Cellular Pump Control

tacocomfort.com

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PROJECT MOTIVATION:

The mining and agricultural industries use pumps for irrigation and water removal respectively. Easy access is not always possible since the pumps are often located far from the base of operations. The operators have to either drive out into a field or travel deep into a mine to switch the pumps on and off and sometimes just to check if the pump is operating properly. If a pump was to malfunction then fields could flood destroying a farmer's crops. In the case of mining it is very important that water levels are monitored and controlled since flooded mines can result in loss of life. To better ensure the safety of their employees and to protect their operations, customers want a solution that will allow them to control and monitor their pumps remotely. There is currently no solution on the market that allows wireless long-range communication to an industrial grade water pump. Taco Comfort Solutions, Inc. hopes to be the first to put a product on the market that will satisfy their customer's requests and hopefully their competitor's customers as well.

ANTICIPATED BEST OUTCOME:

We are expecting to have a working prototype of our design soon. Minimally, we hope to have a functional proof of concept for Taco to develop and to produce. Our goal is to exceed our minimal goal. We are aiming to lay the foundation for a marketable product that the company can continue developing and begin selling by summer 2018. A large portion of this project involves the building of infrastructure which lies outside of the scope of this project. We plan to have a final design for this infrastructure. These are the best possible outcomes. Our team has the skills and passion required to complete this daunting task.

IMPLICATIONS FOR COMPANY AND INDUSTRY:

Upon the successful completion of this project, Taco will be the first company to provide an industrial grade internet of things device that is capable of controlling pumps used for agriculture and mining. Taco aims to provide a platform that will provide their clients with detailed information about their pumps. With this system, customers will be notified of any potential problems with their pump. Detecting potential issues and preemptively shipping replacement parts to the owner to eliminate costly down time. This will push the mining industry forward and save time for farmers that would be wasted managing their pumps manually.

PROJECT OUTCOME:

The Anticipated Best Outcome was achieved: remote and wireless long-range communication to monitor and control industrial grade water pumps.

KEY ACCOMPLISHMENTS:

Power Creation of Prototype: We were successful in creating a prototype pump controller which could be powered by 480, 277, 240, 208, or 120 Volts AC which is present with most standard TACO pumps, communicate remotely via Verizon cellular modem through a web app with any pump with a variable frequency drive through our controller.

UL Listed: We sourced exclusively UL listed components. The process to obtain UL Listing is costly and time consuming. By using only previously UL Listed components, we have negated the time and cost in favor of a design that is inherently UL Listed.

FCC Compliant: All of our communications components were prefabricated and meet FCC requirements as designed. By only using components which already meet FCC Guidelines we have created a design that meets FCC requirements without the need to test compliance.

Safety: All major metallic parts are grounded through the attached power cord and plug. There are three individual fuses integrated into the design. One for each voltage level: 120 V AC. 24 Volts AC, and 24 volts DC are each separately protected by a dedicated fuse. This provides safety at each of the voltage levels present within our design.

Mobile Application: The parameters for the mobile application were changed several times, underwent many iterations and were not fully finished. We were successful in creating a prototype which can connect to the controller and has basic functionality.

Communication: We implemented a cellular connection to allow the controller to access the internet from any location where a Verizon signal can be received.

Interface: We created an interface through our mobile app to allow user interaction with the pump controller anywhere their device is connected to the internet.

IP66 Rating: We used a polycarbonate watertight enclosure as well as a watertight cellular antenna. Both of these components give our design an IP66 rating. An IP66 Rating means that our design, in addition to being protected from dust and environmental contaminants, is protected from *"Powerful water jets: Water projected in powerful jets (12.5 mm nozzle) against the enclosure from any direction shall have no harmful effects."*

Ease of Access: Our "Consumer First" design was created with easy access, installation and maintenance in mind.

Sensors: Our sensor connections are adaptable so that the user can modify it to only the sensors desired. Sensor data is fed from the controller to the user.

App Functionality: Our app provides a *Remote Power Control and Status of the Pump* from the mobile app.

AWS Backend: We used AWS to provide all the backend tools necessary to keep these devices connected.

Bill of Materials: We created a complete bill of materials listing quantity, cost, supplier, and vendor contact information for all of the components which we selected to be used in our project.

Fig 1: The mobile app displaying a sensor reading and button to turn the pump on/off.

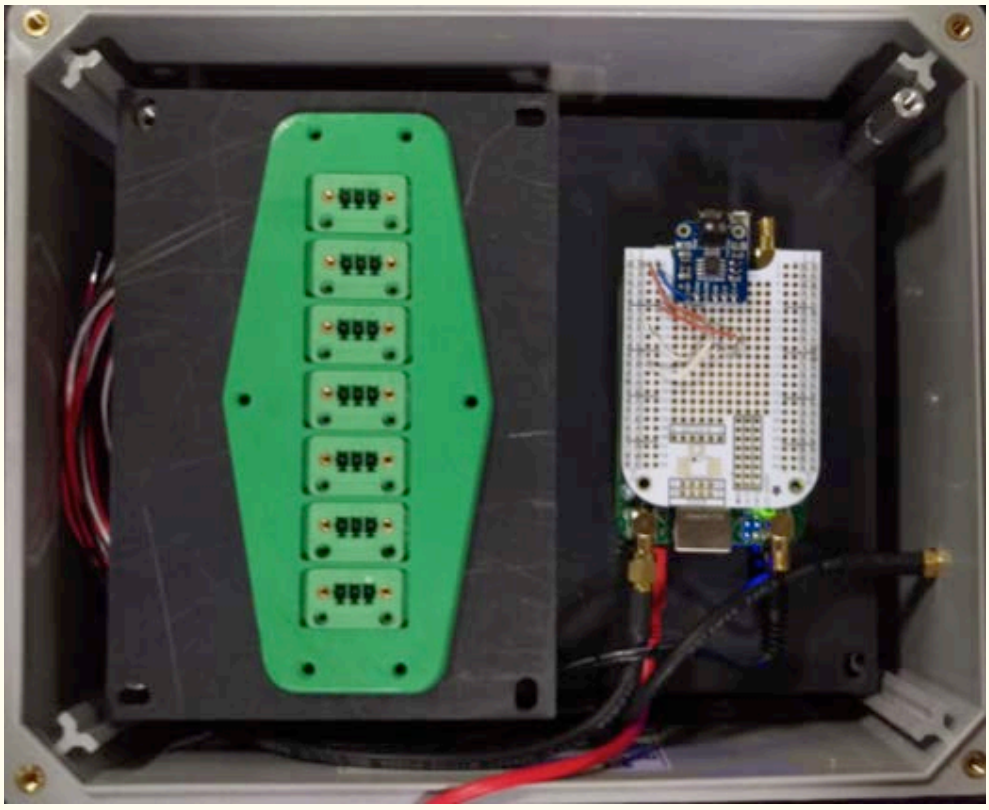

Fig 2: The top level of our enclosure, including microcontroller and terminal blocks for sensors to be mounted.

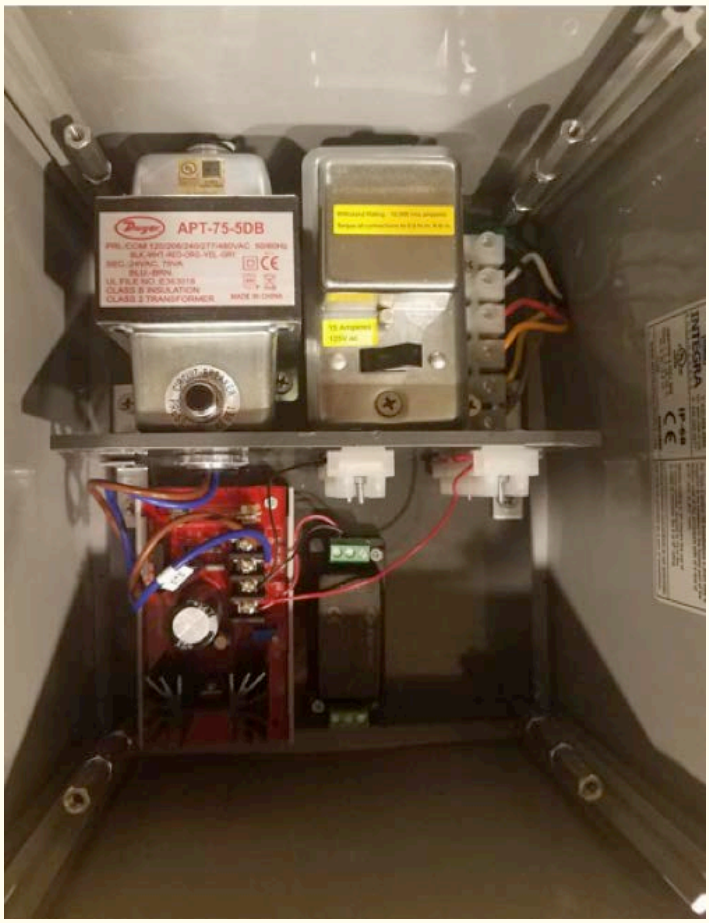

Fig 3: The lower level of our enclosure where the voltage conversion and power supply circuitry is located.

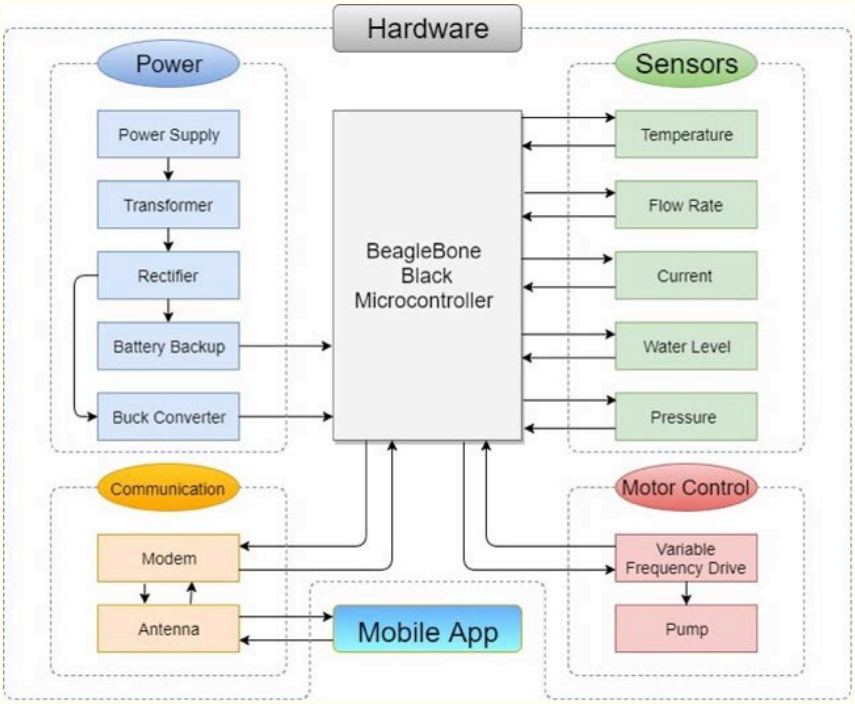

Fig 4: Our block diagram showing how each of the different components are interconnected.