

Portable DAQ for Dogs

PROJECT PLAN

Team 15

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List of Symbols

N/A

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DAQ: Data Acquisition

1 Introductory Material

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 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 it 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.

1.3 OPERATING 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. However, another important feature that we need to consider is to make a waterproof casing, because the device might be exposed to rain or the pet might jump into a pool.

1.4 INTENDED USERS AND INTENDED USES (TWO PARAGRAPH +)

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. This is the main purpose of our project, but there can also be other uses since our final product will be so versatile.

Since we are building a portable DAQ with the capability to take in data from a resistance sensor, this can be used by anyone that is working with a resistance sensor. Our DAQ is also a small and lightweight DAQ making it a better option for users than a bigger and bulkier one.

1.5 ASSUMPTIONS AND LIMITATIONS

Assumptions

1. Our client has told us that any sensor needed will be provided and that we do not need to develop anything besides the DAQ
2. We are only reading data from one sensor

Limitations

1. The overall size and weight must be minimal to not discomfort the dog
2. We have been provided a \$200 budget for this project.
3. Measurement precision must be within %20 error of the reading
4. Need a 16 bit reading precision.

1.6 EXPECTED END PRODUCT AND OTHER 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 Proposed Approach and Statement of Work

2.1 OBJECTIVE OF THE TASK

Through this project we propose to have a functioning DAQ system which is able to collect the stress exerted on the stitches which would be there on dogs. Our system would be a portable data collecting device capable of storing the stitch-stress data on the storage device of a circuit board. Overtime as the dog wound begins to heal we would expect the stress on the wound to reduce. Otherwise, our system would detect anything unexpected and alert the owner. In addition, we would be collecting data which would be used in understanding the how the stitch stress affects the healing process and whether there can be any changes made in the tightness of the stitch while stitching dog wounds.

2.2 FUNCTIONAL REQUIREMENTS

- 1) Data acquisition and parsing to circuit board
- 2) Data storing
- 3) Computations on the acquired data
- 4) Parsing data/computed data from circuit board to a computer server
- 5) Making an application using server data
- 6) Application for non-technical audiences

2.3 CONSTRAINTS CONSIDERATIONS

Our client has mentioned the following restraints -:

- 1) We need to be collecting data using USB or an SD card
- 2) The resistance data can have an error upto 20%
- 3) Our data should be collected with a frequency of 100Hz
- 4) Each data segment which is collected should be 16bits
- 5) There needs to be ON/OFF measures
- 6) It should be small and light to attach to a dog collar.

2.4 PREVIOUS WORK AND LITERATURE

We could not find a product which is similar to the design our client expects us to make. However, in the market there are many DAQ systems which serve different purposes. Fundamentally, we would collect data and do computations as per our client's instructions. The design of the DAQ system is also going to be original. In the market there are DAQ systems for collecting soil humidity, water temperature etc. We would be studying the designs of these DAQ systems to get an understanding of the data acquisition processes deployed in this system. Secondly, we would be making the raw data which is collected readable after performing calculations on it. This would be presented in the form of an application. There exist many applications which similarly perform tasks as the one we propose to have.

2.5 PROPOSED DESIGN

Our ultimate purpose of this project is to make small, lightweight, and low-cost data acquisition system. DAQ system is composed of a programmable microcontroller which is easily programmed based on Arduino. We are planning on built a circuit similar to what it is commonly called “bareduino”, which is a circuit board that uses the same microchip as arduino uno(ATmega328),but it has the minimum components to make it functional. We are going to use “LabVIEW” for the data acquisition because it can be used for personal computer-based data acquisition device in various ways depending on user’s experiment objectives. We are measuring tightness of the stitch while stitching dog wounds. When we receive signals from the sensor, the tightness is recorded in numerical values. We need an A/D converter(ADC) which converts analog to digital. For ADC, we will probably use the 10 bit precision adc built in the ATmega328 which can be configured to increase its resolution to 16-bit. This is our approximate process for the project, but it will be modified and improved by frequent meetings with our teammates and clients.

2.6 TECHNOLOGY CONSIDERATIONS

Another possible discussed highly specialized design was to find each component that meets the minimum requirements of our client and put it together into a fabricated board. However the design which used the arduino as base for our circuit is more practical and it can still meet the requirements of our client.

The DAQ we will make is a miniature and low-cost. The system maintains maximum flexibility while remaining as small and lightweight as possible. But, as it is made in small size, it is easy to be broken by active dog’s movements. Therefore, we will need to build a casing which can protect the electronics parts of the device from anytype of damage.

2.7 SAFETY CONSIDERATIONS

As this is an electronic device, we should concern about electric shock. The purpose of our project is caring dog’s health care, therefore we should put a strong emphasis on dog’s safety. We need to make sure that the electronic of the device do not interact with the dog in a harmful way. Our device will not produce high amounts of voltage or have high amounts of power dissipation, which will make significantly difficult to influence the dog’s health overall.

project. Within the semester some goals we have are to, understand the sensor, learn how to program the arduino, be able to collect data from the sensor using the arduino, filter the data, and to display the data. While these steps seem simple, it will take our team some time to get through each of these steps.

For the Fall semester our goal is to have our product on a board that we designed which will be lightweight and portable. We would also like to having a finished app which will somehow be able to connect to the DAQ. Assuming we have a working prototype going into the fall semester, some goals we have are to design a circuit board to our specifications, be able to transfer all our work onto this new board, run tests to make sure it meets all the requirements, finalize our app as well as its purpose for our project.

2.11 PROJECT TRACKING PROCEDURES

We have created a basic timeline, posted in 3.1, that we will follow throughout the semester. We have also set-up weekly meetings as a group and bi-weekly meetings with our client to notify him of our progress. These measures will ensure that we stay on track or at least are aware of our progress of the overall project.

2.12 EXPECTED RESULTS AND VALIDATION

Our desired outcome is to have a DAQ built on our own printed circuit board that meets all the requirements provided by the client. We also want to have a working app that will be able to communicate with the DAQ.

To test that our product will work on a high level, we can simply use a machine provided by the client that can vary the resistance of the sensor based on user input.

2.13 TEST PLAN

Our plan is to design a platform that mimics the rate of stress and strain of the dog's skin so we can test our final design. Given that we do not have easy access to live specimens of dogs neither a the knowledge to properly attach the sensor on the animal.

3 Project Timeline, Estimated Resources, and Challenges

3.1 PROJECT TIMELINE

| First Semester | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 |
|----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|
| 1-Microcontroller | | | | | | | | | | | | | | |
| Initial research | | ■ | ■ | | | | | | | | | | | |
| Initial test | | | | ■ | ■ | | | | | | | | | |
| Research desing 2 | | | | | | | | | ■ | ■ | ■ | | | |
| Plan design 2 | | | | | | | | | | | ■ | ■ | ■ | |
| Build and test desing 2 | | | | | | | | | | | | ■ | ■ | ■ |
| Final test for design 2 | | | | | | | | | | | | | | ■ |
| 2-Sensor | | | | | | | | | | | | | | |
| Get familiar with hardware | | ■ | | | | | | | | | | | | |
| Initial Test | | | ■ | | | | | | | | | | | |
| Research ways to test senor | | | | | | | ■ | ■ | | | | | | |
| 3-Data Collection | | | | | | | | | | | | | | |
| First test | | | | | | ■ | ■ | | | | | | | |
| Filter & calibrate data design 1 | | | | | | | | | | | ■ | ■ | ■ | |
| Filter & calibrate data design 2 | | | | | | | | | | | | | ■ | ■ |
| 4-App & Data base | | | | | | | | | | | | | | |
| Set up website & data base | | | | | | | ■ | ■ | | | | | | |
| Personalize it for user | | | | | | | | | ■ | ■ | | | | |
| Manage data | | | | | | | | | | | ■ | ■ | | |

Table 1. Overview of the semester 1 plan

| Second Semester | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 |
|----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|
| 1-Microcontroller | | | | | | | | | | | | | | |
| Research design 3 | | ■ | ■ | | | | | | | | | | | |
| Assemble & test design 3 | | | | ■ | ■ | | | | | | | | | |
| Decide final features | | | | | | ■ | ■ | | | | | | | |
| Add final features | | | | | | | ■ | ■ | ■ | ■ | | | | |
| Design case | | | | | | | | | | ■ | ■ | ■ | | |
| Design water proof case | | | | | | | | | | | ■ | ■ | ■ | |
| Final project test | | | | | | | | | | | | | ■ | ■ |
| 2-Sensor | | | | | | | | | | | | | | |
| Built harware to test sensor | | | ■ | ■ | | | | | | | | | | |
| 3-Data Collection | | | | | | | | | | | | | | |
| Filter & calibrate data design 3 | | | | | | ■ | | | | | | | | |
| Filter & calibrate data final 3 | | | | | | | | | | | | | ■ | ■ |
| 4-App & Data base | | | | | | | | | | | | | | |
| Start mobile phone App | | ■ | ■ | ■ | | | | | | | | | | |
| Personalize mobile App | | | | | | | ■ | ■ | ■ | | | | | |
| Personalize computer App | | | | | | | | | | | | | | |
| Final Apps test | | | | | | | | | | | | | ■ | ■ |

Table 2. Overview of semester 2 plan.

Our project has 4 major components: The microcontroller, the sensor, data collection, the computer and mobile application. Our group decided to approach the project by dividing it into 3 phases with 3 designs which are improved upon the previous one.

Design 1:

1. Design thinking and brainstorming ideas.

2. Obtain Basic understanding of the different parts of the project.
3. Build a initial prototype.
4. Set up the web data-base.
5. Create a online computer app.
6. Reflect on the initial prototype and make improvements on the last model

Design 2:

1. Design a smaller microcontroller.
2. Built and test it.
3. Personalize the computer app.
4. Find a battery to suit our needs.

Design 3:

1. Possibly implement wireless module to send warnings to the user.
2. Design a mobile app.
3. Design and print our own circuit board.
4. Arrange the circuit in a neat way and design a protective casing.
5. Design a dynamic way of testing the final product.

3.2 FEASIBILITY ASSESSMENT

We believe that this project is perfectly within reason for this time frame. Given that we have all the resources to test our project currently the success of this project relies on the amount of time spent on the project as well as learning the required material.

We already have an Arduino with built-in data storage, access to software to program the arduino as well as a sensor similar to the final product. We are beginning the testing phase of the arduino given to us to understand more about the hardware and software aspect of this project. With the reasonable timeline we have built, we believe this project can be completed. However, that are a lot of features that we have been discussion on adding to our final design, we plan on implementing as many as we can considering our time and skills limitation. For example, one of ideal features is to send the data wirelessly into our database and have a real time feedback system connected to the users mobile app.

3.3 PERSONNEL EFFORT REQUIREMENTS

Include a detailed estimate in the form of a table accompanied by a textual reference and explanation. This estimate shall be done on a task-by-task basis and should be based on the projected effort required to perform the task correctly and not just "X" hours per week for the number of weeks that the task is active

3.4 OTHER RESOURCE REQUIREMENTS

For the first prototype the group will use circuit boards and material that can be obtained from the electronic shop on Coover. However, for our final design we want to be able to print circuit

board to solder the components of our DAQ. We will also need to add a data storage system onto our board so that the information can be stored and moved onto another platform.

For long term use, we should consider cost effective battery in particular for the Arduino Uno. We should read through the datasheet of the Arduino Uno (Figure 3) and then try to choose battery based on the recommended voltage range on the Arduino. Figure 4 shows an example with 9V battery to operate the device.

3.5 FINANCIAL REQUIREMENTS

For this project, financial requirements will be minimal, all of the hardware required are basic circuits board materials that are fairly inexpensive. The only part that would require some investment would be purchasing a microcontroller, which the group decided on buying an Arduino Board.

4 Closure Materials

4.1 CONCLUSION

Our end goal for this project is to have developed a small and portable DAQ that will be able to filter and display data received from a biosensor placed on a dog. We must also develop an app with the goal of adding more functionality to our product. We must design a circuit board for our final product to add all the necessary components to make our project more personalized.

4.2 REFERENCES

Some links:

How to connect the adafruit SD module to an Arduino board:

<https://thecavepearlproject.org/2014/07/01/a-10-diy-data-logger-is-born/>

Ideas on how to make the smallest “bareduino” possible:

<http://forum.arduino.cc/index.php?topic=130806.0>

Using Attiny84 as our microchip:

<https://harizanov.com/2012/05/toying-with-attiny84-and-sd-card-in-arduino-ide/>

How to use Matlab to log data with Arduino:

<https://www.mathworks.com/matlabcentral/fileexchange/51710-data-logger-on-arduino-uno>

How to build a “bareduino”:

<http://tuttle.merc.iastate.edu/eClubs/projects/bareduino.pdf>

<https://www.farnell.com/datasheets/1682209.pdf>

<http://www.instructables.com/id/Powering-Arduino-with-a-Battery/>

4.3 APPENDICES

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. You may also include your Gantt chart over here.

- Any additional information that would be helpful to the evaluation of the project plan or should be a part of the project record shall be included in the form of appendices
- Examples of project documentation that might be included are property plat layouts or microprocessor specification sheets germane to the proposed project.

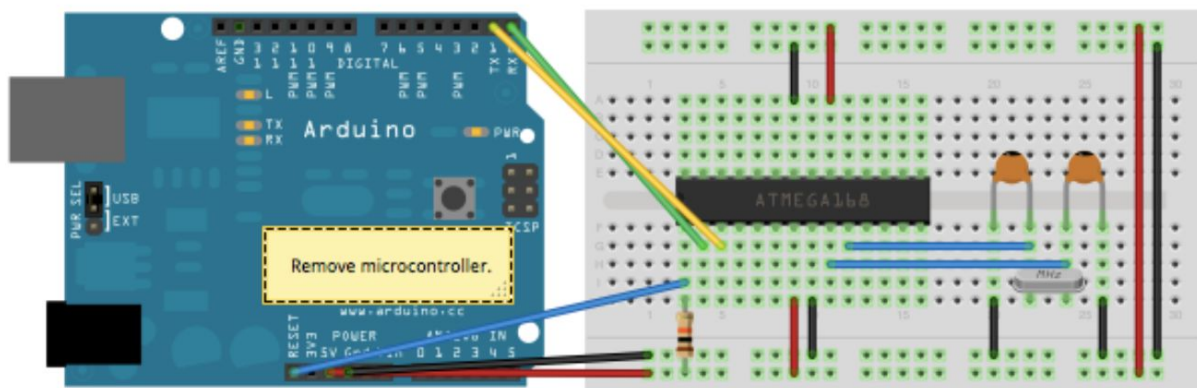


Figure 2. Schematic of design 2

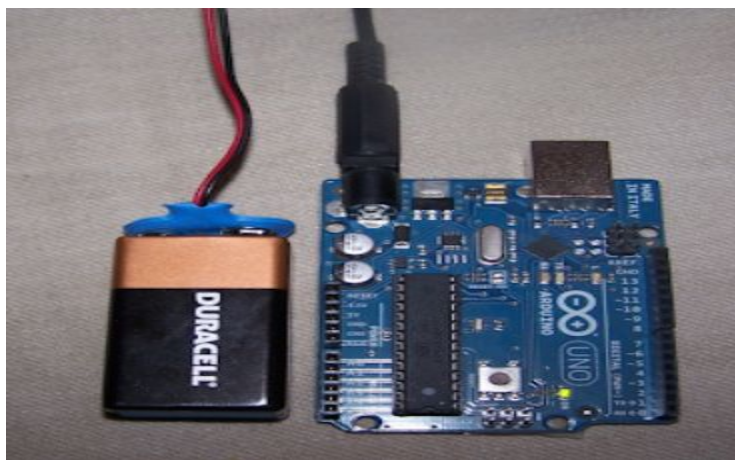


Figure 3. Power the Arduino Uno with 9V battery

| | |
|-----------------------------|--|
| Arduino Uno Datasheet | |
| Microcontroller | ATmega328 |
| Operating Voltage | 5V |
| Input Voltage (recommended) | 7-12V |
| Input Voltage (limits) | 6-20V |
| Digital I/O pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 6 |
| DC Current per I/O pin | 40mA |
| DC Current for 3.3V pin | 50mA |
| Flash Memory | 32KB (ATmega328) of which 0.5KB used by bootloader |
| SRAM | 2KB *ATmega328) |
| CLock Speed | 16MHz |

Figure 4. Arduino Uno Datasheet