Digital Medication Management for People with Alzheimer's Disease

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Alzheimer's Disease

Goal of Project:

Create a system to help patients with Alzheimer's Disease (AD) manage their medication.

AD is a neurodegenerative disease that causes memory loss, confusion, and renders one unable to complete complex tasks.

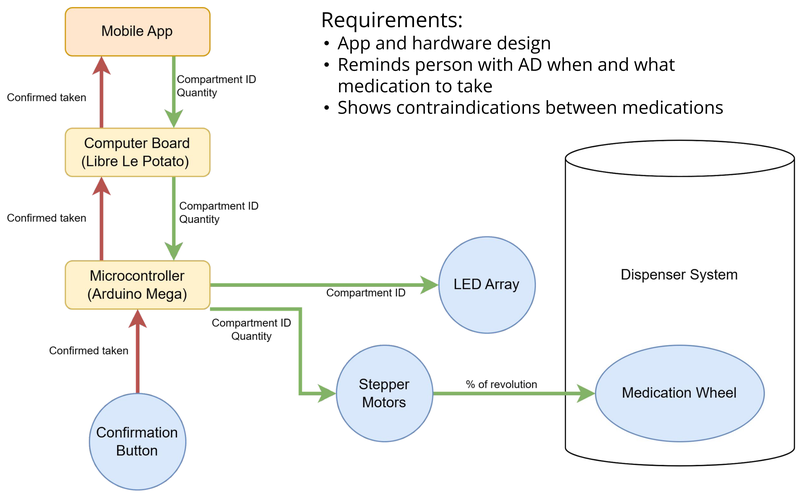
Challenges may include:
- Contraindications between drugs due to comorbidities
- Difficulty managing all the medication

Pain Points

Early Stage:
1. Delays to seek medical help for their symptoms
2. Confusion that symptoms can be from old age
3. Other medications may introduce unwanted interactions with AD medications

Later Stages:
1. Feels needy, helpless, and does not want to be a burden
2. Frustrated with lack of independence

Overall Design



Requirements:
- App and hardware design
- Reminds person with AD when and what medication to take
- Shows contraindications between medications

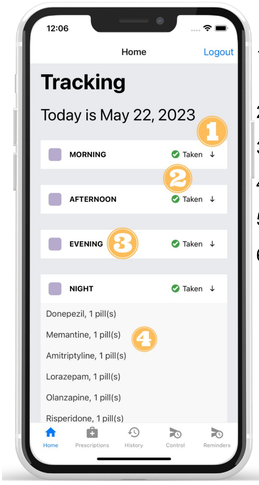
User Testing

Our team conducted a cognitive walkthrough for the app and its UI with A1 testing group from Novo Nordisk, assessing patient flow for two key tasks:

Task 1: Take medication on time.
Task 2: Be aware of contraindications based on their prescriptions.

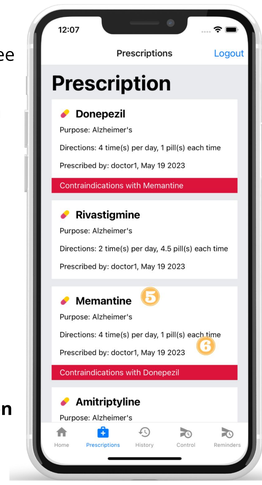
Takeaways:
- **The cognitive walkthrough indicated the app requires no significant changes**
- **Consider a confirmation message on the app after pressing the dispenser button**

Frontend Design



1. Collapsible drop down to see medication list
2. Indicator if medication was taken
3. When to take medication
4. Medication list
5. Prescription details
6. Medication contraindication warning

Results
- **Can communicate with created dispenser**
- **Reminds user to take medication**
- **Indicates contraindications**



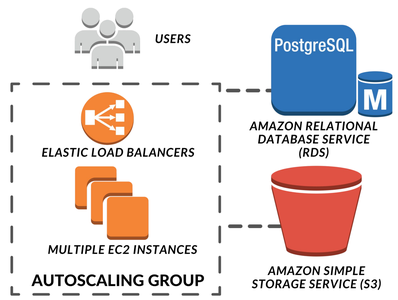
Backend Design

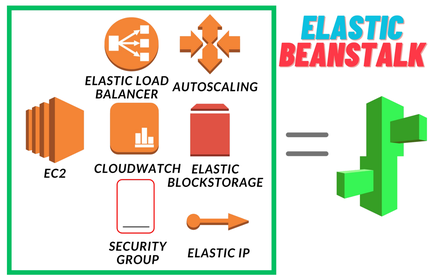
Server Resource Management: AWS Elastic Beanstalk
- 99.999% High availability
- Smooth application deployment

API Server: Express and Sequelize
- Robust Object-Relational Mapping
- Customized API endpoints

Database: PostgreSQL hosted on AWS RDS
- 99.999% High availability
- Automated backups and snapshots

GitHub/AWS CodePipeline
- Easy updates
- Continuous deployment

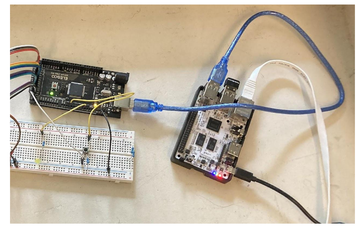




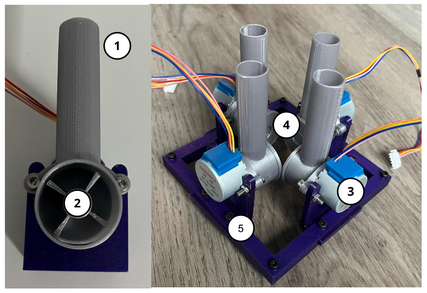
Hardware Design

Computer Board (Le Potato)
- AML-S905X-CC (Le Potato) to host the server to communicate with the mobile app
  - Ubuntu Server OS for receiving and sending
  - Server built with Express

Microcontroller (Arduino Mega)
- Receives commands to control peripherals
  - Peripherals include: four stepper motor drivers, LEDs, pushbutton



Dispenser



1. Medication container
2. Medication wheel – easy control to dispense one pill at a time
3. Stepper Motor (28BYJ-48) – drives the medication wheel
4. Medication wheel cover
5. Mounting Base

Results:
- **Can dispense from all four compartments**

Conclusion and Future Work

In our project, we:
- Provided crucial aid in **managing complex medication regimens**
- Addressed complications such as **comorbidities and potential contraindications** among various drugs
- Provided a **comprehensive list of prescribed medications** and **warnings for contraindications**
- Simplified the medication management process with **our dispenser integration** and a reliable **medication reminder system**

Some Next Steps:
- **Utilizing patient data** for early AD diagnosis and contraindication detection **with ML/DL**
- Have **less motors** but still scalable for **more pills**
- **Computer Vision** for automated pill intake confirmation
- **AI integration**: offering explanation on drug contraindications and providing 24/7 medical support

References and Acknowledgments

F. Jessen, J. Georges, M. Wortmann, and S. Benham-Hermetz, "What matters to patients with Alzheimer's disease and their care partners? Implications for understanding the value of future interventions," *The Journal Of Prevention of Alzheimer's Disease*, Feb. 2022.
"3. Pain Points" *Novo Nordisk* 2022
"Early AD Patient Journey" *Novo Nordisk* May. 2021

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