Enclosure Test Report

Project: UAVPAYG19 **WP Name:** WP-ED-04 **WP Number:** Subsystem Testing		**Type of Test:** Unit Test	
Test Article: Enclosure component fitting		**Part Number:** N/A	**Serial Number:** N/A
System Requirements:		**Test Equipment:** See "equipment used" section of each test	
REQ-M-01	REQ-M-13 REQ-M-14		
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Test Summary

This test report contains the testing of the Enclosure subsystem. This included fitting components of other subsystem into the Enclosure for sizing. The outcome of this test report was that all requirement for the ED subsystem was met and no major changes are required to be made.

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Revision Record

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1.0	Initial Issue	21/10/2022	M.B
2.0	Updates	26/10/2022	M.B
3.0	Further updates	28/10/2022	M.B

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Definitions

AQS	Air Quality Sensor
TAIP	Target Acquisition & Image Processing
ST	Sampling Tube
ASP	Advance Sensor Payload
UAV	Unmanned Aerial Vehicle
ED	Enclosure Design

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 test report covers testing within the Enclosure Design subsystem and its integration with components from the other subsystems.

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, the equipment used, in depth descriptions, results, analysis of the tests and a conclusion with recommendations. The purpose of this test document see if the tests satisfies the relevant System Requirements/HLO's in RD/1 for the Enclosure Design subsystem.

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/30	UAVPAYG19-ED-FD-02	ED Final report
RD/3	UAVPAYG19-PM-PMP-03	PMP document

2.2 Non-QUT Documents

3 Test Objectives

The primary object of this test report is to test if the enclosure completes the requirement listed in Table 1. If these tests prove to be a success, then no more modifications would be required on the Enclosure design. If any tests resulted in a fail, then any required modifications will be complete and ready for a future test

Table 1: Enclosure Design Subsystem 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-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.
REQ-M-14	Developed solution shall conform to the systems engineering approach.

4 Testing

The ED subsystem there are no software components involved as the test only consists of physically fitting on the hardware into the Enclosure. This testing was completed so ensure that all components fit as planned and if any modifications need to be made.

4.1 Hardware Tests

4.1.1 Hardware Test 1: Raspberry Pi mounting

The purpose of this test was to see if the Raspberry Pi was able to fit within the enclosure and that the model hole for the power port was located in the correct spot. This is to allow for the pi to be powered

Equipment Used

The equipment used in this test consists of the following:

- Raspberry Pi
- Enclosure

Procedure:

1. Attach the Raspberry Pi to the enclosure plate using M2.5 bolts in all four corners
2. Then attach nuts to the bolts to hold the Pi in place
3. Place the plate with attached Pi into the enclosure
4. Insert the power cable into the pi

Results and Evidence:

The results of this experiment were that the Raspberry Pi was able to be successfully mounted on the designed enclosure plate (Figure 1). The power port located in the correct position for the power plug to access the Pi (Figure 2).

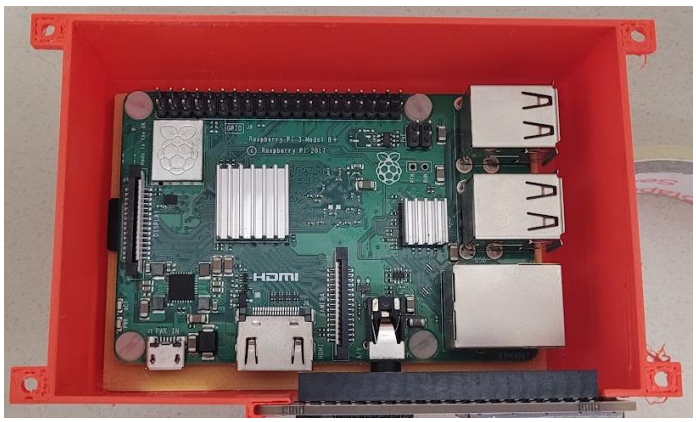


Figure 1: Raspberry Pi mounted within Enclosure

Figure 2: Power Plug hole in enclosure

4.1.2 Hardware Test 2: Enviro+ Mounting

The purpose of this test was to see if the mounting of the Enviro+ was successful. The secondary motive of this test was to ensure that the LCD screen and sensors were facing outward with no obstructions.

Equipment Used

The equipment used in this test consists of the following:

- Enclosure body
- Enviro+

Procedure:

1. Place the Enviro+ into the slot position on the side of the enclosure

Results and Evidence:

This test was if the enviro+ is capable of fitting within the designed position. As can be seen in figures 3 and 4, the sensor can sit place in the correct position.

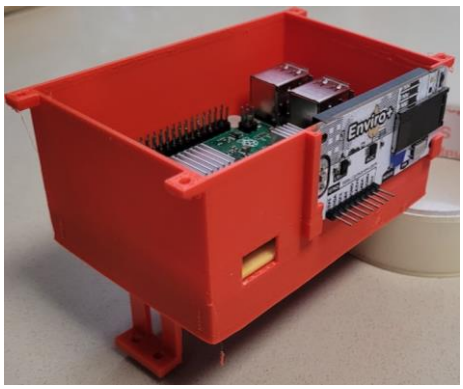


Figure 3: Side View of mounted Enviro+

Figure 4: Front View of mounted Enviro+

4.1.3 Hardware Test 3: Raspberry Pi Camera mounting

Equipment Used

The equipment used in this test consists of the following:

- Raspberry Pi Camera
- Enclosure

Procedure:

1. Insert the raspberry Pi camera inside the enclosure with into the modelled holes
2. Attached camera using M2 bolts then secure with nuts

Results and Evidence:

The results of this experiment display that the raspberry Pi camera successfully fits in place within the enclosure. The camera lens and mounting holes align perfectly with the modelled design. Figure 5 displays this.

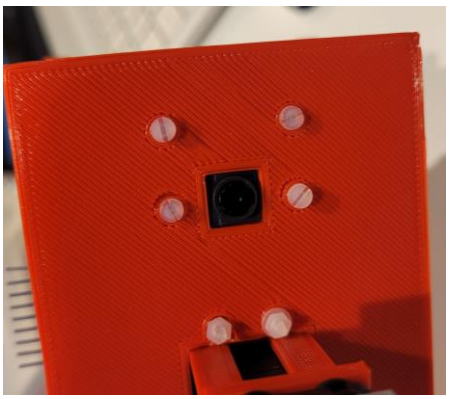


Figure 5: Raspberry Pi camera mounted

4.1.4 Hardware Test 4: Servo Motor mounting

The purpose of this test was to mount the servo motor onto the bottom of the enclosure. This is to ensure that the servo could be successfully mounted with obstructions.

Equipment Used

The equipment used in this test consists of the following:

- Servo Motor
- Enclosure
- Prototype servo Motor mount
- Bolts and nuts

Procedure:

1. Insert the servo motor into place within the designed enclosure legs
2. Place the prototype serv motor mount upon of the servo.
3. Using bolts, secure these pieces together

Results and Evidence:

The results of this experiment show that the servo motor fit in its correct position at the bottom of the enclosure. The motor sits in a pressure fit between the enclosure legs and secured in place using bolts. In this test however only 2 bolts were used (Figure 6) but the final product will be using four bolts. The gap on the enclosure leg also allow for the servo cable is accessible. This can be seen in Figure 7.

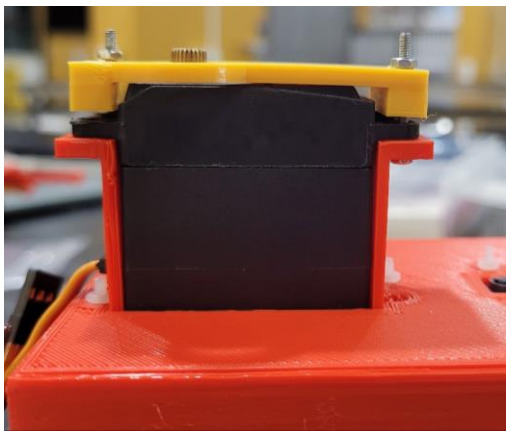


Figure 6: Side view servo attached to enclosure

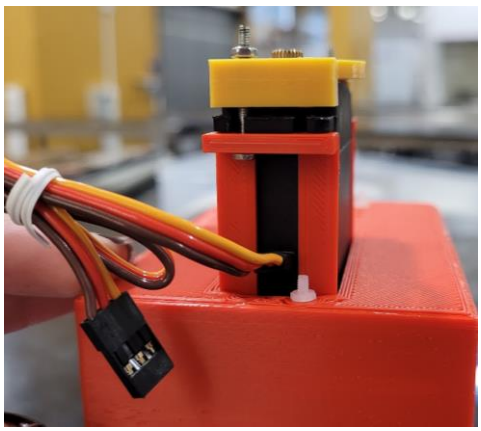


Figure 7: front view servo attached to enclosure

4.1.5 Hardware Test 5: Enclosure Body and Lid

The purpose of test was to test if the designed lid of the enclosure was capable of fit flush against the main body. This test was conducted to ensure that the bolt holes lined up and that there were no other obstructions between the lid and body.

Equipment Used

The equipment used in this test consists of the following:

- Enclosure body and lid
- Enviro+

Procedure:

1. Place the Enviro+ into its slot mounted position on the enclosure
2. Place lid on top of the enclosure
3. Secure lid using M2 bolts and nuts

Results and Evidence:

The results of this experiment show that the mounted enclosure lid is successful in attaching flush against the payload to the enclosure body. The model bolt holes on each corner and centre back were also all lined up allowing the bolts to be placed through cleanly. Figure 8 displays this.

Figure 8: Enclosure with lid attached

4.1.6 Hardware Test 5: Weight Test of just Enclosure

The purpose of this test was to find the weight of the payload. It is vital that this weight does no exceed the maximum allocated stated in the PMP document RD/3.

Equipment Used

The equipment used in this test consists of the following:

- Enclosure body, lid, motor leg mounts
- Digital Scale

Procedure:

1. Place all enclosure components on the scale
2. Read the value of the scale

Results and Evidence:

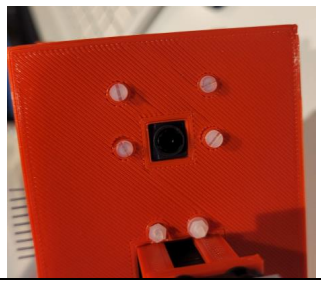
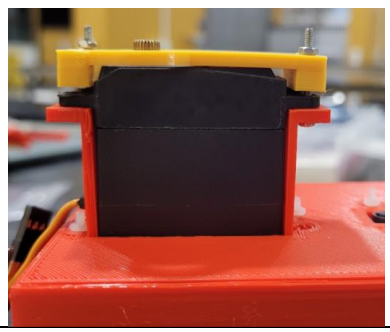
The result of this test show that the 3D printed enclosure weights 69g. This can be seen in Figure 9

Figure 9: Enclosure weighted on scale

5 Results

Table 2 show the results of all tests that were completed. All tests passed and no further testing was required for this subsystem.

Table 2: Results from tests

Test Title	Result	IMG	Requirement Met
Raspberry Pi mounting	Success		REQ-M-01 REQ-M-14
Enviro Mounting	Success		REQ-M-01 REQ-M-13 REQ-M-14
Raspberry Pi Camera mounting	Success		REQ-M-01 REQ-M-14
Servo Motor mounting	Success		REQ-M-01 REQ-M-14

Enclosure Body and Lid	Success		REQ-M-01 REQ-M-14
Weight Test of just Enclosure	Success		REQ-M-01 REQ-M-14

6 Analysis

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

6.1 Hardware Analysis

6.1.1 Hardware Test 1: Raspberry Pi mounting

The Raspberry Pi mounting test is successful in that the enclosure plate holes line up exactly with the Pi holes. If the enclosure design changes this same mounting plate will be used. The Power port was also located in the correct location and was the appropriate size to fit the power cable. The cable used in this experiment how was slightly smaller than the one used in the final demo, therefore there would be less of a gap on all sides.

6.1.2 Hardware Test 2: Enviro+ Mounting

The mounting design for the Enviro+ was successfully able to hold the sensor input on the outside of the payload. This design also prevents movement of the Enviro+ to occur while payload is in motion. The LCD is also visible from the outside of the payload. This design also satisfies the IP41 requirement as the enviro sits flush against the enclosure.

6.1.3 Hardware Test 3: Raspberry Pi Camera mounting

The Raspberry Pi camera mounting test was successful in that the camera fits in place at the bottom of the payload. The mounting holes also lined up correctly for the bolts to fit through fully. This design also completes the requirement of IP41 as the camera lens sits flush against the enclosure

6.1.4 Hardware Test 4: Servo Motor mounting

The Servo motor was capable of fitting within the designed mounting legs. This legs are attached within the enclosure and due to thickness of these legs, it allows for some bendability to fit the servo tightly in place. By having gaps vertical down the sides of both legs, it allows for the servo to be mount facing forwards and backwards. The purpose of these gaps were for the servo cables to exit. By having a gap at the base of the enclosure it allow for the servo to sit slightly within the body. With this the IP41 rating was satisfied.

6.1.5 Hardware Test 5: Enclosure Body and Lid

Enclosure lid and body test was completed to test if the lid fits in place aligned with the bolt holes. As the results stated, the lid was successful in this as well as sitting flush against the enclosure body. Through this the IP 41 rating was achieved.

6.1.6 Hardware Test 6: Weight Test of just Enclosure

The weight of the enclosure was below what was estimated in the PMP. This value was 70g and the actual weight is 69g. Due to this this test passes the requirement of the weight of the system being under a total of 320g.

7 Conclusions and Recommendations

The conclusion of this test report is a successfully designed enclosure design capable of holding all components required for the project. In included the raspberry pi, Enviro+, Raspberry pi camera and servo motor. The outcome of these test proved that all requirements for the Enclosure subsystem has been achieved. This can be seen in table 3.

Recommendations for future design plans are to have the servo rotated 180 degrees so that the servo head is towards the centre of the payload. This is so the Centre of Gravity isn't affected as much when the sampling system is activated. The current system is not capable of this as the servo cables would obstruct the view of the camera.

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 of Hardware Test 1. The weight requirement has also been met but is discussed further in RD/20 and RD/28
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, tests relating to it are described in the following test reports: RD/25 and RD/28
REQ-M-14	Developed solution shall conform to the systems engineering approach.	**Met:** - This has been demonstrated throughout the semester with reports showing this to be true