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# 1 Introduction

## 1.1 Project statement

*What are you trying to do?*

To put in simple terms, the primary objective of this project is to create a simple MATLAB MEX function that can process LMS SCADA DAQ binary files into whatever format Honeywell wants. With this data in stow, we then must read off said data to the user (i.e. Honeywell) in a FAST and PROGRESSIVE manner.

 It is worth noting that there is already a process similar to this in existence at Honeywell. However, the process in itself can take from a half an hour to 45 minutes. It is our desire to drop that time to a more reasonable amount (5-10 minutes). The construction will involve the use of both MATLAB and C++ code, in order to use the C++ infrastructure provided by Honeywell as a starting point, and using the MATLAB MEX functionality as the final implementation of the project.

## 1.2 purpose

*Why is this work of benefit to the society?*

As mentioned before, in completing this project successfully, we will have created a system that reads LMS data in a more efficient and faster time period. In this manner, it will make the process time at Honeywell significantly less and thus make their jobs more efficient. After all, with our additions, they will hopefully be able to complete this process in a matter of minutes rather than a half hour or more. They can then be able to utilize this extra time for more practical purposes versus just “sitting at a screen and waiting”.

## 1.3 Goals

*What would you like to achieve?*

One of the major takeaways from this project will be a skill many EE professors, including Dr. Tuttle and Prof. Phillip Jones, believe EE majors should have more experience with: programming. Programming is everywhere in today’s electronic world. From cell phones to computers to even the traditional coffee maker, an engineer can only reach so far without this vital asset.

Since our group composed is all electrical engineers, none of us are familiar with C++. We have used C previously in some classes, but this only took us through the basics of the language and implemented it through a means that has little in common with this project. In addition, we will also be investigating the file conversion between the .mat file and the Microsoft Visual Studio C++ files. This would be challenging but at the same time beneficial for us to know because we wouldn’t learn them from any EE classes. In completing this project for Honeywell, we will be broadening our programming language horizons. It make take a bit of time and assistance to write a program and apply it to an engineering task, but in the end it will ultimately add to the technical skills we graduate with and overall make every member of the team more versatile.

# 2 Deliverables

*What deliverables are necessary to meet the goals outlined in the introduction?*

In order to successfully “complete” this project, as if programs can ever be completely done, we feel a fulfilled project consists of a runnable Visual Studio project with:

1. Associated C++ source codes, so they can be edited for user preferences
2. Use of MEX functionality, which allows VS to access MATLAB’s infrastructure, allowing direct contact from creating .mat files and thus reducing time duration in the overall process. After all, in using this, the RAM of the CPU is further optimized
3. Associated various file types such as API, HTML, etc.
4. Sample output from the function based on the example LMS data the team was given

 Of course, as with any senior design project, the team also plans to demonstrate a presentation of our program, highlighting all of the methods utilized and overall showing that our program is truly a solution to Honeywell’s time constraint issue. There more than likely will be additional deliverables as the project progresses, including details we feel need some form of concentration or details Honeywell itself wants to know more about. However, as engineers, we will react and respond accordingly.

# 3 Design

## 3.1 Previous work/literature

*Similar products or research done on this topic previously*

 As mentioned previously, no one on the team has had previous knowledge of C++ or for that matter LMS SCADA data. The closest approximation to this would be basic projects executed within the few programming classes all electrical engineers (EEs) are required to take. Therefore, there is no experience to bring to the table for any of us, which really highlights the need to accept input from our advisor and/or Honeywell and to put forth as much effort as possible.

## 3.2 Proposed System Block diagram



*Figure #1: Group dec1604’s Proposed System Block*

 Figure #1 is a proposed system of how the basic procedure is going to be handled when completing this project. It is worth noting this is a BASIC diagram, as the team currently has not researched into the recently acquired Honeywell data as of yet.

## 3.3 Assessment of Proposed methods

 Exact approaches are a bit hard to determine to determine for a C++ project we essentially have no background on. Therefore, it is crucial to rely on the input provided by our advisor, Dr. Zambreno, to guide us in the right direction. After all, from the few brief discussions with him, it appears he has sufficient programming capabilities and strengths. In addition, it is also worthwhile to remain in weekly contact with Honeywell. They are the ones that initially created the basic foundation of this program, so likewise they are more than likely will be able to provide tips and tricks on how to approach this problem.

 At this point, we planned to compile the codes provided by the Honeywell to get a sense on how the conversion of the LMS file to MATLAB works; at the same time, we are also learning how to compile a C++ codes in Visual Studio and how to fix the error popped up during the compilation. After getting the codes compiled, we should be able to have a greater understanding on how the LMS files is being loaded into the MATLAB. In fact, Honeywell already provided us an incomplete C++ script for this project.

 After few weeks of meeting with our advisor, Dr. Zambreno; the approach for this project completion is much clearer. Our current plan is to compile and run the C++ codes provided by the Honeywell using Visual Studio so that it convert the LDSF file into a MATLAB readable codes.. Indeed, we are currently in a pretty good shape in debug and run C++ script in Visual Studio after some guidance from Dr. Zambreno; some practices with the Visual Studio is all we need. After that, we would create the MATLAB mex function from the output from Visual Studio that would allow further analyze on the LDSF data. The format for the output data would be specified by the Honeywell.

## 3.4 Validation

*How will you confirm that your solutions work?*

Multiple testings are the key to determining if our function progression is heading in the right direction. If we receive the correct readable output, we are on the right track. Consequently, if not, then obviously more work and progression is in order. Of course, being that each test (at first) will more than likely be equivalent to Honeywell’s 30-minute wait time, if not more, the tests must be run conservatively and smartly. Perhaps this can be done testing only a portion of the code. Whatever the case may be, the fact remains time is one of the constraints within this design, which means it must be used wisely.

# 4 Project Requirements/Specifications

## 4.1 functional

*Functional requirements of the project?*

1. Create the C++ code for converting the provided LMS data file into a file readable by MATLAB.
2. Create a MATLAB MEX function that can interpret and read a LMS formatted file
3. The target execution time for this read should be around 5 to 10 minutes.
4. The output, whatever that may be, must be readable or otherwise easy to understand

## 4.2 Non-functional

*Non-functional requirements of the project?*

1. Comments on the C++ script to explain the functionality of the codes
2. C++ software introduction and utilization to write the code

# 5 Challenges

*Any concerns or details that may slow or hinder your plan as it is now?*

Since our project involves both MATLAB and C++ programming, there are quite a few concerns and factors that may hinder or slow down our plan. Our main concern right from the git-go is lack of knowledge in the C++ programming. As mentioned, we all only have learned basic C programming from EE 285 and Cpr E 288, which are associated programming classes at Iowa State. Currently, the team is utilizing [www.cplusplus.com](http://www.cplusplus.com) to further alleviate this lack of knowledge. However, the process of learning and attaining a new language is time consuming.

Once we learn the C++ programming function and design, we also need to further study and understand the script and codes Honeywell has provided us with. Again, we are instructed to create a direct Visual Studio to MATLAB conversionary file while at the same instance reducing the time taken for the MATLAB function to read the LMS formatted data. However, with no prior indication or involvement with this Honeywell code, it is going to be difficult to redesign or to even interact with the basic infrastructure they provided us. We need to study it progressively, essentially, and correct as needed. One approach to achieving this objective would be to correct it in pieces, pinpointing specific parts of the MATLAB or C++ function where we can shorten the time taken to execute that particular part of code. Another approach would be to, once all the code has been analyzed, create a whole new MATLAB code with the end result being a function with incredible execution time. This would be pretty challenging, but there is always the option.

 Other than that, time is also an issue. As mentioned earlier, the time taken to read the LMS formatted data right now in Honeywell is about half an hour. Our first few trials in testing the MATLAB function, therefore, would probably be around half an hour as well. The point here is we wouldn’t be able to know the result and debug the code right away. We have to be smart in trying to test the code. Every trial or run is important, so if the team based our design technique based off multiple testings and corrections, we would be wasting time.

# 6 Timeline

This is the rough timeline of tasks we would like to accomplish between the next two semesters.



As can be seen from the figure, most of our major objectives run concurrently, such as designing the final presentations and testing. It is consequently important therefore to remain on task and “always moving forward” as we progress through the intricacies 0f building the function.

# 7 Conclusions

 Overall, the main goal of our project will be to create a combination of C++ and MATLAB code that increases the overall efficiency of the program provided to us by Honeywell. In order to accomplish this we will have to acquire the new skills of coding and C++ and being able to read and interpret data from the LMS SCADA files from the client. While most of our project goals will be accomplished concurrently, we believe that by the end of this semester that at the very least we will have a functional C++ program, leaving next semester to be spent implementing the program with MATLAB.

# 8 References

This is a continuous list of all the resources and tools we utilized in building our overall final submission:

1. Online Source
2. [www.cplusplus.com](http://www.cplusplus.com). C++ programming learning
3. [www.mathwork.com](http://www.mathwork.com). Understanding MATLAB Mex, Mex file creation from C++, API and etc.
4. <https://www.youtube.com/watch?v=IZJ-IlI3QR0>. C++ and Matlab Tutorial: Speeding up MATLAB code using C++ and mex files.