

Problem Statement and Goals

Mechtronics Enigeering

Team 32, Wingman
Edward He
Erping Zhang
Guangwei Tang
Peng Cui
Peihua Jin

Table 1: Revision History

Date	Developer(s)	Change
2022-09-24	Edward He	Problem Statement Vision 0
2022-09-25	Edward He, Erping Zhang Guangwei Tang, Peng Cui Peihua Jin	ProbState and Goal Vision 1
2022-09-26	Edward He, Erping Zhang Guangwei Tang, Peng Cui Peihua Jin	ProbState and Goal Vision 2

1 Problem Statement

1.1 Problem

Ever having an occasion when you are desperately trying to find something and despite you scratching your head and searching for hours, that specific item is nowhere to be found? It can be a very frustrating experience, especially if that item appears out of nowhere when you no longer need it and once again gone missing when you are looking for it. Although there has been different technology employed for digital devices that can help identify where the device is located, it does not help with small items that are not digital. Our team's proposed solution will be able to assist the user to remember where his/her belongings are and the most recent time the user had used or placed their belongings. The proposed system is capable of tracking and following human activities to position itself best for capturing any moving objects caused by the

user. The system will identify each item that is being moved and record/update their corresponding positions. The user then has the ability to interact with our system through an interface and select which item the user is looking for. Given this information, our system would identify where that specific item is and assist the user to locate their belongings in a short time.

1.2 Inputs and Outputs

Input:

- Live video feed from camera capturing human and object activities.
- Frames of start and end position of a complete movement of an object.
- User inputs of description of the missing items or the items to be found.

Output:

- Based on the position of the human detected by the camera, camera will be repositioned itself to keep human in the center of the frames.
- Based on the frames detecting moving object, record the end position and update to the database its new position.
- Upon receiving user input, scan over the database and match the item that fits user's description and outputs its most recent position to the user.

1.3 Stakeholders

Anyone who has struggled in their daily life trying to find some of their belongings and people who has bad memories.

1.4 Environment

Hardware:

- Single board computer capable of image processing, GPIO control tasks
- A mount for attaching the camera and single board computer.

Software:

- Real time software program running on device capable of handling large batch of image processing tasks.
- Webpage user interface

2 Project Goals

The goal of the project is divided into three parts: Hardware Part, Software Part, User Interface Part, and Stretch Goals Part. The following paragraph will discuss those three parts in detail.

2.1 Hardware Goals

2.1.1 Rotational Mechanical Structure

To identify each object that exists in the room, the camera should be able to have a whole view of the room. As a result, the camera should be supported by arms that can rotate both horizontally and vertically. What's more, the main pole may also be able to move up and down so that the camera can always find the best position for scanning the room.

2.1.2 Reliable Embedded System Communication

The embedded system of the product should make a strong communication between the peripheral elements and the software part. It should also be able to show good controllability and stability in manipulating those components.

2.2 Software Goals

2.2.1 Accurate and Fast Data Manipulation

The project should have a good performance on machine learning and project detection. It should first be able to recognize the movement of the object within a fast response time, either artificially or passively (e.g., colliding with other objects and falling). In addition, the final position of the object should be recorded and stored well in a file with details of the movement like the time of the final movement or the screenshot of that object. All of the data will be used for the object tracking system.

2.2.2 Smart and Flexible Image Analyzing Method

When the system receives images from the camera, it should be able to identify humans and can always adjust the position of the camera so that the user always stands in the center of the image. When half of the image is covered by objects, which may cause the dysfunction of the object manipulation method. The system is able to handle this situation either by making sounds or using portable arms to move to a suitable position.

2.3 User Interface (UI) Goals

2.3.1 Clean and Easy-to-use UI Design

A qualified UI design should actively guide users to understand the operation logic by themselves. It should keep the design simple to use, easy to play with. Once entered in the UI, users shall comfortably be able to make use of its functionality. SmartVault will conduct surveys with potential customers during the development of the system to get feedbacks and use them to improve the end user's experience.

3 Stretch Goals

3.1 More Accurate and Predictable Image Processing

Additional cameras should be placed at different locations in the space other than the main camera location to achieve multiple observation from different angles. The position of an item can be recorded more accurately, thereby avoiding the situation that the item cannot be identified when it is covered by other objects. According to the long-term learning of the user's habit, the system ought to predict the next possible position of items, thus obtaining more accurate and predictable location of different items. At the same time, the amount of calculation and the burden of the system would be reduced.

3.2 Real Time Data Updating

Real-time data collection and uploading them to a database where updates the positions of the tracked items. This would allow the system to collect a considerable amount of data with confidence and consistency. Sequentially, users can clearly know the time when the position of the item changes.

3.3 Minimizing User Costs

In the case of insufficient light such as at night, the camera or the system automatically enters the sleep mode, so as to save the cost of the user. In future, solar panel could be added to the main camera port, therefore acting as the secondary energy source for the system. Also, pricing the system cost lower than the competition without effecting the overall experience is the key.