

Techblazers

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Project Planning Paper

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This project involves the construction of hardware and the implementation of some software. For the hardware, we would need to modify a keyboard which would involve the use of capacitive keys, voltage signal processing, and soldering. The software includes the development of an application which takes the readings from the capacitive keys to know the positioning of a person's fingers and displays that on the computer screen. Our paper will lay out the plan for which we will carry out the development stages of our project throughout the remainder of this semester.

### **Team Skills Analysis**

The team involves a combination of two electronic Engineering majors, two computer Engineering majors and one computer science major.

Overall our team is strong in software development, circuit simulation, and research. Chase has experience with programming in Python and is willing to conduct the necessary research to learn any skill needed to complete this project. Victor Siooh has experience with programming in C++ from CS 211 courses along with MATLAB and Visual Basic. He's also had experience with building circuits from EE 282 and experience with diodes and transistors from EE 492. Chief is more software oriented, with experiences in C++ and C# programming to help out on the application development. Chief is also willing to spend time to learn the skills which would help him build the hardware component. Emmitt has some experience programming in C++, Python, and MATLAB from prior programming classes, as well as having done Soldering and CAD. Slate has experience when it comes to electrical hardware, soldering, etc as well as programming experience.

As a group, we do not have a lot of experience with the hardware that will be needed to create the keyboard device. More specifically we don't have experience with PCB design or the building of physical circuitry. This could lead to delays in

development initially with us needing to research to learn about the hardware aspects of the device.

The group members are more software inclined than it is hardware. The team also shows good project management skills with the majority of the team having some programming experience. We also have the willingness to research and learn different skills that may be lacking in order to execute the development of this project.

## **Legal and Ethical Analysis**

Overall, we do not believe there are any major legal or ethical concerns for how this product will be used on the electrical side. With us using a USB 3.0 keyboard that operates at 5 volts, there is not going to be a high chance of electrocution.

However, there could be an issue with some of the capacitive keys coming off as we reconfigure the keyboard, which is a mechanical problem. This would be a hazard for toddlers that might put one of these keys in their mouth, which could lead to legal troubles. While this is not a likely occurrence, we will consider creating a requirement for the users of the device to be above a certain age. Our target users will be students in elementary and middle school, who are learning to type, so swallowing a key will not be an issue for them.

Nevertheless, a scenario could arise where the user accidentally causes one of the capacitive keys to break off and a toddler could put the key in their mouth. To avoid an issue with the child choking on the key, we could add another requirement. This requirement would need to establish how much force one could apply before the key comes off. The amount of force needs to be high enough so that one would need to deliberately take the key off in order for it to separate from the board. We could also have all the capacitive keys connected together in one piece, which would nullify the problem with the keys coming off the board.

No specifically ethical issues should arise either. Keyboards are typically rather controversy-free. Theoretically the device could potentially monitor when fingers are on a keyboard, but much more invasive, effective, and thorough monitoring technologies are already built/easy to build into computers.

## **Milestones**

First, we will need to make design requirement decisions, which will come from the research we conduct. Some of the research will come from what our target users need in our device. Our findings will be used to help us decide what keyboard we will

want to modify, exactly how we will integrate the capacitive keys in our design, how many keys we will want to use to track finger positioning, and communication protocols such as Bluetooth and USB 3.0. In addition, research will need to be performed to help us determine whether we will develop our app for Windows or Mac computers, the programming language needed for this project, how we want to display the keyboard along with the finger positioning on the keyboard. All of the above decisions will need to be made by September 30th.

Many of our milestones will come from successful system integrations. A couple of these that involve the keyboard device are the integration between the keyboard with the capacitive keys as well as the integration between the capacitive keys with either the USB cord or Bluetooth module. A couple more that mainly involve the app we plan to build are the integration between the input we receive from the capacitive keys into our program along with the integration between the program and either the Mac or Windows operating system.

We will need to design a companion app to run with the keyboard. This app will need to take in inputs from the keyboard and display them on the screen. It will need to do this without interfering with whatever other apps are running, and preferably display over whatever app is currently running to remain visible. Milestones for it include: Properly receiving and displaying inputs from the keyboard. Properly rendering where your fingers are on the keyboard and whether they're pressed. Overlaying without interfering with other running apps.

Finally, we will need to conduct patent research to assess whether our idea has already been patented. The United States Patent and Trademark Office's database will be searched. Once we complete our search, we will understand whether we can attempt to profit from our idea.

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Milestone	Requirements	Time allotted
Initial research completed	All team members must be sure of what needs to be done and have researched their topics	2-3 weeks estimated, more research will be done as necessary for future parts.
Orders placed	All orders for physical materials must be placed	1 week. orders should be placed as soon as possible.
Materials Delivered	Materials must have	1 week. Fast delivery is

	arrived	best to be able to get started
Keyboard Built	Keyboard must be built/Modifications must be completed	2-3 weeks. The keyboard will be built in parallel with some aspects of the software.
Application functional	Application must be in a functional state. Must overlay on screen Must display keystrokes Must display finger position	3-4 weeks. Building and testing to be done incrementally. Focus on making sure it works with each aspect.
Functional Prototype	Keyboard must be completed Application must work with the physical keyboard	1-2 weeks Getting the two working together.
Final Prototype Testing Completed	All testing for device must be completed	1-2 weeks Ironing out any leftover problems with hard/software integration

## Metrics

We will need to create a schedule through some software such as Excel and track our progress each week for tasks that connect to an overall milestone. Progress will have to be measured based on each member's completion of a task towards a due date to determine any adjustments. Our weekly minutes will be used in cohesion with our schedule to identify what needs to be completed to meet deadlines.

A few key metrics to track with the aforementioned methods include schedule adherence, cost variance, team member contributions, and scope variance. Schedule adherence will track if we are on schedule with our tasks for our milestones along with any deviation from our project flow. Cost variance will detect if we are within our budget based on the limits that we set. Scope variance will track if we are deviating from the scope of the project based on our schedule adherence and team member contributions.

## Acquisition Schedule

Materials that will be included in this project will include a USB keyboard for modification, capacitive keys either custom or conductive material, USB cord, and a Bluetooth module to be installed in the USB keyboard.

- Conductive keys to allow the capacitive sensitivity.
- Capacitive sensors for each key to detect when a finger is touching.
- Circuitry and controller to compile and send data through USB or Bluetooth about which keys are currently being touched.
- Bluetooth module or USB to interface with computer
- Software on computer to receive data and display on-screen keyboard overlay showing which keys the user is currently touching.

Order of Materials	Week
1.) Keyboard to modify and capacitive sensors	10/11 - 10/15
2.) Conductive keys or Bluetooth module( or USB interface)	10/18 - 10/22
3.) Controller and Circuitry	10/25 - 10/29
4.) Software Subscription	11/01 - 11/05

## Project Risks:

If any of the hardware components needed to build our keyboard device are not received on time, then we will obviously not be able to build the keyboard device. In addition, we may not be able to create the inputs that the app will read in order to display the user's finger positioning on their computer screen. Late delivery may also result in inability/difficulty in testing, which would make it very difficult to tell exactly how well things have been completed.

## Data Management Plan

For configuration management methodology for Software we would need to track and control changes to the software for which our application would be developed. In order for us to track and control changes, we would need to test the application we develop frequently, mostly after every change we make to the application to ensure that

each component of the code performs the task that is intended. This could be completed by running the code and observing its output, and using the debug tool to indicate the areas where there may be a fault in the code. We would be able to save progress made on the development of the application on primary and secondary storage devices; In this case we could keep our progress either saved on the laptop or on a pendrive/hard drive.

In our configuration management methodology for the hardware, we will need to verify that our device provides consistent outputs for our programs to read. After testing the hardware portion of the project, we will analyze and document the outputs. This will help us access if it meets our requirements and performs as intended. As we make changes to the device that still align with the design requirements, we will document the changes made. The documentation of the changes will provide information about the hardware in its initial and final states, specifically the parts used and their configuration. This information will be beneficial to collect just in case we make a change to the device that results in lower performance. Our documentation would allow us to resort back to a previous state.

In our configuration management methodology for documentation We will use Microsoft teams to share and edit documents. Any relevant documents shall be placed into our Microsoft Team files location. When work on a document begins, it should be uploaded to teams where it can be viewed and worked on by any and all party members that need to use it.

## **Software Development Model**

In terms of methodology, the iterative process is what we are going to use for software modeling. The task at hand has a number of distinct, set goals. These include rendering the GUI, registering incoming signals from the keyboard, and showing which keys there are fingers on. This suggests that as there are many distinct tasks, tackling them one at a time seems to be the most efficient method.

Requirements for the software portion of our project will be defined before development. However, I imagine there will be some unknowns from the developer's perspective involving the integration between the inputs received from the keyboard since we will not have the keyboard completed before the software development begins. Although we may have general requirements about how each finger's position is displayed, there may be some specific adjustments we would like to improve the user interface in a trial-and-error fashion. Consequently, we should use the Iterative model.

## First Semester Schedule

System Integration/Testing Step Description	Completion Date
Integrate the keyboard with the capacitive keys.	Week 1
Test the integration between the keyboard with the capacitive keys.	Week 2
Integrate the capacitive keys with either the USB cord or Bluetooth module.	Week 3
Test the integration between the capacitive keys with either the USB cord or Bluetooth module.	Week 4
Integrate the input we receive from the capacitive keys into our program.	Week 5
Test the integration between the input we receive from the capacitive keys into our program.	Week 6
Integrate the program and either the Mac or Windows operating system.	Week 7
Test the integration between the program and either the Mac or Windows operating system.	Week 8