

# Hazard Analysis Mechtronics Enigeering

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Table 1: Revision History

<b>Date</b>	<b>Developer(s)</b>	<b>Change</b>
Date1	Name(s)	Description of changes
Date2	Name(s)	Description of changes
...	...	...

## Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>Component Overview</b>	<b>4</b>
2.1	Movement of Camera . . . . .	4
2.2	Human Body Detection . . . . .	4
2.3	User Interface . . . . .	4
2.4	Database . . . . .	4
2.5	Objection Detection . . . . .	5
<b>3</b>	<b>Safety Considerations and Connection with Requirements</b>	<b>5</b>
3.1	Movement of Camera . . . . .	5
3.1.1	Servo motor overload . . . . .	5
3.1.2	Short circuit . . . . .	5
3.1.3	Unstable connection with other components . . . . .	5
3.1.4	Risk of falling . . . . .	5
3.1.5	Non-appropriate angular velocity of camera . . . . .	5
3.2	Human Body Detection . . . . .	5
3.2.1	Human Body not Detected . . . . .	5
3.2.2	Wrong Human Body Detected . . . . .	6
3.2.3	Body Movement not Detected . . . . .	6
3.2.4	Wrong Body Movement Detected . . . . .	6
3.3	User Interface . . . . .	6
3.3.1	General . . . . .	6
3.3.2	Login In Issue . . . . .	6
3.3.3	Authentication . . . . .	6
3.4	Database . . . . .	6
3.4.1	Overflow . . . . .	6
3.4.2	Mismatch . . . . .	6
3.4.3	Miss time requirement . . . . .	7
3.5	Object Detection . . . . .	7
<b>4</b>	<b>FMEA Worksheet</b>	<b>7</b>

## List of Tables

1	Revision History . . . . .	2
2	FMEA Table Part 1 . . . . .	8
3	FMEA Table Part 2 . . . . .	9
4	FMEA Table Part 3 . . . . .	10

# **1 Introduction**

This document describes the components making up the system and identify the possible hazardous behavior that could cause functional issue and safety problem. The Failure Modes and Effects Analysis method are being used in this document to clearly identify possible hazardous behaviors and the recommended actions that could be done to reduce the risk level. The system is meant to be implemented to help people locate items they have difficulty remembering. The mean function of this system are object recognition and item tracking which is used to satisfy daily-life need instead of industrial level. Safety requirement is crucial to be satisfied in the case users are considered to be non-professional. In the follow sections, all components of the system and hazards caused by the failure will be taken into consideration and methods can be applied in each case to solve the issue will also be clarified.

## **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 should 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. This is the main logical system for smartVault to help locate a “lost” item.

## **3 Safety Considerations and Connection with Requirements**

### **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 not Detected**

When a human presents in the room and the images have been shown in the computer, the program fail to detect the human body in the screen.

**Related Requirements:** IPR1

### **3.2.2 Wrong Human Body Detected**

When the software component of the oobject detects a human body shown in the camera, the body shown on the screen is not actually a body of a person.

**Related Requirements:** IPR1

### **3.2.3 Body Movement not Detected**

When people moves in the room and thhe images has been sent to the computer, the program cannot detect the movement of the body.

**Related Requirements:** IPR4

### **3.2.4 Wrong Body Movement Detected**

When the program detects the movements of human body, only part of movement or wrong movement is identified by the program.

**Related Requirements:** IPR4

## **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**

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	NA	H1-1
	Short circuit	Liquid spill	The camera stop moving, and the whole system may stop working	Strongly High	Need technician to repair	MAR1	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	RAR2	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	SCR1	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	SCR3 RAR1	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	IPR1	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	IPR4	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	RFR1 INR2	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	UIR4 RFR2	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	AER1 PRR1	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	NA	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	NA	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	NA	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-	UIR3	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	IPR3 IPR5	H5-2

Table 4: FMEA Table Part 3