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Project Plan

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May 15-20

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## Team Overview

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## Problem Statement

Currently, the CprE 388 class is an Android development class. The course is listed as ‘Embedded Systems II’ and while Android is a form of embedded systems it is lacking some of the lower level experience gained by working with hardware components. Our project aimed to develop a hardware infrastructure and 3 labs to be added to the existing class. This required finding hardware that worked with the Android devices currently used (Nexus 7 tablets) as well as allowed students the opportunity to use interesting hardware that showed them how the labs are applicable to technology seen on the market today.

## System Description

The setup will consist of a Nexus 7 Android tablet connected to an Arduino ADK board attached to a computer running the Android Studio SDK.The Arduino board will be used to communicate with external hardware in the form of an LED board.

The LED board comes with libraries to be used with the Arduino that will make some communication easier for students. This should make the expected completion time for the labs more reasonable. There are also libraries provided by the Arduino for communication between Android and Arduino. The LED board also requires more power than the Arduino can provide, so an external power supply is necessary.

The computers themselves will be Windows machines. They must have USB drivers installed on them for the tablets to work with them.

## Lab Breakdown

Our project requires that we come up with 3 labs that involve the Arduino ADK board and some form of external hardware. This includes a rough breakdown of our current plan and at what completion point each of the labs is at.

**Lab 1: Blink and Morse Code**

This will be a 2-part lab aimed at introducing students to the LED board that they will be using for most of the labs following. The first part is a simple “blinker app” that will involve a simple button on the Nexus Tablet that can toggle an LED on the board on or off.

Part 2 is creating a “Morse Code translator” . Users should be able to type a string on the Nexus 7 tablet and the LED board should flash with the Morse code equivalent in long or short blinks. This is very similar to part 1, but takes it one step further requiring the use of the LED board.

*Learning Objectives:*

* Communication between the tablet and Arduino
* Experience writing Arduino Code
* Adding basic hardware to the Arduino

**Lab 2: Sketchpad**

This is a two-week lab requiring that students create an application on their tablet that allows them to light up a corresponding light on the LED board by clicking a button.

The first week is focused on the hardware side of the lab. Students must create a very simple app that allows a user to type in an X and Y coordinate and RGB values. This will then light up the LED at that X-Y location and the colors.

the second week is more focused on the UI of the android application. Students will be required to create a 32x32 grid of buttons that will be used to select the coordinates. It will require 3 sliding bars, for the red, green and blue values of the colors.

*Learning Objectives:*

* Experience using complex hardware connected to the Arduino
* Understanding and using external Arduino libraries
* Keeping track of the state of the LED board
* Complicated UI design
* Drawable XML files

**Lab 3: SpyCam**

This lab uses a wireless IP camera that students will be able to stream video and audio from. Students will be required to create an application where they can see the live video and move the camera. This lab requires the use of asynchronous tasks in order to stream the video and audio.

*Learning Objectives:*

* Experiences wirelessly connecting to hardware
* Using asynchronous tasks
* Complicated UI design

## Deliverables

There are a variety of deliverables that will be given to our client at the end of CprE 492.

This will include the lab manuals for 3 labs using the Nexus 7 tablets and some external hardware, like the Arduino Mega ADK board and the IP camera. We will also provide our client with source code for a sample solution of each lab.

We will also provide a set-up guide so that lab stations can be set up in the future, as well as for students to use when setting up a lab environment on their person machines.

**First Semester**

We will have full understanding of the Arduino ADK board being used and the components.

All hardware will be ordered by mid-November.

All labs will be roughly planned, with one lab roughly written and completed. The is will allow us ample time to test the labs in the next semester.

Draft of setup guide complete.

**Second Semester**

All labs written and initial testing done by the middle of March so that user testing can be done.

Will have students complete labs to evaluate their usability and understandings gained from them.

Labs will be re-evaluated after reading through feedback from students and re-written to reflect this feedback.

Finished and polished guide is complete for future use with the class.

## Specifications

The project should include 4 labs working with the Nexus 7 tablets and the Arduino Mega ADK board. These labs will also involve LED boards that will require students to interact with hardware outside of the LED board.

The labs will be written out with clear requirements, but should require students to think critically about the task. The physical setup for each lab should be as simple as possible so that there are as few issues as possible and the labs can focus more on learning and less of troubleshooting.

## Schedule and Gantt Chart

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## Resources Required

|  |  |  |
| --- | --- | --- |
| **Resource** | **How will we get it?** | **Estimated cost** |
| Arduino Mega 2560 board | Provided by client | $59 x N |
| Printed Circuit Board Shield | Provided by client | $12 x N |
| Nexus 7 Tablets | Provided by department | $0 x N |
| LED Board | Provided by client | $40 x N |
| IP Camera | Provided by client | $50 x N |

\*N indicates the number of lab stations required by the department.

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## Testing

In order to test new labs as well as get feedback for improvement, we have set up an experimental class where students will complete our labs. This is a two hour class, meeting twice a week and running for four weeks.

The class is broken into two parts. The first two weeks are labs taken from the existing CprE 388 class and will introduce students to Android programming. The last two weeks will be the labs developed for this Senior Design project.

After completing each lab, students will be required to fill out a feedback form. This will allow us to understand how much time students are spending on each lab, if they have enough information and what they would improve.

This class has some challenges as there is not lecture associated with it. Students are required to learn Android programming just from the labs, whereas in the full CprE 388 course there will be a lecture associated with it.

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## Risks

* Documentation that we have found to interact with the Arduino is not sufficient, then we will have to research further for proper documentation.
* Reliability of the hardware for consistency in lab is important and may pose a challenge.
* Getting the USB drivers installed on the lab computers is a challenge as it currently requires Administrative access.

Solutions

* Through reading documentation and testing on our own we have put together lab documents that explain everything needed to know. We have also provided a “Getting Started Guide” that can be used for the setup of future lab stations.
* By selecting hardware with good reviews and thorough testing we have found reliable hardware that works consistently.
* After working with ETG extensively, we have found a solution that allows any tablet to use the drivers on any of the lab computers. Previously, each student could only use one lab computer for the whole semester.

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