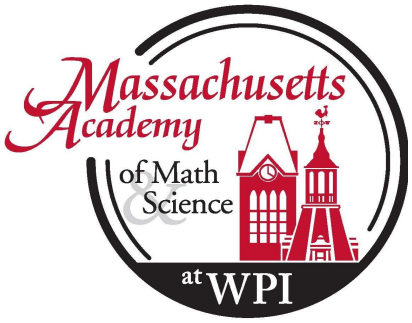

Project Proposal

SEARCH: Smart Electronic Assistance and Retrieval Companion for Home

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Executive Summary

Over 40% of people will experience some form of memory loss by the time they turn 60 years old. While memory loss and cognitive impairments come in many forms, one of the most common symptoms includes misplacing important objects such as wallets, keys, hearing aids, and glasses. This significantly impacts the ability of elderly people to live independently. Coupled with declining eyesight and physical strength, searching through an entire living space for objects can be extremely strenuous for elderly people, and can often end up being unsuccessful. While current widespread solutions in production to track and locate missing objects, such as Air Tags and Tile Trackers, use Bluetooth transmitters, the resolution of these devices is limited to areas often larger than the entire house, making it unsuitable for isolating a specific area of the house for an elderly person to search. Thus, we propose three cost-effective and user-friendly designs for a misplaced item locator: (1) a rover-based design, (2) a drone-based robot, and (3) an enhanced Bluetooth triangulator.

Introduction

Problem Statement

Dementia, ADHD, and various other cognitive impairments often cause forgetfulness in the elderly population, especially in short-term memory function, and further cause a greater number of misplaced items.

Target Audience

Although many elderly patients require care from caretakers or facilities, elderly patients typically have the desire to be independent and self-sufficient. A common association within the elderly care field is that greater independence for the elderly yields a higher quality of living. A strong measure for independence is characterized as the avoidance of visiting a care center for a period of time, such that the elderly will be able to remain in the comfort of their own homes. Furthermore, by the year 2030, 1 in every 6 people will be 60 years or older, meaning that providing a method to allow the elderly to live healthier lives will become increasingly important (World Health Organization, 2023).

The goal of our project is to develop a system or device that can address the problem of misplaced items in the elderly population, and consequently, increase independence in their day-to-day lives.

Design Specifications

We propose a system that shall:

1. (Level 1) Identify the locations of misplaced items within an area with at least 90% accuracy; reduce the frequency of searching for lost items by at least 50%; have a product lifespan of at least one year; respond to client requests for misplaced items

within 10 seconds; accept commands from natural language; not cause injury or damage to clients or their property.
2. (Level 2) Conduct searches for misplaced items at least once a day; not cost greater than $300.00; sustain movement and data collection for at least half an hour; be secured properly; not store recordings for over 10 minutes; not capture unauthorized media.
3. (Level 3) Shall be customizable to suit the client; shall have maintenance costs of less than $100.00 per year; shall be aesthetically pleasing; and shall be less than 10 pounds.

For implementation, our *Minimum Viable Product* (MVP) shall include:

1. Search within a household for misplaced items.
2. Provide misplaced item locations when requested.
3. Be portable and installable into any household.

Throughout the process of design and iteration, we will be following the feedback and testing plan as outlined below.

1. Design prototype of product.
2. Preliminary testing (1 hour) with our product on a simulated scenario.
3. Explain design to clients, provide a quick demonstration and instructions, and ask for feedback.
4. Reiterate steps 1-3.

Design Concepts

Design Concept #1

The first design concept will be a rover-based device equipped with computer vision technologies that can be a powerful tool for locating misplaced items. The device can navigate autonomously through an environment on the ground while using its onboard cameras and advanced object recognition algorithms to identify and locate specific objects. Once an item has been located, the device can alert the user to its location through an application. This technology has the potential to save time and reduce frustration by quickly locating lost or misplaced items.

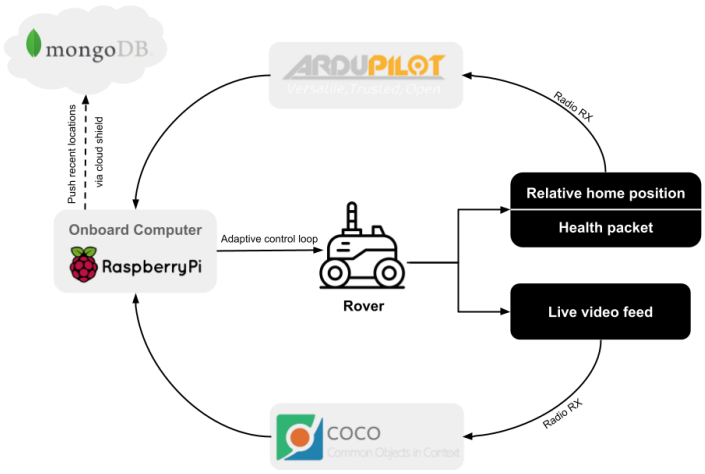

Figure 1: **Rover-Based Misplaced Item Finder.** This design concept uses multiple technologies such as deep learning, Raspberry Pi, adaptive control loops, and cloud databases.

Timeline

Table 1. Timeline for Design Concept #1.

Mar.				Apr.				May			
1	2	3	4	1	2	3	4	1	2	3	4
Market Research											
	Client Search										
		Brainstorm and Design									
				Product Development and Initial Testing							
						Feedback and Reiteration					
						Final Testing and Review					
									Delivery and Presentation		

Note. This timeline was given a normal-length time frame for design and iteration.

Resources and Budget

Table 2. Budget for Design Concept #1.

Item	*Quantity*	*Cost*
Base Rover	x1	$47.00
Nav and processing systems	–	$75.00
Camera + Components	–	$70.50
Base Station	x1	$15.25
Various Software / Databases	–	$15.00
TOTAL		**$222.75**

Pros and Cons

Table 3. Design Evaluation for Design Concept #1.

Pros	*Cons*
● More simple and reliable control loop ● Quieter ● Longer battery life ● In-house positioning is more easily maintainable ● Object avoidance is simpler ● Lower costs ● Better APIs/testability	● Tripping hazard ● Limited visibility / range of sight ● Slow ● Stairs is hard to navigate ● Could be bulky

Future Additions

Beyond the scope of this design, we could add stair mobility to the design in order to allow the device to access areas currently limited by stairs. One potential addition could be to add additional sensors, such as ultrasound and LiDAR, to improve misplaced item detection capabilities. Furthermore, we could add a more scalable system with swarm robotics and deploy a larger system.

Design Concept #2

The second possible design concept would be a drone-based device equipped with computer vision technologies that can address the problem of locating and identifying misplaced items. The device will be able to fly autonomously through an environment while using its onboard cameras and advanced image recognition algorithms to identify and locate specific objects.

Furthermore, control algorithms will be present to prevent collisions and enhance autonomous navigation through a house. Once an item has been located, the device can alert the user to its location through a mobile application. This technology has the potential to save time and reduce frustration by quickly locating lost or misplaced items from a bird's-eye view.

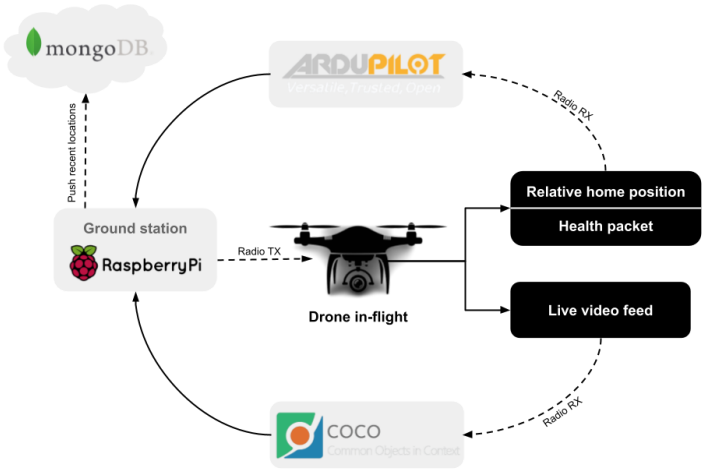

Figure 2: **Drone-Based Misplaced Item Finder.** This design concept uses multiple technologies such as deep learning, Raspberry Pi, mission planning, and cloud databases.

Timeline

Table 4. Timeline for Design Concept #2.

Mar.				Apr.				May			
1	2	3	4	1	2	3	4	1	2	3	4
Market Research											
	Client Search										
		Brainstorm and Design									
			Product Development and Initial Testing								
					Feedback and Reiteration						

								Final Testing and Review	
									Delivery and Presentation

Note. This timeline was given extra time for design and iteration.

Resources and Budget

Table 5. Budget for Design Concept #2.

Item	*Quantity*	*Cost*
Avionics Drone	x1	$100.00
Additional Drone Components	–	$75.00
Ground Station	x1	$50.00
Various Software / Databases	–	$20.00
TOTAL		**$255.00**

Pros and Cons

Table 6. Design Evaluation for Design Concept #2.

Pros	*Cons*
● Multiple and easily adjustable visibility ● Compact ● Does not impede client	● Limited search time (battery) ● Hazard for in-house property ● Complex control system ● High costs

Future Additions

Beyond the scope of this design, we could add sound buffers and quieter motors to prevent sound pollution. One potential addition could be to add additional sensors, such as ultrasound and LiDAR, to improve misplaced item detection capabilities. Furthermore, we could add a more scalable system with swarm robotics and deploy a larger system.

Design Concept #3

The last design concept would be a proximity device that uses Bluetooth and triangulation technologies that can effectively locate misplaced items. By communicating with other Bluetooth devices and determining their relative distances, the device can pinpoint the location

of a specific misplaced object. Once found, the device can notify the user of its location or provide auditory or visual guidance to retrieve it. This technology offers a quick and efficient way to find lost items within a specific area, ultimately saving time and reducing frustration in the elderly population.

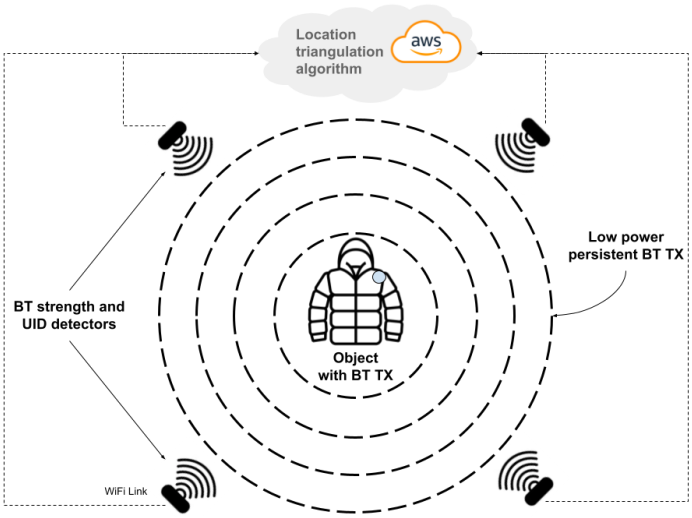

Figure 3: **Bluetooth-Based Misplaced Item Locator.** This design concept uses multiple technologies such as triangulation techniques, bluetooth sensors, and cloud-based algorithms.

Timeline

Table 7. Timeline for Design Concept #3.

Mar.				**Apr.**				**May**			
1	2	3	4	1	2	3	4	1	2	3	4
Market Research											
	Client Search										
		Brainstorm and Design									
					Product Development and Initial Testing						
							Feedback and Reiteration				

								Final Testing and Review	
									Delivery and Presentation

Note. This timeline was given less time for design and implementation.

Resources and Budget

Table 8. Budget for Design Concept #3.

Item	*Quantity*	*Cost*
Bluetooth Tracker	x20	$75.00
Bluetooth Hub + Amplifiers	x5	$50.00
Various Software / Databases	–	$20.00
Total		**$145.00**

Pros and Cons

Table 9. Design Evaluation for Design Concept #3.

Pros	*Cons*
● Low cost for small scale applications ● Does not impede movement and home environment ● Similar to current testing technologies	● Needs a tag for every misplaced item ● Complex triangulation mathematics and calculations ● Location of items is hard to determine ● Limited range ● Interface with many devices ● Expensive to deploy at scale ● No differentiation between objects without client management

Future Additions

Beyond the scope of this design, we could add the capabilities to detect individual objects without using different bluetooth tags. Additionally, we could also implement a mobile application to support misplaced item recovery and identification with a care-taker side as well.

Team Qualifications

Our team brings together a diverse set of skills, from both a technical and non-technical perspective. Our CEO, Joseph Yu, brings strong project management, communication, and deep

learning skills. Our CTO, Tarun Eswar, brings strong coding and web development skills. Our CIO, Charles Tang, brings strong document delivery and writing skills. Our CMO, Nevin Thinagar, brings strong hardware development and planning skills.

Some of our key technical skills include:

- Programming languages and tools:
    - Java
    - C++
    - Javascript (Node, React)
    - Typescript
    - Dart
    - Python
- Skills:
    - Project management
    - web development
    - deep learning
    - hardware development

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