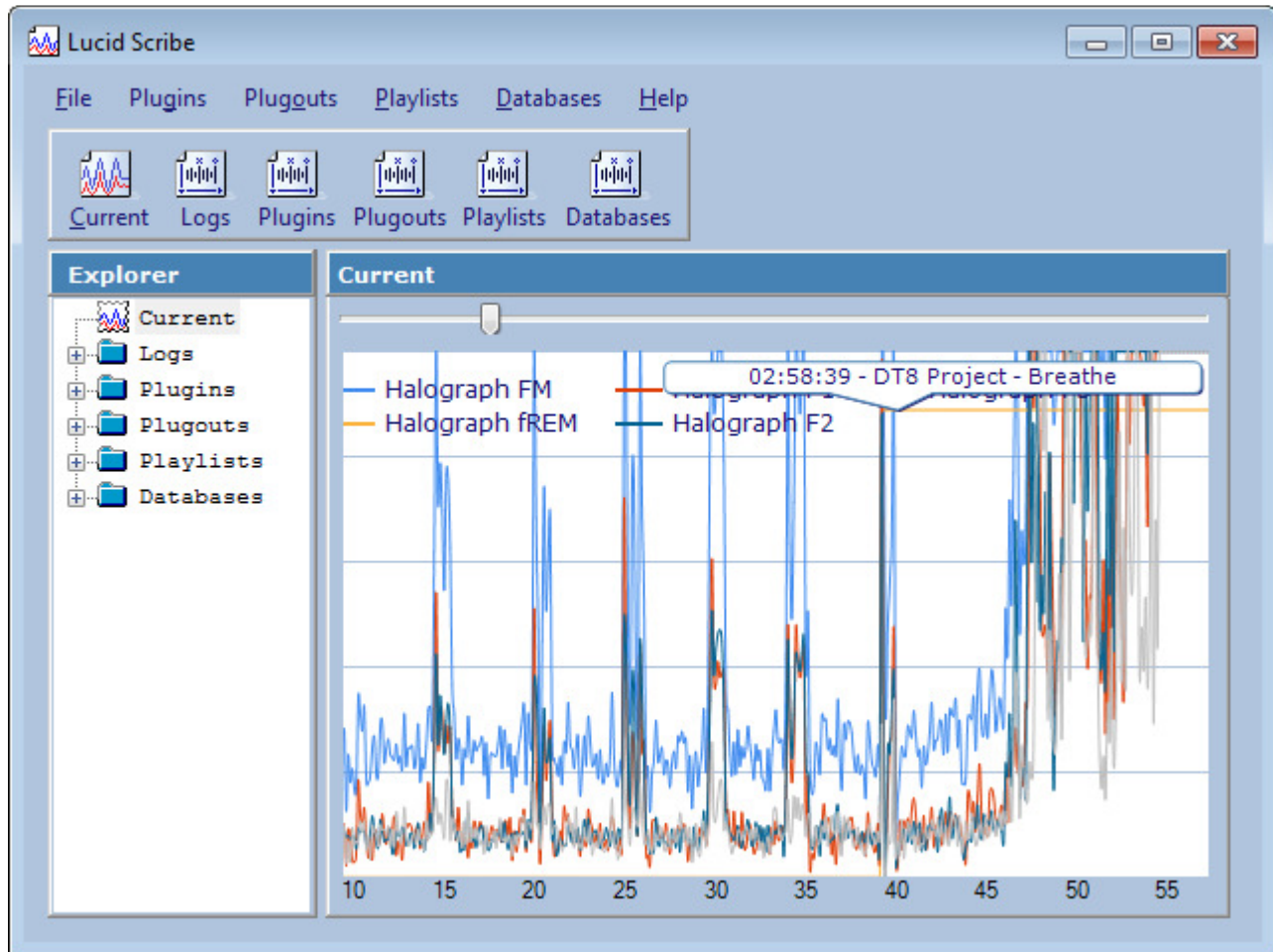


Lucid Scribe

User's Guide

Lucid Scribe is a program to record various body signals, detect REM sleep and trigger various outputs when REM sleep is detected.

This document describes the functions of Lucid Scribe, how they work and how to use them.



Lucid Scribe can be used to measure and record brain wave patterns using an EEG device connected to the computer and play back audio files or trigger another device when REM sleep is detected through eye movement. For the recording the corresponding plugin for the EEG in use has to be installed along with the main software. For example to use Lucid Scribe with a headset or headband that contains a ThinkGear AM, like the MindWave, you have to install at least Lucid Scribe and the NeuroSky ThinkGear EEG plugin.



2 The User Interface

Main Window

Upon startup a small window opens for each plugin that is enabled and has settings. After all settings are chosen, the main window opens and graphs each channel in the Current view. A new entry is created in the Explorer tree on the left under the Logs folder for each minute that is recorded. It can be selected by expanding the year, month, day and hour folders that it is saved under.

1. Menus

The context menus can be accessed by right-clicking on an item in the Explorer or the graph.

2. Explorer

The Explorer can be used to navigate through logs, plugins, plugouts, playlists and databases. The folder structures can also be accessed under `\My Documents\lucidcode\Lucid Scribe\` in the file system. The LSD files are based on the XML format and are human readable.

3. Current View

The Current view graphs each channel in real time from the plugins that have been installed and are enabled.

3.1 View Slider

The view slider determines how many data points are kept in the graph. It defaults to twelve seconds worth.

3 Plugins

Plugins add channels to Lucid Scribe. They can be installed from <http://lucidcode.com/LucidScribe/> and are automatically integrated into Lucid Scribe during the installation process.



When a plugin is selected from the Plugin menu or node in the Explorer, it can be enabled or disabled and the appearance (color, line width and dash style) can be altered in the Plugin view.

3.1 Halovision

Used for: Monitoring a video feed of a close-up of a face and identifying rapid eye movements (video EOG).

Provided Channels:

Halovision: The amount of change between the last two frames.

vREM: Charts when eye-movement patterns are detected in the video and plays audio tracks or triggers plug-outs during REM.

Settings:

Algorithm:

Motion Detector: Triggers whenever the frame threshold is reached.

REM Detector: Triggers whenever a blinking pattern is detected.

Pixel Threshold: Amount that a single pixel must have changed between frames to be detected.

Pixels in a Row: Amount of neighboring pixels that have to reach the pixel threshold to be detected.

Frame Threshold: Amount of pixels that must change for the algorithms to detect a change.

Amplification: Value that each changed pixel contributes to the frame threshold.

Tips: Draw a contrasting triangle on your eyelids to help the algorithm pick up changes.

Product Link: Any webcam

Plugin Status: Active

3.2 Mouse FIELD

Used for: Monitoring the mouse activity. Enhancing the Finger Induced (Electronic) Lucid Dream induction technique.

Provided Channels:

Mouse X: Displays horizontal movement.

Mouse Y: Displays vertical movement. (LucidScribe.Mouse opens as a new window to display x and y mouse coordinates in real time.)

Mouse REM: For use originally with Rob's modified mouse mask.

Button: Displays mouse clicks.

Mouse TCMP: Morse code characters displayed from relative mouse movement.

Button TCMP: Morse code characters displ

FILD REM: Practice FILD on the mouse by tapping on it. If you stop for too long it triggers to remind you to RC.

FIELD: Hold the mouse button down and when you fall asleep and let go, it plays an audio track.

Tips: Flip the mouse over and tap on the infrared sensor.

Product Link: Any mouse or trackpad.

Plugin Status: Active

3.3 Zeo EEG

Used for: Monitoring the data stream from the Zeo EEG headset.

Provided Channels:

Zeo RAW: The raw EEG data recorded 128 times a second.

Zeo EEG: The greatest peak or trough in the raw EEG data measured 10 times a second.

Stage: The sleep stage, categorized as Awake, REM, Light, Deep or Sleep.

Product Link: Active

Plugin Status: Active

3.4 Keyboard

Used for: Monitoring the keyboard activity. Measuring performance while working on the computer.

Provided Channels:

Keyboard: Registers each time a key is pressed.

Product Link: Any keyboard.

Plugin Status: Active

3.5 LightStone IOM

Used for: Biofeedback measurement.

Provided Channels:

IOM Heart: Monitors the heart rate.

IOM REM: Will trigger on an increase in the chaoticity (decrease in D2 degree of freedom):

http://www.psycho.hes.kyushu-u.ac.jp/~lab_miura/Kansei/Workshop/proceedings/P-205.pdf.

IR LED REM: For use with Rob's modified Lightstone sensor project, initially featured on the Lucid Dream Art blog: <http://luciddreamart.wordpress.com/2014/11/22/deepaks-a-real-punch/>.

IOM GSR: Monitors the galvanic skin resistance.

IOM BPM: Counts the hearbeats per minute.

IOM HRV: Calculates the heart rate variance.

IOM HRV2: A slightly different formula of calculating the change in the heart rate.

Product Link: <http://www.wilddivine.com/>

Plugin Status: The algorithm for the IOM REM channel is under investigation.

3.6 lucidcode Halograph FM

Used for: Monitors the output of an accelerometer that is sensitive enough to pick up the heartbeat.

Provided Channels:

Halograph F1: Measures the acceleration on the x-axis.

Halograph F2: Measures the acceleration on the y-axis.

Halograph F3: Measures the acceleration on the z-axis.

Halograph FM: Measures the average acceleration on all axes.

Halograph fREM: Looks for eye movement and heartbeat patterns indicative of REM sleep in the FM channel.

Product Link: <http://lucidcode.com/halographs> (DIY)

Plugin Status: Active

3.7 Mattel Mindflex

Used for: MindFlex headset with added serial output

Provided Channels: Mindflex REM, MF Attention, MF Meditation, MF Delta, MF Theta, MF Low Alpha, MF High Alpha, MF Low Beta, MF High Beta, MF Low Gamma, MF Mid Gamma

Product Link: <http://www.mindflexgames.com/> http://www.ebay.com/sch/i.html?_nkw=mindflex

Plugin Status: Active

3.8 Microphone

Used for: Monitoring the volume of any microphone connected to the PC.

Provided Channels:

Microphone: Monitors the microphone volume.

Plugin Status: Active

3.9 Milliseconds

Used for: Developing and debugging plugins.

Provided Channels:

Milliseconds: Graphs the current millisecond.

Plugin Status: Active

3.10 InteraXon Muse EEG

Used for: Recording EEG signals from the InteraXon Muse.

Provided Channels:

Muse EEG1: Monitors the EEG data on channel 1.

Muse EEG2: Monitors the EEG data on channel 2.

Muse EEG3: Monitors the EEG data on channel 3.

Muse ACC1: Measures the acceleration on the x-axis.

Muse ACC2: Measures the acceleration on the y-axis.

Muse ACC3: Measures the acceleration on the z-axis.

Product Link: <http://www.choosemuse.com/>

Plugin Status: Awaiting test from someone with a Muse. Was only able to replay data with the MusePlayer.

3.11 NeuroSky ThinkGear EEG

Used for: Monitoring brainwave activity from NeuroSky ThinkGear EEG compatible devices.

Provided Channels:

NeuroSky RAW: Monitors the raw EEG data at 512 Hz.

NeuroSky EEG: Measures the greatest peaks and troughs in the raw data ten times a second.

NeuroSky REM: Climbs each time the EEG channel exceeds the threshold. If it climbs 8 times, an audio track is played or the active plug-outs are fired. Should be set to the peak of the EEG channel when looking sharply to the left or right.

NS TCMP: Morse Code typing / EEG keyboard: <http://lsdbase.org/2014/01/24/mindwave-keyboard/>.

NZT-48: Highlights when the Beta channel is above the threshold.

Attention: Measures 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. Distractions, wandering thoughts, lack of focus, or anxiety may lower the Attention meter levels.

http://developer.neurosky.com/docs/doku.php?id=thinkgear_communications_protocol#esense_tm_meters

Meditation: Measures the level of a user's mental "calmness" or "relaxation". 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.

Alpha:
Beta:
Delta:
Gamma:
Theta:

Settings:

Algorithm:

Motion Detector: Triggers whenever the EEG channel exceeds the threshold.

REM Detector: Triggers whenever an eye-movement pattern is detected in the EEG channel that is above the threshold.

Gamma Detector: Triggers whenever the Gamma channel exceeds the threshold.

Beta: Used in conjunction with the NZT-48 channel.

Threshold: The value of the NeuroSky EEG channel at which the algorithms will trigger.

NZT-48: The movie / video file to play when the Beta channel is above the threshold.

TCMP: Determines whether to look for Morse Code patterns from blinks in the EEG channel.

Product Link: <http://neurosky.com/products-markets/eeg-biosensors/hardware/>

Plugin Status: Active

3.12 OCZ NIA

Used for: Measuring brain and body biosignals via a headband.

Provided Channels:

OCZ NIA:

OCZ NIA REM:

OCZ NIA RAW:

Product Link: <http://www.bcinet.com/products/> N.B. The early OCZ NIA model is now EOL.

Plugin Status: Active

3.13 OpenEEG

Used for: Monitoring neurofeedback activity from devices compatible with the OpenEEG project.

Provided Channels:

OpenEEG Ch1 - 6: Monitors the EEG data on channels 1 - 6.

OpenEEG RAW: Monitors the raw EEG data.

OpenEEG: Sums up and averages the OpenEEG channels.

OpenREM: Climbs each time the EEG channel exceeds the threshold. If it climbs 8 times, an audio track is played or the active plug-outs are fired. Should be set to the peak of the EEG channel when looking sharply to the left or right.

Settings:

Channels: The amount of channels to monitor (1 - 6).

Algorithm:

REM Detection: Triggers whenever an eye-movement pattern is detected in the EEG channel that is above the threshold.

Motion Detection: Triggers whenever the EEG channel exceeds the threshold.

Blink Interval: The amount of time, in milliseconds, that has to pass before the REM Detection algorithm starts looking for the next eye movement (10 – 1000).

Product Link: <https://www.olimex.com/Products/EEG/OpenEEG/EEG-SMT/>

Plugin Status: Active

3.14 Pranayama

Used for: Breathing exercises that can be followed by keeping the lungs filled at the level of the graph.

Provided Channels:

Pranayama: shows the level at which the lungs should be filled and how long the breath should be retained.

Plugin Status: Active

3.15 tACS

Used for:

Provided Channels:

Product Link:

Plugin Status:

3.16 TCMP

Used for: Sending messages in Morse Code.

Provided Channels:

Product Link:

Plugin Status:

3.17 tDCS

Used for:

Provided Channels:

Product Link:

Plugin Status:

3.18 TI EZ430 Chronos

Used for:

Provided Channels:

Product Link: <http://www.ti.com/tool/ez430-chronos>

Plugin Status:

3.19 Emotiv EPOC

Used for: Emotiv EPOC (and EPOC+?) EEG

Provided Channels:

Product Link: <http://emotiv.com/>

Plugin Status:

4 Plugouts

Plugouts can be installed from <http://lucidcode.com/LucidScribe/> and are automatically integrated into Lucid Scribe during the installation process. Plugouts are triggered by plugins – usually when eye movement patterns are detected.

4.1 Audio

Spins the next audio track in the playlist. Included with Lucid Scribe.

Bonus tracks: <http://lucid-code.com/LSDBase/Anthems>

4.2 Screen LED

Flashes the screen: opens a full-screen black form after a minute and then flashes the screen once a second when triggered.

4.3 Arduino

Triggers any devices wired into an Arduino: <http://www.arduino.cc/>.

4.4 Yocto PowerRelay

Triggers any devices wired into a Yocto PowerRelay: <http://www.yoctopuce.com/EN/products/usb-actuators/yocto-powerrelay>.

5 Data Export

To export data, right-click on a day, hour or minute log in the Explorer tree and select Export -> File.

5.1 Lucid Scribe Data (LSD)

LSD files are based on the XML format and are human readable.

<http://shell.windows.com/fileassoc/0409/xml/redirect.asp?EXT=lsd>

Each hour contains a node for each plugin and every minute contains the raw data.

```
<LucidScribeData>
  <Plugins>
    <Plugin Name="Keyboard" Value="2">
      <M N="0" V="2">1,2,3,...</M>
      <M N="1" V="2">1,2,3,...</M>
      <M N="2" V="2">1,2,3,...</M>
    </Plugin>
  </Plugins>
</LucidScribeData>
```

5.2 Comma Separated Values (CSV)

CSV files can be opened in spreadsheet applications like Microsoft Excel.

5.3 European Data Format (EDF)

EDF files can be opened with EDF viewers.

5.4 Video

Right-click on an hour or minute log in the Explorer tree and select Export -> Video. Select the exact time range, resolution (360p for YouTube, 1080p for HD) and plugins, and then select a filename. In the Video Compression dialog, select Microsoft Video 1 as the Compressor.

5.5 Lucid Scribe Database (LSDBase)

LSD files can also be uploaded to the Lucid Scribe Database by selecting Export -> LSDBase.

The Lucid Scribe Database is an online collection of LSD files recorded from various biofeedback devices during deep sleep, the onset of sleep and other states in which hallucinations occur. The focus is on the physiological changes with only the briefest mention of any subjective experiences.

Eye movements, brain waves, heart beats and breathing patterns are of primary interest. Audio tracks are also noted if triggered when the dream state is detected. The songs can sometimes be heard in the dream world and that knowledge can be acted upon – by flying, for example.

Each entry in the database contains a printout of the most interesting minute in the recording along with a brief description of any interesting findings. And sessions in which the audio track played include a video.

Anyone with a compatible biofeedback device can contribute to the database.

<http://LSDBase.org/>

6 Plugin Development

Plugins can be created in Visual Studio: <http://msdn.microsoft.com/vstudio>, or MonoDevelop: <http://monodevelop.com>.

Lucid Scribe Interface

The Lucid Scribe Interface holds the plugin's properties and Initialize() and Dispose() functions:

```
namespace lucidcode.LucidScribe.Interface
{
    public interface ILucidPlugin
    {
        /// <summary>
        /// The name of the plugin.
        /// </summary>
        String Name
        { get; }

        /// <summary>
        /// Initializes the plugin.
        /// </summary>
        /// <returns>Success or failure.</returns>
        Boolean Initialize();

        /// <summary>
        /// Gets the current value of the plugin - 10 times per second.
        /// </summary>
        Double Value
        { get; }

        /// <summary>
        /// Gets the settings panel.
        /// </summary>
        Control SettingsPanel
        { get; }

        /// <summary>
        /// Disposes the plugin.
        /// </summary>
        void Dispose();
    }
}
```

To develop a new plugin for Lucid Scribe simply follow these steps:

- 1.) Add a reference to lucidcode.LucidScribe.Interface.dll.
- 2.) Create a public class and inherit the LucidPluginBase class.
- 3.) Override the Name and Value properties and the Initialize function.
- 4.) Compile the project and copy the DLL to the Lucid Scribe directory.
- 5.) Run Lucid Scribe and attach to its process to debug.

Millisecond Plugin

The following plugin simply returns the current millisecond (ten times a second if Lucid Scribe is running on the default over-clock value of 100):

```
namespace lucidcode.LucidScribe.Plugin.Millisecond
{
    public class PluginHandler : lucidcode.LucidScribe.Interface.LucidPluginBase
    {
        public override string Name
        {
            get
            {
                return "Millisecond";
            }
        }

        public override bool Initialize()
        {
            try
            {
                return true;
            }
            catch (Exception ex)
            {
                throw (new Exception("The '" + Name + "' plugin failed to initialize: " +
ex.Message));
            }
        }

        public override double Value
        {
            get
            {
                return DateTime.Now.Millisecond;
            }
        }
    }
}
```

