Table 1: Revision History

Date	**Developer(s)**	**Change**
Date1	Name(s)	Description of changes
Date2	Name(s)	Description of changes
...	...	...

Hazard Analysis
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Contents

1 Introduction

2 Component Overview

The project can be divided into five different main components. Those components are listed in the paragraphs below.

2.1 Movement of Camera

A stable and accurate motorized camera mount is necessary for the movement tracking. The servos need to move in a appropriate speed and angle in order to make the camera capture the best view of both objects and user.

2.2 Human Body Detection

A good detection method should be used so that the human body can be detected by the program in the images provided by the camera. The movement of the human body shoudl also need to be detected to help the camera to judge its angular position.

2.3 User Interface

This component provides a communication layer between the system and the user through a computer app.

2.4 Database

A fast and accurate data flow is the cornerstone for a system to be able to work properly and meet and requirements. The design and implementation of database is playing a major role in the whole system design.

2.5 Objection Detection

This system is responsible for detecting any moving object in the area and identifying each object with unique set of characteristics. The is the main logical system for smartVault to help locate a “lost” item.

3 Safety Considerations

3.1 Movement of Camera

3.1.1 Servo motor overload

When the camera got block by something or the gear of servo get stuck during the rotation, the system will lose the tracking of user and the worst result could be a motor overheat and burn.

3.1.2 Short circuit

If some liquid gets spilled on the parts, it might cause the short circuit of the controller board and servo motor, which will cause the entire system stop working and possible to lose data.

3.1.3 Unstable connection with other components

If the connection between camera and system is unstable during rotation, the detection and tracking system will stop working since the system cannot capture the image.

3.1.4 Risk of falling

When the parts assembly get loosen after a long-term operation, there is a chance for the parts to fall off from mount or the main body. This situation will cause the injure of user and the damage of the entire system.

3.1.5 Non-appropriate angular velocity of camera

If the rotation speed of the camera go too fast or too slow, the the system may lose the tracking of user. It is also possible to cause injure of user by hitting the users' body.

3.2 Human Body Detection

3.2.1 Human Body Detection Failure

When a human presents in the room and the images have been shown in the computer, the program fail to detect the human body or identifies other objects presents in the room as a "Human".

3.2.2 Body Movement Detection Failure

When people moves in the room and thhe images has been sent to the computer, the program cannot detect the movement of the body or detects the movememnts of other objects as human body movement.

3.3 User Interface

3.3.1 General

App closes unexpectedly, it could lead to the loss of current progress.

3.3.2 Login In Issue

User cannot log in to the app successfully, such that he/she do not have the ability to interface with the system.

3.3.3 Authentication

An unauthorized user logs in as a privileged user with high-level access.

3.4 Database

3.4.1 Overflow

As video are divided into frames to analyze, the files may occupy unexpected large spaces without restriction and further crash the program.
Related Requirements: IPR6

3.4.2 Mismatch

The object information are not collected completely and create wrong identification.
Related Requirements: IPR5

3.4.3 Miss time requirement

As the system is designed to be real-time, timing issue might occur when dealing with large data stream.The algorithm takes time longer than expectation and can not proceed next task.

3.5 Object Detection

SmartVault will return error message when connection between camera and the object detection system is lost. When connection is lost, object detection system will not be able to monitor moving objects.

4 FMEA Worksheet

5 Software Requirements

From the table provided above, several safety requirements for this project can be concluded and described in paragraphs below.

SR-1: The rotating pattern, like the speed, angle of rotation of the camera should be controlled within a controllable range, the circuit should also be stable and securely connected.
Associated Hazards: H1-1, H1-2, H1-3, H1-5, H5-1.

SR-2: The camera should be installed in a safe and stable environment, while keeping the camera working properly at all times. The images the camera takes should not be used to other impporper uses.
Associated Hazards: H1-2, H1-4, H3-3.

SR-3: The product should provide the user with a stable and safe control window, so that users can achieve their goals through the interface. At the same time, the stability of the internal system and the privacy of users should be protected to the greatest extent possible.
Associated Hazards: H3-1, H3-2, H3-3.

SR-4: The product should effectively identify and screen the information transmitted by the camera, and at the same time ensure a stable connection between the database and the working system.
Associated Hazards: H2-1, H2-2, H4-2, H4-3

SR-5: The database should respond to the information provided by the operating system in a timely manner, and ensure the stable storage of the information
Associated Hazards: H4-1, H4-2

Failure Mode and Effects Analysis							
Components	**Failure Modes**	**Causes of Failure**	**Effects of Failure**	**Severity**	**Recommended Actions**	**SR**	**Ref**
Movement of Camera	Servo motor overload	Servo gear or components stuck	Motor overheat and damage	Strongly High	Lubricate the parts when hear uncommon noise	SR-1	H1-1
	Short circuit	Liquid spill	The camera stop moving, and the whole system may stop working	Strongly High	Need technician to repair	SR-1, SR-2	H1-2
	Unstable connection	Loosen connection during rotation	Whole system stop working, cannot tracking new objects	High	Unplug the connections and plug in again then restart the whole system	SR-1	H1-3
	Risk of falling	Loosen assembly	The parts will disassembly and may cause injury	Strongly High	Concern about any abnormal movement or noise of the camera, technician may needed depend on situation	SR-2	H1-4
	Abnormal rotation speed of camera	Caused by the control algorithm error	High	System will lose the tracking of user and objects	Restart the system	SR-1	H1-5

Table 2: FMEA Table Part 1

Failure Mode and Effects Analysis							
Components	**Failure Modes**	**Causes of Failure**	**Effects of Failure**	**Severity**	**Recommended Actions**	**SR**	**Ref**
Human Body Detection	Human body detection failure	a. Detection method Failure b. Wrong Human Body Detected c. Wrong postures of human body	a. Wrong position description of the objects	High	a. Restart the program b. Compare detected body with human body database stored inside the system	SR-4	H2-1
	Body movement detection failure	a. Detection method failure b. Wrong movement detected	Hard to associate movement of objects with movement of human body	High	a. Retart the program b. Rejudging movement zone around the human body	SR-4	H2-2
User Interface	App closes unexpectedly	Host device loses power, or Crash due to instabilty	Current progress is lost	High	a. Store unsaved data locally on user's device	SR-3	H3-1
	User cannot log in to the app successfully	User's credential is unmatched	User is unable to use the system	High	a. Reset user's credentials	SR-3	H3-2
	An unauthorized user logs in as a privileged one with high-level access	Authentication issue	User could view or modify data even he/ she is not allowed	Strongly high	a. Fix the account permission and undo changes made by unauthorized user	SR-2, SR-3	H3-3

Table 3: FMEA Table Part 2

Failure Mode and Effects Analysis							
Components	**Failure Modes**	**Causes of Failure**	**Effects of Failure**	**Severity**	**Recommended Actions**	**SR**	**Ref**
Database	Overflow	Files of frames are stored without size restriction	Program crash	High	Set a strict time period for the camera to capture picture for each task	SR-5	H4-1
	Mismatch	Object information are not collected completely	Inaccurate behavior done by the system	Medium	Fist ensure the functionality of camera is in good condition then re-enter information about the object	SR-4, SR-5	H4-2
	Miss time requirement	Too much items in one frame and takes the program longer time to proceed	Long time delay of the system behavior	Medium	Increase search frame and prioritize the assigned area	SR-4	H4-3
Object Detection	Connection lost with camera live feed	a.Temporary internet lost b.Camera system is out of battery	a.There will be no video frames for SmartVault to process and monitoring object movement b.Same as H5-1a	High	a.System output error message to user and retry connecting b. Refer to H1-	SR-1	H5-1
	Object detection faults	a. Unable to detect moving object b.Unable to uniquely identify an object (sharing all characteristics with two or more recorded item)	a.SmartVault will not be able to update the specific item's new position b. same as H5-2a	High	a.Well rehearsed image processing and detection method will be implemented to mitigate the chance of this event b. Refer to H5-2a	SR-4	H5-2

Table 4: FMEA Table Part 3