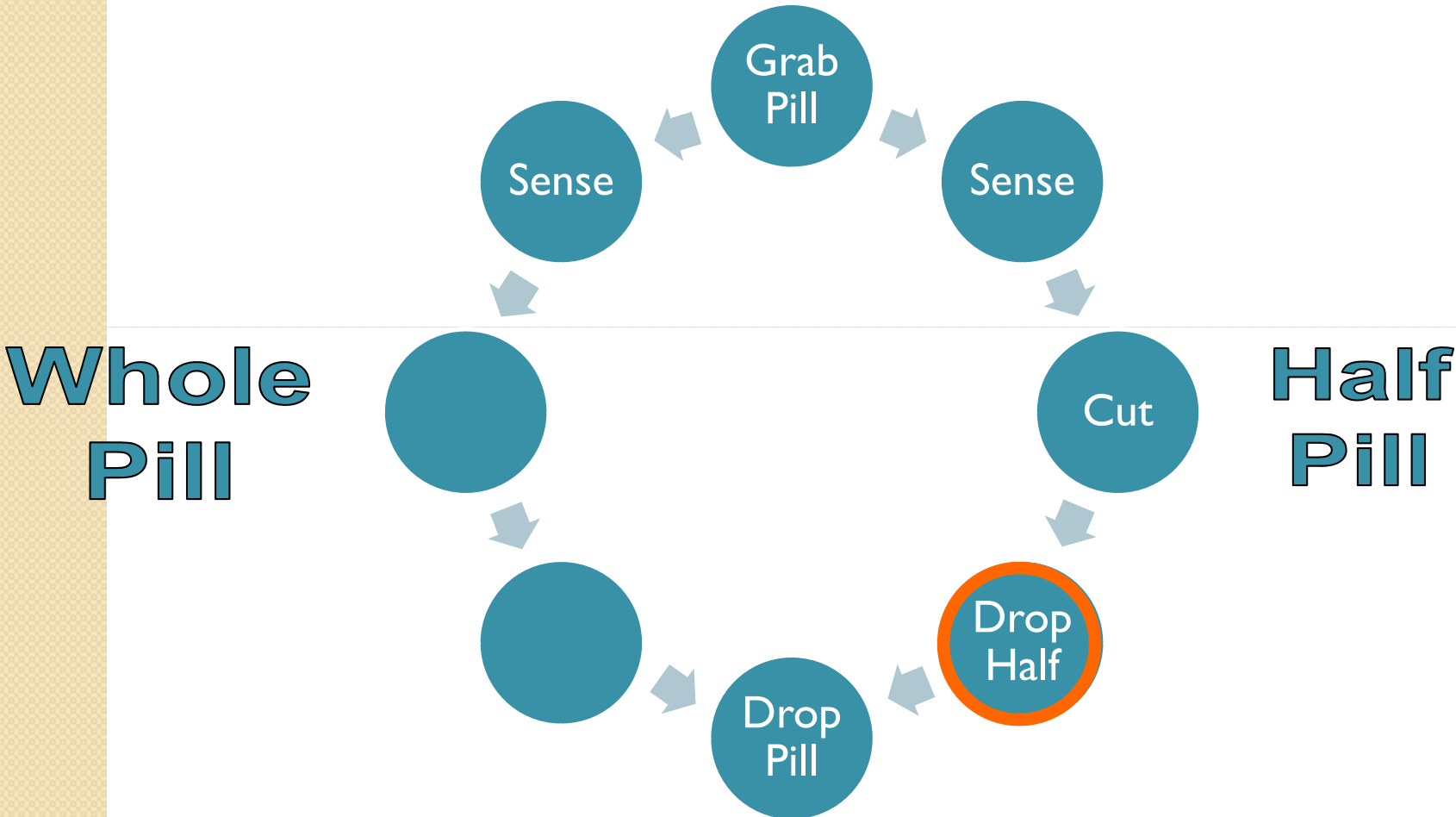
- **Function:**

- Once activated, solenoid drives blade
- Held while drum rotates
- Retracts once pills are dispensed





Inside the Pill Drum

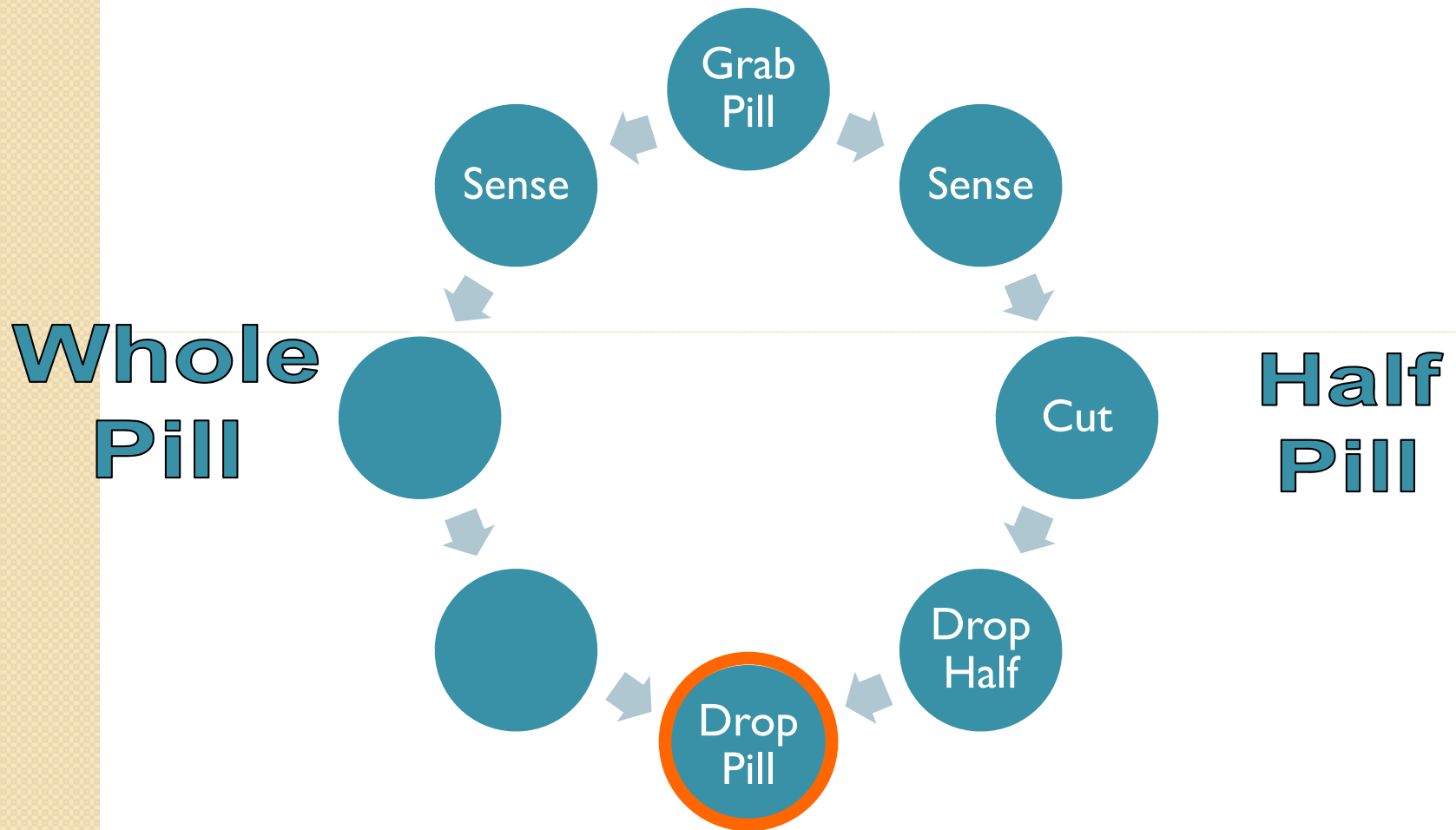




Half Pill Separation

- **Purpose:**
 - Stores 2nd half of pill until needed
- **Components:**
 - Servo motor with disc attachment
 - Cutout in pill drum casing
 - Sensor
- **Function:**
 - After the cut, half of the pill is stored while other half is dispensed
 - Once another half of pill is needed, servo motor opens trapdoor

Inside the Pill Drum

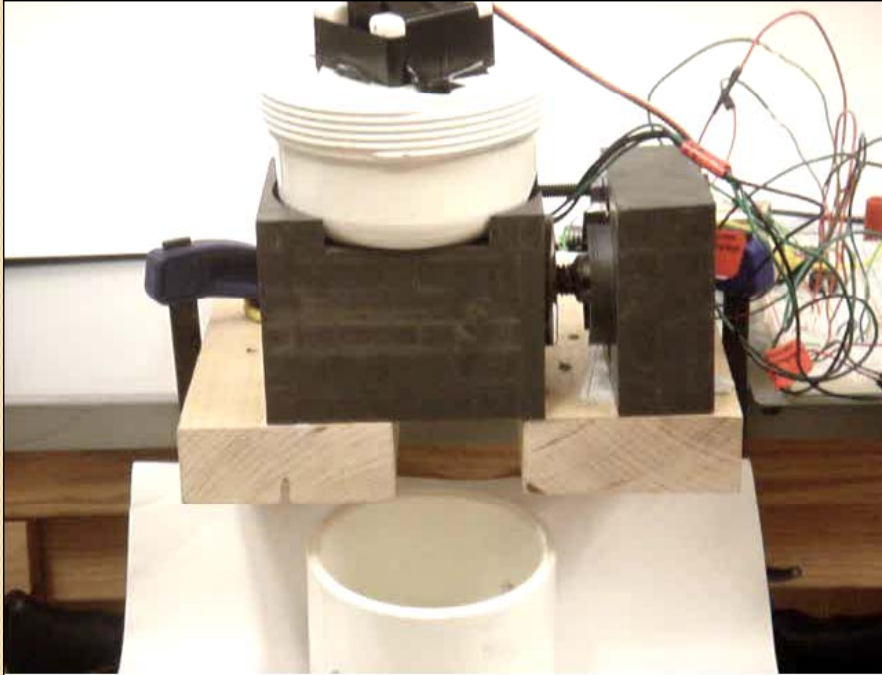


Pill Administration

- **Function:**
 - Alarms patient that pill needs to be taken
- **Components:**
 - User interface
- **How it works:**
 - Audio and visual alarms serve as reminder

Take pills and select ok to silence alarm.

OK



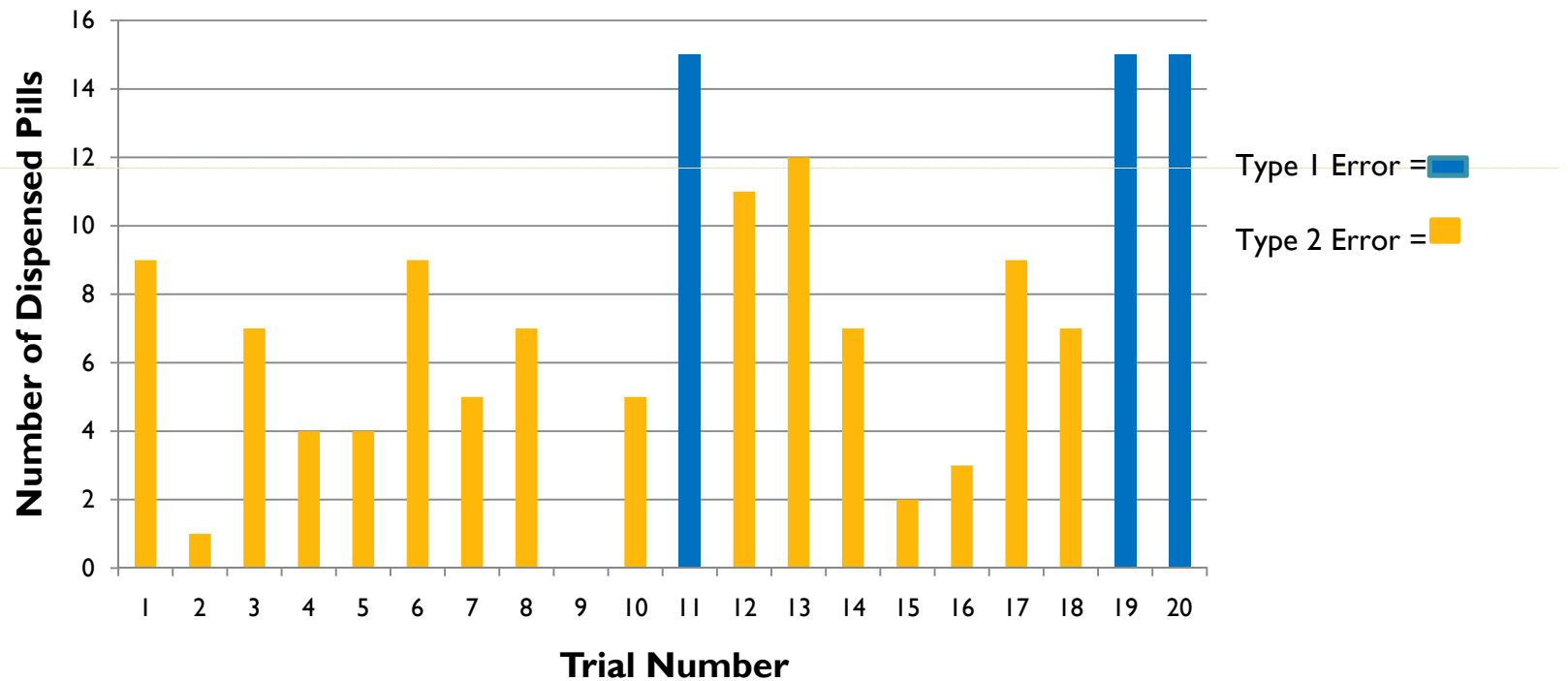


Electromechanical Testing

- **Solenoid**
 - Reliability of cut
 - Accuracy of cut
 - Material lost
 - Evenness of cut
- **Sensors**
 - Accuracy of sense
- **Pill dispensing**
 - Repeatability

Preliminary Testing

Pills Dispensed Before Error





Human Subjects Testing

- Apply for IRB exemption
- Administer short questionnaire to medical personal and user

Medical Personal

- Program Navigation
- Information Input
- Medication Loading
- Changing Inserts

User

- Screen Settings
- Output Information
- Speaker Effectiveness
- Pill Delivery Tray



Future Work

- Add pill cutter to prototype
- Build final casing for device
- Integrate interface and mechanical component programs
- Perform testing
- Submit to RERC competition