Acceptance Test Report

Project: UAVPAYG19 **WP Name:** Acceptance Test **WP Number:** WP-PM-TAIP-WVI-ST-AQS-ED-02	**Type of Test:** Unit Test	
Test Article:	**Part Number:** N/A	**Serial Number:** N/A
System Requirements: REQ-M-01 REQ-M-02 REQ-M-03 REQ-M-04 REQ-M-05 REQ-M-06 REQ-M-07 REQ-M-08 REQ-M-09 REQ-M-11 REQ-M-12 REQ-M-13 REQ-M-15 REQ-M-17 REQ-M-18 REQ-M-19	**Test Equipment:** See “equipment used” section of each test	
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Test Summary

All tests contained within the report resulted in a success or partial success. The outcome of this was that almost all requirements supplied were satisfied. This test was not completely successfully was the Image Processing component of the TAIPs subsystem, where there were two misreads that occurred.

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Revision Record

Document Issue/Revision Status	Description of Change	Date	Approved
1.0	Initial Issue	23/10/2022	M.B
1.1	Added In TAIP Integration Tests	27/10/2022	C.H
1.2	Added ST Acceptance Test	28/10/2022	J.N
2.0	Minor updates	28/10/2022	M.B

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Definitions

USB	Universal Serial Bus
AQS	Air Quality Sensor
TAIP	Target Acquisition and Image Processing
ED	Enclosure Design
ST	Sampling Tube
WVI	Web Visualization and Interface
QUT	Queensland University of Technology
GPS	Global Positioning System
ASP	Advance Sensor Payload
UAV	Unmanned Aerial Vehicle
HLO	High Level Objective
RPi	Raspberry Pi

1 Introduction

The team members of Group 19 have been appointed to research, design, plan and implement an Advance Sensor Payload (ASP) for Unmanned Aerial Vehicle (UAV) target detection and air quality monitoring in GPS denied environments. The group has committed to the specified budget whilst implementing the project requirements stated by the client. The team has also committed to meeting the deadline date specified by the client with a full functioning ASP that has been tested to ensure the client requirements have been met. This reports the Acceptance Test that was completed of the payload. These tests completed cover all the system requirement given by the client.

1.1 Scope

The scope of the project is to research, plan, design, implement and test the ASP for UAV target detection in GPS denied environments. This document contains the objectives of the test, the equipment used, in depth descriptions of the tests, results, an analysis of these results and a conclusion with recommendations. The purpose of this test document see if the tests satisfies the state System Requirements/HLO’s in RD-1

1.2 Background

The Queensland University of Technology’s Airborne System Lab (ASL) has commissioned the group UAVPAYG19 to design and develop a payload capable in detecting specific objects, recording air quality data to be displayed on a web interface and to pierce a ground sample. This payload is to be attached to a S500 UAV which will complete an automated flight path. The payload is mounted on the bottom of the UAV using a provided bracket. This payload must contain all components to complete its required tasks. These components are:

- Raspberry Pi 3b+
- Raspberry Pi Camera
- Pimoroni Enviro+ sensor
- DF15RSMG 360 Degree Motor

The payload is required to identify three targets, a valve (In open or closed position), a fire extinguisher and an ArUCO marker. The Pimoroni sensor is to be used to record air temperature, pressure humidity, light and potentially hazardous gas level data. This data along with a live feed of the Raspberry Pi Camera is to be visualized on a Web Interface. Lastly a soil sample must be obtained using a sampling mechanism.

2 Reference Documents

2.1 QUT avionics Documents

RD/1	UA–System Requirements	UAVPayloadTAQ System Requirements
RD/2	UA –Customer Needs	Advanced Sensor Payload for UAV Target Detection and Air Quality Monitoring in GPS Denied Environments
RD/20	UAVPAYG-19-ED-TR-01	Enclosure Test Report
RD/21	UAVPAYG-19-AQS-TR-01	Air Quality Sensor Test Report
RD/22	UAVPAYG-19-ST-TR-01	Sampling Tube Test Report
RD/23	UAVPAYG-19-TAIP-TR-01	Target Acquisition and Image Processing Test Report
RD/24	UAVPAYG-19-WVI-TR-02	Web Vision Interface Test Report
RD/25	UAVPAYG-19-AQS-TAIP-WVI-TR-01	AQS TAIP WVI Integration Report
RD/26	UAVPAYG-19-ED-AQS-TAIP-ST-TR-01	ED AQS TAIP ST Test Report
RD/27	UAVPAYG-19-ED-AQS-TAIP-WVI-ST-TR-01	ED AQS TAIP WVI ST Integration Report
RD/28	UAVPAYG-19-TR-AT-01	Acceptance Test Report

2.2 Non-QUT Documents

3 Test Objectives

The tests that were completed that is discussed in this report was the tests completed during the final demo. These tests were required to cover almost all of the requirements aside from some of the documentation requirements.

Table 1: Acceptance Test Requirements

Requirement Code	Description
REQ-M-01	The UAVPayloadTAQ shall remain under the maximum weight of 320 g and comply with an IP41 rating. The air quality sensors must be exposed to the environment to allow for accurate reading.
REQ-M-02	The UAVPayloadTAQ must measure hazardous gases1 , humidity, pressure, temperature and light via on-board sensors.
REQ-M-03	The UAVPayloadTAQ shall communicate with a ground station computer to transmit video, target detection and air quality data.
REQ-M-04	The target identification system shall be capable of alerting the GCS of a target’s type.
REQ-M-05	The Web Interface is required to display real time air sampling data that is recorded directly from the UAVPayloadTAQ and updated dynamically throughout the duration of the flight.
REQ-M-06	The Web Interface is required to display the images of the targets that are taken directly from the UAVPayloadTAQ and updated every time a new picture is taken.
REQ-M-07	The Web Interface shall be designed and run as a web server, which is to be accessible by any computers on the local network. This shall store logged sensor data and target detections with corresponding timestamps.
REQ-M-08	The payload shall include a sampling tube design to collect a simulated soil sample. The payload system must protrude or push into the simulated soil. A mark must be left on the simulated soil (10mm deep, 10mm diameter hole), to ensure the sampling tube has made contact with the soil.
REQ-M-09	The payload shall activate the sampling tube mechanism to collect a simulated soil sample only after the UAV has landed on a designated Aruco marker. Once the soil is sampled the sampling tube must retract to its original position
REQ-M-11	The payload should display its IP address via the integrated Enviro sensor LCD screen.
REQ-M-12	The LCD screen should display live feed of target detection as well as temperature readings from the Pi and the Enviro sensor board.
REQ-M-13	The LCD screen shall be placed on the side of the payload for the user to easily see its operation during flight.
REQ-M-15	The system shall have logged functioning operation for a minimal period of 10

	minutes prior to acceptance test
REQ-M-16	The UAVPayloadTAQ shall process all imagery on-board via the on-board computer.
REQ-M-17	The processing must be able to analyse all data acquired from the camera and sensors while the UAV moves at a maximum speed of 2 m/s.
REQ-M-18	The processing must be able to analyse all data acquired from the camera and sensors while the UAV operates at an altitude of between 1 to 3m.
REQ-M-19	Live data from the UAV must be made available through the web server within 10 seconds of capture.

4 Testing

The Acceptance test was completed on the Demo day where all subsystems was tested as a single integration system. These tests were to perform and validate all System requirements outlined in RD/2.

4.1 Enclosure Subsystem Test

Equipment used:

The equipment used in this test consists of the following:

1. All Enclosure components
2. Raspberry Pi
3. Raspberry Pi camera
4. Servo Motor
5. Sampling Tube
6. Enviro+
7. UAV mounting brackets
8. UAV

Procedure:

Following is the procedure used to conduct the test:

1. Mount Raspberry Pi, camera, servo motor, sampling tube and enviro+ to the enclosure
2. Attached the UAV mounting brackets to the lid of enclosure
3. Attach the enclosure lid to the enclosure body
4. Attach the enclosure to the UAV
5. Power on the pi using UAV power supply
6. Cover remaining gaps around power cable with blue tack
7. Perform visual inspection to check if IP41 Rating is achieved
8. Perform visual inspection to check if LCD screen is visible
9. Perform visual inspection to check if all sensors on Enviro+ is visible and accessible
10. Place the payload onto the scale and check total weight

Results and Evidence:

The results of this test should that the enclosure was able to fit all components within the enclosure and successfully be attached to the UAV. The Enviro+ was visible on the outside of the Enclosure (Figure 1) and there were no visible gaps that would breach the IP41 rating, notably blue covering gaps around power port (Figure 2). Lastly the total weight of the enclosure was 240g which under the maximum of 320g shown in Figure 3.

Figure 1: Blue tack covering power gaps

Figure 2: Enviro sensors and LCD showing

Figure 3: Weight total 240g

4.2 Air Quality subsystem Test

This acceptance test has been completed in relation to the AQS subsystem showing all stages completed during the acceptance test. As such some components of the test may overlap with other subsystems

Equipment used:

The equipment used in this test consists of the following:

1. All Enclosure components
2. Raspberry Pi
3. Raspberry Pi camera
4. Servo Motor
5. Sampling Tube
6. Enviro+
7. UAV mounting brackets
8. UAV

Procedure:

Following is the procedure used to conduct the test (steps 1-5 can be skipped if these have been completed by a previous test):

1. Mount Raspberry Pi, Raspberry Pi camera, servo motor, sampling tube and enviro+ to the enclosure
2. Attached the UAV mounting brackets to the lid of enclosure
3. Attach the enclosure lid to the enclosure body
4. Attach the enclosure to the UAV
5. Power on the pi using UAV power supply
6. Read and record the IP displayed on the enviro+ LCD
7. Using the IP address ssh into the Pi
8. Navigate to the main program
    a. cd ~/IntegrationV2
9. Start the main program
    a. python3 G19-integration.py
10. Once running complete the calibration steps described in the tests completed in RD/21
    a. Note: if the gas sensor has not been calibrated this will need the full 5 minutes to calibrate. During the acceptance test this was completed before testing started
11. To confirm that the AQS data is being recorded and sent to the web visualiser the console should be returning the following: <Response [200]>. This can be seen in Figure 4:

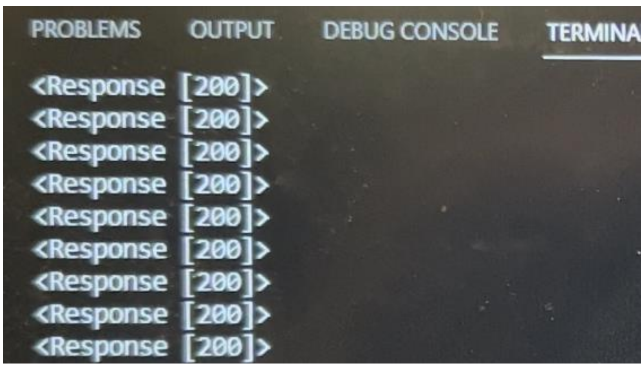


Figure 4: Website Response

12. Once this is running check that data is being displayed on the web visualiser
    a. This data should include
        i. Temperature (Graph)
        ii. Pressure (Graph)
        iii. Humidity (Graph)
        iv. Light (Graph)
        v. NO2 (Bar Graph)
        vi. CO (Bar Graph)
        vii. NH3 (Bar Graph)
13. At this stage confirm that the data is reasonable
14. Position the UAV such that the Enviro+ LCD and light sensor are viewable and accessible
15. Press and hold a finger to the LCD screen until the screen view changes
16. Repeat step 15 until the temperature data is displaying
    a. By default the order that will display in a loop is:
        i. Raspberry Pi IP
        ii. Current temperature reading
        iii. Imagery live stream with detection
17. Place a finger over the temperature sensor to confirm that the readings are live
18. Launch the UAV and fly the mission observing the web visualiser for updates to data
19. Once landed logged data can be viewed from the AQS Data tab

If all conditions above are met this concludes the AQS acceptance test

Results and Evidence:

During the acceptance test for the AQS subsystem there were no issues in running through the procedure. This includes all data displaying properly and within the requested time period (10 seconds) on the web visualiser. Due to this the acceptance test has passed. An image of the web visualiser during the flight can be seen in Figure *5*:

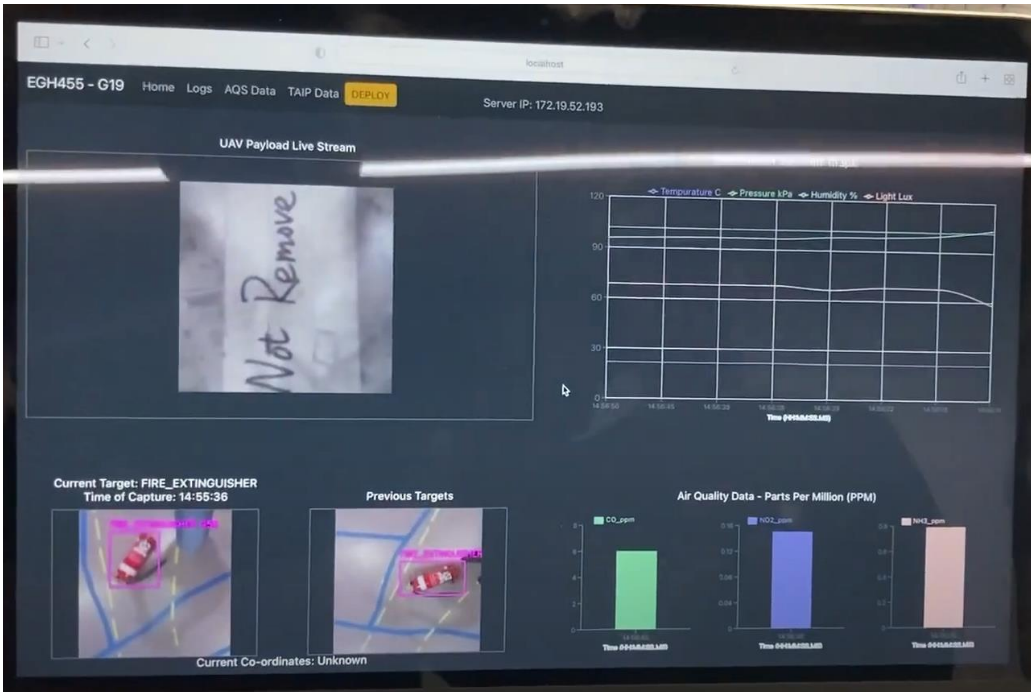


Figure 5: WVI Data During Acceptance Test

Video Evidence Flight on Day: https://www.youtube.com/watch?v=0qbnhZ04XqA

4.3 Web Visualization and Interfaces Subsystem Test

This acceptance test has been completed in relation to the WVI subsystem showing all stages completed during the acceptance test. This test performed to show that the subsystem can connect to the payload and receive transmitted data. The data was then to be displayed on the Web Interface and updated dynamically when the Web Interface has received new data. The test should show that the deployment of the ST subsystem becomes active within 700mm of an Aruco marker with the Id of 45.

Equipment used:

The equipment used in this test consists of the following:

1. Laptop (GSC)
2. Wireless Router
3. Assembled Payload (Including Raspberry Pi)
4. Web Browser (JavaScript Enabled)

Procedure:

1. First ensure that the GSC and payload are connected to the same wireless network provided by the wireless router
2. Open a terminal on the laptop
3. Navigate to the Server Files folder
    a. ./cd {Server File Location}
4. Start the Server using command
    a. node server
5. Start the Web Interface using commands
    a. cd ./client
    b. npm start
6. Open browser and navigate to http://localhost:3000 on GSC
7. Go to AQS and TAIP tabs in the navigation to confirm that there is 10 minutes of logged data displaying
8. Record the Server Ip and use in the main script on the Payload
9. Run the main script on the Payload
10. Observe the Web Interface to see web components updating dynamically with new data, and observe the timestamps to ensure data is being transmitted within 10 seconds
    a. These components should include
        i. Environment Variables Graph
        ii. Air Quality Data – Parts Per Million
        iii. UAV Payload Live Stream
        iv. Current Target
        v. Previous Targets
11. Next ensure that the Volume is turned up on the GSC
12. Observe the audio coming from the GSC to ensure that targets are being vocalized
13. Finally, once the Payload is within 700mm of the Aruco marker with Id of 45, observe the Deploy button becoming active

Results and Evidence:

During the acceptance test for the WVI subsystem there were no complication whilst running through the procedure. The payload successfully connected to the server and was able to transmit data. This shows that all the data sent to the Web Interface was displaying correctly and updating dynamically within the 10 second requirement. The interface also vocalised the targets identified by the TAIP subsystem. The ST subsystem deploy button also became active once the payload was within 700mm of an Aruco marker with the Id of 45. Finally, the test also showed that the user could access 10 minutes of logged data via the web interface. The Web Interface during the acceptance test is shown in Figure 6.

Figure 6: Web Interface During the Acceptance Test

Video Evidence Flight on Day: https://www.youtube.com/watch?v=0qbnhZ04XqA

4.4 Target Acquisition and Image Processing Subsystem Test

Two main tests were performed to check the integration of this subsystem, the first being to see if the webserver and ground control station could be sent target detection data and information, and the second being if the model could be run and seen through the attached LCD screen.

4.4.1 Sending and viewing of video and target detection data to the ground station computer

This test was performed to find out if data was being successfully sent from the payload to the webserver. This is with video and imagery data properly needing to be sent to the server which was viewable via the GCS. All had to happen within 10 seconds of capture.

Equipment used:

The equipment used in this test consists of the following:

- Raspberry Pi 3B+
- Raspberry Pi 3B+ Camera
- Webserver
- Ground Control station

Procedure:

1. Set up the raspberry pi and webserver
2. Ensure the camera attached to the pi
3. Set up the GCS by connecting to the webserver
4. Run the main python script on the raspberry pi
5. Allow the drone to flight its automatic flight path

Results and Evidence:

On the day, as shown in the Figure 7, the payload was able to accurately detect what was captured. The WVI was able to present the type of current target, time of capture, current/previous target detections, live stream and updates of when a target was detected. All information regarding this was captured and transmitted within 10 seconds, with a measured delay of less than 2 seconds between capture and it being viewable on the web server.

When the payload was above the ArUco marker it was successfully able to calculate its coordinates and send this data to the webserver. This was then displayed through the live feed of the detection with a visual highlight on the marker. The past and present detections were also saved as image where could be viewed at a later date. This live feed and current/previous images can be seen in Figure 7.

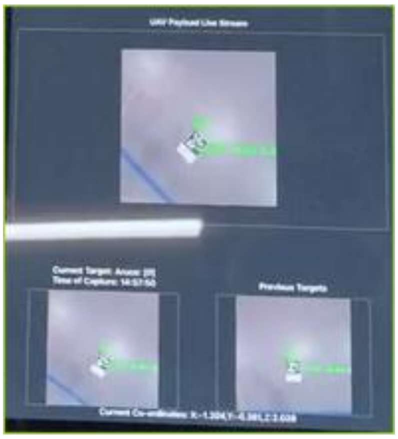


Figure 7: Live Feed (Top) and Previous/Current Images of ArUco marker

Using this detection data, the payload was able to send the type of object it is detecting to the WVI. Thus, allowing the webpage to vocalise the object type.

There were however, two problems with the target detection present on the day during the demonstration. This was a false positive for the fire extinguisher and errors when detecting a closed valve. While the system was verified as working with no errors using test videos, it was unable to be validated as working during the acceptance test. This can be seen in Figure 8 from left to right respectively. A link of a video displaying is shown below.

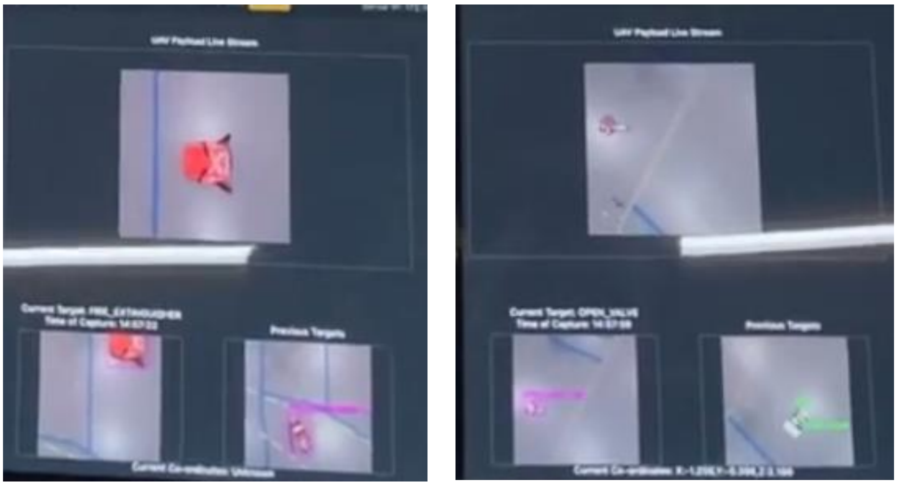


Figure 8: Image processing system reading errors (Fire Extinguisher Left, Closed Value Right)

Video Evidence Flight on Day: https://www.youtube.com/watch?v=0qbnhZ04XqA

During the demonstration, the deploy button was successfully enabled when the payload was within the required 700mm distance from the ArUco marker with the ID 45. This can be seen in Figure 9 where on the left image the UAV is not within range and on the right it is.

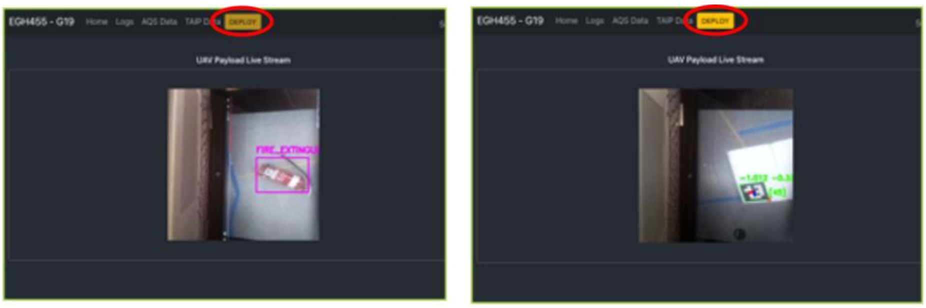


Figure 9 Deploy Button (Left: out of range, Right: within Range)

4.4.2 Checking live feed to LCD screen

Equipment used:

The equipment used in this test consists of the following:

- Raspberry Pi
    - Camera
    - Enviro+
    - Payload Enclosure
    - Laptop

Procedure:

1. First the raspberry pi was setup, with the LCD screen attached, all attached securely to the drone within the payload
2. The main IntegrationV2.py script was remotely run
3. Then the drone was carried and held over a fire extinguisher, this was recorded

Results and Evidence:

The LCD screen could indeed show imagery data as it was being captured during the demonstrations. The test was performed with a fire extinguisher showing on the LCD screen. The target could be picked up by the camera and was displayed with the included bounding box and accuracy values.

Figure 10 Enviro+ LCD Screen test with Model running

4.5 Sampling Tube Subsystem Test

Equipment used:

The equipment used in this test consists of the following:

1. Enclosure Subsystem
2. Raspberry Pi
3. Raspberry Pi camera
4. Servo Motor
5. Sampling Tube Subsystem
6. Enviro+
7. UAV mounting brackets
8. UAV
9. TAIP Subsystem
10. WVI Subsystem
11. Computer

Procedure:

Following is the procedure used to conduct the test:

1. Ensure all Subsystems are connected together and mounted on the UAV
2. Ensure that all Subsystems have been enabled and the G19-integration.py script is running
3. Ensure that the web-server from the WVI Subsystem is running
4. Use a computer to connect to the WVI Subsystem website
5. Have the UAV hover over the simulated soil that has the Aruco marker on it, higher than 700mm
6. Lower UAV to the ground to allow TAIP Subsystem to detect that the Aruco marker is within 700mm, enabling the button on the WVI Subsystem website
7. Click the button on the WVI Subsystem website to enable the ST Subsystem to start cutting into the simulated soil
8. Wait for the ST Subsystem to complete drilling and to retract fully.
9. Record results.

Results and Evidence:

The final validation test for the ST subsystem has been deemed a success. Once the UAV fell below 700mm above the Aruco marker the button was able to be selected on the WVI Subsystem website. Once the UAV landed, the button was pressed, and the ST Subsystem started drilling into the expanded polystyrene. Once the drilling was complete and the ST Subsystem had retracted to its original position, the hole created was validated to be 10mm wide and 10mm deep. A full video can be seen at https://youtu.be/98DXXmkbLoI, with Figure 1111 showing the sampling tube extended into the simulated soil, and Figure 1212 showing it retracted.

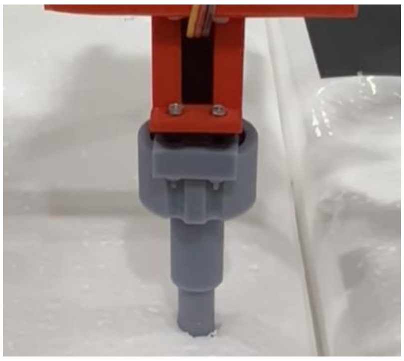


Figure 11: ST Extended into simulated soil

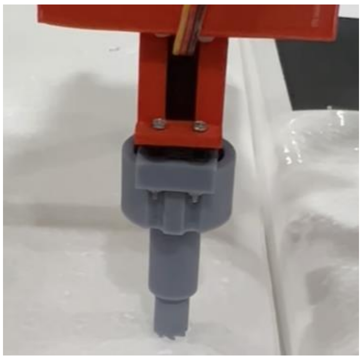
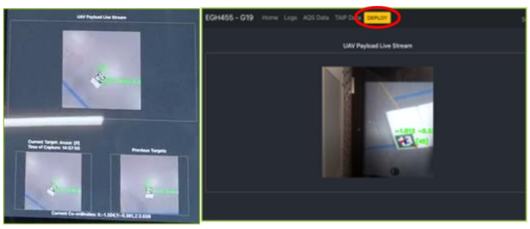


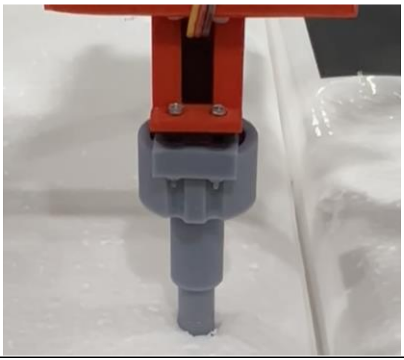
Figure 12: ST Retracted from simulated soil.

5 Results

As displayed in Table 2, almost all requirements are met. The partially met requirement involved the targets system as there were two misreads that occurred. Therefore, only requirement REQ-M-04 was not 100% complete.

Table 2: Results from tests

Test Title	**Result**	**IMG**	**Requirement Met**
Enclosure Subsystem Test	Pass		REQ-M-01 REQ-M-13 REQ-M-14
Air Quality subsystem Test	Pass		REQ-M-02 REQ-M-03 REQ-M-05 REQ-M-11 REQ-M-12 REQ-M-13 REQ-M-14 REQ-M-15 REQ-M-19
Web Visualization and Interfaces Subsystem Test	Pass		REQ-M-03 REQ-M-04 REQ-M-05 REQ-M-06 REQ-M-07 REQ-M-15 REQ-M-19
Target Acquisition and Image Processing Subsystem Tests	Pass		REQ-M-17 REQ-M-18 REQ-M-14
Test 1: Viewing target detection	Pass		

from ground station			
Test 2: Display to LCD screen working	Pass		
Sampling Tube Subsystem Test	Pass		REQ-M-08 REQ-M-09 REQ-M-14

6 Analysis

The analysis section will discuss if the aims of the test have been achieved and were there any issues involved with this.

6.1 Enclosure Subsystem Analysis

The aims of this subsystem test were to be able to fit all components within the enclosure (Evidence in related test report RD/20), ensuring that the enviro+ sensors and ICD is visible and can mount to the UAV drone. As shown in the results section all of these aims were complete. By attaching the enviro+ on the outside of the enclosure it allowed for maximum visibility of the entire component whist still achieving the IP41 rating. As the power cable used in the final done test differed from the used in the in tests, by using blue tack to cover the remaining gaps it all completed the IP41 rating.

6.2 Air Quality subsystem Analysis

The aim of this acceptance test was to show the client that the AQS system is capable of meeting all requirements and HLO’s relevant for this subsystem. This has been achieved through the use of the Enviro+ air quality sensor as well as a web visualiser developed as part of the WVI subsystem. Overall, this subsystem has performed well and is able to meet all requirements as seen in the video evidence and related test reports (RD/21, RD/25, RD/26 and RD/27).

6.3 Web Visualization and Interfaces Subsystem Analysis

The aim of this acceptance test was to show the client that the WVI subsystem meets all the requirements and HLO’s relevant for this subsystem. This has been achieved using a Web Server that hosts a Web Interface. The web interface can integrate with the TAIP and AQS subsystems to receive data that is displayed on the Web Interface within the required time. The TAIP subsystem target data is also vocalized through the web interface. The web interface is also able integrate with the ST subsystem to implement a manual deploy system. Overall, the subsystem has performed to the expectations set. This acceptance test has proved that all related tests carried out in the test reports (RD/24, RD/25 and RD/27) are valid and that the subsystem has met all the requirements set.

6.4 Target Acquisition and Image Processing Subsystem Analysis

The aim of this acceptance test was to show the client that the TAIP system could meet all requirements and HLO’s relevant for this subsystem. There were two main tests performed to show this. The first was a test to see if the image stream was accurately displayed on the web server. The Web Server also displayed the target type and current position data that was estimated from the ArUco marker. The test also included a check to see if the sampling tube could be deployed based on the position estimation. The second test then being to see if the onboard imagery could be viewed on the attached LCD screen. Both tests proven to be successful.

Overall, this subsystem performed extremely well in a test environment with the subsystem's model being validated using test videos of differing heights and resolutions. The test videos also included different obstacles and shapes of targets. The subsystem failed to meet a requirement as it identified a bag as a fire extinguisher and failed to identify the Closed Valve during the demo. This could have been caused due to the constant changing of the environment around the obstacles. This had an extremely large impact on the model and its performance during the demo as it was trained on different obstacles and in a different environment. The subsystem was however able to validate all other targets as seen in pictorial and video evidence and related test reports (RD/23,RD/25, RD/26 and RD/27).

6.5 Sampling Tube Subsystem Analysis

The aim of this acceptance test was to prove that the ST Subsystem functions as required by the client. It can meet all the HLO's that are relevant to the subsystem. The ST Subsystem can integrate with the Enclosure Subsystem, WVI Subsystem, AQS Subsystem, and the TAIP Subsystem. Overall, this subsystem has performed well above expectations with a perfectly clean sample that was also captured within the ST cutting tool. This acceptance test has proven that all the related tests carried out and demonstrated in the test reports (RD/26 and RD/27) are valid. REQ-M-01 is inherently met as the overall weight of the system is within limits as shown in the Enclosure acceptance test.

7 Conclusions and Recommendations

Overall, almost all requirements were completely satisfied as the payload was capable of performing most customer requirements stated in RD/1. Further recommendations for this system would be to train a better model for the image processing. This was due to the two misreads that occurred because of the model that was being used.

Table 3: Requirements Met

Requirement Code	Description	Requirement Met
REQ-M-01	The UAVPayloadTAQ shall remain under the maximum weight of 320 g and comply with an IP41 rating. The air quality sensors must be exposed to the environment to allow for accurate reading.	**Met: -** This requirement has been met as seen by the results in RD/20 and the enclosure subsystem test of this report
REQ-M-02	The UAVPayloadTAQ must measure hazardous gases, (these include Carbone monoxide, Nitrogen dioxide, Ethanol, Hydrogen, Ammonia, methane, and Iso-butane) humidity, pressure, temperature and light via on-board sensors.	**Met: -** This requirement has been met as seen by the results in RD/21 and the results of this report
REQ-M-03	The UAVPayloadTAQ shall communicate with a ground station computer to transmit video, target detection and air quality data.	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report
REQ-M-04	The target identification system shall be capable of alerting the GCS of a target's type.	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report
REQ-M-05	The Web Interface is required to display real time air sampling data that is recorded directly from the UAVPayloadTAQ and updated dynamically throughout the duration of the flight.	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report
REQ-M-06	The Web Interface is required to display the images of the targets that are taken directly from the UAVPayloadTAQ and updated every time a new picture is taken.	**Met: -** This requirement has been met as seen by the results of this report
REQ-M-07	The Web Interface shall be designed and run as a web server, which is to be accessible by any computers on the local network. This shall store logged sensor data and target detections with corresponding timestamps.	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report
REQ-M-08	The payload shall include a sampling tube design to collect a simulated soil sample. The	**Met: -** Hardware test 1 & 2 were a combined test with the TAIP

	payload system must protrude or push into the simulated soil. A mark must be left on the simulated soil (10mm deep, 10mm diameter hole), to ensure the sampling tube has made contact with the soil.	This requirement has been met as seen by the results in RD/22, RD/26, RD/27, and the results of this report
REQ-M-09	The payload shall activate the sampling tube mechanism to collect a simulated soil sample only after the UAV has landed on a designated Aruco marker. Once the soil is sampled the sampling tube must retract to its original position	**Met: -** This requirement has been met as seen by the results in RD/26, RD/27, and the results of this report
REQ-M-11	The payload should display its IP address via the integrated Enviro sensor LCD screen.	**Met: -** This requirement has been met as seen by the results in RD/25 and the results of this report
REQ-M-12	The LCD screen should display live feed of target detection as well as temperature readings from the Pi and the Enviro sensor board.	**Met: -** This requirement has been met as seen by the results in RD/25, RD/26, and the results of this report
REQ-M-13	The LCD screen shall be placed on the side of the payload in order for the user to easily see its operation during flight.	**Met: -** This requirement has been met as seen by the results in RD/20 and the enclosure subsystem test of this report
REQ-M-15	The system shall have logged functioning operation for a minimal period of 10 minutes prior to acceptance test	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report
REQ-M-17	The processing must be able to analyse all data acquired from the camera and sensors while the UAV moves at a maximum speed of 2 m/s.	**Met: -** This requirement has been met as seen by the results of RD/23
REQ-M-16	The UAVPayloadTAQ shall process all imagery on-board via the on-board computer	**Partially Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report, there was a misfiring of this twice during the testing
REQ-M-18	The processing must be able to analyse all data acquired from the camera and sensors while the UAV operates at an altitude of between 1 to 3m.	**Met: -** This requirement has been met as seen by the results of RD/23
REQ-M-19	Live data from the UAV must be made available through the web server within 10 seconds of capture.	**Met: -** This requirement has been met as seen by the results in RD/24 and the results of this report