Bout Master
Homework 4 (Group Report):
Engineering Principles
Due: Feb. 18

“ I pledge my honor that I have abided by the Stevens Honor Code”

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Introduction

The Boutmaster is a wireless system which utilizes radio, Bluetooth, or WiFi to keep track of scores in fencing matches wirelessly. Knowledge from fields such as wireless technology and fencing regulations is required to design this product. Below is a list of topics and who the responsibility of research was assigned to:

Research Topics

Wireless (Bluetooth/RF/Wifi) - Rob & Jorge
- Electric Imp
- Bluetooth module
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Programming Languages - Jorge
- Ruby
- JavaScript
- C++
- Java

Prototyping (Arduino, FPGA, Raspberry Pi, etc.) - Jorge

Fencing Rules & Regulations - Gamal

Fencing Equipment (swords/scoring equipment) - Gamal

	Jorge Rojas	Robert Skowronski	Gamal Mohamed
Percentage of effort towards this assignment	33%	33 %	33%

Explanation of Idea In Depth

The suit created with the ElekTex would be a responsive fiber. We could get a reading from this system and record the results off of a transceiver to a cloud information storage device. The fabric contains fibers that have a good thin coating of silver or copper. The material conducts electricity and the microchips in the fabric send out the electrical impulse from the fibers into digital data. The digital data would be taken from the cloud and viewed on a computer screen. The material can be folded up and washed.

The following diagram shows how the contact would generate a signal.

QTC™ Material sensor used to record foot pressure distribution.

Monitor and evaluate athletes weight bearing with regards to footwear design, material construction or comfort on track running surface. Can be used in medical diagnostic. QTC™ Material provides advantages by carrying out and recording tests results in practical circumstances.

QTC™ Material sensor within the fencing jacket to register touches during training.

No long retracting wires are required as the person would be wearing a small lightweight electronic box. buzzer sounds contact, points can transmitted for scoring.

Key benefits of using QTC™ Material

QTC™ Material is a pressure/force sensing material. It can be easily integrated into existing products to enable force sensing opportunities and solutions.

QTC™ Material is mechanically strong.

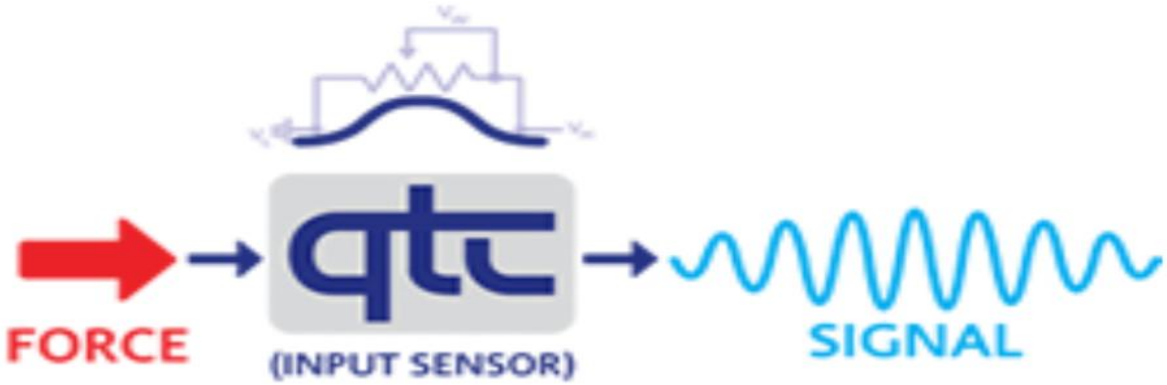
QTC™ Material is an enabling technology which is simple and reliable to use.

QTC™ Material can be directly interfaced to standard electronic and electrical devices.

QTC™ Material is durable - it has no moving parts to wear out.

QTC™ Material and/or technology can be customised for customer requirements, applications and products.

‘**Theory**



Looking at the theory behind this project. We would like to incorporate the wireless system knowledge learned at Stevens Institute of Technology in our sixth semester.

Electric Imp

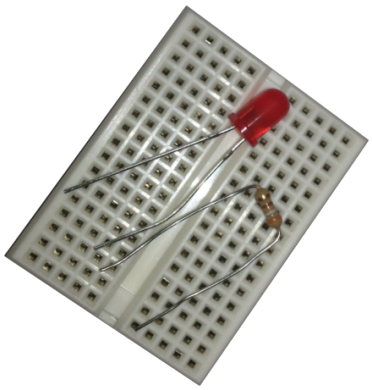
The Electric Imp is an idea we had to send the information into the cloud storage system we are designing.

- **Imp Hardware:** The Electric Imp platform starts with the imp, a powerful module containing WiFi and a processor that acts as the gateway to connect your device or service to the Internet, providing it with a brain in the cloud.
- **Imp OS:** The software foundation for the imp's features and services that allows your code to concentrate on bringing your product's functions to life.
- **Imp Cloud:** Our cloud allows you to run agents - server side code that runs in a secure environment - that are used to provide HTTP I/O and cloud-side processing, and easily connect your products to anything with Internet access. Agents can act as a central hub to your products, apps, third-party services, and even your own servers.

The following devices will be needed to get the first imp online and running code.

imp

April breakout board



Breadboard, 330Ω resistor, and an LED

USB Mini cable

iPhone or Android Phone

We tried calling Omega electrical appliances but they have nothing that transmits data as we would like. Electric Imp seems like the best desicion. We program the FlekTex to the electric imp server to store data into the iiphone or Andriod Phone.

Radio Frequency vs. Bluetooth

Bluetooth technology has quickly become commonplace in most wireless electronic devices. This method of communication allows quick pairing of any two devices. With this connection established, close-proximity file transfer is possible. All the way from sending singular bits to images, audio, or even video is possible with Bluetooth. There is one drawback for this technology though: it can only establish one connection at a time. This means that a system where two wireless devices connect to a single application wouldn't be possible. Also, there is a big distance restriction. There is a distinction between two classes: class 1 has a range of about 10 meters, which is too short for this application, and a class 2 with a range of about 100 meters. Nonetheless, class two devices consume a lot more power and tend to be bigger in size (McClain). With this said, the other type of wireless communication available is the well-known radio frequency. This one has a better potential of establishing the connection. There already exist a wireless system that uses RF; however, since the device running the application has Wi-Fi capabilities, the publishing of data would be possible. RF technology has developed a lot, making it reliable. Also, it enables more than one component to connect to one device. There is a down side, though. There is going to be a need for a small receiver that plugs in with the mobile, tablet, or laptop. This will increase the cost of manufacturing, but it is a good and reliable path to take. Further investigation on pricing and reliability is needed to make a stronger argument in favor of one of these technologies.

FIE Equipment Standards

In order to ensure the system is utilized by as many consumers as possible, it is important that the device follows regulations and standards set by fencing organizations. Organizations such as the USFA and the FIE have documents which give specifications the system must follow, including the allowed resistance of the connecting wires to the tone of the sound played when a fencer is hit. In addition to following the regulations, the apparatus must be submitted to and approved by the SEMI Committee of the FIE six months prior to the competition date. (British Fencing)

Rules of Fencing

The Boutmaster will be able to interface to the three weapons in fencing: the foil, the epee, and the sabre. Each weapon has it's own set of rules to follow:

Epee

The entire body is a valid target when using the epee. The epee is a stabbing weapon, so only hits made in a stabbing manner should register. When this option is set, the Boutmaster needs to differentiate between a valid hit (opponent's body), and an invalid hit (bell guard/

floor). (British Fencing)

Foil

Valid targets are everything except for the limbs and head. The foil is a stabbing weapon, so only successful stabs should register a hit. There is a small bib that hangs from the mask that is also a fair target. The Boutmaster must differentiate between a valid hit (the specified target), an off-target hit (limbs/ head), and an invalid hit (bell guard/ floor). (British Fencing)

Sabre

Everything above hip bone can be a target. The sabre is both a slashing and stabbing weapons, so a slash or stab will register a hit. The Boutmaster must be able to tell the difference between a valid hit (upper body), an invalid hit (floor/ bell guard), and an off-target hit (lower body). One thing to note, the an off-target hit with a sabre does not cause play to stop, so if the Boutmaster detects an off-target hit, it should not respond. (British Fencing)

Scoring Machine

One of the main modules of the Boutmaster is the scoring machine. The machine acts as a centralized hub for processing hits, keeping track of score, and communicating with external databases. Is is important that the right technology is used when working with the system. The scoring machine would need to wirelessly communicate with the fencers' devices to record when a hit was made and whether the hit was on target or invalid. This could be accomplished with WiFi, Bluetooth, or radio technology. The scoring machine is also in charge of lockout times; when one fencer tags another fencer, there is a short period where the other fencer can still tag the attacker. This lockout time changes from weapon to weapon, and the Boutmaster would need to adjust the time. It is also important that the Boutmaster operates at a high enough sampling frequency to ensure the lockout time is accurately enforced. After determining the hits, the Boutmaster would need to light up depending on the events that occured and forward the information to a database for later use.

Programming Languages

With all the different programming languages out there, how does an engineer pick which one is best for a given application? There are a lot of details about a certain language that need to be considered before starting to develop software: is it compatible with the hardware, is it

object-oriented, is it dynamic, is it possible to create multi-platform applications, how much does the compiler and environment cost, what is the learning curve, and much more. Given the constraints and scale of this project, it is ideal to have a programming language that is adaptable to other native languages used in android, iOS7, Windows, and Mac. There are a couple of languages that can be used for this type of application: Java, C++, Ruby, and JavaScript. Based on some research, JavaScript and Ruby are good candidates for the BoutMaster application. Ruby on Rails has the potential to give fast deployment (Shah), but not very efficient for when more complexity is added to the application and the business grows; on the other hand, JavaScript would take a little more time to implement, but it does give great performance. Also, the latter requires knowledge of HTML and CSS. However, they are very common languages, especially found in web development (Nickolay). Both paths taken will need different frameworks that will translate the code into its native language for the given platform. More thought needs to be given to what is really necessary for the project given future projections and compatibility.

Prototyping

For a project of this nature, prototyping is crucial. Whether the project is done using a microcontroller or an FPGA is also a question. Each has their own benefits. An FPGA gives moderate performance and moderate flexibility, a microcontroller gives great flexibility, but slow performance. In this case, a prototype is needed as quick as possible for a proof of concept. This idea is already public and it's only a matter of time before some other company implements the idea first. Having the FIE as our main investor, timing is paramount. With this said, a microcontroller such as an Arduino or an MSP430 is ideal for quick prototyping. The implementation would be slow, but it would be good enough for a demonstration that would interest investors. Also, it is very simple to write Arduino code. Although there are many other microcontrollers out there, the Arduino and the MSP430 are ideal. There is also the Raspberry Pi and the Beaglebone black, which serve as fully fledged computers, but the processing power is incredible. However, it is not necessary to have so much processing power, especially for the price of these boards. Another controller that was mentioned before is the MSP430, which is programmed in C making it harder and slower to implement. With this said, the quickest route is using an Arduino board. It is easy to program, it is implement, and there are many shields and accessories that allow easy wireless communication (Arduino). However, there are many different Arduino boards, which one should be used? The main difference between them is number of pins and memory. The project nonetheless, does not require that many pins nor memory to develop a Minimum Value Product (also known as MVP). For future projections, a microcontroller is not the preferred choice. There would be a need to decide between ASIC (Application Specific Integrated Circuits) and FPGA's (Field-Programmable Gate Arrays). Even though the ASIC gives the best performance, the design team needs to think about whether or not is worth to sacrifice the flexibility. Later versions of the product might need an update of the software, or even the hardware. Thus, the possibility of changing its hardware with some external pins without having to manufacture new chips is preferred. Further

research will allow the team to make a more educated decision.

Additional Information

Gamal's Citations

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Rob's Citations

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Jorge's Citations

1) "Arduino - ArduinoBoardUno." *Arduino - ArduinoBoardUno*. Arduino, n.d. Web. 21 Feb. 2014. <http://arduino.cc/en/Main/ArduinoBoardUno#.UwflRPldXh4>.
2) Bigioli, Petronel, Adrian Ionas, and Peter Corcoran. "Connectivity Solution to Link a Bluetooth Camera to the Internet." *IEEE Xplore*. Institute of Electrical and Electronics Engineers, n.d. Web. 21 Feb. 2014. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=935193&queryText%3DConnectivity+Solution+to+Link+a+Bluetooth+Camera+to+the+Interinet>.
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