IRISHSAT

Senior Design Project Proposal

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Introduction

NASA’s CubeSat Launch Initiative (CLSI)

- Provides opportunities for CubeSats built by U.S. universities, high schools and non-profit organizations to fly on upcoming launches
- Ultimate goal of IrishSat is to launch a CubeSat through this initiative
- Currently writing the proposal and working on various projects to prepare our subsystems and collect the background knowledge needed
- The ProtoSat project is to design and implement a prototype CubeSat

Problem Description

CubeSats live 3 years, but components and subsystems are expected to start experiencing significant failures in as early as 6 months

- Faulty sensor data causes subsystem misoperation
- Data transmission will waste space on invalid data
- No system for recovery

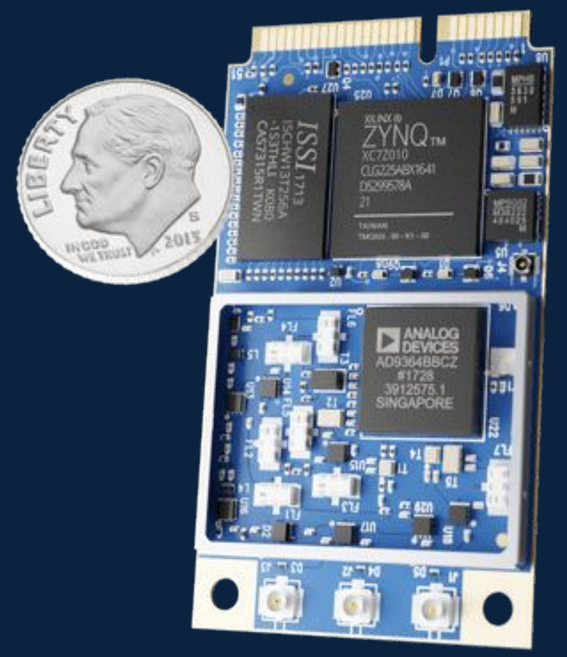
IrishSat has acquired an SDR for data transmission, but has no subsystem to interface with it

- Data must be selected, packetized, and sent to the SDR
- Incoming transmissions must be processed and sent to the flight computer

Proposed Solution

A subsystem utilizing an ESP32 for monitoring, controlling, and transmitting sensor data

- Interface with flight computer, a Pi microprocessor with associated RAM and necessary peripherals
  - Notify of sensor malfunction
  - Receive transmission messages to send to SDR
  - Relay necessary incoming transmissions
- Monitor and control all sensors
  - Read in all sensor data
  - Detect anomalies and notify Pi to adjust subsystems
  - In cause of a faulty sensor, either attempt reboot or shut it off
- Dynamically handle data transmission
  - Interface with the SDR
  - Select sensor data for transmission
  - Packetize sensor data and flight computer messages and send to SDR for transmission



Demonstrated Features

1. Communicate via I2C connection with the flight computer
2. Parse I2C communication between the sensors and the flight computer to extract sensor data
3. Ability to start reboot sequence and cut the power supply of each sensor on the board
4. Monitor software to detect anomalies in sensor data
5. Packet incoming sensor data and send it to the SDR for transmission

Available Technologies

- Sidekiq Z2 SDR (acquired - donated by Epiq Solutions)
- Raspberry Pi Processor (Broadcom BCM2711)
- Sensors
  - IMU
  - Digital Thermometer
  - Magnetorquers
  - Digital Barometer
  - Surface mount components (resistors, capacitors, etc.)

Sensor selection will be a joint effort to ensure capabilities the ProtoSat team requires are met. Network design and biasing as well as surface mount component selection will be a solo effort.

Engineering Content

1. PCB design for components and subsystems (sensors, actuators)
2. Bias networks for components (space-efficient)
3. Design and implementation of subsystems to monitor, control, and notify peripheral devices
4. Packetized data preparation and selection for transmission from SDR
5. Interface with flight computer for state notification and adjustment of operation
6. Interface with second PCB designed by ProtoSat team to process actuator data

Conclusion

- Monitoring and controlling sensor data and data transmission alleviates the work needed to be done by the flight computer and adds to the longevity of the prototype CubeSat
- Developing and testing this board will enable the ProtoSat team to continue forward with developing their subsystems
- The PCB is space-efficient, which is key for CubeSats
- Adds legitimacy to NASA proposal
  - Large part of this proposal is that it is used in an educational sense
  - This project will show that our team learned the necessary skills and information about the industry to complete it