Portable DAQ for Dogs

PROJECT PLAN

Team 15

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Table of Contents

List of Figures

List of Tables

List of Definitions

DAQ: Data Acquisition

1 Introduction

1.1 ACKNOWLEDGEMENT

Our client, Simon Laflamme, as well as Austin Downey will be our main sources of technical knowledge and funding for this project. Having vast background knowledge on the project and past experience, their input will be vital to the success of this project.

1.2 PROBLEM AND PROJECT STATEMENT

Our client is currently developing a biosensor that can be used on live animals to detect strain data on skin. The specific location where the sensor will be placed is on stitches made on dogs. This will allow vets and medical personnel to be able to collect data regarding movements made by the dog and the resulting effect on the stitches.

Our task for this project is develop a data acquisition system that will be able to take the input from the sensor, convert and display the data so that is can be used by vets. Since the sensor will be on the dog, another important aspect of our project is to make our DAQ small enough to also be placed on the dog without causing discomfort. Another goal for this project, is to build an app that can display the data for the purpose of providing a user friendly interface for vets to be able to manage the data.

The final goal of this project is to help our client to understand the variations of strain applied on the dog's skin in order to help veterinarians design and perform better surgeries on these animals. This could help dogs to have a faster recovery time and possible decrease the costs of post-surgery maintenance.

1.3 OPERATIONAL ENVIRONMENT

Our DAQ has the versatility to be used with any wired resistance sensor, however for our purpose it will be placed on a dog. For this reason, it will need to be very sturdy. As most pets are very active and reckless at times, we will need to build a case of some sort to house our DAQ to keep the components safe. We were also told by our client that our dog would most likely be wearing a safety cone as well as a harness. This makes our job a little bit simpler as we have a location to store it as well as being able to avoid the dog's mouth from damaging our device. Another feature that we it needs to have it to be able to be resistant against the outdoor environments, such as been able to resist to water and dust.

1.4 INTENDED USERS AND USES

The intended users of this project will mainly be veterinarians and our client. The data that we will be recording is the effects of various kinds of movement on stitches. This can be used for medical research on stitches as well as administering more effective stitches.

Our DAQ will have specific use, which is to be operated in dogs to collect data from the strain sensor throughout the day. However, it could be adapted to be use in different environments if the sensor is changed and the program calibrated.

1.5 Assumptions and Limitations

List of assumptions:

- The product will only be used by our client
- The sensor will be provided by the client
- The DAQ only has to collect resistance data from one sensor

List of limitations:

- The overall size and weight must be minimal to not discomfort the dog
- We have been provided a $200 budget for this project.
- The device should have a personalized app
- The DAQ has to have a 16 bit ADC
- Minimum clock speed of 100Hz
- The range of resistance error should be 20%.

1.6 Expected End Product and Deliverables

Spring 2018:

DAQ

- Working model on Arduino provided by client:
  - Be able to collect data from sensor.
  - Filter the data.
- Possible second smaller design:
  - Work the same as the first prototype, but smaller design.

DAQ App

- Computer App:
  - User have a safe and reliable way to store and access data.
  - Display Data with different plot options.
  - Warning notification: resistance data is high(damage to stitches)

Fall 2018:

DAQ

- Third and final design:
  - Printed circuit board for the last design.

- ○ Extra features: on off button, micro Sd card, battery life display, wireless communication(possibly).

DAQ App

- ● Computer app:
  - ○ Personalize the features to the user liking.
- ● Mobile app:
  - ○ Develop a mobile app with similar features of the computer app and possible have wireless communication with our DAQ.

2. Specifications and Analysis

2.1 PROPOSED DESIGN

Our group decided to solve the problem by designing a DAQ that can read and store data from the sensor as well as designing an app to let the user manipulate and visualize the data.

The DAQ will be base on the Arduino microcontroller, which is a open source. Our design will use the same microchip use on arduino(Atmega328), however our device will only have the minimum components necessary for the DAQ to perform all the required tasks. For the data storage, we are going to use a microSd card, which is a convenient way for the user to save data. One more feature we are going to implement is a wireless module which will be able to send alerts to the user.

The app will be consisted of a website which will be connected to a database in which the user will be able to store the data. The online app will serve as a interface in which the user can also manipulate and plot the data for analysis. A mobile app will also be created, besides giving more versatility to the user, it will also serve as a way for the DAQ wirelessly alert the user of high strain values on the sensor, which can indicate problems which the stitches.

2.2 DESIGN ANALYSIS

First Stage: Hardware provided by the client: strain sensor, arduino uno, platform to test the sensor, Sd card and Sd shield. The first stage of our project is to make sure we have the arduino collecting data and storing it into the SD card. We decided to use MatLAB as our coding interface to program the arduino, because we thought the program would provide easier visualization of the blocks and more versatility with data analysis. After starting working with MatLab we were able to make progress, however we realized that there were not a lot of documentation online for us to study. Which made us decide to take a couple of steps back and use the arduino IDE.
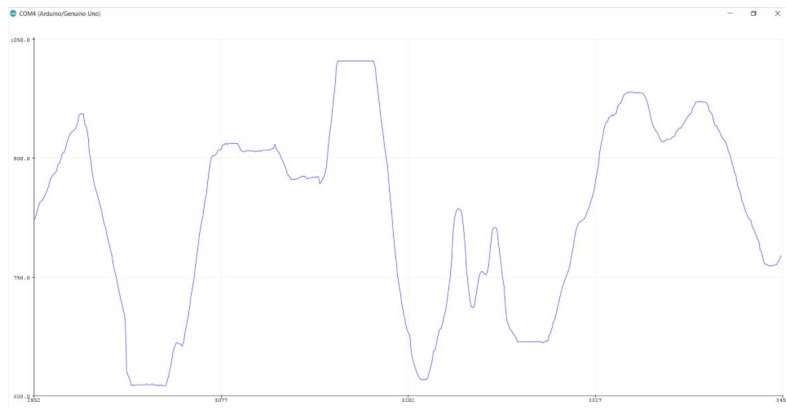
Figure 1. Design 1

Figure 2. Data Design 1

Second Stage: Once we got the first design to work, we started looking into how to make our device small. We listed all the requirements of our client and we started looking for components for our DAQ, however we realized that a smarter solution is to use microprocessors available in the market to control our circuit. These microprocessors have various functions built in, which we are not going to use and might be an overkill of resources, however they are low coast and we can easily meet all the requirements for the project. The only possible risk is that by using premade components we might not be able to make the device as small as our client desires. At this stage we would also be working on the online app in which the user will be able to access and analyse the data by logging with his account.
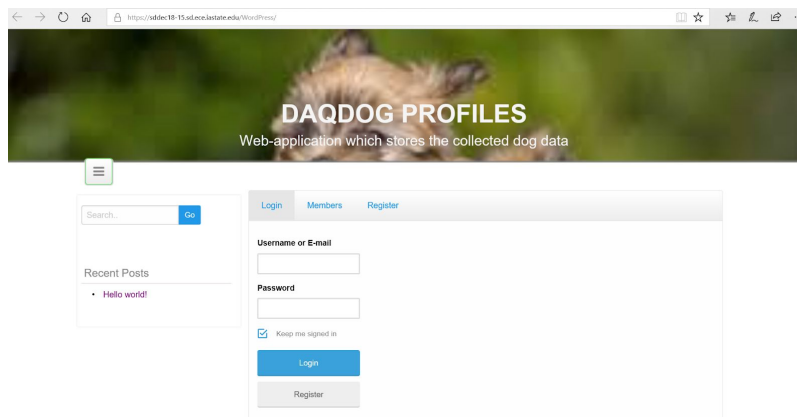
Figure 3. Design 2

Figure 4. Design 1 Online App

Third Stage: Once we have the smaller circuit working are planning on improving the previous prototype by adding more features such as wireless communication and possible decreasing it's size. At this stage we would like to improve the online app by personalising it to the user as well as start working on the mobile app.

3   Testing and Implementation

3.1 Interface Specifications

1. Multimeter
2. Oscilloscope
3. Moving stretching platform
4. Dynamic stretching platform
5. Plotting Software

3.2   Hardware and software

Hardware:

- Multimeter: we are going to use the multimeter to measure voltages and currents in our circuit to make sure we are within the safe and recommended limits.
- Oscilloscope: we are going to use the oscilloscope to observe the data in the computer while testing the accuracy of our device readings.
- Slow stretching platform: we are going to use the platform to profile and calibrate the sensors.
- Dynamic stretching platform: we are going to use this second platform to better simulate the strain vs time real use environment.

Software:

- Plotting software: we are going to use a software to plot the data in order to analyse and calibrate the device according to our sensor.

3.3   Functional Testing

As mentioned, our device must: record data with a error percentage of 20%;sample with a sampling frequency of 100Hz; be small(around 1 inch^2); light enough not to cause discomfort on dogs. Our app must be able to plot the data and secure it by giving access to the proper user.

3.4   Non-Functional Testing

This will be tested the second semester. Our plan is to build a dynamic testing platform to make sure the data is consistent. If possible, a live specimen of the dog will be provided by the vet department so we can do some tests and calibration.

3.5   Process

Our project will be divided into 3 design prototypes. To make sure we successfully complete the project, the prototypes need to meet the following requirements:

Prototype 1: Read data from analog input and store in SD card.

- No resting is going to be required in this phase

Prototype 2: The Device should be a smaller version of the first prototype, it should record data within 20% error, it should power efficient. In order to confirm the functionality of our decide the following tests will be performed in this order:

1. Multimeter: Check all voltages and currents are within the safe and recommended limits of our circuit. This step is essential, because we don't want to have any of our components burned and changed during our resting phase.
2. Static testing platform: Profile the sensor resistance behavior due to strain. We are going to plot resistance vs strain on excel by recording various different point on the multimeter in order to find a mathematical relationship.
3. Oscilloscope: Once we profile the sensor behavior, we will be able to test the accuracy of the collect data by hooking the oscilloscope to our sensor while our device is in use. The data should be with in 20% error compared to the oscilloscope values.
4. Dynamic platform: In the end we would like to perform a dynamic stretching test by using a platform that we would build. This test has the purpose of making sure our device can still record accurate data when high changes of strain values are applied on our sensor.
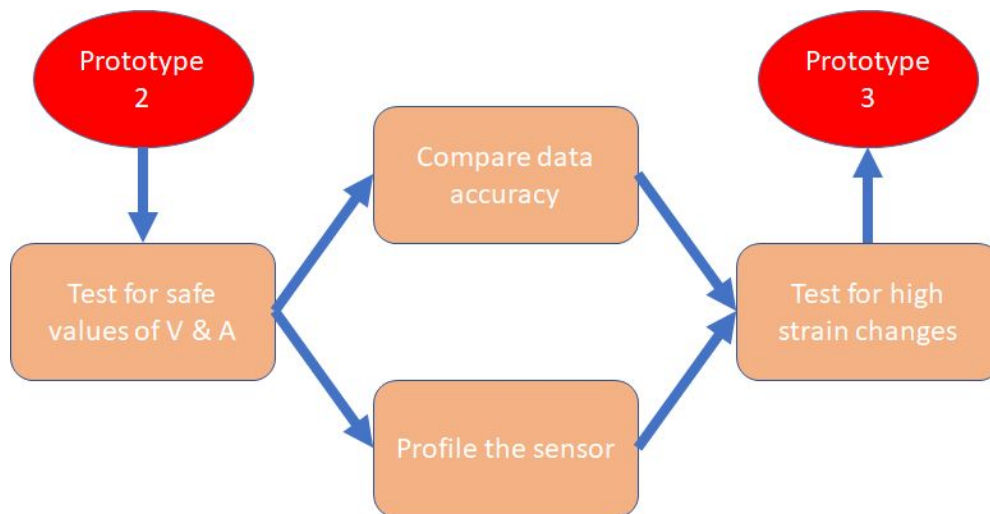
Prototype 3:

- In progress

Figure 5. Test prototype 2

3.6   RESULTS

Phase One:

Arduino: We were able to set up MatLab to program our design 1 to output and input data. However, took a step back and decided to use Arduino IDE because of more documentation available.We use the design 1 of our device to read data and store it into the SD card. We can also display the data on the arduino IDE.

Phase two:

Titanium-dioxide sensor: Tests were conducted my using the sensor which was attached to the moving platform and the resistance values followed a linear relationship with the strain

applied, however because the sensor it is a prototype itself, de decided not to calibrate our DAQ yet.

Smaller device: We were able to size down our device on a scale of 1:4 by using the same microchip on the arduino with connected with the minimum components to make it function.

Online App: The design 1 of the webpage is ready and we are editing its functions.

Phase Three:

Last device design: In progress.

Finalized online App:In progress.

Mobile App:In progress.

4 Closing Material

4.1 CONCLUSION

So far we have tested our device and have collected data in an ideal as well as a non-idea l(external disturbance) based environment. Our device needs to be keeping accuracy in case of external disturbances and to do so it must detect such conditions. Once these conditions are detected the data collected for that period would be termed as "corrupt" data and it would not be used in data analysis. Alternatively, we could have included every value collected by our device in our computations but we observed a very high fluctuation which would not give us accurate results. Thus we chose to go with the method involving cutting out bad data.

Summarize the work you have done so far. Briefly reiterate your goals. Then, re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested.

4.2 REFERENCES

This will likely be different than in project plan, since these will be technical references versus related work / market survey references. Do professional citation style(ex. IEEE).
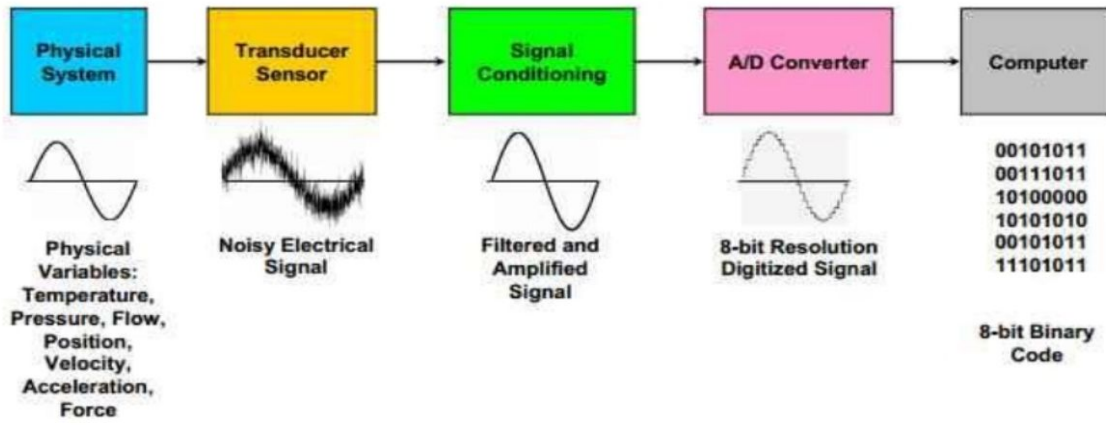
4.3 APPENDICES

Figure 1. DAQ Module