TASK HISTORY	TASK TITLE Control System Updates	TASK NUMBER ISS-TH-H003	PROJECT IREC Hybrid
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DATE	MILESTONE	REVIEWER'S INITIALS	
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Purpose

The team required fresh data from the hot fire tests in order to characterize oxidizer flow into the engine. In order to do this, the sensors that have been used for the past few years had to be updated to a separate, centralized, and simple data collection package meant for rapid reuse and easy operation. This allows them to capture pressure and temperature prior to injection (good for verifying operating status) as well as the force produced by the engine, read by a load cell. A time file is also included to understand at what rate data is being collected.

Background

Past tests have not included the data collection system due to inexperience and complexity of data collection. It wasn't too complex, but it was slightly convoluted, including a separate python script, a sensor bridge for the load cell, sensor code embedded in the control code, and the sensors also being integrated into the control box which led to some confusion with wiring. Due to all of this, the sensors were usually just left out of the tests and so we had to gather qualitative data, which has luckily provided us good data.

Results

A sensor suite was created that allows the team to start a separate sensor collection Arduino. This includes:

1. One Arduino Uno
2. One 9V battery (for Arduino and other amplifier boards)
3. One 11.1V Lipo Battery (for the Pressure Transducer)
4. One 200 kg Load Cell and Amplifier Board
5. One K-Type Thermocouple and Amplifier Board
6. One 2000 psig Pressure Transducer

The sensors are situated on a breadboard and are hot glued (low density polyethylene [it isn't conductive dw]) for strength. The wires then feed to the Arduino Uno in the different channels dictated on the Sensors_Code.ino on the Github. There are also various tutorials on both Adafruit and Sparkfun for each of the boards. Their respective part numbers can be found on the faces of the boards.

The Sensors_Code.ino records data at about 10Hz to a microSD card on the breadboard. This is because the sensor suite sits out on the test stand and no one can be out there to turn it on or read the data off a computer screen. It also makes data manipulation relatively easy post-hotfire.

Future Changes

- The board still needs a dedicated on/off switch, as right now the operator has to plug a wire into a breadboard situated in the bunker.

- The code should utilize the SDFat Arduino Library, and not the base SD library due to speed and efficiency. This should allow higher data collection rates.
- Possibly transferring this all to a solder board so that we don't rely on hot glue for the physical connections.
- The Control_Box_Code.ino code would turn on the sensor Arduino so that there is not a separate human doing it.
- More sensors could be added to collect data like thermocouples all over the engine.
- The battery powering the pressure transducer could be smaller, as in not 5000 mAh but more like 1000 mAh.
- Get any of the sensors code in the control box code out so the control box is dedicated to only controlling the valves.

Impact Statement

There is still plenty to make the Sensors_Code.ino a more efficient way to collect data, but it should be good for the next hot fire. It will be especially useful soon as we try to form more CFD models. It will also allow us to finally get calibrated thrust measurements. Hell yeah. Anyway, that's all I got.