# Ion Medication System

Independent Study Mid-Review
Team Ion: Duke University

Challenge Definition

A large percentage of medication errors in nursing homes is due to inconsistent or incorrect administration and documentation of medication distribution. We believe that an embedded system that dispenses and keeps track of medication distribution/adherence can significantly reduce the amount of these errors and lighten the load of caretakers.

Time of Error

- Prescribing — 1%
- Dispensing — 4%
- Administration — 54%
- Documentation — 39%
- Monitoring — 2%
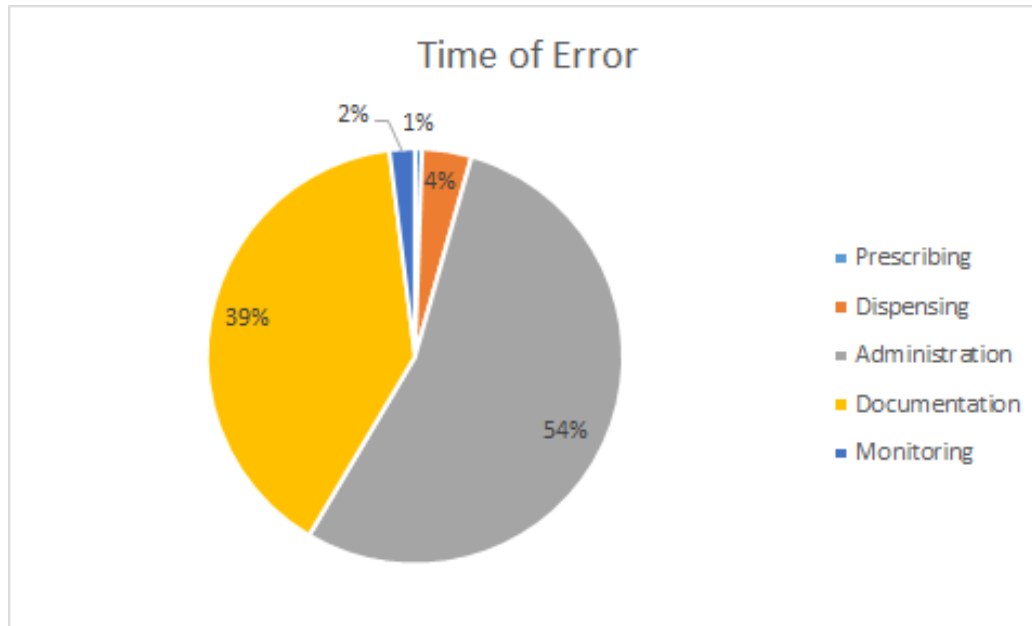
Medication Error Breakdown in North Carolina Living Homes

R Desai et al. " Exploratory Evaluation of Medication Classes Most Commonly Involved

in Nursing Home Errors". Journal of the American Medical Directors Association, 2013-06-01, Volume 14, Issue 6, Pages 403-408

Entry Solution

Our solution consists of three parts. Bodypacks for receiving medication notifications/reminders, central dispensers for efficiently and accurately distributing medication to the proper individuals, and a web application that facilitates medication adherence monitoring, efficient management operations, and system maintenance. Physical communication between these three components will be achieved through RFID and wireless communication through WiFi.
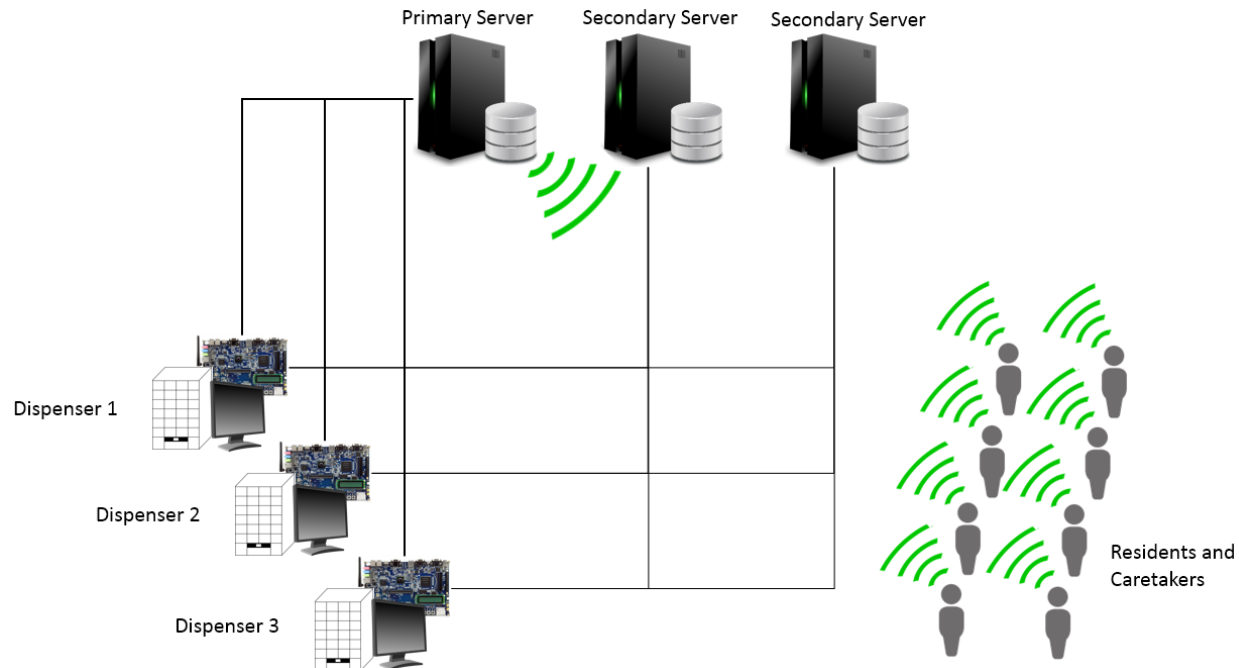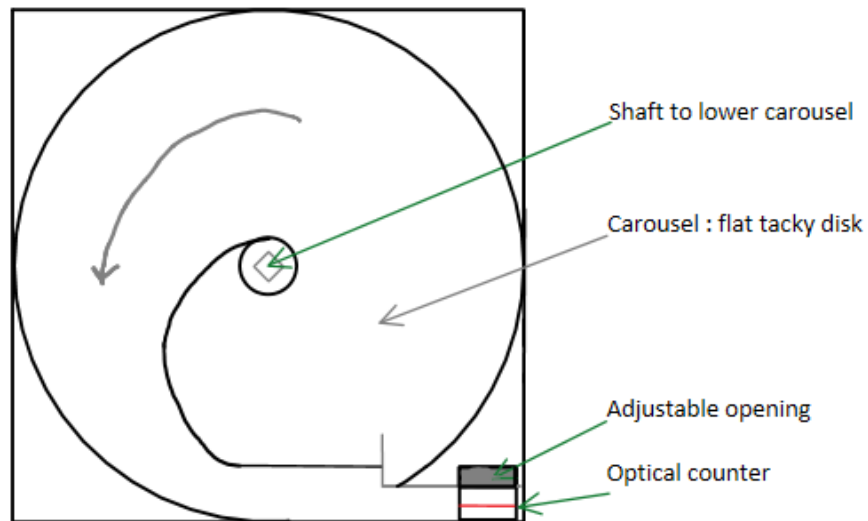
Comparison to Precedent

OTHER SYSTEMS

- Mostly designed for pharmaceutical/hospital use
- Created to reduce dispensing errors
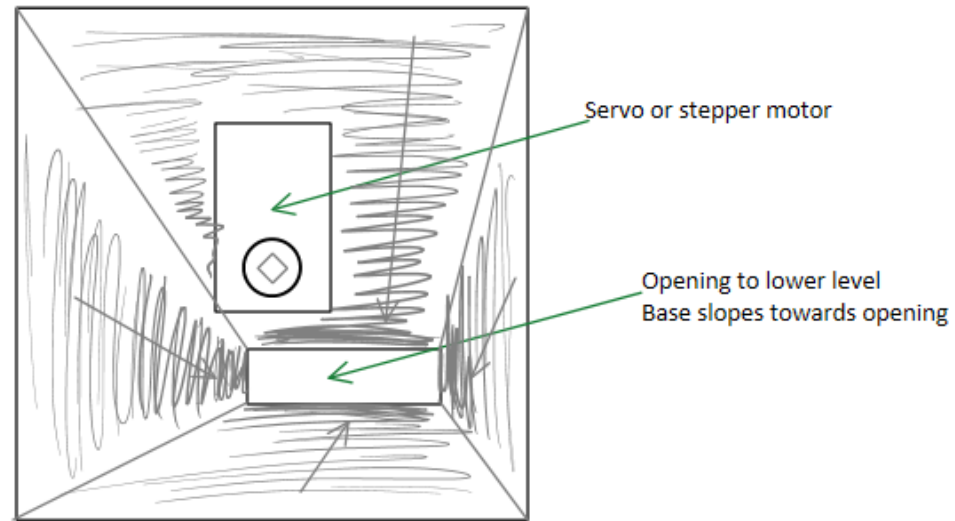
ION MEDICATION SYSTEM

- Designed for general usage (not just trained pharmacists)
- Provides tools for monitoring and responding to medication distribution and administration over time
- Also provides enhanced documentation ability
- Aims to improve medical **adherence** through automated reminders and ease of use
- Intended to integrate into everyday life, targets living home-like communities
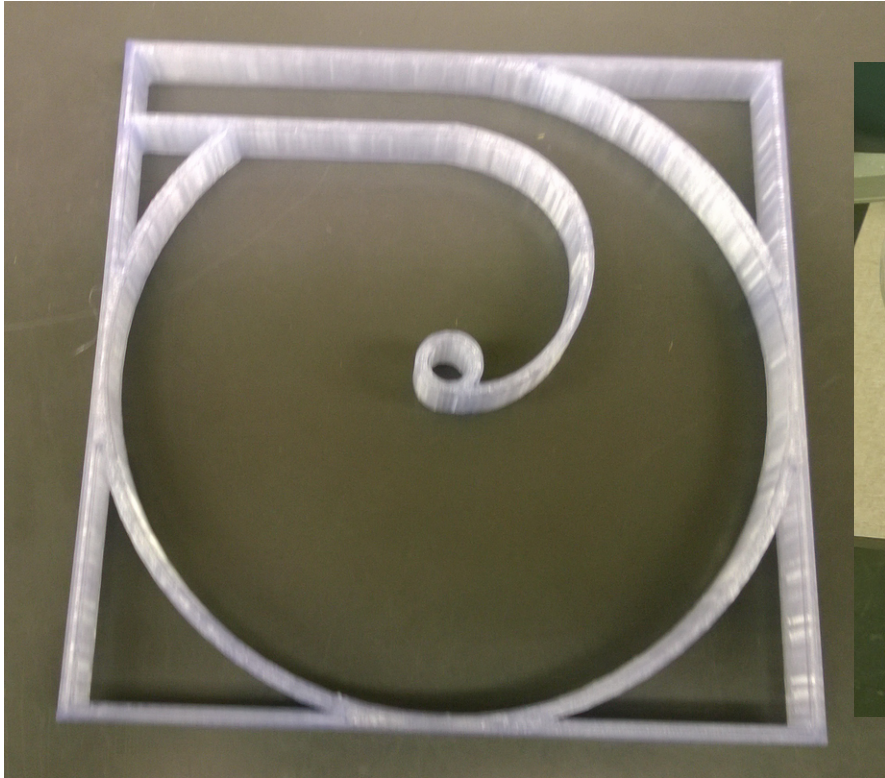
Dispenser Compartment Outline

Lower level

Shaft to lower carousel

Carousel : flat tacky disk

Adjustable opening

Optical counter

Upper level

Servo or stepper motor

Opening to lower level
Base slopes towards opening

Dispenser 3D Print and Testing

Work to date

Stages Completed

Stage one - laying the foundation, outlining structures, logistics
Stage two - basic web functionalities
Stage three - acquiring physical parts/demoing various technologies

Functionalities implemented

- Intel processor running centralized server
- Database structure and design implemented
- Ability to add medication/schedules to patients through web interface
- Dispenser compartment conception
- Dispenser/Compartment administration through web interface
- Few measurable performance metrics at this point in time

(add medication)

RXUID: [   ] [⬍] RXUID Lookup
[Number of pills] [⬍]
☑ Dispensable?

Start:
6:00am
7:00am
8:00am
9:00am
[mm/dd/yyyy] [⬍] [▼]

Schedule
Repeat? ☑
Every [   ] [⬍] days

[Add Medication]

Web Portal Design

Users   Dispensers   Medication   Account   Logout

Admin Portal

Common Tasks

Add new user

Edit user

Add dispenser

Edit dispenser

Tools

User has logged on.

Medication was added into Dispenser.

Notifications

No notifications

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Project Execution Decisions

WEB APPLICATION BACKING

Decision: Python, Mongo, Django

Motivators: Flexibility, quick development time, and plentiful documentation

BODYPACK BOARD

Decision: Galileo, **Yun**, Edison

Decision: Xbee vs **WiFi**

Motivators: Size, implementation complexity, existing infrastructure

ATOM PROCESSOR OS

Decision: Linux, **Windows** XP/**7**/64-bit/**32-bit**

Motivators: Component/software compatibility, drivers and familiarity

INFORMATION STORAGE

Decision: RFID vs. Barcode

Motivators: Information density and system simplicity

Timeline Update Summary

Stage one - laying the foundation, outlining structures
Stage two - basic web functionalities
Stage three - acquiring physical parts/demoing various technologies
Stage four - Physical system design
    Target completion date: April 1
Stage five - Integration
    Target completion date: April 13
Stage six - Testing
    Target completion date: April 16
Stage seven - Polishing/Competition prep
    Target completion date: April 21

Budget Summary

YTD spendings: $350

    Major cost points:

        Yun

        RFID tags/reader

        Touch screen

Estimated future expenses: $750

    Major cost points:

        Motors

        Scale

        Metal supports/acrylic

        Plugs/ports

Upcoming

Stage four - Physical system design
- improving SolidWorks proficiency *(completed)*
- learning how to use the 3D printing resources at Duke *(completed)*
- printing necessary components parts
- acquiring necessary non-system physical design components
- testing performance and refining dispenser design until dispenser functions smoothly and accurately
- physically assembling the dispenser