Automatic Face Tracking Camera Final Test Report

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1.1 Purpose

This Test Report document presents the system test of the Automatic Face Tracking Camera. This document's purpose is to describe the extent of which the System's Requirements, defined in the System Requirements Specification, were met.

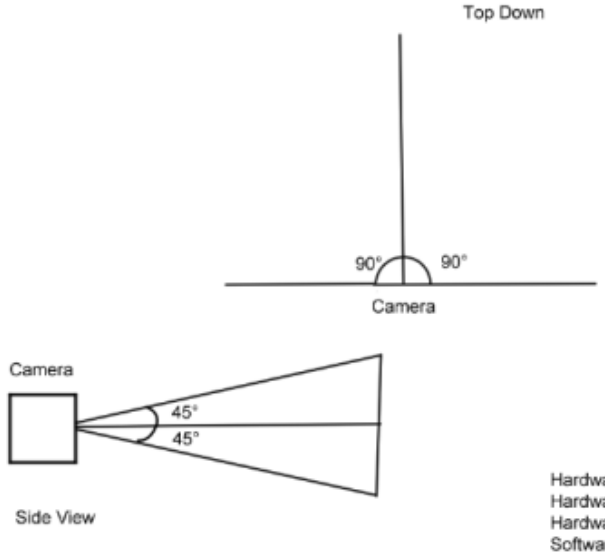
1.2

The system test report will include all recorder data collected from our system test. As described in the System Test Plan, raw data will be collected and presented for each defined test case. The test report will analyze the data and, based on the Requirements Specification, will make a determination on the quality of each test case.

2.1 FOV Test

2.1.2 Test Case Description

This test is conducted by facing the camera towards a wall and measuring the horizontal distance that it is within it's view. Then the distance from the wall. We can use these two values to calculate the camera's FOV. This test will be conducted 8 inches from a wall. These calculations will be done using Scantips' Field of View Calculator.



Hardware Component 1: Camera
Hardware Component 2: Raspberry Pi
Hardware Component 3: Motors
Software Component 1: Motor Control

2.1 FOV Test Results

For this Test we were expecting an FOV of at least 50 degrees horizontally and 40 degrees vertically.

Measuring the distance within camera's field of view gave a focal length of 30mm. After calculations this resulted in a width angle of view of 61.93 degrees and a height of 43.6 degrees. These results satisfy our requirements.

Data Type	Mean Degree Error: ± 0.5 Degree	
Degrees of Elevation	>= 40	Excellent
	>= 35	Good
	>= 30	Satisfactory
	< 30	Failure

Data Type	Mean Degree Error: ± 0.5 Degree	
Degrees of Azimuth	>= 60	Excellent
	>=55	Good
	>= 50	Satisfactory
	< 50	Failure

2.2 Camera FPS

The camera FPS test will be conducted by using the Raspberry Pi's timer to calculate the amount of frames it can capture within 1 second. Each time a frame is captured it will increment a counter and the counter total will be displayed and reset after 1 second has elapsed. This test will be conducted with a user present and without a user present. The average FPS over 1 minute will be our final value.

2.2 Camera FPS Results

For this test we expected an FPS of at least 10 FPS both while a user is present and while they are not.

The test case without the user resulted in an average FPS count of 10.00 FPS. With the user present the average of FPS was 9.91 frames per second. These Values meet the our requirement specification.

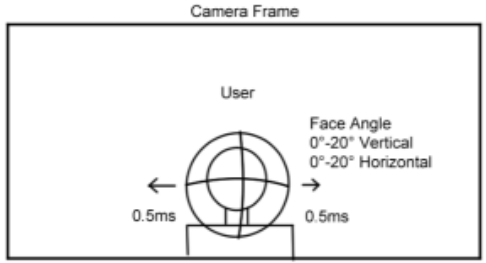
Data Type	Mean FPS Error: ± 1 Frame	
FPS	15 >=	Excellent
	>= 10	Satisfactory
	< 10	Failure

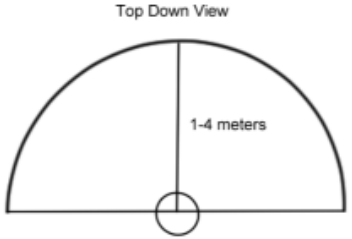
2.3 Camera Detection Accuracy

This case will test the number of times the system can successfully detect the user's face vs the number of failed attempts. The system will run for 1 minute and the percentage of successes will be calculated at the end.

This test will be run under the following conditions.

- While the user is facing forward 1 m away
- While the user is facing 45 degrees left
- While the user is facing 45 degrees right
- While the user is facing 45 degrees down
- While the user is facing 45 degrees up.
- While the user is moving within frame
- At distances greater than 1 m.





Hardware Component 1: Camera
Hardware Component 2: Raspberry Pi
Software Component 1: Facial Detection

2.3 Camera Detection Accuracy Results

For this test we expected at least 80% accuracy for all cases previously described.

Data Type	Mean Percent Error: ± 0.5%	
Percentage (of Seconds)	> 90%	Excellent
	>= 80%	Satisfactory
	< 80%	Failure

Moving within frame
616 successes out of 699
88.12% accuracy

Straight Forward
652 successes out of 658
99.08% accuracy

45 Degrees Right
562 successes out of 686
81.92.08% accuracy

45 Degrees Down
663 successes out of 665
99.69% accuracy

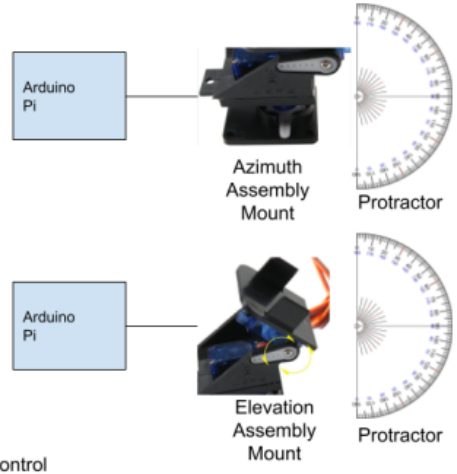
User 1.5 Meters away
125 successes out of 632
19.77% accuracy

45 Degrees Left
502 successes out of 665
75.48% accuracy

45 Degrees Up
712 successes out of 718
99.16% accuracy

2.4 Camera Rotation Range

This test will measure the motors' maximum range of rotation. The camera mount will be put in its initial position at 0 degrees. It will then be rotated as far as it can clockwise and counterclockwise, both horizontally and vertically.



Module: Motor Control
Hardware Component: Servo Motors
Hardware Component: Arduino
Hardware Component: Raspberry Pi
Software Component 1: insertDegreeAngles

Test Diagram 1.4.4: Component and Modules used in Test Case 4 to validate Requirement 3.2.1

2.4 Camera Rotation Range Results

The expected value for this test is a horizontal turning range of at least 90 degrees clockwise and counterclockwise horizontally and 45 degrees vertically.

The results for both cases were satisfactory.

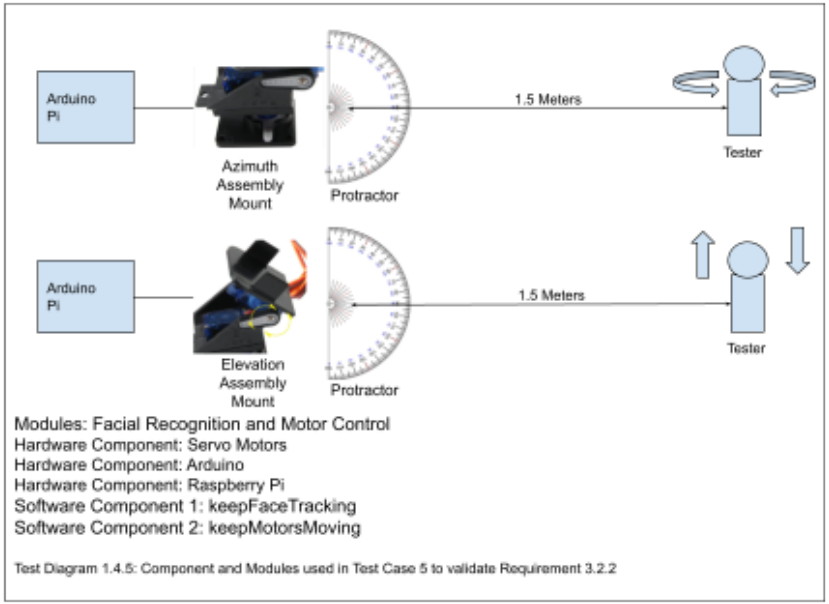
The Horizontal Motor had a maximum turning radius of 90 degrees and the vertical motors can rotate to at least 45 degrees.

Data Type	Mean Degree Error: ± 0.5 Degree	
Degrees of Azimuth	>90	Excellent
	$80 \leq X \leq 90$	Satisfactory
	< 80	Failure

Data Type	Mean Degree Error: ± 0.5 Degree	
Degrees of Elevation	> 50	Excellent
	$45 \leq X \leq 50$	Satisfactory
	< 45	Failure

2.5 Camera Rotation Speed

This case will test the system's ability to physically track the user's position as they are moving. The user will begin in front of the camera 1 meter away, in view of the camera. They will then walk a distance of 2 meters left or right perpendicular to the device. The user will be timed from when they start moving to when they reach the 2 meter mark. This time measurement will be used to approximate the user's speed.



2.6 Image Aspect Ratio

This will test the aspect ratio of the output images taken after the system has determined that the user is standing still.

The expected Value for this test are images that have an aspect ratio of 1080x1080.

When the camera's aspect ratio is set to 1080x1080 within the software it results in distorted images. However an aspect ratio of 800x800 resulted in clear images.

Data Type		
Aspect Ratio	>= 1080x1080	Excellent
	< 1080x1080	Failure

2.7 Taking and Storing Images

This test will determine if the system will save an image after the user has remained still for 6 seconds at least 80% percent of the time. This will also test if the system can only save a maximum of 20 images.

After the test was run the system can only save a maximum of 20 images and out of 30 trials the system successfully saved the user's face after 26 out of 30 times.

Data Type	Mean Error: None	
Max Number of Images Saved	<20	Failure
	`= 20	Satisfactory
	< 20	Failure

Data Type	Mean Percent Error: ± 0.5 %	
Percentage (Completion of Storing Images)	>= 80%	Excellent
	>= 75%	Good
	>= 65%	Satisfactory
	< 60%	Failure

Test Case	Test Name	Test Result	Rating
1.1	FOV Horizontal	61.93 degrees	Excellent
1.2	FOV Vertical	43.6 degrees	Excellent
2	FPS	10 FPS	Satisfactory
3.1	Accuracy Straight	99.08%	Excellent
3.2	Acc. Right	81.92	Satisfactory
3.3	Acc. Left	75.48%	Failure
3.4	Acc. Down	99.69%	Excellent
3.5	Acc. Up	99.16%	Excellent
3.6	Acc. Moving	88.12%	Satisfactory
3.7	Acc. 1.5 Meter Away	19.77%	Failure
4.1	Rotation Horizontal	90 degrees	Satisfactory
4.2	Rotation Vertical	50 degrees	Excellent
5.1	Rotation Speed 0.5m/s	0%	Failure
5.2	Rotation Speed 0.25m/s	82.40%	Satisfactory
6	Aspect Ratio	800x800	Failure
7.1	Taking Image	20	Excellent
7.2	Storing Images	86.66	Satisfactory

Path Forward

- For case 3.3 (Detection Accuracy facing left), to improve this aspect would require the implementation of classifiers that detect a wider range of the face.
- For Case 3.7 (Accuracy 1.5m Away), to improve accuracy at further ranges would require a higher aspect ratio or a classifier that includes the entire body. However, increasing the aspect ratio will cause the Speed to suffer, requiring a more powerful processor to match the speeds it is currently at.
- Case 5.1 (Rotation Speed) to remedy this failure it would require a complete rework of the motor control design as well as new motors that support feedback control. As it is now our current open loop system is not fast enough.
- Case 6 (Aspect Ratio) To remedy this case it would require a higher quality camera that supports the aspect ratio.

System Test Summary

Overall many of the test case were either satisfactory or excellent, however the range and motor control make it an extremely restrictive system for users. As a proof of concept we believe that it works, but as a product it fails and therefore the system test was a failure.