Team Analysis Memo

ME476C: Capstone I

Ian Torp will be focused on the programing of the Raspberry Pi. Specifically, he will oversee the required coding it takes to turn the electrical output of each sensor into readable data. For this to be successful, he will be working closely with Rowan McCullough, as Rowan is focusing on calibration math. Each sensor will require its calibration math coded into the Raspberry Pi. Professor Pete has approved this analysis, as this project will require a lot of programming. As there will be a lot of coding in this project, I will also be working alongside Chenxi, as his focus is on the programming of the website and uploading the data from the Raspberry Pi to its database. If more topics were approved and added to my workload, it would likely be more programming of some kind, possibly programing the website with Chenxi to calculate averages and other important factors. Additionally, I would like to be part of the work on uncertainties in our measurements. Calculating uncertainties of our measurements are very important for the sake of validating our data.

Rowan McCullough will focus on calibration math for the sensors. This will include ensuring that the proper equations and relationships for converting raw output of the sensors into readable weather data are used. This will also include calibrating the sensors based on information from the manufacturer to ensure they produce accurate readings and are properly positioned. This will closely relate to the topic chosen by Ian as he will need the Raspberry Pi to properly perform these calculations to read the sensor outputs and upload the data. Professor Pete has approved this topic as it is vital to receive accurate data from sensors. An extension of this topic is the uncertainty analysis which will be required for each set of sensor data and this will be the backup topic. It will be important to know what uncertainties may arise in our data and where they may stem from in order to be prepared to offset them in the future.

Chenxi Dong will focus on programming the project website, uploading sensor data from the Raspberry Pi to a secure and accessible database. Ensure that all environmental data collected by the sensors can be transmitted accurately, efficiently and in real time. I will use programming languages such as Python to write server-side scripts and APIs to handle data transmission, storage and call. In addition, the front end of the website will display visual interfaces such as charts and tables for real-time or historical meteorological data. Due to the key role of this work in the user interface and data access in our weather station system, it has been approved by Professor Pete. At the same time, my work is closely related to Ian's work, and we will work together to solve some problems. As an extension, I may also participate in the design of the website.

Shutong Wang will be responsible for the task of "Electrical Component Design and Verification", which aims to ensure the functional reliability and long-term stability of various electrical modules during project operation. The analysis will focus on component selection, electrical connections, voltage and current calculations, and power system stability assessment, involving core components such as sensors, microcontrollers, power regulator chips, and battery management modules. Based on the datasheets of the components and the actual requirements of the project, I will calculate the operating voltage, current and power consumption, and evaluate the safety margin under different loads and ambient temperatures. Meanwhile, for some power devices, I will use thermal resistance analysis model to estimate their heat generation and design appropriate thermal countermeasures, such as arranging heat sinks, adjusting the position of ventilation holes, or optimizing the arrangement of components, in order to prevent the system from thermal runaway problems. In addition, as an important part of this task, I will also complete the structural design analysis related to the electrical system to ensure that the various components have stable support, reasonable wiring and

protection during the actual installation process. This part of the work will include modeling and strength verification of the circuit board mounting methods, fixing holes, structural supports for power modules and sensors, preliminary stress calculations using simplified mechanical models, and structural layout and dimension optimization using CAD tools. The analysis will take into account the external forces that the components may be subjected to, such as vibration, shock, thermal expansion and contraction, and calculate their safety coefficients to ensure the mechanical reliability of the system during transportation, installation and operation.