Overview

This test plan will describe the process for testing and assembling the electronics system. It will discuss the required equipment, applicable engineering requirements, desired outcomes of each test and a procedure that will run the user through every test needed during and after the development of the subsystem.

During the following assembly and testing the user must follow all laser safety, electronics handling and lab rules. The user must also use an electrostatic discharge mat and a wrist band while conducting the testing and assembly.

During the test, the testing engineer should takes notes of anything deemed useful information. These notes should be written in the note section of each test. These statements can include, but are not limited to anomalies, odd functionality, failed tests, suggested further testing and causes for confusion.

The lead engineer should contact David Sawyer Elliott if there is any confusion or if any component does not pass a test.

During the testing of this subsystem, the lead test engineer must initial every step in the procedure. The lead engineer also needs to scan the completed document and email it to dse2737@rit.edu.

Note: It is assumed that all parts have been previously machined and worked to completion. If any parts are not complete, start the testing and development of other subsystems. However, do not start higher level testing until all earlier testing had been completed.

Personnel to Contact in Case of Problems

Name	Email	Phone number
David Sawyer Elliott	dse2737@rit.edu	(585)880-5845

Testing Information

Lead Testing Engineer _____

Assisting Test Engineer _____

Date and Time of Testing _____

Location of Testing _____

Required Tools

All equipment must be calibrated and deemed functional through external testing

Equipment	Description of Component	Calibration Date	Initials
Ohm Meter	Digital multimeter capable of measure resistance to .001 ohms		
DC Power Supply	Capable of supply >2 amps and 12 volts		
Soldering Iron	Soldering iron for use on .032 lead free solder		
Wire Cutter			
Philips head screw driver			
Wire Crimpers	To crimp pins of connectors		
#4-40 Allen key			
¼ in wrench			
Solder	.032 lead free solder		
Stop Watch	Millisecond resolution		
#6-32 Allen key			
Flat Head Screw Driver			
Heat Gun			
Scissors			

Required Components

Component	Part Number
Open Box Frame Push Solenoid	70155K78
90 degree Angle Stock	8982K87
MSP-EXP430G2 Launchpad	MSP-EXP430G2
Perforated Development Board	B00ARTP1J4
Hookup Wire	27WK22STR25
4-40 Nuts	90480A005
4-40 Washers	90126A505
4-40 Bolts	1128655
2-56 Standoffs	761-4501-256-SS
4-40 Bolts	1173410
Laser Diode 850nm	365-1889-ND
Phototransistor 850nm	751-1003-ND
5 mm LED holders	516-1394-ND
Silicon Sealant	Dap 00688
Hinge	1603A2
6-32 Bolts	90128A144
#6 Washer	90126A509
9 Pin D-Sub Female	609-1525-ND
9 Pin D-Sub Backshells	909GME-ND
9 Pin Mounting Hardware	A32023-ND
9 Pin D-Sub Male	3M10604-ND
9 Pin D-Sub Female Board Mount	626-1561-ND
2 Pin Connector Male	571-14806980
2 Pin Connector Female	571-14806990
3 Pin Connector Female	571-14807010
3 Pin Connector Male	571-14807000
Electronics Housing	546-1590EFL
Rubber Pads	4215495N
DPST Switch	360-3244-ND
SPST Switch	EG4817-ND
Wire Shielding	B003HGHR32
USB Connector Female	MUSB-A511-00-ND
USB Connector Male	A103877-ND
12 V power Supply	EG-GC-2A
Male BNC	ARFX1119-ND
#4-40 bolts	72498
Appliance Connector	Q336-ND
Wire Shrink Wrap	QW60311
1-64 1/4" FHCS	91253A972
1-64 Hex Nut	90480A036
3 mm LED holders	67-1330-ND
LEDs	B004JO2PVA
2-56 Washers	90107A003
2-56 Nuts	90480A003

Female BNC	A97548-ND
PINS 3, 2 Contact Connectors Male	571-3506901
PINS 3, 2 Contact Connectors Female	571-3506891

Procedure

Component Level

Laser

1. Set power output of the DC power supply to 3.3 volts with a current limit of 1 amp. _____
2. With the power supply powered down attach the positive lead of the laser to the positive terminal of the power supply and the negative lead of the laser to the negative terminal on the power supply. Ensure a 220 ohm resistor is in series with the Laser. _____
3. Power on the laser and conduct the test listed below. _____

Test	Measured Value	Acceptable Value Range	ER#	Initials
Read the Current Draw		30mA < x < 150mA	10, 28, 13, 18,2 ,3	

4. Power down system. _____

Notes:

Microcontroller

1. Attach microcontroller to a computer using a USB to mini-USB cable. _____
2. Launch TI's code composer. _____
3. Upload the LED_Test_Final program to the microcontroller. _____

Test	Measured Value	Acceptable Value Range	ER#	Initials
Ensure LED 1 and 2 light up on the PCB		Yes	10, 28, 18, 27,2, 3	

4. Power down system. _____

Notes:

Solenoid

1. Set the output voltage of the DC power supply to 12 volts and set the peek current to 1.5 amps. _____
2. Connect the solenoid to the power supply. _____

3. Power on the power supply. _____

Test	Measured Value	Acceptable Value Range	ER#	Initials
Ensure the solenoid actuates		Yes	10, 28, 18, 27,2, 3	
Time of actuation		X <.5 seconds	10, 28, 18, 27,2, 3	

4. Power down system. _____

Notes:

Force Senor

1. Attach the leads with no connectors to the force sensor as shown in document Electronics_Layout_Final _____
2. Attach the positive side of the multimeter to one of the legs of the resistor and attach the other to the other side of the resistor. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read resistance of the sensor		100 ohm < x <5000 ohms	10, 28, 18, 2, 3	

3. Power down system. _____

Notes:

Phototransistor

1. Attach the positive lead of the transistor to the positive terminal of a 3.3 volt dc power supply with a peek current of 1 amp. Attach the negative lead to the negative terminal. _____

2. Attach the positive side of the multimeter to the drain leg of the transistor and the negative side to the negative terminal of the power supply. _____
3. Power on system

Test	Measured Value	Accepted Value Range	ER#	Initials
Cover transistor with opaque tape and read the voltage across the transistor		0< x < 1.5V	10, 28, 18	
Point transistor at a light source and read voltage across the transistor		2V < x < 3.3V	10, 28, 13, 18	

4. Power down system. _____

Notes:

Subsystem Level

Power Regulation and Switching Board (PRSB)

1. Assemble and test this board with compliance to Power_Regulation_Assembly_And_Test_Plan _____

Notes:

Fish Feeder

1. Assemble and test this component as shown in the Fish_Feeder_Assembly_And_Test_Plan _____

Notes:

Fish Detector

1. With the photo transistor still attached to the power supply upload the Photo_Transitor_Test_Final code to the microcontroller. _____
2. Attach drain leg of the transistor to Pin P1.0 with a 220Ohm resistor in series. _____

3. Open a serial monitor for the microcontroller's com-port. _____
4. Power the microcontroller with mini-USB cable. _____
5. Power on the power supply. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Cover transistor with opaque tape and read values off the serial monitor		0< x < 400	10, 28, 18,2, 3	
Point transistor at a light source and read the values off the serial monitor		400 < x < 10000	10, 28, 18, 2, 3	

6. Power down power supply. _____
7. Upload the Photo_Transitor_Normilize_Final code to the microcontroller. _____
8. Open a serial monitor for the microcontroller's com-port. _____
9. Power on power supply. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Wait 1 second and cover transistor with opaque tape, push switch 1 and read values off of the serial monitor		0 < x < 400	10, 28, 18, 2, 3	
Point transistor at a light source and read values off of the serial monitor		400 < x < 14000	10, 28, 18, 2, 3	

10. Power down system. _____
11. Attach laser diode and the phototransistor to the corral using part OHE-S1BK as shown in document Corral_Assembly
12. Upload the Photo_Transitor_Normilize_Final code to the microcontroller. _____
13. Open a serial monitor for the microcontroller's com-port. _____
14. Power laser diode with 5V and the phototransistor using a 3.3V dc power supply. _____
15. Press switch one on the microcontroller _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read the values of the phototransistor off of the serial monitor		0< x < 400	10, 28, 18, 2, 3	
Block the laser with an opaque material and read the transistor values off of the serial monitor.		400 < x < 14000	10, 28, 18, 2, 3	

16. Power down the system. _____
17. Seal the leads of both the laser diode and the phototransistor using silicone. _____
18. Submerge the entire corral into the water including the laser diode and the phototransistor.

_____

19. Upload the Photo_Transitor_Normilize_Final code to the microcontroller. _____
20. Open a serial monitor for the microcontroller's com-port. _____
21. Power laser diode with 5V and phototransistor using a 3.3V dc power supply. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read the values of the phototransistor off of the serial monitor		0< x < 400	10, 28, 18, 2, 3	
Block the laser with an opaque material and read the transistor values off of the serial monitor.		400 < x < 14000	10, 28, 18, 2, 3	

22. Power down system.

Notes:

Finger Analog

1. Attach part 103 and part 101 to part 100 as shown in document Finger_Analog_Assembly using 8 #4-40 1-1/2in cap head screws, 16 #4 washers, and 8 #4-40 nuts. _____
2. Attach the hinge 105/1603A2 to part 104 using 4 #4-401/2in cap head bolts, 8 #4 washers and 4 #4-40 nuts. _____
3. Attach the hinge and plate combination to part 100 as shown in document Finger_Analog_Assembly using 4 #2-56 1/2in bolts 8 #2-56 washers and 4 #2-56 nuts. _____
4. Attach the part 106 to the other side of the hinge as shown in document Finger_Analog_Assembly using 4 #2-56 1/2in flat head bolts 8 #2 washers and 4 #2-56 nuts.

_____

5. Attach the force sensor to the finger using electrical tape as shown in document Finger_Analog_Assembly. _____
6. Attach the rubber foot to the force sensor as shown in document Finger_Analog_Assembly.

_____

_____

7. Using a bread board attach a terminal of the force sensor through a 220 ohm resistor to the ground pin on the microcontroller board and attach the other terminal of the force sensor to pin P1.0.

_____

8. Power on controller using a mini-USB. _____
9. Upload Force_Senor_Test_Final to the microcontroller. _____
10. Open a serial monitor for the microcontroller's com-port. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read the values off the serial monitor		0< x < 800	10, 28, 18, 3	

11. Upload Force_Sensor_Normilize_Final code to the microcontroller. _____
12. Open a serial monitor for the microcontroller's com-port. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Push switch one and read values form serial monitor		0 < x < 400	10, 28, 18, 3	
Squeeze force sensor and read values form serial monitor		400 < x < 14000	10, 28, 18, 3	

13. Power down system. _____
14. Place a micro-switch underneath the finger. _____
15. Power on the system as before with the addition of the solenoid attached to the power supply as before. _____
16. Actuate switch one on the MSP430. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Push switch one and read values form serial monitor		0 < x < 400	10, 28, 18, 3	
Power on solenoid and read values from serial monitor		400 < x < 1000		

1. Repeat the previous test many times changing the position of the solenoid until the micro switch is actuated with a proper amount of force. This requires working with David Sawyer Elliott. _____

Notes:

Finger analog and Fish Detector

1. Create the cable that connects the microcontroller to the PRSB with compliance to document Electronics_Layout_Final. _____
2. Check all wiring with an ohm meter to ensure correct pin out. _____
3. Connect the free hanging leads to the microcontroller using a bread board as shown in document Electronics_Layout_Final. NOTE: Do not connect MSP430 power cables. _____
4. Create cables that connect the finger analog system and the fish detector system to the PRSB. _____
5. Check all wiring with an ohm meter to ensure correct pin out. _____
6. Attach connectors to the force sensors, phototransistor, solenoid and laser as shown in document Electronics_Layout_Final. _____
7. Connect solenoid, force sensor, phototransistor, and laser to the PRSB as shown in document Electronics_Layout_Final. _____
8. Attach power supply to the PRSB as shown in document Electronics_Layout_Final. _____
9. Connect microcontroller to computer using mini-USB cable. _____
10. Upload Detector_Actuator_Test_Final program to the microcontroller. _____
11. Open a serial monitor for the microcontroller's com port. _____
12. Power the system. _____
13. Press switch 1 on the microcontroller PCB. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read force sensor values off of the serial monitor		0 < x < 400	10, 28, 18, 3	
Read photo transistor values off of the serial monitor		0 < x < 400	10, 28, 18	

14. Block laser with opaque object. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Time how long it takes for actuation of solenoid		x <.5s	10, 28, 18, 3	
Time for each double click		.75s < x < 1.5s	10, 28, 18, 3	
Number of double clicks until stop of clicks		5	10, 28, 18, 3	
Apply force to the force sensor and time how long it takes for the solenoid to retract		x <.5s	10, 28, 18, 3	

15. Release force on force sensor _____
16. Unblock the laser. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Time how long it takes for the solenoid to retract.		x <.5s	10, 28, 18, 3	

17. Power down system. _____

Notes:

System Level

1. Assemble remaining cables as shown in document Electronics_Layout_Final. _____
2. Test all cables using a multimeter to ensure correct pin-out. _____
3. Attach Bulk head connectors to the electronics housing as shown in document Electronics_Assembly. _____
4. Fasten the PRSB to the electronics housing using 8 #4-40 1/4in machine screws, and 4 #4-40 5/16in studs. _____
5. Attach MSP430 PCB to the electronics housing using Velcro. _____
6. Attach power supply to the electronics housing using 8 #4-40 1/4in machine screws, and 4 #4-40 5/16in studs. _____
7. Attach all of the components as shown in Electronics_Layout_Final with exception the PIV camera, PIV Computer, and Fish Feeder. Also for the MSP430 make the connections as before using a bread board. NOTE: Do not connect Power MSP430 Power cables. _____
8. Connect microcontroller to computer using mini-USB cable. _____
9. Upload Detector_Actuator_Test_Final program to the microcontroller. _____
10. Open a serial monitor for the microcontroller's com port. _____
11. Press switch 1 on the microcontroller PCB. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Read force sensor values off of the serial monitor		0 < x < 400	10, 28, 18, 3	
Read photo transistor values off of the serial monitor		0 < x < 400	10, 28, 18	

12. Block laser with opaque object _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Time how long it takes for actuation of solenoid.		X <.5 seconds	10, 28, 18, 3	
Time for each double click		.25 seconds < X< .75 seconds	10, 28, 18, 3	
Number of double clicks until stop		X = 5	10, 28, 18, 3	
Apply force to the force sensor and time how long it takes for the solenoid to retract.		X <.5 seconds	10, 28, 18, 3	

13. Release force on force sensor and unblock laser. _____
14. Power down power supply. _____
15. Attach the fish feeder to the MSP430 as shown in document Electronics_Layout_Final. _____
16. Upload Detector_Actuator_Test_Final program to the microcontroller. _____
17. Power on system. _____
18. Open a serial monitor for the microcontroller's com port. _____
19. Press switch 1 on the microcontroller PCB. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Watch for time between activations		5 seconds < x < 15 seconds	10, 28, 18, 27,2, 3	
Time the duration of each motor actuation.		1 seconds < x < 5 seconds	10, 28, 18, 27,2, 3	

20. Power down the power supply. _____
21. Upload PIV_Computer_Trigger_Test code to the MSP 430. _____
22. Attach the PIV computer as shown in document Electronics_Layout_Final. _____
23. Launch the Trigger_Test MatLab script on the PIV computer. _____
24. Power on power supply. _____
25. Press switch 1 on the microcontroller PCB. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Watch MatLab and ensure the message "Trigger Received" Is shown in MatLab		Yes	10, 28, 18, 2	
Check the voltage across the PIV Camera trigger pins as shown in Electronics_Layout_Final using a Volt meter		2 volts < x < 3.3 volts	10, 28, 18, 2	

26. Power down entire system. _____
27. Detach the MSP430 form the electronics housing. _____

28. Switch jumpers to external 5 volt mode on the MSP430 as shown in document MSP430 Launchpad User's Manual. _____
29. Solder on all of the connections as shown in document Electronics_Layout_Final _____
30. Reattach the MSP430 as before. Ensure all components are attached with exception to the PIV Camera. _____
31. Upload System_Software _Final program to the microcontroller. _____
32. Run the Trigger_Test script on the PIV computer. _____
33. Power on entire system. _____
34. Press test switch attached to the electronics housing. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Watch for time between activations		5 seconds < x < 15 seconds	10, 28, 18, 27,2, 3	
Time the duration of each motor actuation.		4 seconds < x < 5 seconds	10, 28, 18, 27,2, 3	

35. Block laser with opaque object. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Time how long it takes for actuation of solenoid.		X <.5 seconds	10, 28, 18, 3	
Time for each double click		.25 seconds < X< .75 seconds	10, 28, 18, 3	
Number of double clicks		X = 5	10, 28, 18, 3	
Watch MatLab and ensure the message "Trigger Received" Is shown in MatLab		Yes	10, 28, 18, 2	
Check the voltage across the PIV Camera trigger pins as shown in Electronics_Layout_Final using a Volt meter		4 volts < x < 6 volts	10, 28, 18, 2	

36. Power down system. _____

Notes:

Final Testing

1. Close the electronics housing. _____
2. Attach all components as shown in document Electronics_Layout_Final. _____
3. Set up the data capture of the DUS and PIV data acquisition rigs as shown in document PIV_Test_Preparation. _____
4. Repeat the following test as many times as necessary to confirm the robustness of the system.

_____

5. Power on system using power switch. _____
6. Launch Data_Migration_Final script on the PIV Computer. _____
7. Push test button. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Watch for time between activations		5 seconds < x < 15 seconds	10, 28, 18, 27,2, 3	
Time the duration of each motor actuation.		4 seconds < x < 5 seconds	10, 28, 18, 27,2, 3	

8. Block laser with opaque object. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Time how long it takes for actuation of solenoid.		X <.5 seconds	10, 28, 18, 3	
Time for each double click		.25 seconds < X< .75 seconds	10, 28, 18, 3	
Number of double clicks		X = 5	10, 28, 18, 3	

9. Unblock the laser. _____

Test	Measured Value	Accepted Value Range	ER#	Initials
Ensure DUS data was taken and Migrated		Yes	3	
Ensure PIV data was taken and Migrated		Yes	2	

10. Return to step 6. _____

Notes:

Concluding statements

Please put all notes regarding the testing in the following area. Important things to note include but are not limited to odd functionality, possible further testing, and sources of confusion.