

# GYEEM of the Future

## The LatinPower

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# 1 Introduction

It might be because we're engineers that we're drawn to precision in scheduling, and that we appreciate real-time updates of relevant information. But then again it might not – it might just be another of those things that we're not sure if its engineers only. The fact of the matter is, however, that we understand people have busy schedules, and that there are certain activities that can change a day's plan dramatically, depending on the hour at which they are completed. One such activity is exercising at the gym.

## 2 Problem Description

If you've been to the gym at a busy time, then you can probably relate to the problems this project will tackle. *Don't you just hate it when you're alternating between two machines and some foreign PhD student wearing jeans and a polo decides to work on one right as you're finishing using the other and going back to the first?* Perhaps not, but we are sure that you can imagine that sometimes the gym gets too crowded. Consider for a moment reasons *why* people *don't* go to the gym: maybe they can't find the time to do so, maybe they feel uncomfortable working out in front of other people, perhaps they have had bad experiences. Bad experiences come in several different forms; a bad experience could be going to the gym knowing you really only have 45 minutes to get your workout done, and finding that a lot of the machines or benches you need to use are occupied, and realizing that you're not going to be able to get your workout done properly with the time you have; maybe if you're only a beginner at weightlifting, going to the gym and finding that there are a lot of "meatheads" there will intimidate you and make you feel uncomfortable. It is evident that timing is key in exercise, not only with regards to your body and its development, but also with respect to your busy schedule and/or your preferences while exercising. The problem is that it is hard to plan around busy hours at the gym if you don't know when busy hours are!

## 3 Proposed Solution

Our proposed solution to the problem of scheduling workout times is to provide a means for gym members to check how busy the gym is at any given time. To accomplish this, we will develop a system that can be installed on any regular gym that will keep track of when a machine is in use. This will be implemented with sensors and a centralized

microcontroller device that will communicate with a gym administrator's computer which will in turn make that information available on an internet page. This way, gym members will be able to check how crowded the gym is in real-time. The interface will be developed by us, and will not only provide current statistics on gym usage, but also will provide time series information expressed in plots to show historical usage for a given day of the week, as well as another graph showing a "forecast" for a particular time of day – this will be derived from analysis of the time series, and will allow gym to get some of reference as to what to expect. In addition to this, we plan to have a feature that allows a user to declare he or she will be occupying a particular machine; we plan to implement this with a simple green/red light system. To prevent people from abusing this, though, we plan to have a time limit on how long you can use a machine. Our goal with this project is to develop our system and get it installed in the various gym facilities on campus. The primary objective is to create a means for people to plan their workouts more efficiently, which we hope will not only make students more productive, but also will increase their motivation in working towards their fitness goals.

## 4 Demonstrated Features

### *- Detectors on weight racks and cardiovascular equipment*

The first feature that will be demonstrated is the presence of the weights in the rack. This will be achieved by placing infrared motion sensors on the weight rack that will create a voltage when the dumbbell is present and no voltage when it is not there. This voltage will then be detected by the microcontroller to send the Wifi signal.

Motion detectors will also be used for the treadmills, ellipticals, and bicycles. The sensors will detect if there is a person using the equipment. If a person is using the equipment a voltage signal will be sent

### *- motion or power sensors on Treadmills/elliptical/and bikes*

The goal of the power sensors that will be added is to detect whether the elliptical, Bikes and treadmills are on

### *-Interface between microcontroller/equipment and website*

The microcontroller will analyze the voltages coming from the sensors and depending on the values of the voltages it receive it will send a signal to the website. This signal will then be analyzed to determine which specific piece of equipment is being used. The

microcontroller will have the code that will analyze the voltages and will determine what signal to send to the website.

- *Website that demonstrates equipment usage*

The GyEEm website will be able to tell the users if the different equipments are being used or not. The website will have a list describing which equipment specifically is being used and it will make a prediction of how many people are at the gym depending on how many dumbbells and cardiovascular equipments are in use. This way the different users will be able to know how busy the Gym is.

## **5 Available Technologies**

Our design requires several key technologies: a infrared sensor, a Wi-Fi interface, and a microcontroller. Decisions on these components will impact the design and capabilities of the entire project. These components will all need to be available and affordable enough to fit within our \$500 budget.

The choice of the infrared sensors is impacted by two important considerations. First, we are limited by distance between the dumbbell and the weight rack. We will also have to consider the distance between the weight racks, and the ceiling. This same consideration has to be taken for the different cardiovascular machines and the distance between the next machines. Distances will have to vary between the different machines and therefore different voltages will be obtained. The IR sensor that is being considered for our design has a reach of up to 80 cm and a voltage range from 0.4v to 4V. The closer the object is to the sensor the higher the voltage. One of the limiting factors of our design will be the amount of sensors we would be able to install, because even though they are relatively inexpensive, their cost could build up.

For the Wi-Fi embedded chip we will have to use an MRF module. This type of module allows us to connect to PIC32 microcontrollers via a 4-wire SPI interface and the usage of interrupts. Moreover, it is a low-data rate solution, which makes it convenient for a low data device. This module will be the one sending the signal to the wireless web server.

Finally, our microcontroller will have to read the voltages from the sensor to analyze if the equipment is being used. Then, it will identify which equipment is being used to send the signal through the Wi-Fi embedded chip.

# 6 Engineering Content

Our overall system will consist of two major blocks. The first block will encompass all of the hardware that we will be using on the gym equipment. The second block will be centered around the design and construction of our website. Our hardware in the gym will collect data about gym use and the website will bring the data to the gym's members.

## 6A. EQUIPMENT

The main hardware that we will be employing to create a better gym will be infrared sensors, weight sensors, our micro controller and a wifi interface.

### 6A.1 SENSORS

We will be using infrared sensors to detect when dumbbells are lifted off of the weight rack. The infrared sensors will also detect when the weights are returned to the weight rack. We will position the infrared sensors on the rack so that they are not at risk of being destroyed by the weights. We will also calibrate the sensors accordingly so that only the replacement of the weight on the rack is detected and all other motion is ignored.

On the stationary machines and weight benches we will be using weight/pressure sensors that we will install in the seats to detect if it is in use. We feel like these sensors will be the best method of determining use of a machine without interfering with the normal operation of the machine.

We will be using motion sensors on the bottom of the treadmill. This will allow the sensors to detect when the belt on the treadmill starts turning without having to account for other unwanted motions of gym members walking by the treadmill. Having the motion sensor underneath the treadmill will allow us to safely monitor motion while preventing the treadmill user from crushing or damaging the device.

One engineering feat that we will have to overcome will be powering all of our sensors so that they can operate for long periods of time, especially for gyms that are open 24 hours a day.

### 6A.2 COMMUNICATION WITH MICROCONTROLLER

All of our sensors will be wireless. They will be transmitting a signal to our microcontroller. We will have to attach a receiver to our microcontroller so that it can receive data from all of our sensors.

### 6A.3 WIFI INTERFACE

To send the data from our microcontroller to our website we will need to implement a wifi interface into our microcontroller. This will allow our microcontroller to supply real time data to the gym website.

## 6B. WEBSITE

## 6B.1 FEATURES

One of the main goals of our website is to make it user friendly. We need it to provide the user with all the gym information we have collected from the gym in manner that is easy for them to process.

## 6B.2 GYM LAYOUT

Our website will display a map of the gym. Indicating where all of the equipment is located. This includes dumbbells, cardio machines and stationary weight machines/benches. We also plan to include an estimate on the website of how many people are at the gym at any given point. This estimate will be based on how many pieces of equipment are in use at an specific time. This number will update frequently to provide gym members with the most accurate data possible.

## 6B.3 DISPLAYING STATE OF EQUIPMENT

When the equipment is not in use the equipment will be a green color. When our sensors decide that the equipment is being used the equipment will be red.

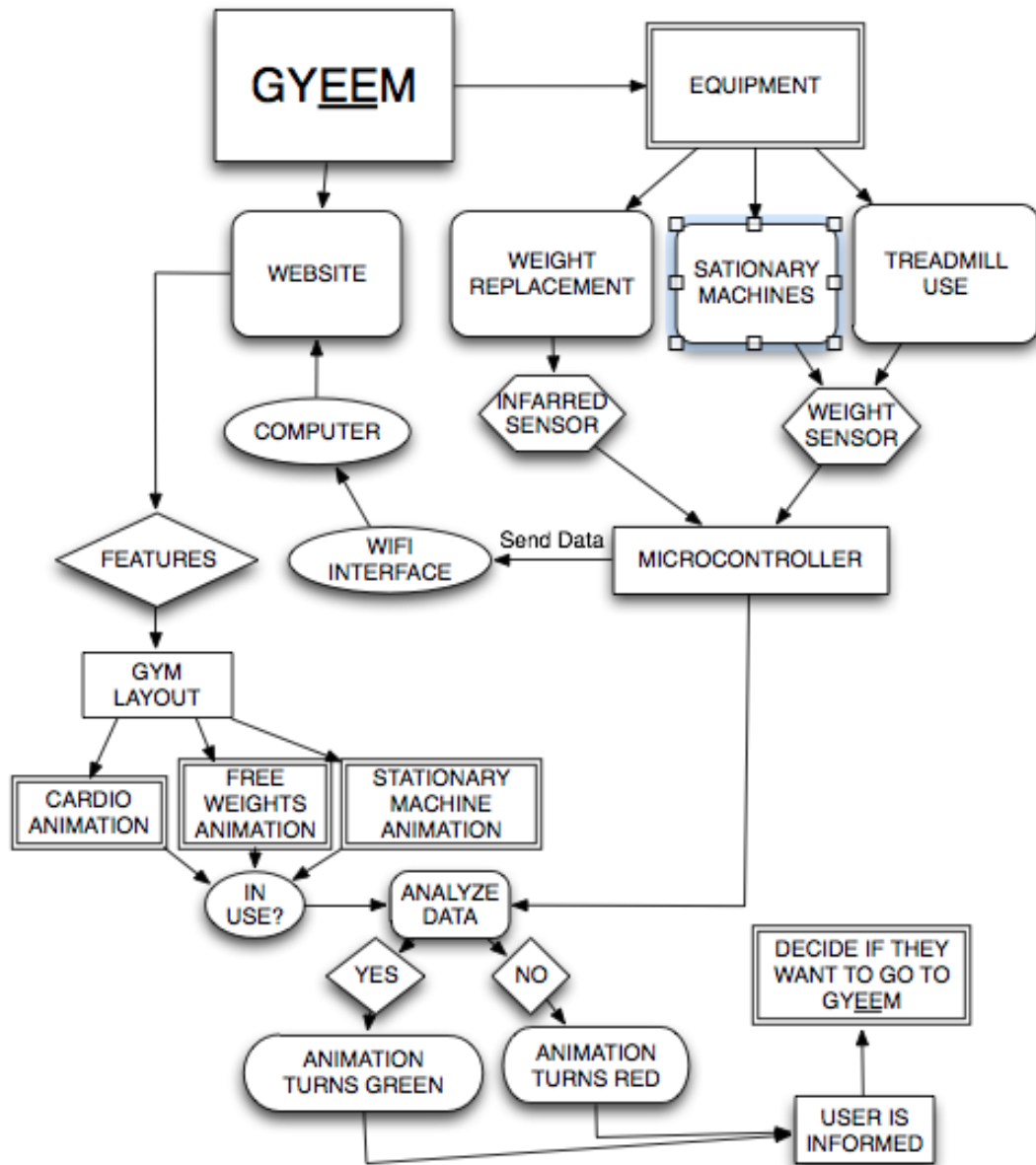


Figure 1. Project Flowchart

## 7 Conclusions

### 7.1 Improving gym experience

The GYEEM is a way that we can use technology and what we have learned as Electrical Engineers to improve gyms everywhere. Many people do not like to exercise in a crowded environment. This slows down ones exercise routine and adds unneeded frustration to the persons workout.



Reducing the traffic in a gym is a problem that can be solved with technology. Guessing when the gym will be crowded is a hard thing to do. Our network of gym sensors will take the guessing out of the gym. Now gym patrons will be able to take a few minutes of their time to check their gyms website and determine if the gym is busy. This not only improves the experience of the person deciding when to go to the gym but it also improves the experience of the patrons that are already at the gym. This website will prevent people from unknowingly arriving to the gym when it is very crowded and it will also keep the gym from becoming more crowded than needed at peak hours. Aside from using the website to remove unneeded stress from your gym workout there are other benefits.

People who are self conscious about their body or who are just beginning to workout are often uncomfortable at the gym. This discomfort is only multiplied when the gym is crowded. When the gym is crowded there are many people there who are very fit and have been going to the gym for a very long time. These people do advanced lifts and often use a lot of weight. This can lower the self esteem of beginners and discourage them from coming to the gym frequently. With our GYEEM beginners and people who are trying to become more fit will be able to find times when the gym is less crowded.

Advanced lifters will also be interested in the GYEEM on days when they are doing supersets (exercises that require the use of several pieces of equipment at one time). When the gym is crowded supersets are impossible. This can be very unfortunate for athletes or professional body builders who have very strict workout regimen. Also when the gym is crowded there is a higher chance that someone can bump into you and possibly cause you to injure yourself.

In conclusion our GYEEM is beneficial in many ways and is a practical solution to several problems that many gyms have. Our sensor network reduces stress, promotes fitness for gym members of all experience levels and improves gym safety. This a feature that all gym patrons would love to have in their gym. Gym owners will also be excited about the GYEEM because it is a very marketable idea that will undoubtedly increase gym membership. The GYEEM is a win-win for everyone involved.