1 Introduction

1.1 PROJECT STATEMENT

The ambition of our project is to collect data from sensors related to the operation of a machine and send that data from a Raspberry Pi to a central server over an internet connection. This system will help users monitor the operational status of their machines over time.

1.2 PURPOSE

To be able to compile operation data from various types of machinery to a centralized, accessible format, owners and operators of these tools will be able to better manage their use and maintenance, increasing the lifespan and productivity of their overall operation. This could include small farms with a few pieces of equipment all the way up to a factory with several hundred machines. Our ultimate goal is to create a system that will help both get the most out of their equipment.

1.3 GOALS

Our goals are as follows:

- Create a product that meets the specifications of our sponsor.
- Understand data collection using Raspberry Pi.
- Develop teamwork skills.
- Understand data management on a Linux server.

2 Deliverables

We plan to deliver a working prototype of a data collection and transmission network to collect real world machine data, transmit this data from the machine to and manage this data in a central database. By the end of the spring semester, we are aiming to have a single Internet of Machines-equipped device delivering data to a server equipped with our software, delivering relevant data, as well as any necessary documentation to allow Vermeer to implement any portion of our system.

3 Design

3.1 PREVIOUS WORK/LITERATURE

3.1.1 SALESFORCE

Salesforce is a proprietary solution towards collecting large volumes of arbitrary data and compiling it to a central server in a readable format. It’s marketed towards large businesses with significant data collection needs, making it not scalable to smaller

operations (EG users of commercial products). For this reason, we need our solution to be considerably cheaper and more scalable.

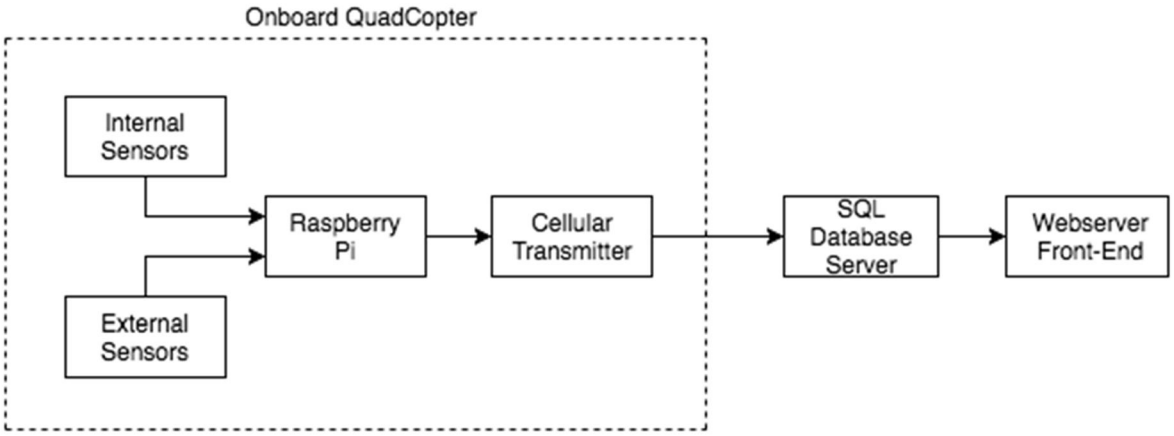
3.1.2 WINDOWS 10 INTERNET OF THINGS CORE

This is a spin of the Windows 10 operating system designed for implementation in “Internet of Things”-type projects. It is designed to be used in smaller “microcontroller” devices such as the Raspberry Pi, and features a suite of software to help connect these smaller components to a primary work station. Ultimately, we decided to not use this particular software on our Raspberry Pi boards due to cost and overhead associated with using the Windows operating system.

3.1.3 HEAVY EQUIPMENT INTERNET OF THINGS

More sophisticated systems measure and track information like engine load, fluid temperatures and pressures, and other operational parameters. Depending on the software, you will receive varying levels of analysis to help you use the data for decision making. Better data and analytics can lead to less downtime by enabling more predictive maintenance, so you only change oil when its physical condition has deteriorated, for example. Predictive maintenance helps owners make repairs only when truly necessary.

3.2 PROPOSED SYSTEM BLOCK DIAGRAM



Sensors that measure the external conditions through which the drone is flying (i.e. temperature, altitude, air pressure, etc.) and sensors measuring internal operations within the drone (i.e. propeller RPM, battery level, etc.) input data to the Raspberry Pi unit. The Raspberry Pi compiles data into packets for transmission, and transmits them over a 3G/4G cellular data connection to the host database server.

The server receives sensor data packets from the drone, through an internet connection, and logs each data point in a database. A light webserver hosts a graphical user interface for retrieving specific data and outputs in useful formats (.csv, .xls) for data processing.

4 Project Requirements/Specifications

4.1 FUNCTIONAL

- The system will have the ability to collect data from sensors
- The system will be able to send sensor data to a Raspberry Pi through a bluetooth signal
- The system will be able to send data from the Raspberry Pi to a server over a cellular connection
- The system will be able to export data from a server to a Excel (.csv, .xls) format

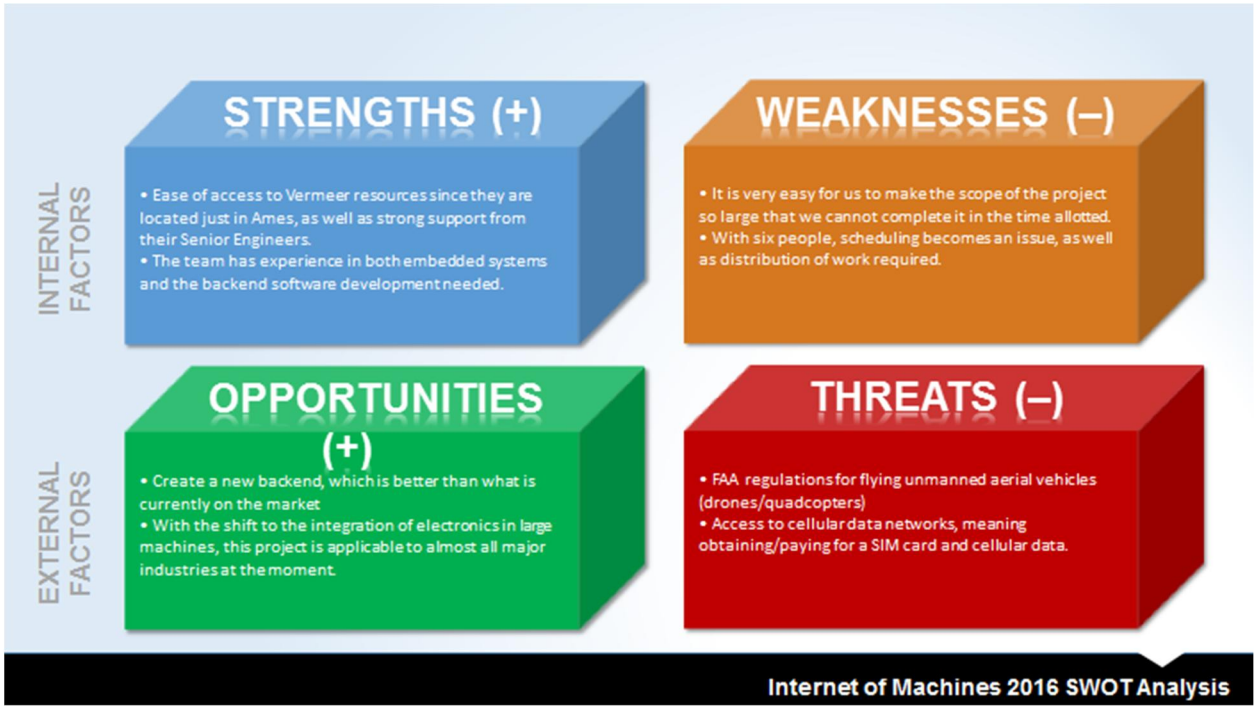
4.2 NON-FUNCTIONAL

- The system shall be portable with its own power supply
- The system shall be expandable to accept various types of sensor data
- The system shall have a sufficient response time between sensor data collection, Raspberry Pi/server transmission/reception, and server upload/download

5 Challenges

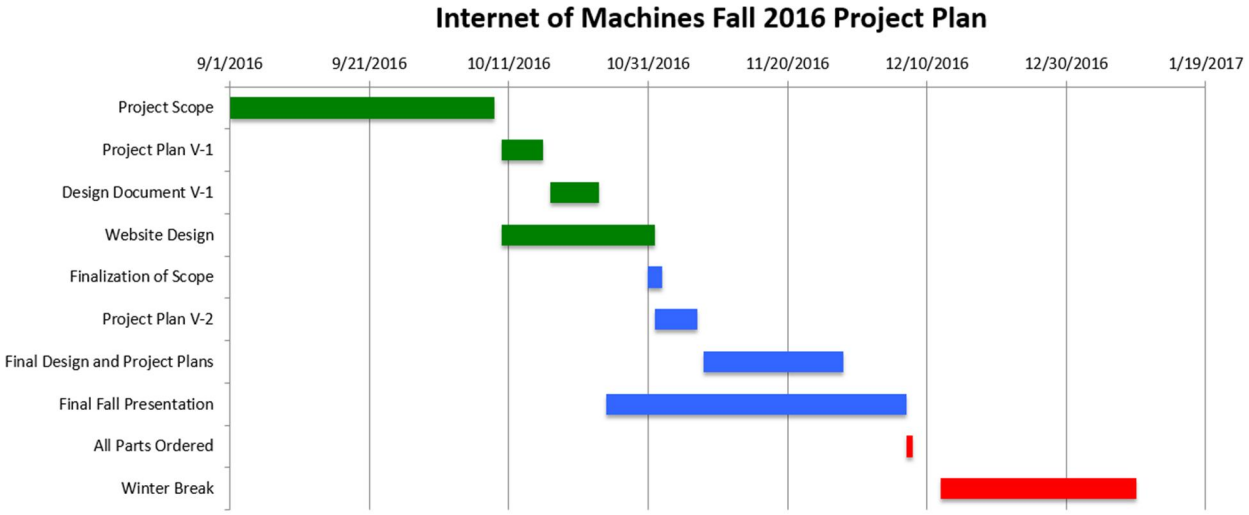
5.1 SWOT Analysis

A SWOT analysis was completed to help identify key areas of strengths, weaknesses, opportunities and threats. Below are the key concepts:

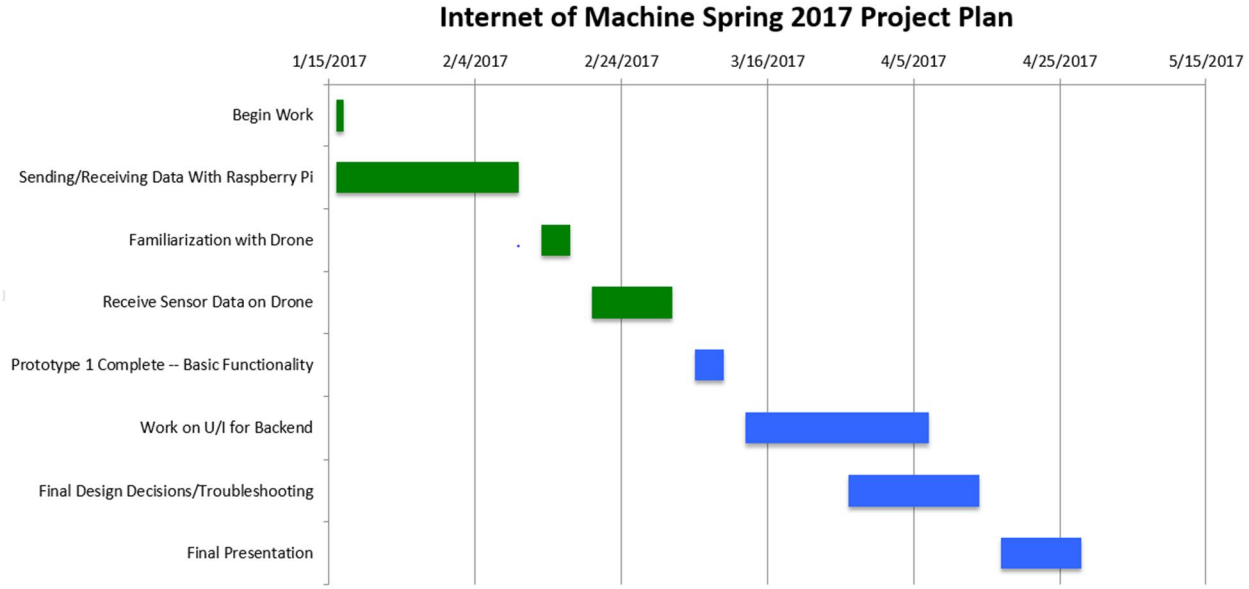


6 Timeline

6.1 FIRST SEMESTER



6.2 SECOND SEMESTER



7 Conclusions

Ultimately our aim is to collect data from sensors related to the operation of a machine and send that data from a Raspberry Pi to a central server over an internet connection. This system will help users monitor the operational status of their machines over time. In being able to compile operation data from various types of machinery to a centralized, accessible format, owners and operators of these tools will be able to better manage their use and maintenance of

the machines, increasing the lifespan and productivity of their overall operation. This could include small farms with a few pieces of equipment all the way up to a factory with several hundred machines. Our ultimate goal is to create a system that will help get the most out of equipment.

8 References

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