ThinkGear SDK for OS X: Development Guide

Introduction

This guide will teach you how to use NeuroSky's **ThinkGear SDK for Mac** to write Mac applications that can utilize bio-signal data from NeuroSky's ThinkGear bio-sensors. This will enable your Mac apps to receive and use bio-signal data such as EEG acquired from NeuroSky's sensor hardware.

This guide (and the entire **ThinkGear SDK for Mac** for that matter) is intended for programmers who are already familiar with standard Mac development using Xcode and Apple's Mac SDK. If you are not already familiar with developing for Mac, please first visit Apple's web site for instruction and tools to develop Mac apps.

If you are already familiar with creating typical Mac apps, then the next step is to make sure you have downloaded NeuroSky's **ThinkGear SDK for Mac**. Chances are, if you're reading this document, then you already have it.

ThinkGear SDK for Mac Contents

- ThinkGear SDK for Mac: Development Guide (this document mac_development_guide.pdf)
- ThinkGear.framework library
- ThinkGearTouch example project for Mac

You'll find the "ThinkGear.framework" in the `lib/` folder, and the "HelloEEG" in the `Sample Project/` folder.

Supported ThinkGear Hardware

The ThinkGear SDK for Mac must be used with a ThinkGear-compatible hardware sensor device. The following ThinkGear-compatible hardware devices are currently supported:

- MindWave Mobile for use with an Mac device's built in Bluetooth

Important: Before using any Mac application that uses the TG-SDK for Mac, make sure you have paired the ThinkGear sensor hardware to your Mac by carefully following the instructions in the User Manual that came with each ThinkGear hardware device!

Your First Project: HelloEEG

HelloEEG is a sample project we've included in the **ThinkGear SDK for Mac** that demonstrates how to setup, connect, and handle data to a ThinkGear device. Add the project to your Xcode enviornment by following these steps:

1. Browse in the TG-SDK to select the Sample Projects/HelloEEG directory
2. Double-click the HelloEEG.xcodeproj file
3. select **Product** **Run** to compile, link and start HelloEEG in the Xcode emulator.

At this point, you should be able to browse the code, make modifications, compile, and deploy the app to your device or emulator just like any typical OS X application.

Developing Your Own ThinkGear-enabled Apps for Mac

For most applications, using the ThinkGear Mac API is recommended. It reduces the complexity of managing ThinkGear accessory connections and handles parsing of the data stream from these ThinkGear accessories. To make a application, all you need to do is to import a library, and assign a delegate object to which accessory event notifications will be dispatched.

Some limitations of the ThinkGear for Mac API include:

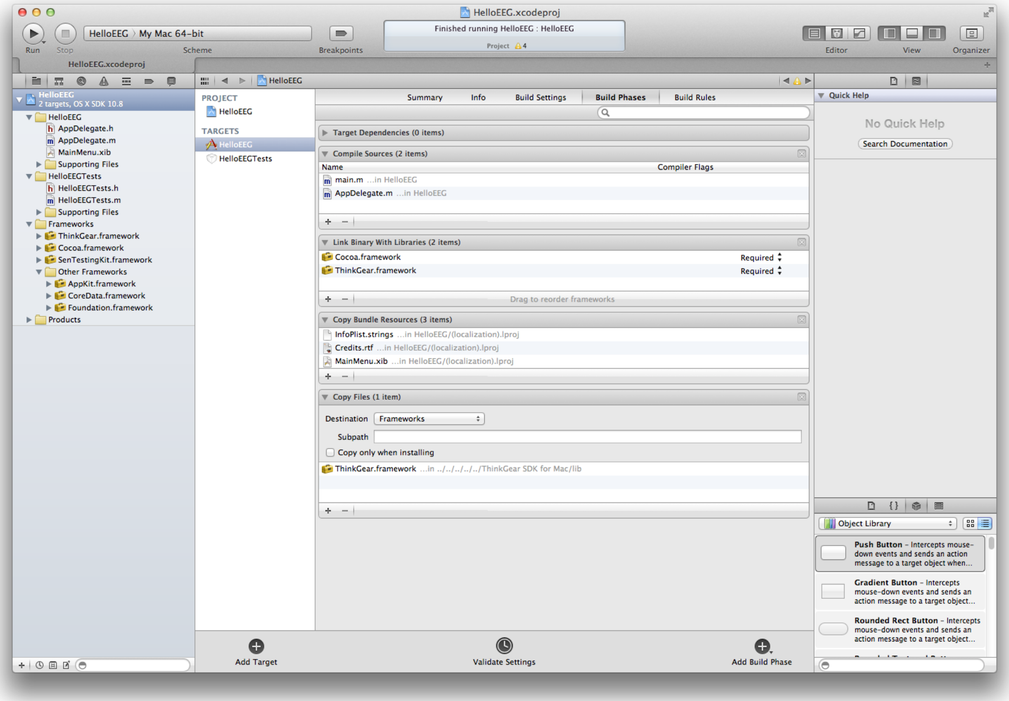
- Can only communicate with one attached ThinkGear-enabled accessory

Configuring Your Environment

Add ThinkGear.framework to your project.

1. Navigate to your project settings
2. Select your target
3. Select Build Phases
4. Expand **Link Binary With Libraries**
5. Click on + and select `ThinkGear.framework` and click **Add**

Your project window should now look similar to this:



Target Dependencies (0 items)

Compile Sources (2 items)

Name	Compiler Flags
main.m ...in HelloEEG	
AppDelegate.m ...in HelloEEG	

Link Binary With Libraries (2 items)

Cocoa.framework	Required
ThinkGear.framework	Required

Drag to reorder frameworks

Copy Bundle Resources (3 items)

InfoPlist.strings ...in HelloEEG/(localization).lproj
Credits.rtf ...in HelloEEG/(localization).lproj
MainMenu.xib ...in HelloEEG/(localization).lproj

Copy Files (1 item)

Destination Frameworks
Subpath
□ Copy only when installing
ThinkGear.framework ...in ../../../../../ThinkGear SDK for Mac/lib

Push Button – Intercepts mouse-down events and sends an action message to a target object when...
Gradient Button – Intercepts mouse-down events and sends an action message to a target object...
Rounded Rect Button – Intercepts mouse-down events and sends an action message to a target object...

Figure 1: Add Framework to Project

App Sandbox

Creating ThinkGear Object

A ThinkGear object is used to manage a single connection to a single ThinkGear hardware device.

- Import following files into your header files

```
#import "ThinkGear/ThinkGear.h"
```

- Declare a ThinkGearObjc object in the header(.h) file

```
@interface AppDelegate : NSObject <NSApplicationDelegate, ThinkGearDelegate>
{
    ThinkGearObjC *thinkGear;

    NSString *devicePortName;
    NSString *deviceNameToSearch;
}

@property (assign) IBOutlet NSWindow *window;


...
@end
```

- Initialize the thinkGear in your implementation(.m) file

```
// initialize the thinkgear object
    thinkGear = [[ThinkGearObjC alloc] init];
    [thinkGear setDelegate:self];

    deviceNameToSearch = @"MindWaveMobile";
```

Connecting to ThinkGear Hardware Device

Simple add the following code to your implementation(.m) file:

```
if([thinkGear connected] == NO) {

        NSArray *devContents = [[NSFileManager defaultManager] contentsOfDirectoryAtPath:@"/dev"
error:nil];
        NSPredicate *ttyPredicate = [NSPredicate predicateWithFormat:@"SELF beginswith 'tty.'"];
        NSArray *deviceList = [devContents filteredArrayUsingPredicate:ttyPredicate];

        devicePortName = @"";
        BOOL found = NO;

        if(deviceNameToSearch.length > 0){
            for(id device in deviceList){
                NSString *temp = (NSString *)device;
                NSLog(@"%@", temp);
                if([temp rangeOfString:deviceNameToSearch].location != NSNotFound){
                    if([deviceNameToSearch isEqualToString:@"MindWave"]){
                        if([temp rangeOfString:@"MindWaveMobile"].location == NSNotFound){
                            found = YES;
                            devicePortName = [@"/dev/" stringByAppendingString:temp];
                            break;
                        }
                    }else {
                        found = YES;
                        devicePortName = [@"/dev/" stringByAppendingString:temp];
                        break;
                    }
                }
            }
        }

        if (found) {
            if(devicePortName.length > 0){
                [thinkGear ConnectTo:devicePortName];
            }
        }

    }
```

Handling Data Receipt

To receive the message from ThinkGear SDK, the `dataRecieved:` method must be implemented. In the header (.h) file, add the following method definition:

```
- (void)dataReceived:(NSDictionary *)data;
```

And in the implementation (.m) file, implement the method.

```
- (void)dataReceived:(NSDictionary *)data {
    if([data objectForKey:@"poorSignal"]){
        ...
    }

    if([data objectForKey:@"rawData"]){
        ...
    }

    if([data objectForKey:@"eSenseMeditation"]){
        ...
    }

    if([data objectForKey:@"eSenseAttention"]){
        ...
    }

}
```

ThinkGear Data Types

Poor Signal

This integer value provides an indication of how good or how poor the bio-signal is at the sensor. This value is typically output by all ThinkGear hardware devices once per second.

This is an extremely important value for any app using ThinkGear sensor hardware to always read, understand, and handle. The value is stored in the key of "poorSignal".

Raw Data

This data type supplies the raw sample values acquired at the bio-sensor. The sampling rate (and therefore output rate), possible range of values, and interpretations of those values (conversion from raw units to volt) for this data type are dependent on the hardware characteristics of the ThinkGear hardware device performing the sampling. You must refer to the documented development specs of each type of ThinkGear hardware that your app will support for details.

As an example, the majority of ThinkGear devices sample at 512Hz, with a possible value range of -32768 to 32767.

As another example, to convert TGAT-based EEG sensor values (such as TGAT, TGAM, MindWave Mobile, MindWave, MindSet) to voltage values, use the following conversion:

```
    (rawValue * (1.8/4096)) / 2000
```

Attention

This int value reports the current eSense Attention meter of the user, which indicates the intensity of a user's level of mental "focus" or "attention", such as that which occurs during intense concentration and directed (but stable) mental activity. Its value ranges from 0 to 100. Distractions, wandering thoughts, lack of focus, or anxiety may lower the Attention meter levels. See eSense\texttrademark Meters below for details about interpreting eSense levels in general.

The value is stored in the key of "eSenseAttention". It is typically output once a second.

Meditation

This unsigned one-byte value reports the current eSense™ Meditation meter of the user, which indicates the level of a user's mental "calmness" or "relaxation". Its value ranges from 0 to 100. Note that Meditation is a measure of a person's **mental** levels, not **physical** levels, so simply relaxing all the muscles of the body may not immediately result in a heightened Meditation level. However, for most people in most normal circumstances, relaxing the body often helps the mind to relax as well. Meditation is related to reduced activity by the active mental processes in the brain, and it has long been an observed effect that closing one's eyes turns off the mental activities which process images from the eyes, so closing the eyes is often an effective method for increasing the Meditation meter level. Distractions, wandering thoughts, anxiety, agitation, and sensory stimuli may lower the Meditation meter levels. See eSense Meters below for details about interpreting eSense™ levels in general.

The value is stored in the key of "eSenseMeditaion". It is typically output once a second.

eSense Meters For all the different types of eSense™ (i.e. Attention, Meditation), the meter value is reported on a relative eSense™ scale of 1 to 100. On this scale, a value between 40 to 60 at any given moment in time is considered "neutral", and is similar in notion to "baselines" that are established in conventional EEG measurement techniques (though the method for determining a ThinkGear baseline is proprietary and may differ from conventional EEG). A value from 60 to 80 is considered "slightly elevated", and may be interpreted as levels being possibly higher than normal (levels of Attention or Meditation that may be higher than normal for a given person). Values from 80 to 100 are considered "elevated", meaning they are strongly indicative of heightened levels of that eSense™.

Similarly, on the other end of the scale, a value between 20 to 40 indicates "reduced" levels of the eSense™, while a value between 1 to 20 indicates "strongly lowered" levels of the eSense™. These levels may indicate states of distraction, agitation, or abnormality, according to the opposite of each eSense™.

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