

# Verification and Validation Report: Mechtronics Enigeering

Team 32, Wingman, SmartVault

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# 1 Revision History

Date	Version	Notes
2023/3/7	1.0	Finish the required parts
2023/3/8	1.1	Fix errors

## **2 Purpose**

This document is intended to support the systematic plan for testing the functionality of the system. It meant to show the system has met the requirements in both software and hardware aspects mentioned in requirements document. In particular, this document will describe the testing results. By the end of testing process, it can be shown that the system is working properly and available for usage.

## **3 Scope**

The document would pay attention to the different functionalities being discussed within the VnVPlan documentation. In addition, it would undergo the testing processes as if it was a black box, which will emphasis on the inputs and outputs of the system instead of the internal process and mechanics.

## **4 Background**

SmartVault is designed 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. This section will not be appropriate for every project.

## 5 Functional Requirements Evaluation

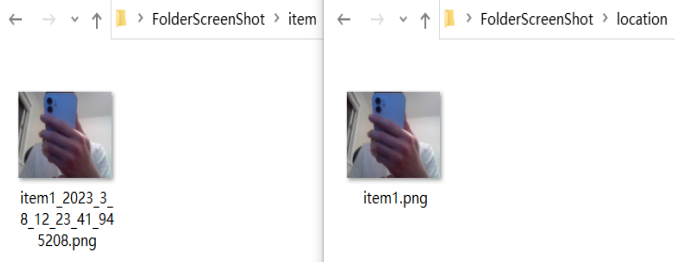
### 5.0.1 Area of Testing1

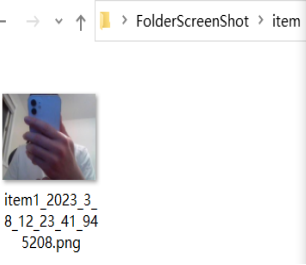
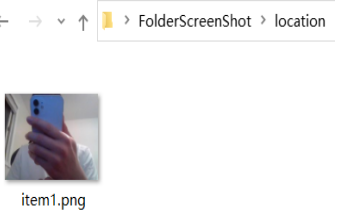
**Automatic Testing**    Testing shown:

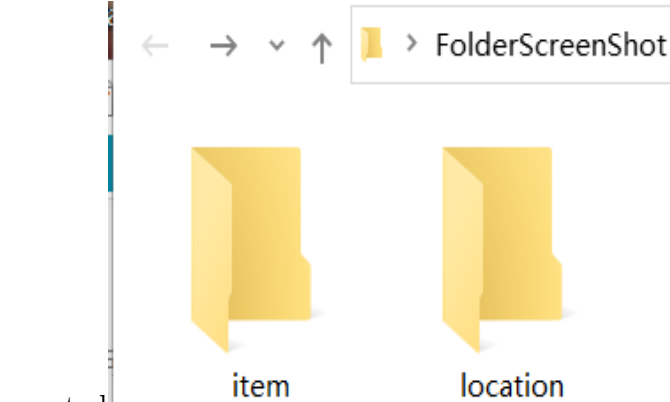
Test Number	IPR1-1
Requirement Reference	IPR1
Requirement	The system should be able to identify human's body
Input	Images of the working environment and a human show up in the environment
Desired Output	Coordinate of the detected human body
Actual Output	Correct coordinate of the detected human body
Conclusion	Pass as expected

Test Number	IPR3-1
Requirement Reference	IPR3
Requirement	The system should be able to identify new objects introduced in the area
Input	Images of the working environment with new objects in the environment
Desired Output	Coordinate of the detected new objects and outlining them with boxes
Actual Output	Correct Coordinate of the detected new objects and outlining them with boxes
Conclusion	Pass as expected

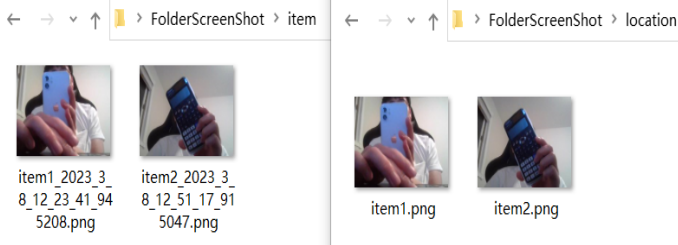
Test Number	IPR4-1
Requirement Reference	IPR4
Requirement	The system should be able to identify moving objects in the area
Input	Images of the working environment with object in different location in the environment
Desired Output	Coordinate of the new location of detected moving objects and highlight the new location
Actual Output	Correct Coordinate of the new location of detected moving objects and highlight the new location
Conclusion	Pass as expected

Test Number	IPR5-1
Requirement Reference	IPR5
Requirement	To store the initial frame
Input	(1, 'i')
Desired Output	Adding item1_{date and time}.png, item1.png
Actual Output	<p>Added as:</p> 
Conclusion	Pass

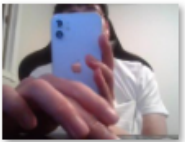



Test Number	IPR5-2
Requirement Reference	IPR5
Requirement	To check whether the frame is stored in the correct path
Input	(1, 'i')
Desired Output	item{num}-{date and time}.png is stored in 'item', item{num}.png is stored in 'location'
Actual Output	<p>item1_2023_3_8_12_23_41_945208.png is within 'item', item1.png is inside 'location'</p> <div> <div>  <p>item1_2023_3_8_12_23_41_945208.png</p> </div> <div>  <p>item1.png</p> </div> </div>
Conclusion	Pass

Test Number	IPR6-1
Requirement Reference	IPR6
Requirement	To create 3 folders sequentially
Input	createFolder() being called
Desired Output	3 folders (FolderScreenShot, item, location) created
Actual Output	<p>3 folders (FolderScreenShot, item, location)</p>  <p>created</p>
Conclusion	Pass

Test Number	IPR6-2
Requirement Reference	IPR6
Requirement	Do nothing if they have already existed
Input	createFolder() being called
Desired Output	No change
Actual Output	No change
Conclusion	Pass

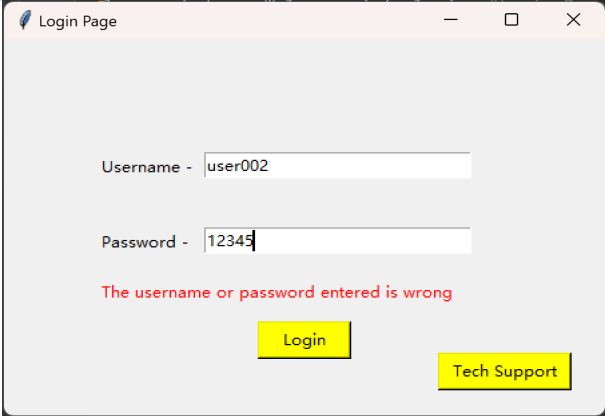
Test Number	IPR6-3
Requirement Reference	IPR5, IPR6
Requirement	To check whether the frame for the second item is captured
Input	(2, 'i')
Desired Output	Adding item2_{date and time}.png, item2.png
Actual Output	<p>Added as:</p> 
Conclusion	Pass

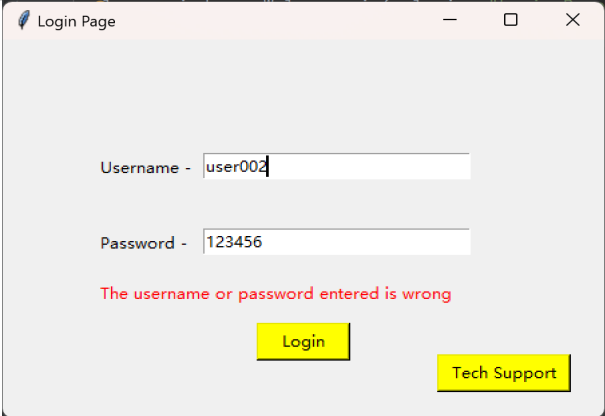


Test Number	IPR6-4
Requirement Reference	IPR4, IPR6
Requirement	To check whether the location frame for the first item is updated, meanwhile the second item won't get affected
Input	(1, 'u')
Desired Output	item1_{date and time}.png should remain, item1.png shall be updated
Actual Output	<p>Only item1.png get updated Comparison shown:</p> <div> <div> <div>← → ▾ ↑</div> <div>FolderScreenShot &gt; location</div> </div> <div> <div>  <div>item1.png</div> </div> <div>  <div>item2.png</div> </div> </div> <hr/> <div> <div> <div>← → ▾ ↑</div> <div>FolderScreenShot &gt; location</div> </div> <div> <div>  <div>item1.png</div> </div> <div>  <div>item2.png</div> </div> </div> </div></div>
Conclusion	Pass

### 5.0.2 UI Interface Menu

**Manual Testing** Testing shown:

Test Number	UIR1-1
Requirement Reference	UIR1
Requirement	The UI should notify the user when the user has a wrong password input
Input	The wrong input of the password
Desired Output	There should be a text notification shown on the window
Actual Output	
Conclusion	The test is successful

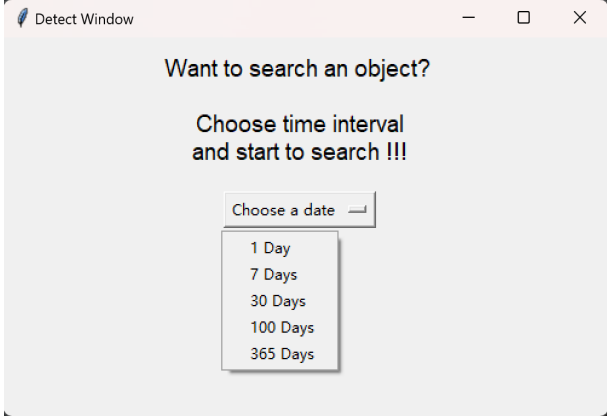
Test Number	UIR1-2
Requirement Reference	UIR1
Requirement	The UI should notify the user when the user has a wrong username input
Input	The wrong input of the username
Desired Output	There should be a text notification shown on the window
Actual Output	
Conclusion	The test is successful

Test Number	UIR2-1
Requirement Reference	UIR2
Requirement	The UI should be able to let the user to switch the pictures shown in the window
Input	The next button is clicked
Desired Output	A different picture is shown
Actual Output	A different picture is shown in the window
Conclusion	The test is successful

Test Number	UIR2-2
Requirement Reference	UIR2
Requirement	The UI should be able to let the user to switch the pictures shown in the window
Input	The previous button is clicked
Desired Output	A different picture is shown
Actual Output	A different picture is shown in the window
Conclusion	The test is successful

Test Number	UIR3-1
Requirement Reference	UIR3
Requirement	The UI should be able to provide information about the location of the item
Input	The user select the item picture
Desired Output	The location of the picture is shown in a new window
Actual Output	
Conclusion	The test is successful

Test Number	UIR3-2
Requirement Reference	UIR3
Requirement	The UI should be able to provide information about the location of the item
Input	The user select the item picture
Desired Output	The UI should notify the user that the item has been taken out of the room
Actual Output	
Conclusion	The test is successful

Test Number	UIR4-1
Requirement Reference	UIR4
Requirement	The UI should be able to let the user to choose the information input
Input	The user select the choose box
Desired Output	The UI provides choices to the user
Actual Output	
Conclusion	The test is successful

## 6 Nonfunctional Requirements Evaluation

### 6.1 Usability

Test Number	APR1-1
Requirement Reference	APR1
Requirement	The User is able to launch the program without help
Input	The servy paper
Desired Output	An average of high rating shown on the paper
Actual Output	
Conclusion	The test is successful

Test Number	EUR1-1
Requirement Reference	EUR1
Requirement	Users without electronics and coding background will be able to connect the hardware and use the program
Input	Users are asked to connect the hardware and start the program
Desired Output	There should not be any unclear instructions for the user to proceed. The hardware system including the Arduino board, camera and mount should be clarified for people to plug the wires
Actual Output	As camera, Arduino board and the motor are already attached to the mount. User just need to plug the wires to corresponding pins then they can simply start the program with one click
Conclusion	The test is successful

Test Number	EUR2-1
Requirement Reference	EUR2
Requirement	The User is able to find the desired item without help
Input	The servy paper
Desired Output	An average of high rating shown on the paper
Actual Output	
Conclusion	The test is successful

## 6.2 Performance

Test Number	LER1-1
Requirement Reference	LER1
Requirement	The User is able to install the software without help
Input	The servy paper
Desired Output	An average of high rating shown on the paper
Actual Output	
Conclusion	The test is successful

Test Number	LER2-1
Requirement Reference	LER2
Requirement	The program can take pictures after the user has been leave the room
Input	The user leave the room
Desired Output	Pictures are taken
Actual Output	
Conclusion	The test is successful

Test Number	UPR1-1
Requirement Reference	UPR1
Requirement	The user is able to see each picture clearly
Input	The servy paper
Desired Output	An average of high rating shown on the paper
Actual Output	
Conclusion	The test is successful

Test Number	APR1-1
Requirement Reference	ARP1
Requirement	No electronic components should be visible and exposed. The mount should stay still without any physical changes
Input	Launch the program normally and give the camera mount a physical impact
Desired Output	The mount should not be broken and there should not be any visible dislocation of any parts
Actual Output	The mount undergoes a planar movement. No visible parts broken or dislocation. The arduino board attached at the bottom stays still
Conclusion	The test is successful

Test Number	SCR3-1
Requirement Reference	SCR3
Requirement	Rotation speed of the camera should be appropriate and will not damage other parts under the condition the camera have to rotate from one end to the other
Input	Human walk through the camera and leave the capture region at high pace
Desired Output	The camera will detect the human body and starts to follow the human movement. Once the human accelerate and leave the region, the camera will stop tracking and the rotation speed will not be fast enough to damage other parts
Actual Output	The camera will rotate to the human position and follow the movement once it detects the existence of human body. As the human quickly leave the capture region, the camera stops tracking and take a photo of the current frame. After 2 seconds, it will rotate back to the original position. There are no parts being damaged during the movement
Conclusion	The test pass as expected



## 7 Changes Due to Testing

Based on the feedback from Rev 0 demo, we have conducted our test case based on larger room with more complex background environments. During the early stages of testing process, performance reliability issues were found, which led to changes to the main algorithm which aims to lower the light sensitivity to increase the repeatability of the test cases.

Taking notes from our discussion with users, we tried to best limit the user interaction with the system. Users is only required to interact with the user interface which has adapted to user feedback to improve usability.

Another point noted was that users would like to have more detailed time for searching specific items. This will be implemented in the upcoming milestone where some other quality of life update will be implemented.

## 8 Traceability Matrices

### 8.1 Traceability for Functional Requirements

Table 1: Traceability for Area of Testing 1		
Test Method	Requirement	Test Number
Automatic	IPR1	IPR1-1
Automatic	IPR3	IPR3-1
Automatic	IPR4	IPR4-1
Automatic	IPR5	IPR5-1
Automatic	IPR5	IPR5-2
Automatic	IPR6	IPR6-1
Automatic	IPR6	IPR6-2
Automatic	IPR5, IPR6	IPR6-3
Automatic	IPR4, IPR6	IPR6-4

Table 2: Traceability for UI Interface Menu		
Test Method	Requirement	Test Number
Manual	UIR1	UIR1-1
Manual	UIR1	UIR1-2
Manual	UIR2	UIR2-1
Manual	UIR2	UIR2-2
Manual	UIR3	UIR3-1
Manual	UIR3	UIR3-2
Manual	UIR4	UIR4-1

## 8.2 Traceability for Nonfunctional Requirements

Table 3: Traceability for Usability and Humanity Requirements		
Test Method	Requirement	Test Number
Automatic	APR1	APR1-1
Automatic	EUR1	EUR1-1
Automatic	EUR2	EUR2-1
Automatic	LER1	LER1-1
Automatic	LER2	LER2-1
Automatic	UPR1	UPR1-1
Automatic	APR1	APR1-1
Automatic	SCR3	SCR3-1

## Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

1. In what ways was the Verification and Validation (VnV) Plan different from the activities that were actually conducted for VnV? If there were differences, what changes required the modification in the plan? Why did these changes occur? Would you be able to anticipate these changes in future projects? If there weren't any differences, how was your team able to clearly predict a feasible amount of effort and the right tasks needed to build the evidence that demonstrates the required quality? (It is expected that most teams will have had to deviate from their original VnV Plan.)

One of the biggest area of difference between VnV plan and VnV report is from some of the changes to the functional requirements. Our system is no longer tracking human hands, which reflected in the VnV report where we did not test that specific requirement. Since VnV plan was made prior to us finalizing the implementation, we had made several assumptions that were later modified. Most of the functionality tests were conducted manually as it required human interaction with the external environment. However, most of our VnV plan turned out to be feasible and essential for the validation of our project. Since we developed our testing plan based on input/outcome, the change to our anticipated algorithm did not affect the general path for our VnV report. The proposed testing case in VnV plan were tested and validated.