

# Mobile Device Mouse Application

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## ABSTRACT

*The goal is to create an app that turns an iPhone into a mouse. Existing mouse applications only turn the phone into a track pad - this is useful when a user wants to control their computer from far away or if their track pad is broken, but does not give the control that a traditional mouse does. A lot of people use a physical mouse because of the limitations of a track pad, and there exists an opportunity in the market for an app which provides this functionality. It would be especially useful for people who are travelling and/or moving around a lot but don't want to carry a mouse with them. It will not directly compete against other apps in the app store, but more so against physical mouse products – in particular Apple's Magic Mouse - <http://www.apple.com/magicmouse> that the app will try to mimic. The Magic Mouse sells for \$60, an app that does the same thing could be sold successfully for \$5.*

*Project Blog: <http://ritvikmenon.blogspot.com>*

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## 1. INTRODUCTION

Although touch and gesture tracking has come to the fore over the past few years, the most prevalent method of interacting with a computer is with a mouse. Track pads do the function of what a physical mouse used to, although with certain downfalls. With designing, gaming and most other tasks that are more involved than simple web-browsing, most people would prefer to use a physical mouse as it allows for higher speed and accuracy.

However, when using a laptop computer most people do not carry around a mouse due to the hassle of carrying around a device that is quite sizable compared to the ever-shrinking computer. I have, while working in countless cafes, on countless occasions forgot to bring my mouse with me and suffered a less productive session. A few misplaced Bluetooth mouse dongles later, I thought there must be a better alternative.

My proposed solution is to turn a mobile device into a mouse - much to my surprise there are no apps in the market that do this. Plenty of apps turn mobile devices into track pads but none of them translate linear device motion into cursor motion. This can be done through motion sensors, camera input analysis or a combination of the two. Further, the touch screen of a phone or the camera could be used to recognize gestures that could drive events, a benefit above the functionality of traditional mice and track pads.

The project provides the following contributions:

- i) a method by which to use a mobile device as input to control computers and or other devices
- ii) a method by which to detect linear mobile phone movement with the level of precision and speed necessary to allow for satisfactory cursor control
- iii) an exploration of innovative gesture recognition-through both touch and video to interact with the computer

## 1.1 Design Goals

The final goal is to publish the mouse application in the Apple App Store, and specifically target those who have an everyday need for a mouse but dislike carrying one around, or suffer from lost Bluetooth dongles. The target market would primarily include designers and gamers but would be of interest to almost anyone who prefers using a mouse to a track pad.

The app provides a cheaper alternative to high tech mice, such as the Apple's Magic Mouse (which retails for \$60), whilst providing the same service with added convenience since it operates on a mobile device.

## 1.2 Projects Proposed Features and Functionality

- 1) Wireless interface through Wi-Fi or Bluetooth between iPhone and computer to swap information
- 2) Cursor control functionality through linear motion detection, and other typical mouse controls - single-click, double-click, scrolling etc.
- 3) Multi-touch gesture recognition similar to those detected by the Mac track pad
- 4) In-air gesture recognition through front facing camera to perform certain tasks on the computer – minimize all windows, switch windows etc.
- 5) Additional side features in existing track pad apps on the market. Ideas include: Keyboard Input, Media Controller, File Browser Visualization on Phone (see section 2.1)

## 2. RELATED WORK

### 2.1 Existing Mobile Mouse Applications

Existing mouse apps only offer track pad functionality but their peripheral features could be added to my product to create a more wholesome experience. These apps include:

Mobile Mouse Pro:

- a) Track pad to control mouse
- b) Works over Wifi
- c) Universal remote to control media applications
- d) PowerPoint Presentation control mode
- e) Ability to launch apps from mobile device

Remote Mouse: (only listing features not mentioned above)

- a) Multi-touch gestures
- b) Number pad
- c) "Wii-mote" style control – swaying up/down/left/right
- d) Password protection
- e) Voice recognition
- f) Wi-fi and 3G network connection

## 2.2 Motion detection through image processing

To detect linear motion, one approach would be to analyze the motion of the images captured by the camera to figure out which way the mouse is moving. Existing IEEE and SIGGRAPH on state of the art methods for camera motion detection will be explored and studied. Examples include:

- a) Camera Motion Detection for Conversation Scenes in Movies - Liu Jiayin, Wang Chuang, Jae Ho Kim

In addition there are established algorithms which can be used to analyze optical flow – the Lucas-Kanade method can definitely be used too, but some research has shown that it is too computationally expensive for mobile phone devices in real-time. Algorithms such as this would have to be modified to be lightweight enough to be practical for this application.

## 3. PROJECT PROPOSAL

This project aims to develop a mobile application that makes the device function as a wireless mouse for a Mac laptop or Apple desktop computer. The expected goal is to have a fully working bug-free product that is ready for distribution in the Apple App Store.

### 3.1 Anticipated Approach

#### 3.1.1 Connecting iPhone to Mac

I will need to create a Mac applet, which can create a server that can accept an incoming connection from the Mouse App. Information will be sent over this connection to drive mouse events on the computer. Initially I will just create a Mac program that has to be opened each time the user wasn't to use the app, but later I will develop an installable version, which always listens for incoming connections from the iPhone app.

To make this part work I will learn about the Bonjour protocol for OSX and iOS programming which can be used to create servers to send information over. To develop the Mac app, I will need to get familiar with Cocoa, which is Apple's native OSX coding API.

#### 3.1.2 Creating App's core cursor control functionality

The app needs to detect the linear motion of iPhone. I shall investigate the following different approaches and use the best or a combination:

##### 1) Camera

Use the images from the camera and analyse pixel changes per frame to extract linear motion. This is how an optical mouse does it – investigate its exact method and adapt it for use with the iPhone camera. Two cameras exist on the iPhone, each with their own shortcomings:

###### i) Front Facing Camera:

Limitations: Outdoor situations, the blue sky might not vary enough with camera movement to detect motion. High ceiling spaces - the farther away things are the less the image changes with small movements.

###### ii) Read Facing Camera:

Limitations: if the iPhone does not have a case, the flash will not illuminate the surface underneath, and so it will only see a black image. Need to do research to find out how many % of people use cases, which raise the iPhone enough above the surface, and test out results on different surfaces.

##### b) Gyroscope, Accelerometer, Magnetometer

Use the inbuilt motion detection sensors to track the linear motion of the iPhone. e.g. one could integrate the acceleration to find out how much the iPhone has moved. However, quick research shows that its not straightforward - linear motion is hard to extract from the sensors and signal from the sensors are sometimes noisy - would need to use some filtering algorithms on top.

**Note:** control of the mouse needs to be precise with a high degree of sensitivity - and using just one of the methods above might not be enough, might need to combine all three together to get over the limitations of each.

#### 3.1.3 Gesture Recognition and Other Features

I will design and implement my own gestures to achieve common tasks on the computer. For example:

- i) making a circle with your finger creates is equivalent to clicking alt+tab to select open windows
- ii) multi-touch swiping can go back and forward in a browser

To detect these gestures I will use shape recognition algorithms, which can be run on the shape the fingers make when moving across the iPhone screen. Physical hand gestures can also be detected through the iPhone camera and could also be utilized to drive events on the computer.

To implement the other features, such as keyboard control, I will learn more about what is possible with the iOS API and what events can be triggered with them using Cocoa.

### 3.2 Target Platforms

The program will be coded in Objective-C and will be developed using the XCode IDE.

The App will run on the iPhone, and a program for the Mac will have to be developed which the App can connect to drive mouse events.

### 3.3 Evaluation Criteria

There do not exist any existing apps that which turn a mobile device into a mouse driven by motion, so the benchmark would be an actual physical mouse itself. To be a successful product the app will have to provide nearly identical control of the cursor that a traditional optical mouse provides.

The connectivity between the computer and the iPhone mouse can be compared to those achieved by the aforementioned apps in Section 2.1.

## 4. RESEARCH TIMELINE (Figure 1)

### Project Milestone Report (Alpha Review October 7-9)

- Learn about iOS development through tutorials online, Cocoa for OSX development and Objective-C fundamentals (I have never used these three before)
- Proposed Mac application to connection iPhone app to Mac is developed and functioning using the Bonjour protocol
- App should be able to control mouse through simple buttons and touch screen events, or mimic track pad like control of the cursor through touch screen panning. Main mouse controls should be supported – e.g. click, double click, scroll, pan

### Project Milestone Report (Beta Review November 3-5)

- Should have implemented linear motion detection through either camera or inertial sensors in the iPhone (the next stage will involve implementing the other approach)
- Should have a clear vision of the user workflow of the app and have UI design mock-ups including logo and App icon design
- Mock up of website to advertise Mouse App, with a more apt name chosen
- Have implemented gesture recognition features

### Project Final Deliverables

- An iPhone Mouse app which exhibits the features described in Section 1.2
- A Mac app which will be run to detect incoming connections from the iPhone Mouse app
- Product launch details which include a website, paid for advertising techniques, new product name, pricing strategy and other general information about launching
- A demo video outlining the features of the mouse
- Documentation of the code

### Project Future Tasks

- Release future betas of the App after taking into account user feedback
  - Create applications which will allow the app to work with other operating systems than OSX i.e. with Windows and Linux
  - Create versions of the app for Android and Windows Phone
  - Extend linear motion detection to 3 dimensions to allow turn iPhone into a 3D motion controller
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## 5. Method

## 6. RESULTS

## 7. CONCLUSIONS and FUTURE WORK

## APPENDIX

### A. Optional Appendix

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## References

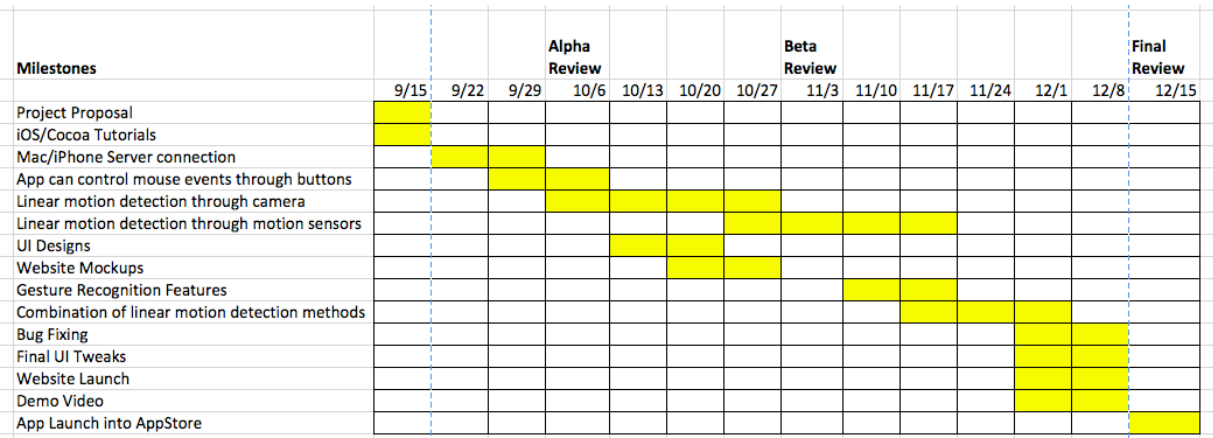


Figure 1: GANT CHART- showing project schedule