

## How to Get High Precision on a Tablet with a Drawing-Like App

Craig A. Will

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One of the issues with tablet computers that use touchscreen user interfaces is that of how to get high precision when a user is doing something like drawing. At first glance this seems impossible or at least very difficult, given that a (large) finger is used instead of a mouse or trackpad.

It is in fact possible, however, to get levels of precision comparable to or even better than that of a mouse on a personal computer when using an iPad.

This note will describe the problem and how to deal with it, using as an example a drawing app that I have been developing for the iPad. (The app isn't publicly available; it is intended for use with apps that I have developed that make use of maps that are drawn by the drawing app.)

### The Problem

Steve Jobs, in a well-known comment a few years ago, said that Apple would not be releasing a tablet smaller than the then-current 10.5 inch iPad. His reasoning was that people's fingers were too big for a smaller iPad to work well. It's impossible to know whether he was really serious, or whether this was a ploy, for example, to focus people's attention on the full-size iPad as a real replacement for the PC. Of course, Apple at that time was making iPhones with small screens, and is now making the mini iPad. What Jobs' comments did do was encourage the idea that finger size was the most significant impediment to many tablet uses.

Jobs did have a point. The size of your fingers *is* an issue. This comes up most often with web sites that are not designed for a tablet. But it is possible to design apps that have high usability even for small size tablets, if you take care in the design.

To understand how to build a high-precision drawing app, we need to understand the real problem.

Why is it harder to draw with precision on a touchscreen with your finger than it is using a mouse on a PC?

I believe that there are two main problems, and that the size of your finger is not itself the direct problem. They are:

#### *1. You Can't See What You Are Doing.*

In most situations when you are drawing you are doing so relative to other elements. You need to see both what you are drawing and how it relates to these other elements. The problem is that your finger obscures much of these. A smaller finger is not going to help much here. The problem is that you are using your finger as a direct drawing instrument and it is blunt, unlike, say, a pencil.

## *2. You Don't Get Feedback About Where The App Thinks Your Finger Is.*

A related problem is that you don't know where the app thinks your finger is. This is somewhat different than where you perceive kinesthetically and visually where your finger is. A mouse or track pad, in contrast, has an associated cursor that displays in real time the exact location of the position at any given time.

### **The Solution: A Virtual Touch Pad Area**

I have a family of apps that are tourist guides for small towns in the foothills and mountains near Yosemite National Park. Included in the guides are maps that show attractions and businesses of interest to a tourist. Because cell and Wi-Fi service in these rural areas has poor coverage and reliability, the apps need to work without an Internet connection. For this reason and others, Apple Maps and Google Maps aren't appropriate. Instead, I've developed a map editor that allows a person to create a set of maps for a particular town. One version of this map editor runs on an iPad and is written in Objective-C. The output is a text-based representation for the map, which serves as instructions for Quartz, the iOS graphics drawing language, to draw the maps.

I was initially unsure about whether I could build a map editor for an iPad that would have levels of precision comparable to that of a drawing program like Adobe Illustrator, which runs on a PC with a mouse or trackpad.

The use of a stylus was something I considered, but this has limited value. The typical stylus for an iPad has a blunt rounded surface and, although smaller, is otherwise not much different from a finger. A stylus helps a little, but doesn't really solve the problem.

I initially built an editor that used the pinch-and-spread zoom capability of iOS. The user could zoom in, take the necessary actions with high precision, and then zoom out again. This zooming capability is implemented in the app, but I soon found a way to provide even higher precision that was also easier for the user than zooming.

This solution was to create a rectangle off to the side of the main drawing area that functions as a "virtual touch pad". Users can move their finger (or stylus) up and down and side to side on the touch pad to cause a change to the elements in the map. This works very much like that of a touch pad on a personal computer. Because this touch pad is virtual, how it works can be different for different contexts, and it can provide much higher levels of precision than a mouse or ordinary trackpad if necessary.

To see how this works in practice, I will show two examples from the map editor: drawing a road, and rotating a building that has been added to a map.

### **Example 1: Drawing a Road**

The map editor works by allowing a user to trace a map that is originally displayed by Apple Maps or Google Maps. The user will, say, select Apple Maps and navigate by zooming and panning to an area of the map that the user wants to use as the basis for the map to be created.

The user then "locks" this area, preventing any further zooming or panning of the original Apple/Google map. (The user can now choose to enter a mode that allows zooming and

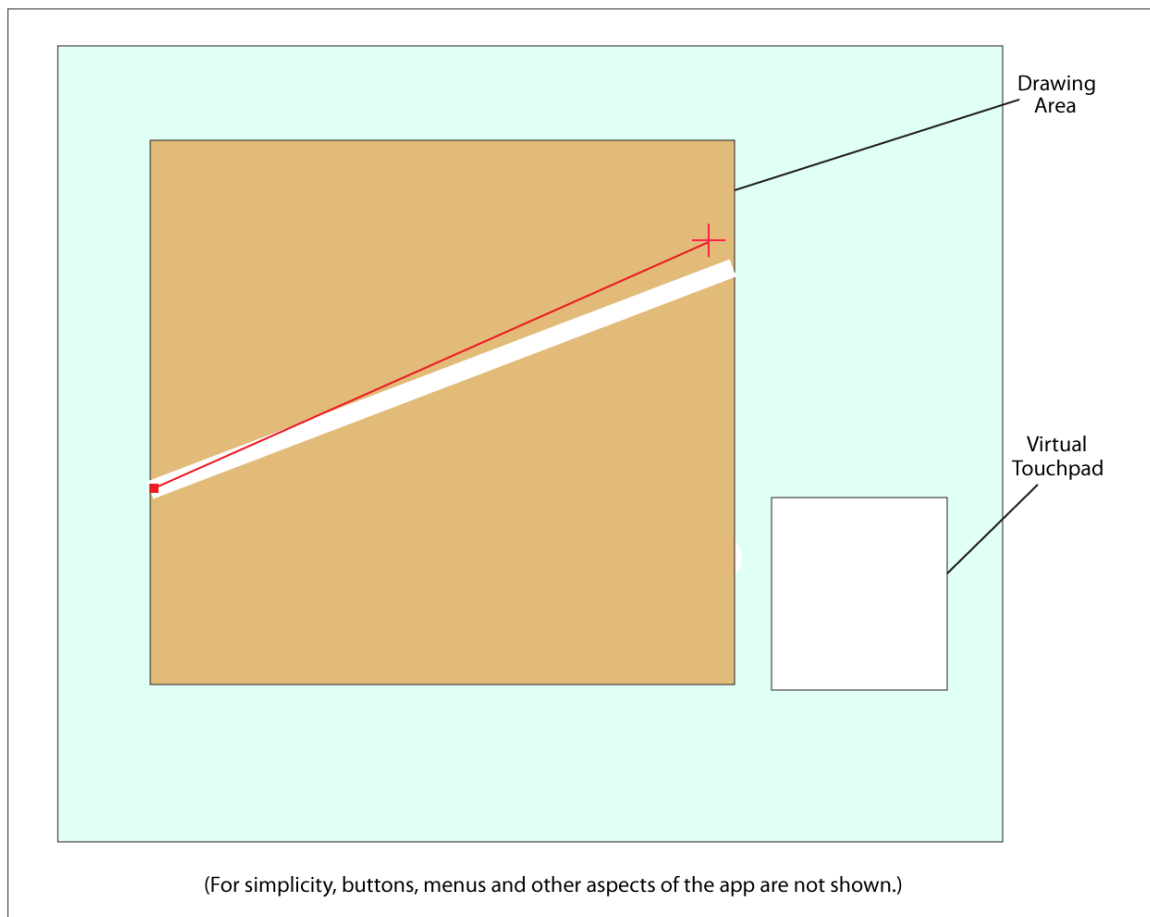
panning, but this is of the new map being created, with the Apple/Google underlying layer only going along for the ride.)

These are tourist maps, and it isn't necessarily desirable to show all of the streets in the area. Typically only the main streets and those needed to travel to tourist attractions and businesses are shown.

The user can draw a road by simply selecting "Draw a Road" from a menu, and tapping on the map for the beginning point and a set of subsequent points. The taps are on top of the road shown by Apple Maps, thus tracing the map.

For many cases this is all that is required. However, if high precision is desired, the setting of each point for the road is a two-step process, with tapping on the map the first step, and the use of the virtual touchpad the second step.

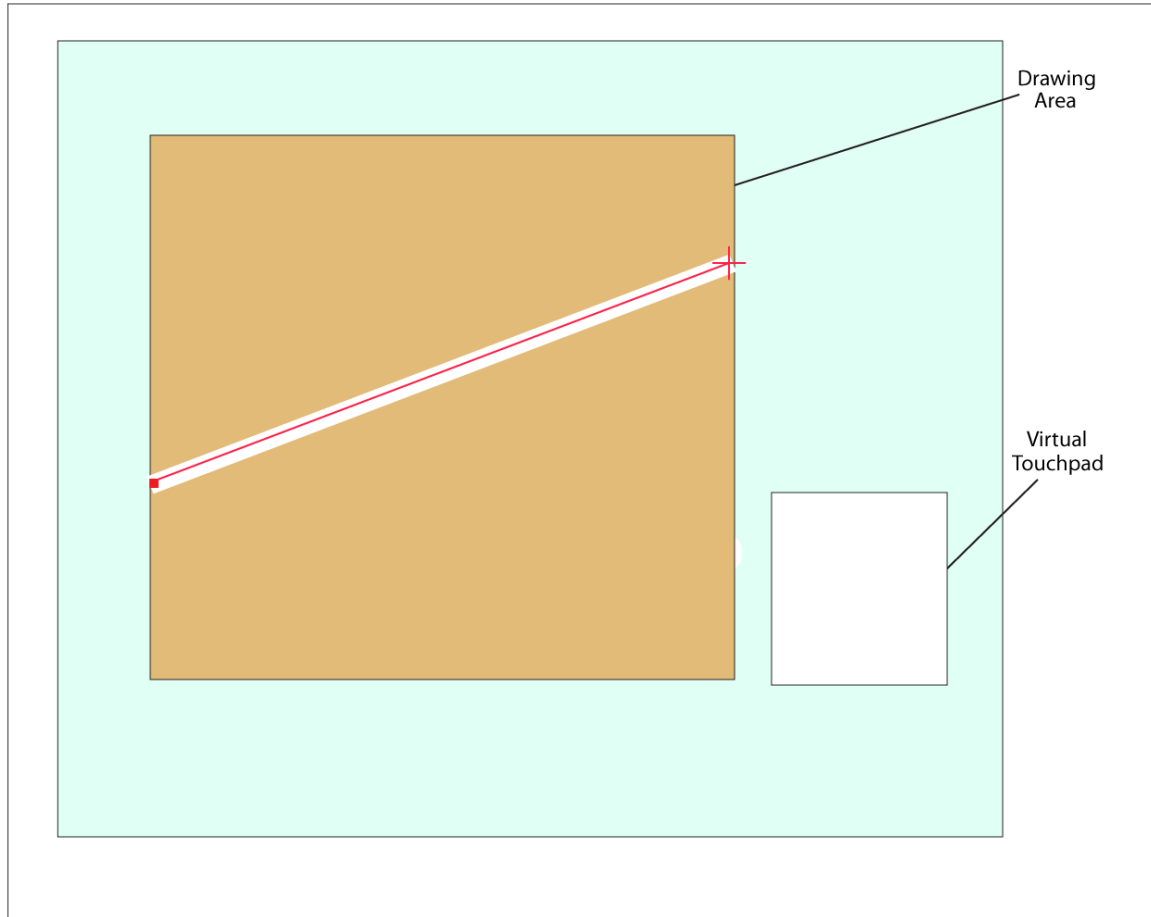
The following figure shows the beginning of a road, in which two points have been added, the initial point of the road and a second point, the latter shown as a crosshair. Note that the second point is off a bit--it should be directly on top of the original road.



What the user does is to move his or her finger across the virtual touch pad. This will cause the position of the second point to change, as shown by the crosshair. With this approach your finger is not obscuring anything, and its size is not an issue. The

distance that the crosshair moves can be as little as necessary in order to get the desired position. The crosshair provides the feedback that the similar cursor of a mouse would provide.

The figure below shows the road after the user has moved the second point of the road by use of the virtual touch pad.



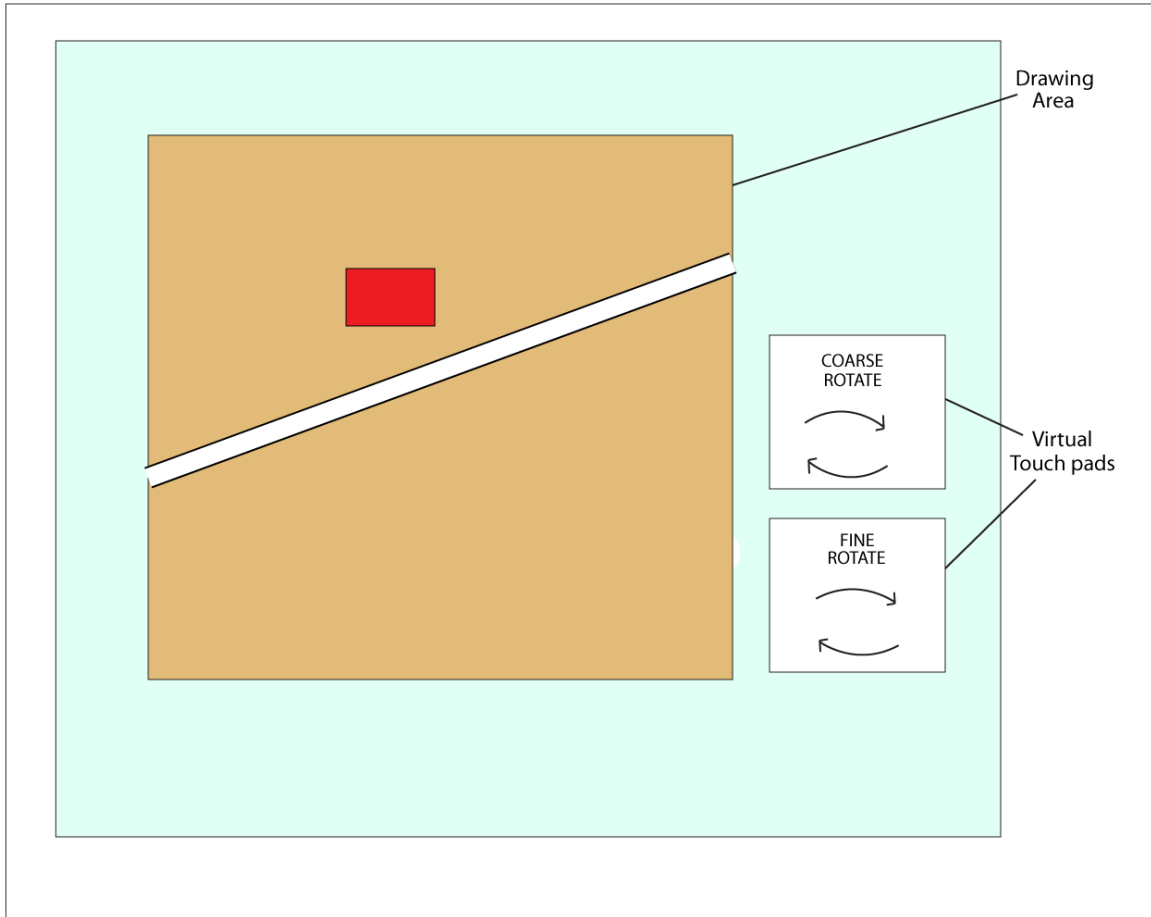
### Example 2: Rotating a Building

A second example is that of rotating a building. With the map editor, a building is just a rectangle that can be drawn of a desired width and height. It can also be rotated.

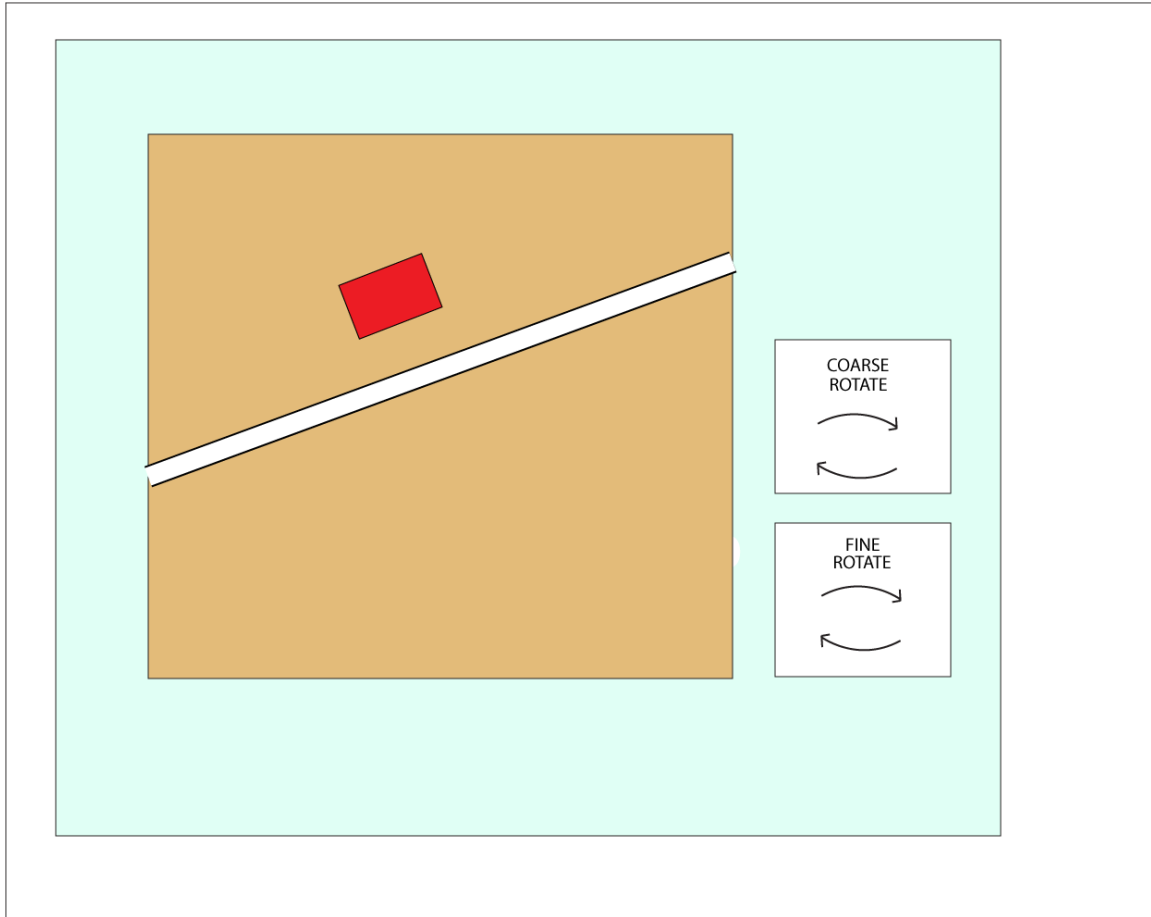
This is done in multiple steps. The user selects "Draw a Rectangle" from a menu, and then taps on the map at the desired location. This is only a rough position, to be corrected later. The size of the rectangle is also modified later. Both of these fine adjustments are done with virtual touch pads.

In the figure below the building needs to be rotated so that it is parallel to the road. There

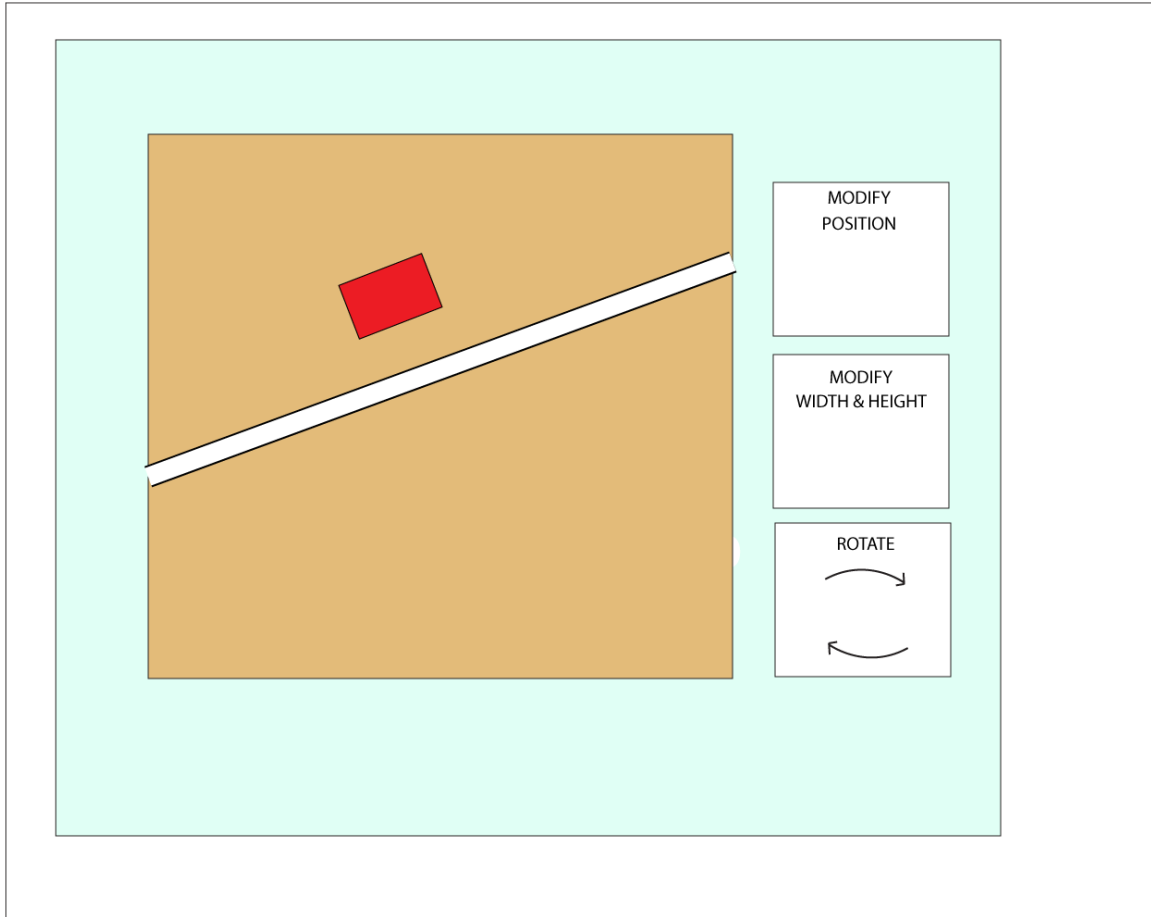
are two virtual touch pads shown. Both will cause a rotation of the building that has been selected when the user moves his or her finger to the right or left. (The arcs with the arrows indicate what rotational movements will occur given a movement to the left or right.)



The top touch pad area does "coarse" rotation, while the bottom one does "fine" rotation control.



The figure below shows a different configuration of multiple touch pads. This allows the modification of the position, width and height, and rotation of a rectangle with a single screen.



## Conclusion

The technique shown here allows very high precision in a touchscreen drawing app, even on a small tablet, and even if your fingers are pretty big. There are some disadvantages. The app is a little more complex, and it takes more steps for a user to draw things than it might on a PC with a mouse. The particular application shown is used mainly for minor updates of tourist maps, and these are not major problems and are offset by the convenience of using a tablet.