THE LCIMU USER MANUAL

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1.0 General Information

This section explains in general the LCIMU system and its purpose.

1.1 LCIMU System Overview

The LCIMU system aids in the capture of inertial motion data from three segments of a human anatomy. The data captured is saved on a base station (laptop/PC). The LCIMU will function on a base station with the appropriate java IDE (preferably IntelliJ).

1.2 Organization of the User Manual

The LCIMU user manual consists of several sections amongst which are: General Information, LCIMU System Summary, Getting Started, Utilizing the LCIMU system and Correspondence.

The General Information section elucidates in general terms the LCIMU system and its purpose.

The LCIMU System Summary section provides a general overview of the system. It outlines the basic uses of the system's hardware and software requirements, it's configuration and behaviour.

The Getting Started section explains how to get the LCIMU system up and running and installed on a device of choice.

The Utilizing the System section provides a detailed description of system functions and how the hardware component is worn.

The Correspondence section describes the ways the data captured by the system is processed and analysed.

2.0 System Summary

This section gives an overview of the LCIMU system application, it's configuration, user profiles and contingencies.

2.1 The Configuration of the LCIMU application.

The LCIMU application is compatible with any laptop that has any suitable java IDE installed (Eclipse, NetBeans, IntelliJ etc.). It is important that the most recent Java compiler version (JDK 8) is installed on the IDE. The base station (laptop/pc) should have a relatively high processing speed, preferably those with Intel processor series of Core I5 and above, as this would increase the functionality of the system. The data is captured offline and saved on the base station so there is no need for continued access to the internet after installing the application as described in section 3. After importing the LCIMU project there is need for further configuration to ensure that the application functions properly, this would be further addressed in section 3.

2.2 User Profile

The LCIMU system application can be assessed by everyone that has downloaded and successfully registered a profile. Although, the data can only be accessed by registered users who have access to the LCIMU system or have been successful in developing the system from scratch as described in the design documentation.

2.3 Contingencies

In case there is an interruption in the transmission of data from the LCIMU system for any given period, unplugging and plugging back the system will eventually fix this. The LCIMU system is powered from the base station with a USB cable so there is no need for a power surge protector. A hard reset on any of the IMU slave sensors that fails to display data will correct any break in the interruption of data transmission.

3.0 GETTING STARTED

This section details how the LCIMU application is downloaded and installed on a device.

3.1 Installation

The current version of the LCIMU application is available for download from its Git hub repository, https://github.com/DrewOma/dragondada. This repository can also be cloned directly into a working directory of choice on a local system. In this section, the steps taken to install the application will be highlighted. It is important to note here that it is assumed that the latest Java IDK would already have been installed on the local system for the installation and all file paths predefined.

Step 1

On a web browser.

- Go to https://github.com/DrewOma/dragondada

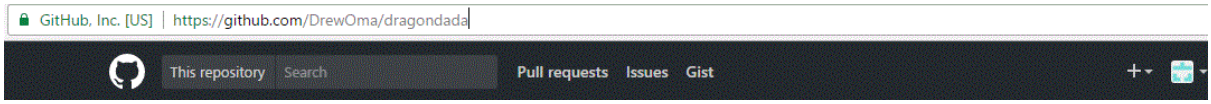


Figure 3.1. Web Browser Navigation

- On the repository, Click Clone or Download, and download the zip file unto a working directory on your local system.

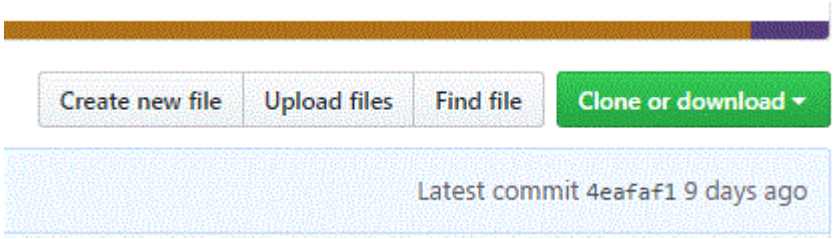


Figure 3.2. Cloning the LCIMU Project Repository

OR

If Git is installed on the local system

- Open Git Bash
- Change the current working directory to a directory of choice for the cloned repository and ensure that the directory is were Git is installed.
- Type in …git clone https://github.com/DrewOma/dragondada

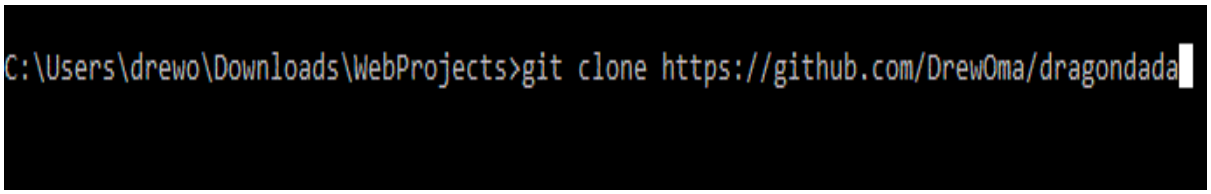


Figure 3.3. Cloning form Command Prompt

- Press Enter and the cloned repository will be downloaded into the system's directory.

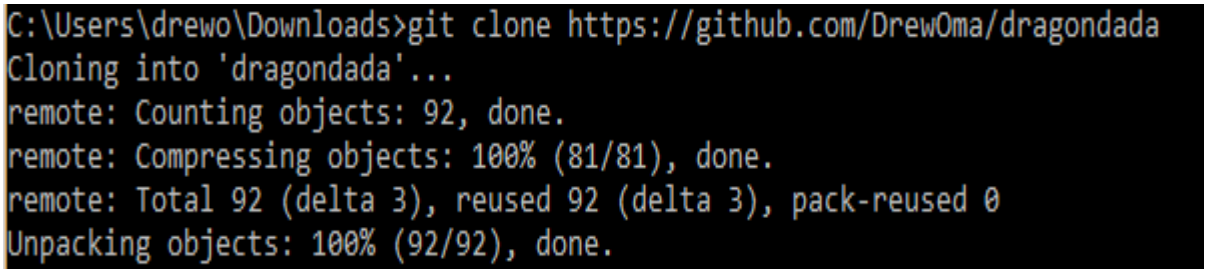


Figure 3.4. Successful Project Cloning from Command Prompt

Step 2

- Download the RXTXComm library from the web.
- There are many websites available to get this library from, one of which is

https://blog.henrypoon.com/blog/2010/12/25/installing-rxtx-for-serial-communication-with-java/ . It has instructions on how to set up the library on the local system as shown below.

> 32-bit version: http://rxtx.qbang.org/wiki/index.php/Download
> 64-bit version: http://fizzed.com/oss/rxtx-for-java
>
> To install the libraries (instructions from JControl):
>
> 1. a. Copy rxtxSerial.dll to %JAVA_HOME%bin, (%JAVA_HOME% is the folder where JRE is installed on your system; e.g. c:Program FilesJavaj2re1.4.1_01)
>
> b. Copy RXTXcomm.jar to %JAVA_HOME%libext

Figure 3.5. Installing the RXTX Library

Step 3

- Download the latest free version (Community) of the IntelliJ IDE from https://www.jetbrains.com/idea/download/index.html#section=windows
- Run the .exe file and complete the installation as prompted.
- On the main IDE, navigate to the Options menu at the top of the IDE and click on *File -> Open* and navigate to the folder that contains the cloned repository and click on the folder to load the project unto Intelli J.

Figure 3.6. Setting Up the Project on Intelli J

- After the project has been loaded navigate to the options menu again and click on *File -> Project Structure* and ensure the Project settings is configured as shown below.

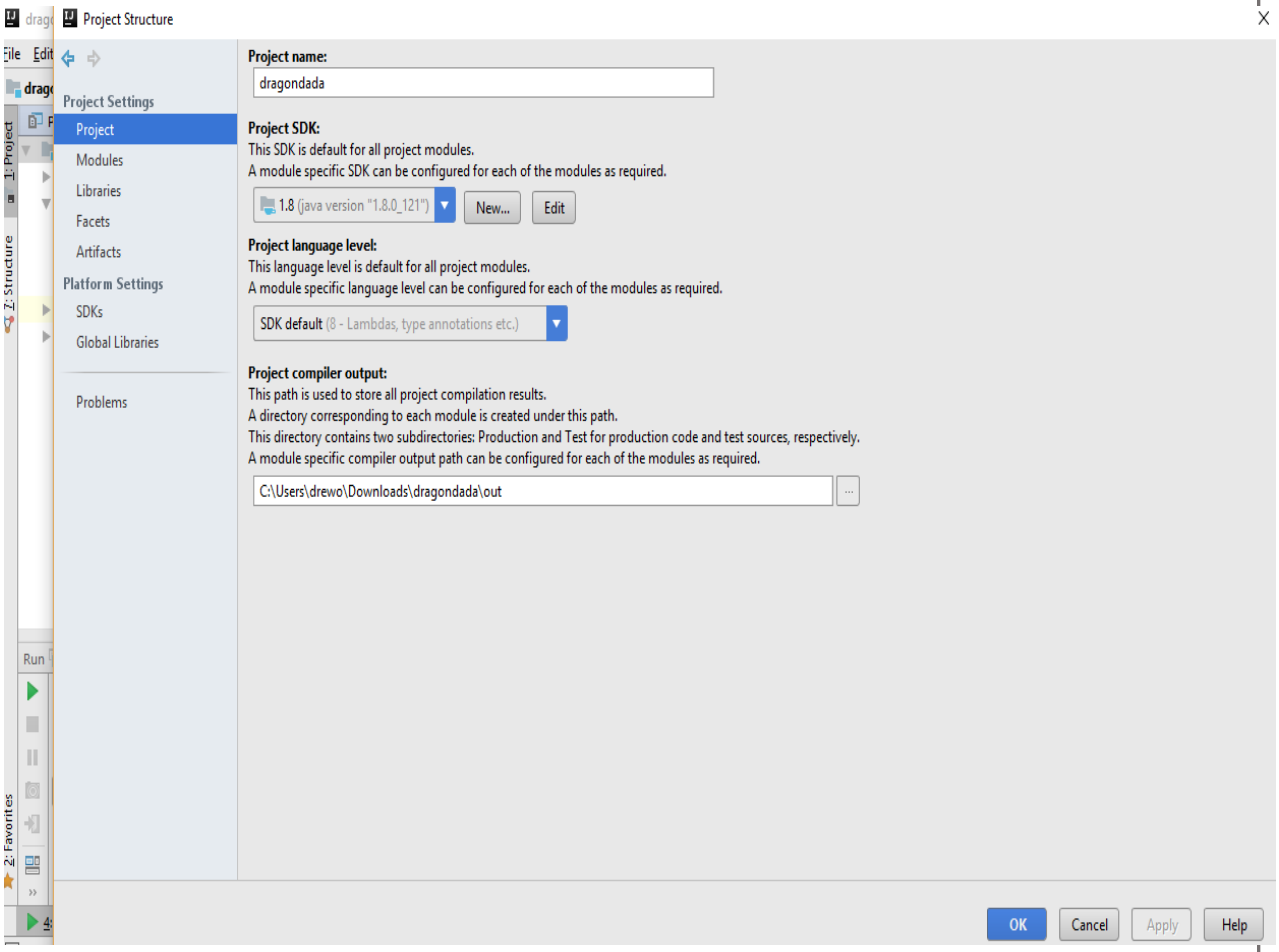


Figure 3.7a. Configuring the Project Structure

- Next Navigate to the Modules settings and ensure that the settings for the Sources, Paths and Dependencies options are as shown in the diagrams below.

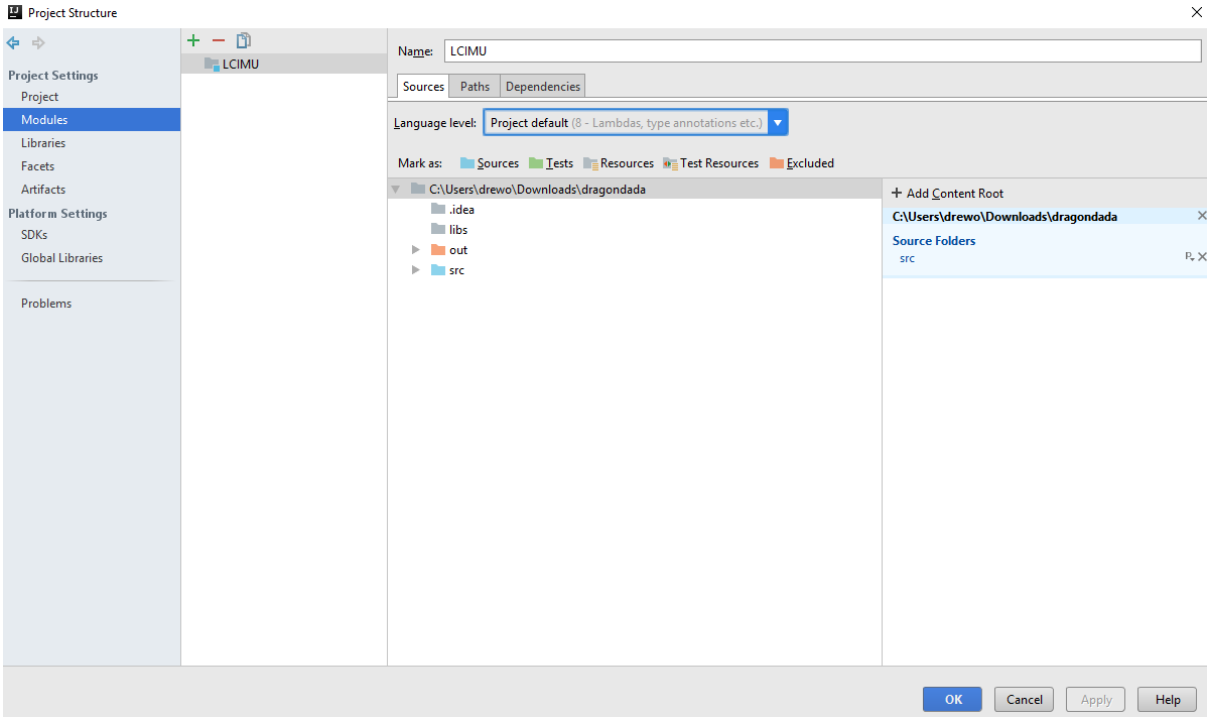


Figure 3.7b. Configuring the Project Structure

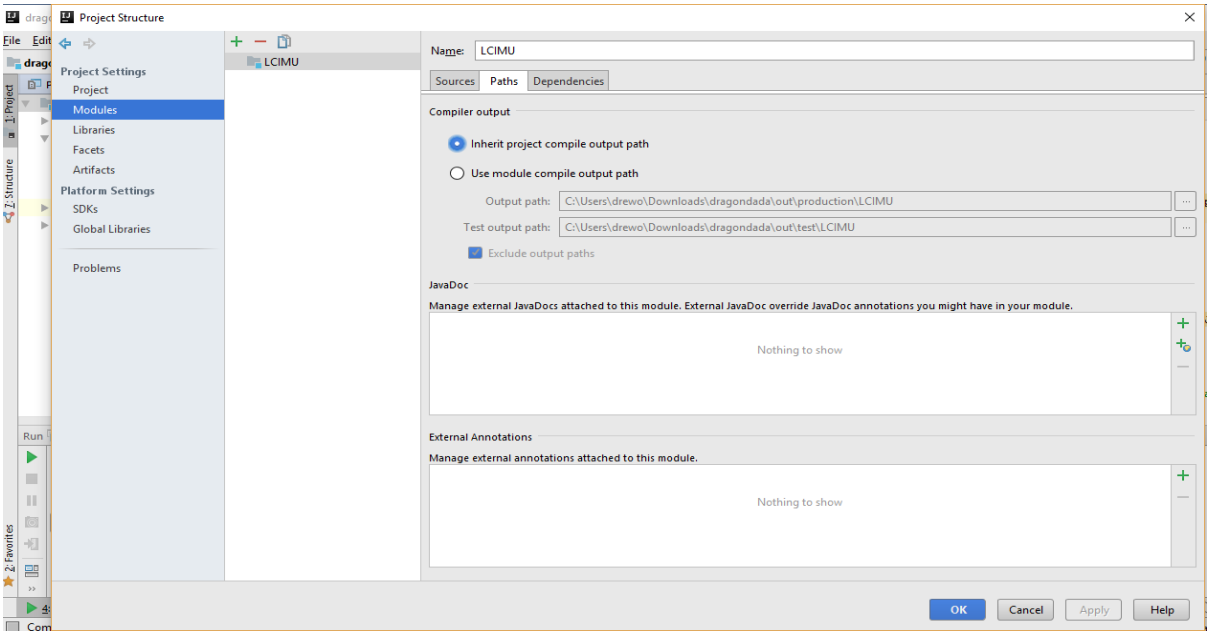


Figure 3.7a. Configuring the Project Structure

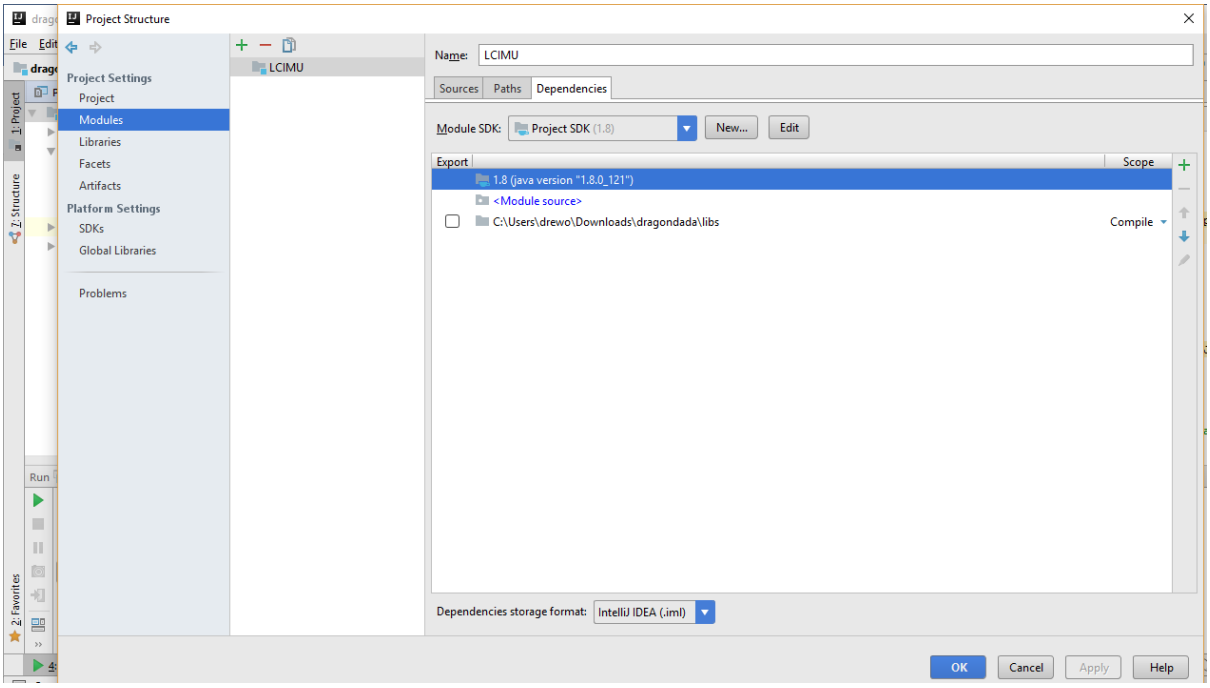


Figure 3.7c. Configuring the Project Structure

- If the project is structured correctly, click ok and return to the project main page.
- Navigate to the top right hand corner of the main page and click on the Edit Configuration menu.
- Set up the Configuration pane as shown below and press ok when done.

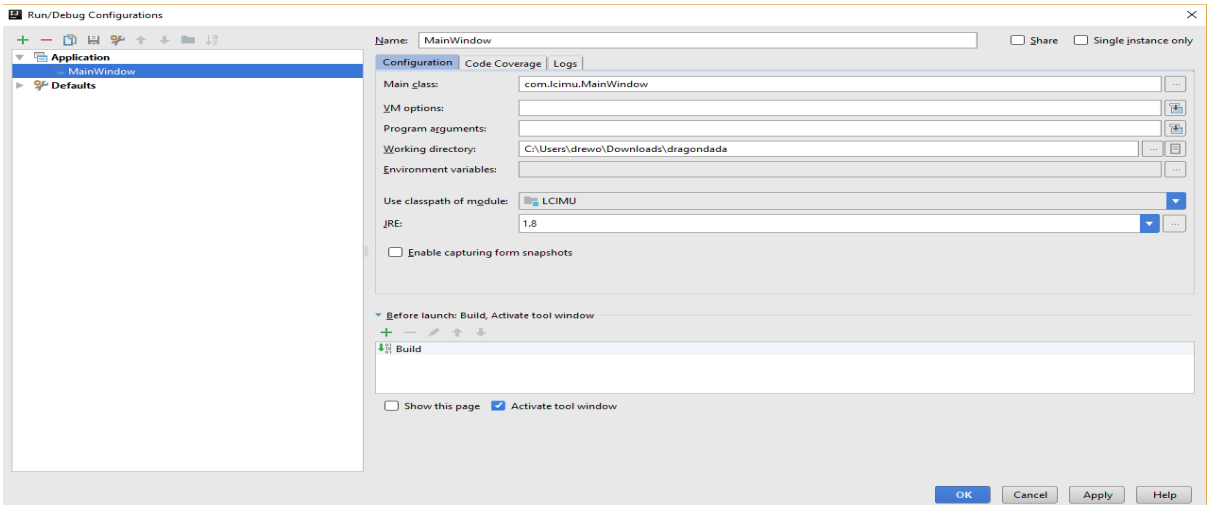


Figure 3.7d. Configuring the Project Structure

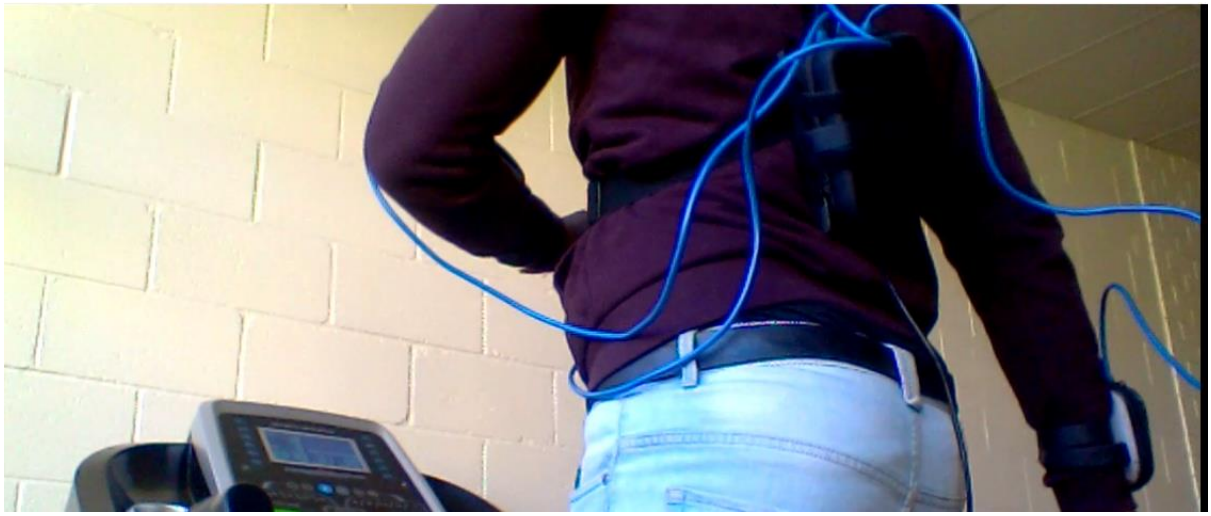
4.0 Utilizing the System

This section would highlight how the LCIMU system is worn and how to use the application connected to the system.

4.1 Wearing the LCIMU system

The LCIMU system comes outfitted with a strap that allows the user to wear the system on the upper part of the body. Figure 4.1 a, b, c, d shows the different profile views of the system being worn.

Figure 4.1a. The Front Profile view of the LCIMU system worn



4.1b. The Peripheral View of the LCIMU system worn

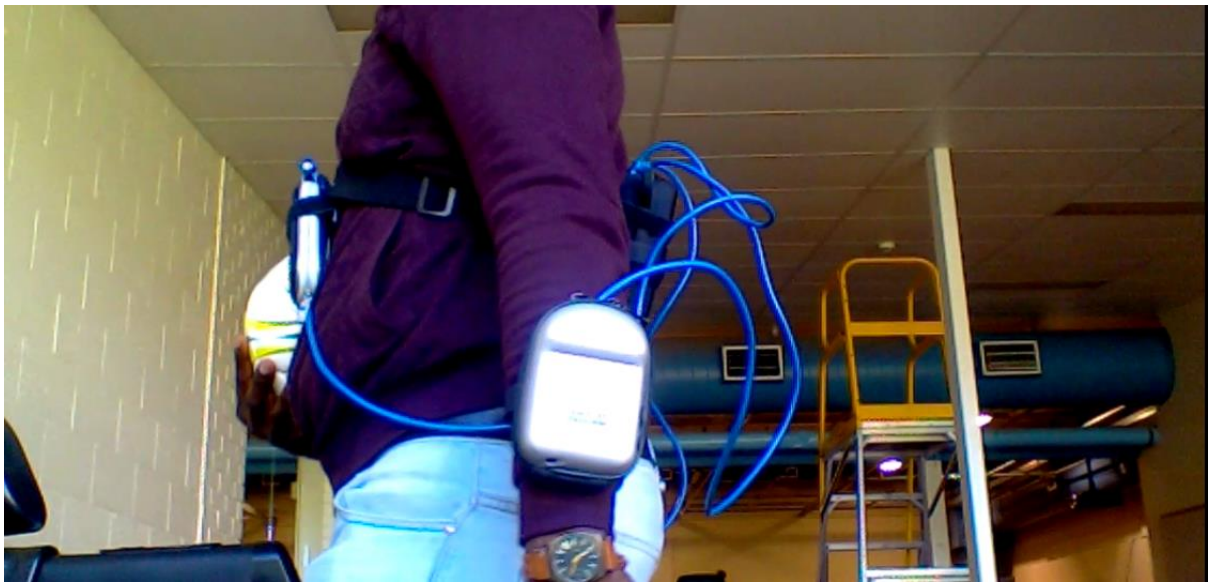


Figure 4.1c. The Side Profile View of the LCIMU System being worn

These different views show how a user can wear the LCIMU system before beginning the data capture process. The system is strapped using a make shift Go-Pro strap to the upper body section of the human anatomy.

4.2 Utilizing the Application

The LCIMU application requires registration to access the main functions. After launching the application, the main window page will be displayed as shown below.

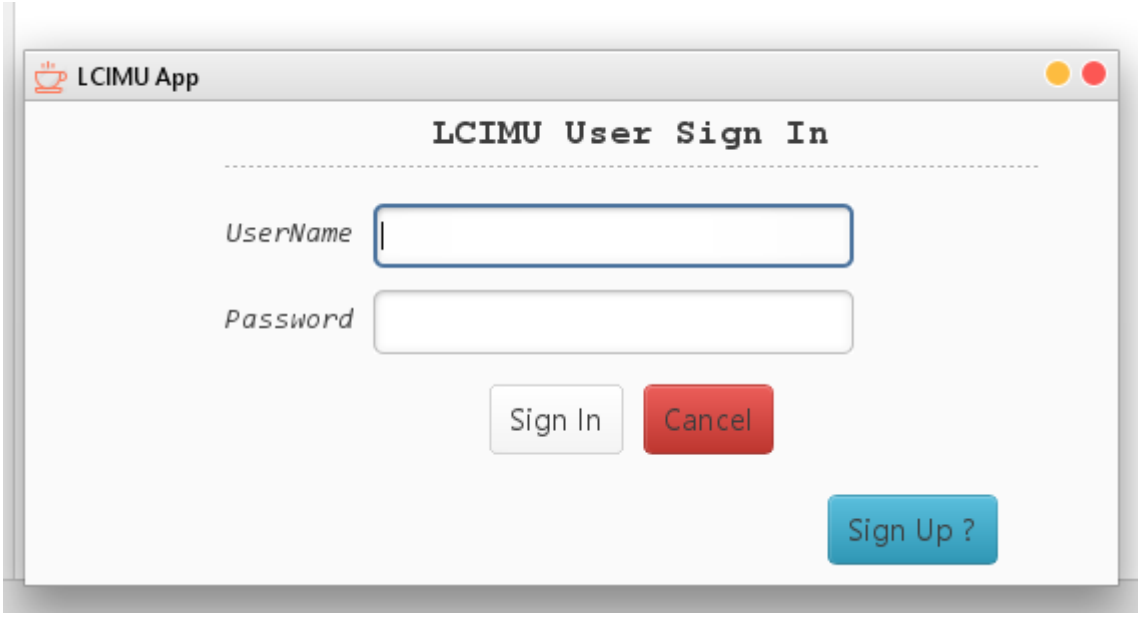


Figure 4.2. User Logging In

Click the *Sign Up* button to input a Username and Password of choice and click the *Sign Up* button again to complete the registration process as shown below.

Figure 4.3. User Registration

On completion of the *Sign Up* process, a redirection to the Sign in Page will then allow logging on to the application.

4.2.1 LCIMU Application Menu

This application consists of three main button controls. A Start button, A Stop Button and a Log Out Button.

Figure 4.4. Application Control Panel

The Start Tab initiates the data capture process, the Stop button terminates the process and the Log Out button logs out the current user from the application.

The Start Button

- On Clicking the Start Button a pop up page appears with a prompt to selecting the serial port where the USB cable from the LCIMU is plugged in as shown below.

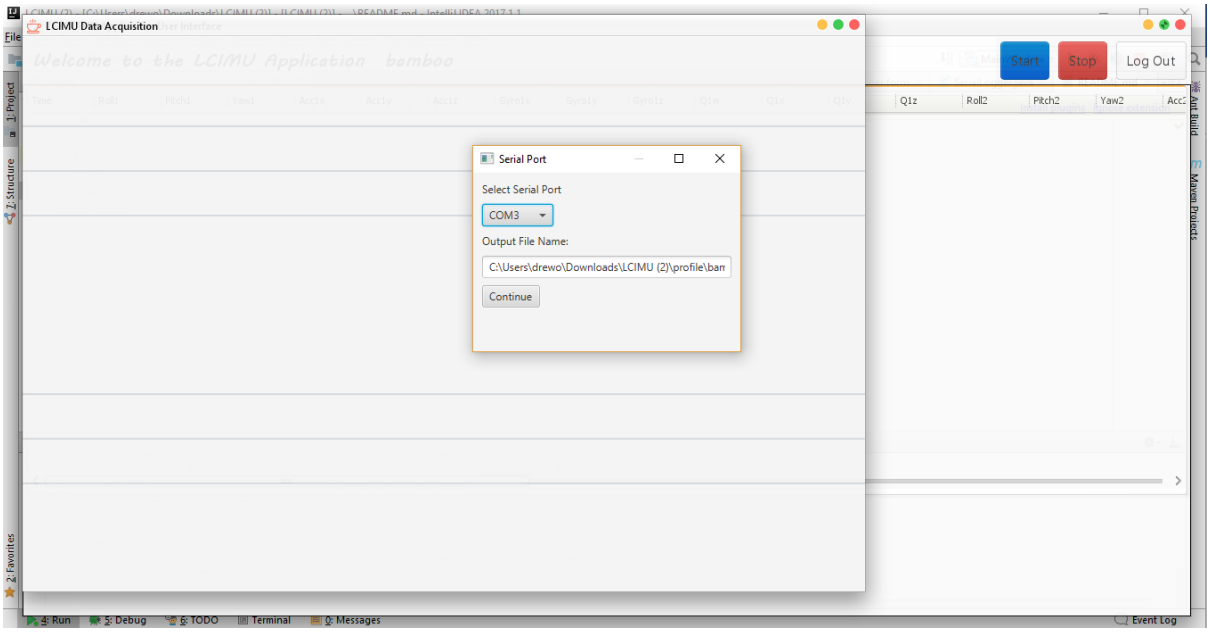


Figure 4.5. Starting the Application

- After selecting the appropriate port, click continue to capture the data. A real-time graph plot will be displayed as shown below.

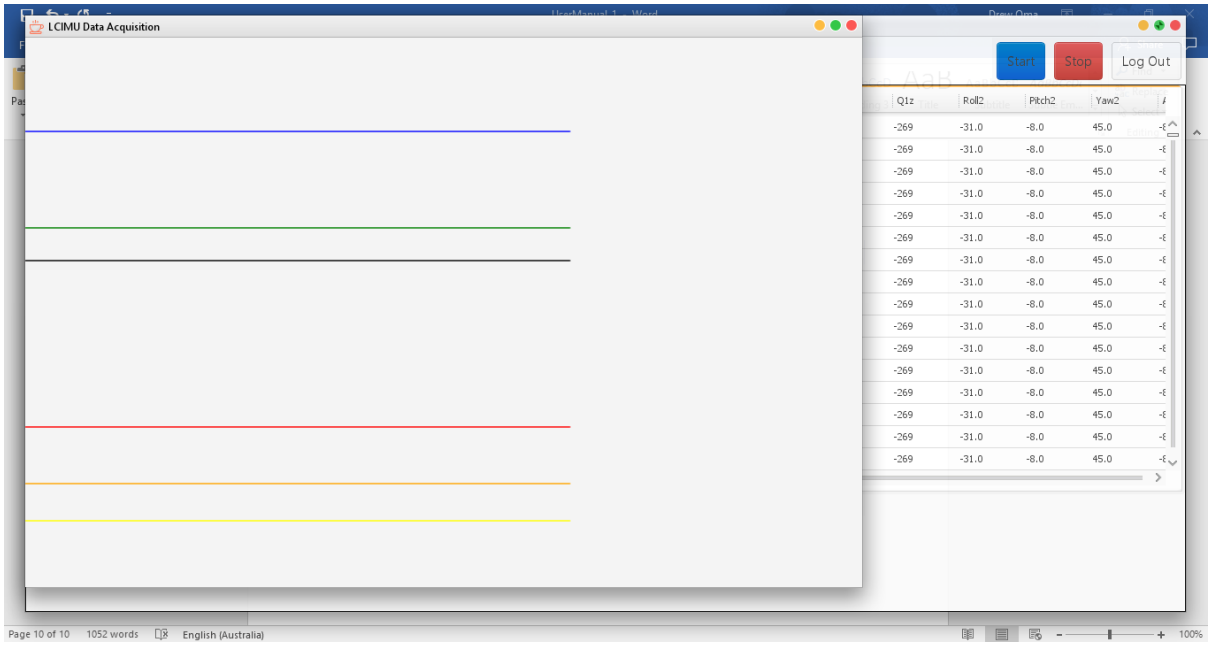
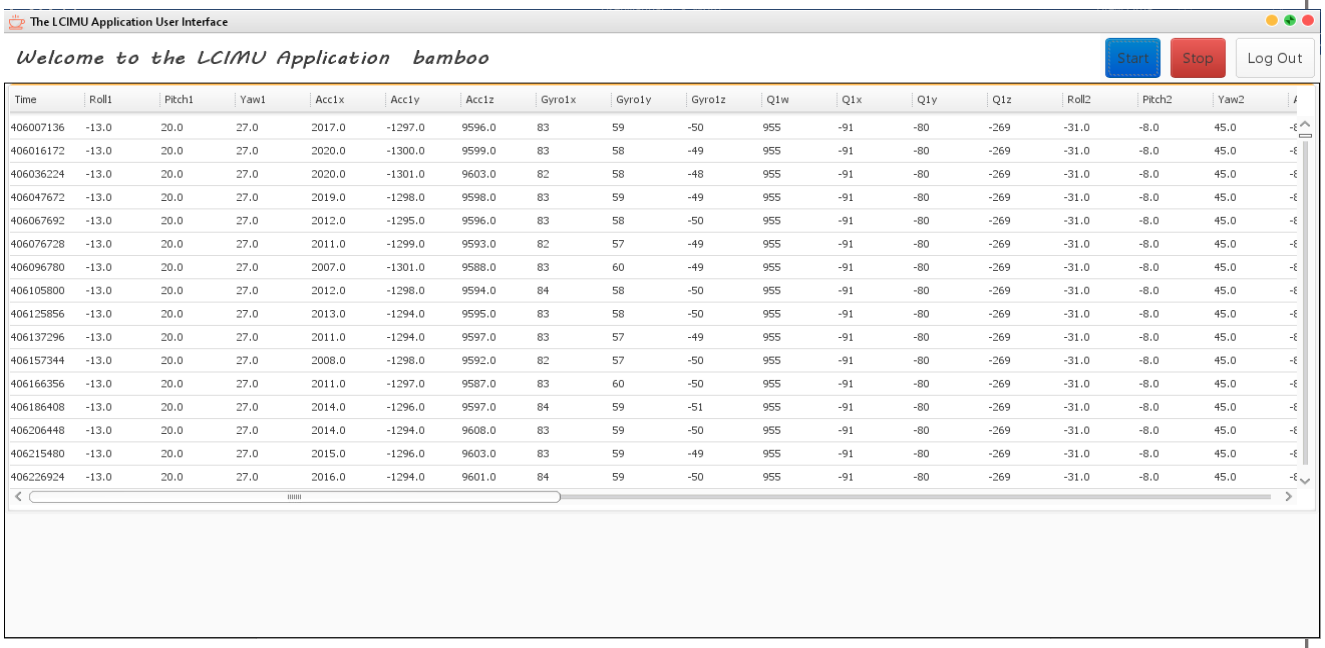


Figure 4.6. Data Display in Real time

As can be seen from the Figure above, the data will be displayed on the graph pane on the left and the raw data will be displayed on a table as shown on the right. Figure 3.10 is an image of the data as displayed on the table.



Time	Roll1	Pitch1	Yaw1	Acc1x	Acc1y	Acc1z	Gyro1x	Gyro1y	Gyro1z	Q1w	Q1x	Q1y	Q1z	Roll2	Pitch2	Yaw2
406007136	-13.0	20.0	27.0	2017.0	-1297.0	9596.0	83	59	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406016172	-13.0	20.0	27.0	2020.0	-1300.0	9599.0	83	58	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406036224	-13.0	20.0	27.0	2020.0	-1301.0	9603.0	82	58	-48	955	-91	-80	-269	-31.0	-8.0	45.0
406047672	-13.0	20.0	27.0	2019.0	-1298.0	9598.0	83	59	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406067692	-13.0	20.0	27.0	2012.0	-1295.0	9596.0	83	58	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406076728	-13.0	20.0	27.0	2011.0	-1299.0	9593.0	82	57	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406096780	-13.0	20.0	27.0	2007.0	-1301.0	9588.0	83	60	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406105800	-13.0	20.0	27.0	2012.0	-1298.0	9594.0	84	58	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406125856	-13.0	20.0	27.0	2013.0	-1294.0	9595.0	83	58	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406137296	-13.0	20.0	27.0	2011.0	-1294.0	9597.0	83	57	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406157344	-13.0	20.0	27.0	2008.0	-1298.0	9592.0	82	57	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406166356	-13.0	20.0	27.0	2011.0	-1297.0	9587.0	83	60	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406186408	-13.0	20.0	27.0	2014.0	-1296.0	9597.0	84	59	-51	955	-91	-80	-269	-31.0	-8.0	45.0
406206448	-13.0	20.0	27.0	2014.0	-1294.0	9608.0	83	59	-50	955	-91	-80	-269	-31.0	-8.0	45.0
406215480	-13.0	20.0	27.0	2015.0	-1296.0	9603.0	83	59	-49	955	-91	-80	-269	-31.0	-8.0	45.0
406226924	-13.0	20.0	27.0	2016.0	-1294.0	9601.0	84	59	-50	955	-91	-80	-269	-31.0	-8.0	45.0

Figure 4.7. Data Display on a Table

The Stop Button

When the Stop Button is clicked, the data capture process terminates and the User can then view the data by scrolling up and down the table shown on Figure 3.14. The User has the option of accessing the data captured in a stored file on the folder *Profile* on the Main IDE has shown below. The data is stored on a csv file and it can be retrieved offline to be used for analysis.

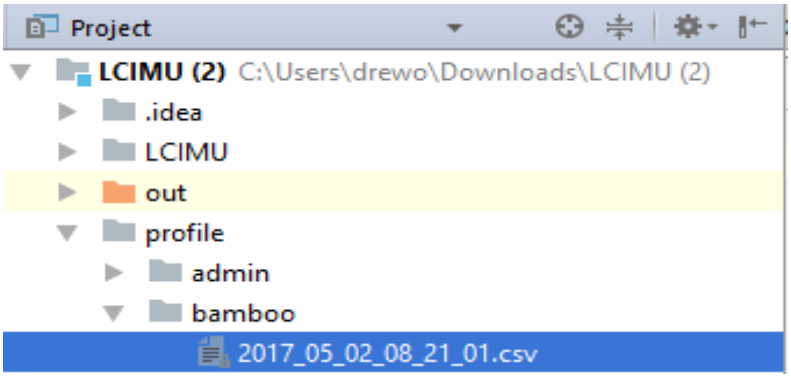


Figure 4.8. Accessing the stored data on the User's profile.

The Log Out Button

The Log Out Button exits the application and returns the user to the Sign-In/Sign-On page.

4.2 Special Instructions for Changing the Data Display

By default, the data being displayed on the application is the Roll and Pitch of the three sensors. Switching the data display to linear and angular acceleration involves a simple switcheroo process. The background of this switch, is that there are two display classes on the project namely, the CanvasGraph class and the CanvasGraphAccelGyro class. The CanvasGraph Class is responsible for the current display of the roll and pitch variables of the LCIMU system while the CanvasGraphAccelGyro class is responsible for the display of the linear and angular acceleration variables of the sensors. They are both shown in the project structure in Figure 4.9a.

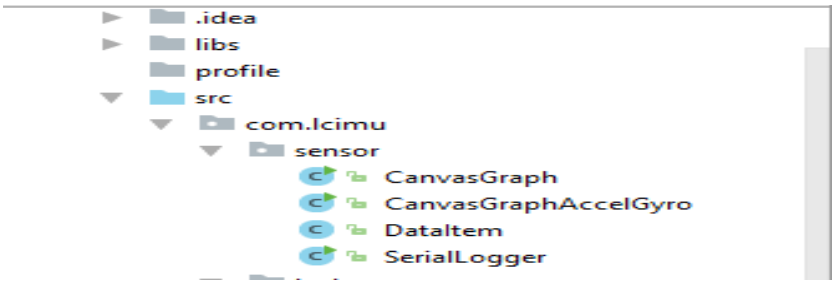


Figure 4.9a. Switching the Display

Switching the display will then involve uncommenting and commenting two sections of the IMUContainer class as shown in Figure 4.9b.

```
148     /*
149      * This method allows the User to
150      * click the 'stop' button to
151       * terminate the application
152      */
153     public void destroyCanvasGraph() {
154         System.out.println("Stop The Data Display");
155         CanvasGraph container = CanvasGraph.getInstance();  //comment to switch display
156        // CanvasGraphAccelGyro container = CanvasGraphAccelGyro.getInstance();  //uncomment to switch display
157         container.dispose();
158         container.stop();
159
160         container.loggerDev.stop();
161         synchronized (container.loggerDev.syncObj) {
162             if (container.loggerDev != null) {
163                 container.loggerDev.tag = 1;
164             }
165         }
```

Figure 4.9b. Switching the Display

The first section to be commented out is on line 155 while line 156 needs to be uncommented. For the second section as shown in Figure 4.9c, comment out line 138 – 140 and Uncomment out line 142 – 144. This should then switch the display as required.

```
128         * This method allows the User to
129         * click the 'start' button to start the application
130         * and Display the Data captured
131         */
132        public void initCanvasGraph() {
133            System.out.println("Display the Data");
134            datas = new Vector<DataItem>();
135            SwingUtilities.invokeLater(new Runnable() {// wait until the call to run as being executed before updating the thread
136                @Override
137                //Comment this section to switch canvas display
138                public void run() {
139                    CanvasGraph.getInstance().initAndShowUI();
140                }
141                //Uncomment this section to switch canvas display
142    //              public void run() {
143    //                  CanvasGraphAccelGyro.getInstance().initAndShowUI();
144    //              }
145            });
146        }
147
```

Figure 4.9c. Switching the Display

It is important to point out here that this display switch could have been accounted for by an additional button that calls the CanvasGraphAccelGyro Class display from the panel but the application was structured to three buttons to reduce complexity in executing the display threads.

5.0 Correspondence

This section describes how the data captured can be applied.

5.1 MATALAB Application

The data captured as described in the design documentation can be retrieved from csv files on the profile folder of the project as shown in Figure 4.6. This data can then be uploaded unto MATLAB and used in analysis. Figure 4.8 is an image of the power spectral density of an individual cycling on a mounted bicycle with the sensors strapped to the biceps and mounted on the chest.

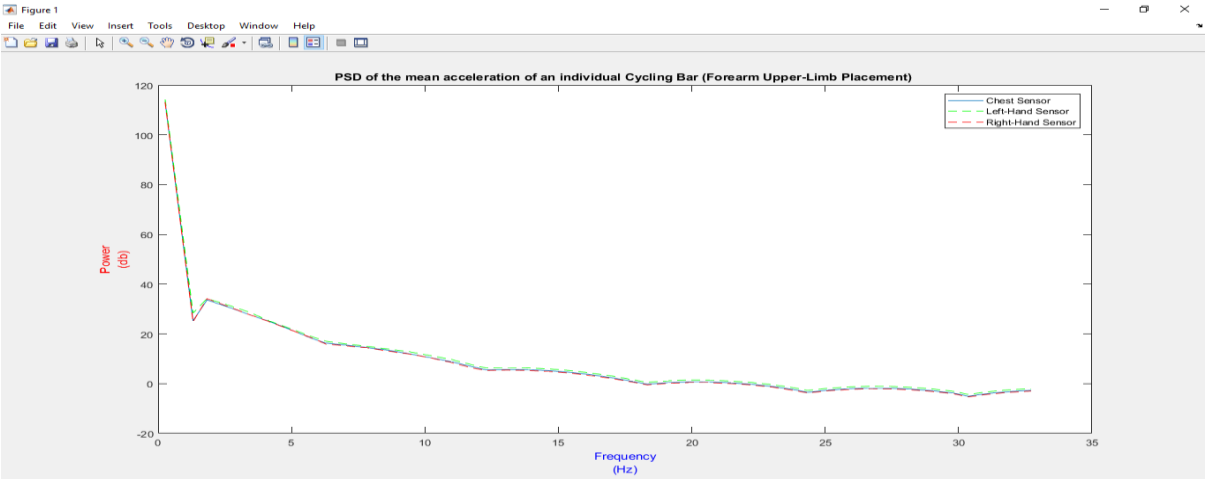


Figure 5.1 Application of the Captured Motion Data

This figure points out that a significant amount of energy is expended in lower frequency cycles of this activity than it does in higher frequencies, also there are no significant changes or variation in the data captured from all three sensors during this activity.

Conclusively, there are other ways and methods the data captured from this system can be applied and the LCIMU system should be robust enough as per its requirements to be utilized as required.