ENGR 302 Final Project Report

Project *12*: *Avionics Package*
Client: *Andre Geldenhuis*
Date: 19 October 2017

Project Objectives

The initial goal of the project was to continue development from a previous group to make an avionics package to allow for control and communication with a rocket. Initially, the avionics package would simply need to log sensor data during flight and establish communications with a base station to assist in finding the package. The end goal was to have the avionics package use the sensor data to gimbal the rocket motor and achieve a controlled flight.

Summary of Project Results

Over the course of this project, an avionics package was designed and built that is capable of measuring the inertia affecting a model rocket. These measurements are logged to an onboard memory device and used to attempt active control by gimballing the motor. The avionics package then connects wirelessly to a base station to relay it's GPS location.

Original and Delivered Scope

The initial scope of the project was to enable the avionics package to broadcast sensor measurements and GPS location over a wireless channel. It also needed to record sensor measurements and use them to gimbal the rocket motor and actively control the flight. The delivered avionics package only falters on the active control which is implemented but as yet untested in a real launch scenario.

Original and Actual Schedule

The original schedule as laid out in part 5.1 of the architecture document aimed to have the minimum viable product completed by the fifteenth of June 2018 and the final prototype ready to fly by the third September 2018. The minimum viable product was completed to schedule, however, as of the writing of this document the final launch has not occurred. This is due to unforeseen delays due to last minute changes that pushed back the new revision of the hardware and several bugs that needed working out. The control system also took longer than expected to tune but at this point, it is believed to be ready for a test flight.

Delivered Expenditure

The original budget as of 07/06/2018 was 389.24 NZD. The breakdown of which included 54.62 NZD to reach the MVP deliverables and 181.04 NZD to purchase backups of existing parts in case of emergency and 153.58 NZD to purchase the parts needed for the final design. The final expenditure is 211.38 NZD, this is because several of the contingency items were not required for the final prototype. There were several components not considered in the initial budget but they were covered by the contingency budget. There was a last minute cost of $158.12 NZD for replacement servos as there was a fault and the original servos used are no longer manufactured.

Project Self-Assessment

The avionics package prototype delivered meets most of the initial scope of the project and adds bonus functionality for future development. An ignition system was added with the aim of allowing the avionics package to ignite the motors and ejection charges for parachutes. Breakouts for both SPI and I2C buses have been added for easier development in the future. The code base has also been improved to operate within separate states which makes the system not only more reliable but also safer as it is less likely to trigger control before it has fully initialized.

Unfortunately, the control system has not yet been tested and further tuned but this is the largest flaw as far as we know.

Lessons Learned Summary

During the project, the team has learnt the importance of documentation and as a result, the documentation has become much more valuable as the project has gone on. This has put the team in a good position to hand over the project not only to the client but anyone who may want to continue development. The team has also learnt how to effectively communicate to each other via commenting on issues and through applications such as Mattermost. This in turn has made the team an improved collective entity.

Procurement Summary

During ENGR301 the only components procured were an MPU-9250 IMU, RFM9X LoRa Radio Unit, and new Teensy 3.6 due to the original one breaking. This Teensy was procured from the Victoria University ECS technicians.

Items procured during the ENGR302 are listed in the bill of materials (BOM) documents on GitLab within the 2018_Avionics_Project folder. The two major suppliers used for procurement are Element14 and Digi-Key.

Transition Plan

A meeting is required with the client to go through the user manual, covering the setup and initialization of the avionics package for a launch. This will ensure the client is prepared to take on the project in its current state and is up to date and able to continue development at his own discretion.

Future software development requires PlatformIO or a similar embedded development system to program the onboard microcontroller. For future development of the hardware, KiCAD is also needed to open or edit the PCB files. Similarly, OnShape is needed to open and edit the 3D designs of the rockets used for testing. All software tools used are open source and free to use.

All documentation required is available on GitLab and should be handed over to anyone wanting to continue development. The User Manual provides a high-level breakdown of the use of the avionics package for anyone wanting to use the prototype while the Technical Manual covers the specifications of each section of the package.

Assumptions

It is assumed that the client has a basic understanding of embedded development and is experienced in the launching of model rockets.

It is assumed that the printed circuit board has already been populated with components and component placement information is not required.

The user has an understanding of CAA regulations governing model rocket launches.

Work Required

A meeting with the client must be planned with the majority of team members present to allow any questions to be properly answered. The purpose of the meeting is to familiarise the client with the setup, use and further development of the avionics package.

Schedule

A meeting is scheduled with the client for 19 October 2018 to assist in transitioning the project to the client. All documentation, research, hardware and the code base will be handed over to the client during this meeting.