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PipeWan

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Team skills analysis

Our project, PipeWan, will likely require proficiency in software development, RF devices, networking, sensors, research, project management, and I/O module wiring. Our team is confident in our development, networking, research, and project management skills. Some key skills we will likely need to develop throughout the course of the project are sensor selection, RF technology implementation, and I/O module configuration.

## Strengths

Every team member is well versed in at least one IDE and some of the advanced features offered in them. Our team can implement programming patterns, use debugging tools, visualize classes with flowcharts, and store data in an SQL database.

The team members each have experience with both Windows and Linux. We also worked with interfaces before and are familiar with them. Aron, Edgar, Moe, and Alex are currently enrolled or have completed the computer networks class. Moe holds a certificate in computer networking as well. Alex has used some I/O modules at work and is decently versed in using them. We also have experience in using sensors connected to computers to read information and display it or react to the information.

We all had to do at least one research-based project throughout our college years. We were taught how to source information and cite them correctly. Almost all of us did a study of how the market works for certain products along with its regulations and standards.

We are all organized and have enough time to work with each other over the week. We decide on each other’s responsibilities and create a schedule for the tasks we need to do. We are all responsive to each other, so this makes tracking and progress visibility easy for us. Reporting and presentation are things we have done several times already, so we are comfortable with this aspect.

Edgar has taken a seminar class where they showed how to solder/de-solder circuit boards. Aron is proficient in soldering. Moe took circuits I, circuits II, and electronic circuits I and so is familiar with breadboards and Multisim software. Aron, Edgar, Moe, and Alex took the Digital Design lab where they had hands on experience wiring a breadboard. Everyone has used a digital voltmeter before and so has at least some basic knowledge of circuits. Aron owns a 3D printer and the whole group will have access to the printers in GoCreate.

## Weaknesses

Aron, Edgar, and Alex are CS students and so have very limited exposure to electrical work. Overall, as a group, we don’t have too much experience with single-board computers. Some of us have used raspberry-pi's but nothing more than that. Moe has taken a class over microprocessors, and he is the only one that has used them in our group. No one in our group has used a microcontroller except for very basic in-class use. Alex and Edgar have used some programmable controllers at work; however, it has not been super extensive.

The most work that any of our group has done with either an actuator, motor, or solenoid, is just wiring them up. However, with past background experience, we believe that we can figure them out. Moe has used an oscilloscope briefly for class, however, besides that no one has used an oscilloscope, however, Alex is interested in using an oscilloscope. No one in the group has used a current probe, frequency analyzer, or spectrum analyzer before. No one in the group has done any point-to-point that is useful for the class. No one in the group has used a perfboard. Edgar is the only member who has used a laser cutter before. No one in our group has designed or manufactured a PCB before, however we do not think we will need to create PCBs for this project. No one in the group has done component level troubleshooting besides physically looking at the hardware and seeing if it has burnt out because of faulty wiring.

# Legal and Ethical analysis

One of the possible legal issues that arises with a system that monitors pipes is monitoring information about people using the pipes. Monitoring pipes uses people’s personal information, such as the amount of water used and when the water was used. Because we are using an Internet of Things device, there is the possibility of using them as a window to access a larger network, such as a building wide network. In many environments, major legal cases can be brought up as a result of such data breaches.

The main ethical issue that comes with this system is privacy, ensuring that data collected about user trends is handled properly and protected from the reach of any potential threats. Misuse of information by landlords/building owners is also an ethical concern for users. Another ethical issue could be the result of the administrator not reporting/fixing the malfunctioning pipes to cause harm for someone.

Milestones

The first major milestone which will put us on track to completing the project is getting full information on the LoRaWan systems already being used by previous students. The next step is to research the hardware that we will use in our system, then we need to complete a bill of materials (BoM). After we have completed our research and BoM, we can then start to get the hardware needed for our system. While we are working on figuring out what hardware we need, we will be creating a test program that has a user interface (UI) and can send notifications via email and possibly text.

After the sensors, nodes, and app are functioning we will have a test unit complete. The test will make sure the product is working according to the specifications so far. Then, we need to make sure our LoRaWan servers and gateways are up and running so we can start using them and can connect our nodes together. This includes making sure the nodes are visible on the server and can send and receive broadcasts. Finally, the computer app will have the node connected and visible for exchanging information with the server (uplink and downlink).

Metrics

For the LoRaWan information we can track our project performance by seeing if we were able to implement the LoRaWan system into our pipe monitoring system and how efficient this was completed. When measuring temperature and flow sensors, we will compare their accuracy, pricing, etc. to other sensors that fit our pipe monitoring system the best.

For our UI we can continually test features and be able to determine their usefulness and add or remove features as the project evolves. The value from our testing unit comes from how accurately we can recreate a pipe in a building as well as the information we retrieve once we begin testing. We can also measure the speed of data transfer between the nodes, server, and gateway. This will make sure the product is reliable in providing real-time information.

Acquisition Schedule

The project architecture will consist of a C# pc application hosted on a remote server, wireless nodes connected to sensors, and a gateway to connect nodes to the server. Late delivery of temperature sensors, the gateway, or the server would delay or even halt project development.

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| --- | --- | --- | --- |
| **Bill of Materials** | | | |
| **Material** | **Price Estimate ($)** | **Order Date** | **Priority** |
| Temperature sensor | 10 | 10-20 | High |
| Mockup materials | 30 | 10-20 | Low |
| Raspberry pi zero w | 10 | 10-20 | Med |
| Raspberry pi accessories | 30 | 10-20 | Med |
| Mounting hardware | 10 | 11-20 | Low |
| Gateway | ? | 12-20 | High |
| Server | 30 | 12-20 | High |
| Development tools | Free | N/A | N/A |
|  | 120 |  | |

Data Configuration Management Plan

For this project, most software development will take place in Microsoft Visual Studio (VS), we have chosen VS because it has a variety of tools built in. And we will keep track of code revisions using GitHub, this is because GitHub is free, widely used, and we have experience using it. GitHub also allows us to have the code stored online. Hardware will be configured and handled mostly in the GoCreate Labs where we have all the tools necessary.

Documentation will be done in Microsoft teams. Teams give us a good platform to easily share files and work collectively on them. All the documents will be stored there safely and be easily accessible by all group members when needed. We will take turns documenting progress and keeping track of what we have done so far and keeping them chronologically ordered in our file depository.

# Software Development Model

# The development model that we are choosing is the iterative model, we have chosen this model because it is simple to implement with a few people. Since we have three main people who will work on software more advanced models are not needed. When we were first deciding which development method to use, we decided to go with the method that best fits us as a group, and that is how we landed on the iterative model.

# Overall First Semester Schedule

|  |  |
| --- | --- |
| **Description** | **Due Date** |
| Research LoRaWan | 9/30 |
| Research hardware (node, sensor, batteries, etc) | 9/30 |
| Research building regulations | 9/30 |
| Research safety considerations | 9/30 |
| Research hardware-software compatibility | 9/30 |
| Analyze crawlspace environment | 9/30 |
| (Syllabus) Midterm: Requirements Review | **10/01** |
| Order sensor and raspberry pi | 10/05 |
| Create node program flowchart | 10/12 |
| (Syllabus) Technical Product Specifications | **10/24** |
| (Syllabus) Block diagram | **10/31** |
| Create node program prototype | 10/20-11/05 |
| Create housing unit for sensors |
| Create testing unit |
| Integration test with hardware and software |
| Integrate hardware and software with Lorawan servers and gateways |
| Program review and iterations |
| Finalize prototype. Essential features and minimal bugs |
| (Syllabus) Work Package, Statement of Work, Work Statement, Product testing | **11/05** |
| (Syllabus) Product Reflection | **11/07** |
| (Syllabus) SPTE conduct, Product Showcase Prep, Open Forum | **11/12** |
| (Syllabus) Product showcase | **12/03** |
| (Syllabus) 2nd Semester Work Statement | **12/10** |