Design Brief

Business name: Azure

Due date for completion: Week before September holidays (11th September)

Review date/s: Once a week / upon completion of a subsystem, review the system

Budget: $220

Product/service/brand name: Air Pro

Key objectives: To launch a rocket using air compression and record flight performance along with the camera feed through a friendly user interface

Marketing objectives and target audience: Adults and scientists interested in rocketry, the atmosphere or air compression

Regulatory issues:

A pressure relief valve of appropriate pressure rating is necessary to ensure the system does not exceed the appropriate pressure limit and have a potential to harm people from shrapnel of PVC.

From AC 101-02 regarding rockets:
101.055
A person must not operate an unmanned aircraft in a way that creates a hazard to another aircraft, another person, or property. A person must not launch a rocket that is not an aircraft in a way that creates a hazard to an aircraft. A person must not launch a rocket that is not an aircraft in a way that creates a hazard to another person or to property.
101.455
A person must not launch a rocket (including a model rocket) to higher than 400 feet AGL in controlled airspace
101.470
A person must not launch a model rocket into cloud. A person must not launch a model rocket to higher than 400 feet AGL within 5 nautical miles of an aerodrome.

7.2.1
When considering a launch site for flying small model rockets several factors need addressing. The launch site should;
(a) be in a cleared area;
(b) be free of tall trees;
(c) be free of overhead power lines;
(d) be free of buildings;
(e) be free of dry brush and grass;

101.425
model rocket means a rocket that:

(a) weighs no more than 1 500 grams; and
(b) carries no more than 125 grams of propellant; and
(c) produces no more than 320 newton-seconds of impulse; and
(d) is made of balsa, wood, paper or plastics or a combination of those materials, but contains no metal as structural parts.

Follows and does not exceed the pressure and performance rating of the equipment and materials.
PVC Piping class 12 has a maximum pressure rating of 174 PSI.

Scope: Pressurize a PVC tank with air through a compressor, utilising a pressure transducer to measure the pressure.

Check the pressure in the system and once complete, ready to launch. Can set the limit of PSI in a set range. Pressure relief valve ensures the system does not compress above the set limit.

Release compressed air to accelerate the rocket upwards to a high altitude and record flight data with a 9-axis sensor along with camera feed. Raspberry Pi in rocket connects in real time with the Raspberry Pi at the launch site.

Recover the rocket through the recovery system, utilising a parachute.

Relay the data through an access point to the server raspberry pi to feed to the screen and display the data to the user in an understandable and informative manner.

Not in scope:

Determine what makes a rocket aerodynamic.

To investigate the relationship between the volume of air and performance of rocket.

To investigate the relationship between temperature of compressed air and the performance of the rocket.

Purpose and function: To use flight data to support the concept that air compression can be used to launch a rocket. Furthermore, the screen interface with the speaker will support the user in launching the trial and understanding the flight data that will highlight key statistics. The rocket's main purpose is to be a projectile and record the flight data, however launches a parachute for recovery, while the gantry system provides support to the rocket before the flight. Lastly, the air compression system compresses air to explosively release at once and launch the rocket.

Format: Proof of concept, a prototype, that air compression can be utilised to launch a rocket. Designed to be portable.

Design Project plan:

Steps:

1. Build launch system
2. Make balance support
3. Integrate Subsystems from 1 and 2 on an appropriate base
4. Program screen and integrate user interface with electronics
5. Fabricate rocket body and fins
6. Construct rocket interior electronics
7. Create rocket parachute recovery subsystem

Attachments:

https://www.casa.gov.au/standard-page/casr-part-101-unmanned-aircraft-and-rocket-operations

Data sheets of parts (located in Systems Folder)

Circuit designs and other learning resources

Measures of success:

The launch system can launch the rocket to a height of 15m. The height of the flight indicates the effectiveness compressed air has been used to project the rocket into the air. As such, the performance of the launch system can be assessed by the flight height of the rocket, with the target being 15m high.

The pressure transducer can measure the air pressure accurately (±1.5% of the actual pressure) and communicate to the system in a timely manner (within 2ms). Essential for accurate calculations leading to wise analysis and deduction.

To timely validate the performance of the launch system, synchronous communication between the rocket and the launcher is vital. Consequently, it is necessary for the data to be wirelessly received with accuracy. As such, the time taken to send and receive data can be assessed with the expectation of 10ms. Furthermore, there is an expectation that no errors occur during data communication, which can be assessed by monitoring the system for such errors.

The rocket land momentum must be reasonable for recovery, to ensure the collision between the ground and the rocket is minimal. Hence improves the cost-efficiency and minimises production time, as the rocket and its parts are reused, appealing to potential experimenters. Considering this, the momentum of the rocket as it lands

must be no more than 5 m/s kg. The flight data can be utilised to assess to what extent the rocket's landing meets this target.

Rocket CEP (Circular Error Probable) is the radius of the circle in which 50% of the fired rockets land. The flight of the rocket regarding its horizontal travel during the flight can be analysed to assess the effectiveness of the fins to keep the rocket stable in flight and on course. As such, the rocket's CEP is expected to be within a 10m radius. Flight data can be used to calculate the horizontal distance and evaluate the performance of the flight regarding the target. This is of serious concern due to the threat to people and infrastructure should the rocket horizontally travel and collie.

With all these measures of success, trials can be performed to evaluate whether the results indicate the performance of the system is consistently within the targets.