Programming for the Internet of Things Course
University of California, Irvine

Paul J Gitschner   Capstone project   Week 3 :   Testing

Project Name: The Pineapple Drink Metal Detector
Tag line: ROOMBA - meets - METAL DETECTOR - meets - ALARM CLOCK

There are five major subsystems that will interact to produce the desired results.
DIAGRAM

SYSTEMS
The Pineapple Drink Metal Detector - P. Gitschner
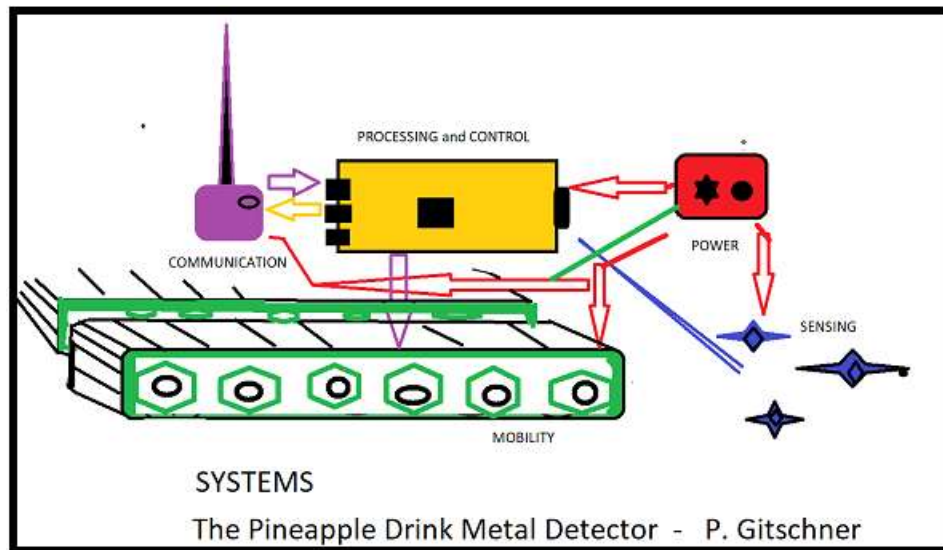
Part 1. Component Testing

Major systems and their Components:

Mobility

Processing

Sensing

Communication

Power

System : Mobility and Movement

Goal - a system that allows the unit to physically move in the desired environment, namely normal beach sand.
Unit is meant to be mechanically agile enough to allow turns required by specified search pattern. It should be vacation portable

Main Components and Tests

Motors (2)

Using an appropriate portable DC battery pack, touch leads to terminals on each motor to verify that motor spins both forward
and then reverse polarity and verify each motor will work in reverse.

Treads (2)
Using the same appropriate portable DC battery pack, touch leads to terminals on each motor to verify it drives its track both forward
and then reverse polarity and verify each motor will work in reverse. This under no load - holding unit off the ground.

Under load(on ground). Using the same appropriate portable DC battery pack, with an on/off switch, and 3 ft leads, clip 2 sets of leads to the terminals on each motor.
Unit will either go forward, backward, circle left or circle right. And stop when leads pull off.Try the other 3 combinations of lead pair/terminal
to identify polarity/terminal/motor combinations needed for each. (Forward. Reverse. Rotating clockwise. Rotating counter clockwise).
Watch for failure to perform and treads coming apart or off.

Platform and structural stability. 1 structure.

Verify that the mobility unit, motors, treads and topside platform has gone a few rounds of tread tests on an **indoor** surface
 and the screws are still tight, and that it is still moving and holding together.

Verify that the mobility unit, motors, treads and topside platform has gone a few rounds tread tests on an **outdoor**, beach sand surface
with a weight attached to the platform approximating the additional weight of the finished unit(processor, sensors, battery)

 and that all screws are still tight, it's not clogging and it's is still moving and holding together.

System :Processing and Programming

Goal - To allow the unit to follow search patterns as chosen by from a standard list or be programmed for an odd shaped territory chosen.
To handle communications processing and allow an AI component where it evaluates finds and learns and have enough memory to log its searches.

Main components:

Raspberry Pi 3A+

Using an appropriate power source (mini USB) apply power and verify red LED lights up to indicate unit is accepting power.

NOOBS mini SD card set up with Raspian OS

Visually verify the Noobs card is correctly inserted in the mini SD slot.

Using an appropriate power source (mini USB) apply power and verify green LED lights up and flashes to indicate the OS is loading.

USB ports

Verify attached a USB 4 point HUB to the 3A+'s single USB port. (The 3A comes with only 1 USB port)

Program memory

Verify attached USB Flash Drive, 32 mb to hub - for on board non volatile program memory

System: Communicating and Alerting

Goal: Two way information exchange between operator and Unit

Physical

Using an appropriate external battery power source applied to terminals verify operation

of:

Lights : Rotating and flashing lamp.

Sounds : Beeper when backing up. Audible alarm when finds something.

Radio

Attach a USB mouse, USB keyboard, an HDMI cable to the HDMI port and a monitor. Test WIFI. Connect to local WIFI with password. Get IP address and initiate SSH access with Putty.

Test Bluetooth by playing some audio though an external speaker.

System: Power and power distribution

Goal - Power all systems for a reasonable duration and cost.

Batteries

Verify:

Visually that batteries are in holder and aligned properly in respect of polarity.

With a circuit tester that a circuit is complete when terminal ends of battery holder, with batteries is touched.

With a multi-meter: that expected voltage is being provided by battery holder.

System: Sensors

Goal - a system able to sense objects under the sand and sense threats to operation so as to avoid them.

Verify each sensor desired is present and firmly attached to the unit, aimed as required and whatever connection required is physically in place.

Including:

Metal detector kit sensor.

Ground drop in front sensor.
Water detector to detect ocean in front.

Ultrasonic sensor to detect obstacles in front.
and a second Ultrasonic to detect ground drop.

Tip switches to detect flipped unit.

and Kid sensors :

R OBSTACLE AVOIDANCE SENSOR MODULE.

VOICE SOUND DETECTION SENSOR.

PIR SENSOR MODULE.

MICROPHONE.

Software : to be tested under integration. Yet to be designed and written.

Part 2. Integration Testing (Progressive)

STARTING :Power UP

Turn on main power switch.

Verify:

Red Power LED on Pi lights up.

Green LED on Pi flashing indicating OS starting.

GUI screen on unit shows menu screen indication main program has started.

"READY" flashes on GUI.
Speakers "ping " to prove on line. (to be programmed)

Light flashes twice to prove functioning. (to be programmed)

Means: Basic static functionality.

Investigate any failures.

RUNNING:

Using external monitor ide keyboard and mouse write a simple program
that makes the unit drive in a square clockwise, when powered up.

Using external monitor, IDE, keyboard and mouse write a simple program
that makes the unit drive in a square counter clockwise, when powered up.

Using external monitor, IDE, keyboard and mouse write a simple program
that makes the unit drive in an expanding circular pattern counter clockwise, when
powered up.

Using external monitor, IDE, keyboard and mouse write a simple program
that makes the unit drive in an expanding circular counter clockwise, when powered up.

Store the 4 programs on the Flash drive attached to the Unit.

Detach attachments and try each on hard surface and beach sand.
 Calibrate by adjusting program if motor performance
is uneven.

Means: Basic Mobile functionality.

Investigate any failures.

COMMUNICATING: LINK

Select "LinkUP" on GUI or User Cell phone App, or controller (to be written) to do a
Bluetooth link up with a remote operator device.

"READY" flashes on remoter device.

Try to run each of the four pattern tests from the remote device.

Means: Basic Communication functionality. It talks.

Investigate any failures.

SENSORS

After the self-defence parts of programming are written and also stored on the Units flash drive.
Power up the unit.
Link the unit .

Run the remote patterns

 WITH OBSTACLES IN THE WAY of it's path:

Including:
Physical Blocks
A LOUD Radio
A person
A puddle
A ramp that narrows so that the unit will fall off before the end.

In all cases observe avoidance or notification to the remote operating unit.

Means: Basic Mobile Situational Awareness functionality. It feels.
Investigate any failures.

METAL DETECTION SYSTEM

Controlled:

Plant some test objects in beach sand within the programmed patterns.

Observe for detection and if detected, evaluation (if AI enabled).

Alert messages should be sent to operator's unit.

Unit should respond as programmed - halt, lights, siren etc.

Field test:

Take out to a probable target rich site. Former building or landfill site.
and test. carefully, under real conditions. etc.

Verify Alert messages be sent to operator's unit.

Verify Unit responds as programmed - halt, lights, siren etc.

OTHER TESTS

Depending on how far the software has been developed:

SOFTWARE:

Test a logging function for areas covered and strikes.
Test CALLING HOME function if lost or stolen.
Test ability to dock for power recharge.

Test search patterns and configuration set up

Means: Basic Task Mobile and Situational Awareness functionality. It's ALIVE!

Investigate any failures.

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