CSE 550 Software Engineering

Term Project – Visualizing and analysing Wearable Sensor Data

Term Project

- Design and develop an interactive user interface to use visualization techniques and visual analysis to explore multimodal sensor signal data and to tell how and what you can discover interesting information and pattern from the visualization.

The data

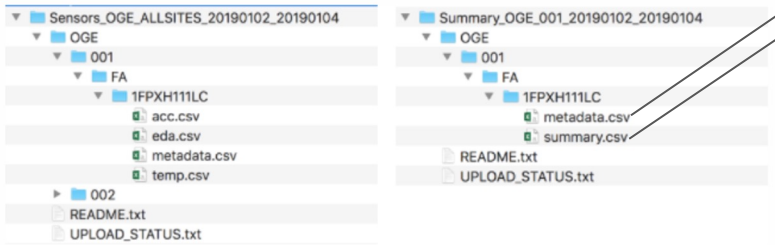
Datetime (UTC)	Timezone (minutes)	Unix Timestamp (UTC)	Acc magnitude avg	Eda avg	Temp avg	Movement intensity	Steps count	Rest
2020-01-17T23:48:00Z	-300	1.5793E+12	1.063262	0.541921	30.155257	0	0	
2020-01-17T23:49:00Z	-300	1.5793E+12	1.005967	0.539037	29.9799	0	0	
2020-01-17T23:50:00Z	-300	1.57931E+12	1.045804	0.535254	29.713417	0	0	
2020-01-17T23:51:00Z	-300	1.57931E+12	1.017389	0.532977	29.416833	0	0	
2020-01-17T23:52:00Z	-300	1.57931E+12	1.03043	0.532688	29.2752	0	0	
2020-01-17T23:53:00Z	-300	1.57931E+12	0.995176	0.541594	29.4671	0	0	
2020-01-17T23:54:00Z	-300	1.57931E+12	1.066957	0.548665	29.84755	0	0	
2020-01-17T23:55:00Z	-300	1.57931E+12	1.076301	0.547429	30.069133	0	0	
2020-01-17T23:56:00Z	-300	1.57931E+12	1.507012	0.546359	30.031567	0	0	

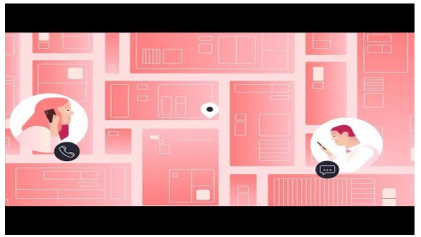
Datetime (UTC)	Timezone	Embrace firmware version	App	App version	Mobile OS	Mobile OS version	GTCS algorithm version
2020-01-17T23:48:28Z	-300	1.3.5602	Mate	2.1.0	iOS	Version	0.6.4724

Raw Data - Archive Structure

The data will download into an archive with a 3-level hierarchy. It is divided into sites, enrolled subjects, and devices as shown in the examples below:

The left image shows an example of the folder structure for **Sensors Data** of an entire study (e.g. with identifier OGE), named here as **Sensors_OGE_ALLSITES_20190102_20190104**. On the right is an example of the folder structure for **Summary Data** for one site (e.g. with identifier 001) of the study, named here as **Summary_OGE_001_20190102_20190104**.





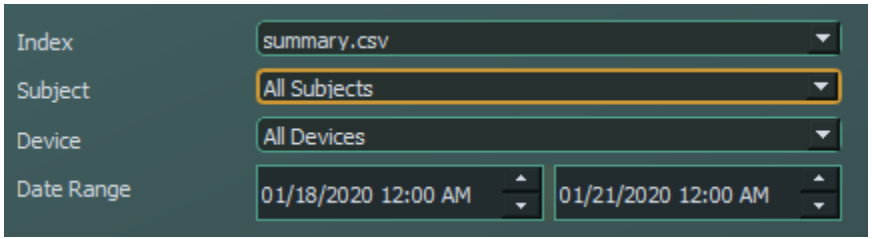
more details

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration

Basic requirements

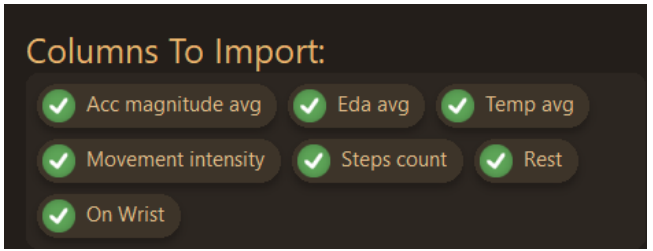
1. A Data Loader to load sensor data for visualization and exploration
    a. **Allow users to select and visualize data between different participants.**



example

Basic requirements

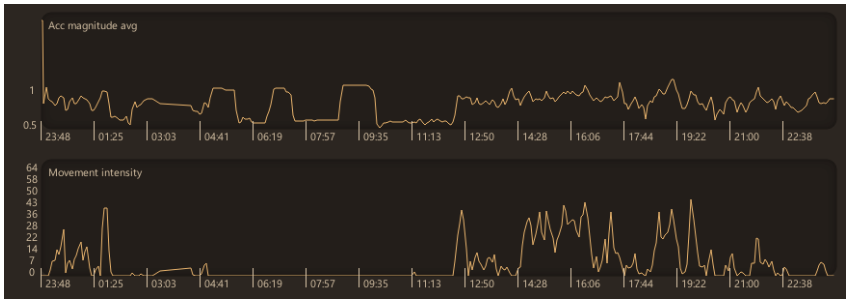
1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. **Allow users to specify the interested data streams to be imported.**



example

Basic requirements

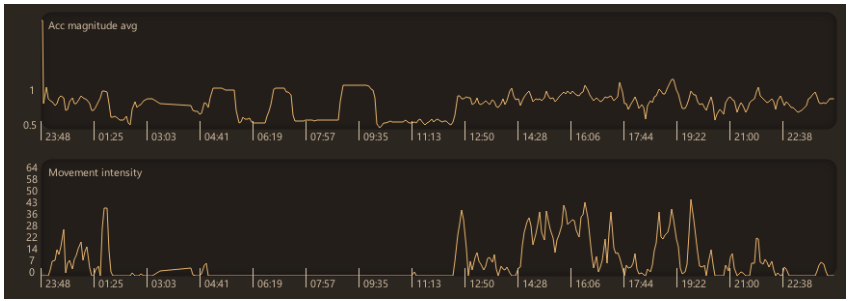
1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. **A visual panel to show the multiple time series**



example

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series

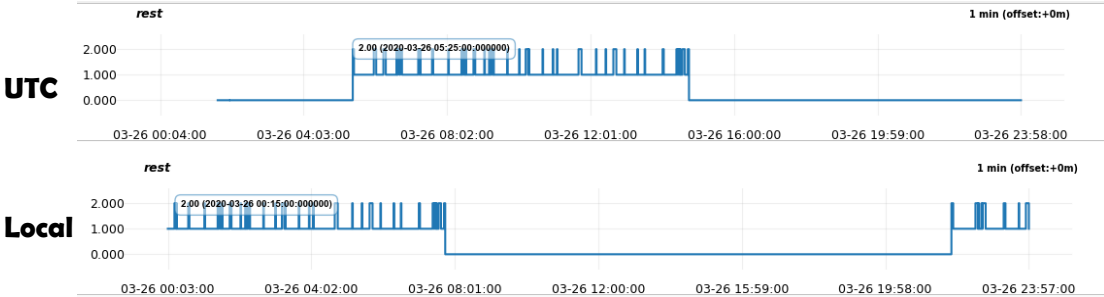


example

Basic requirements

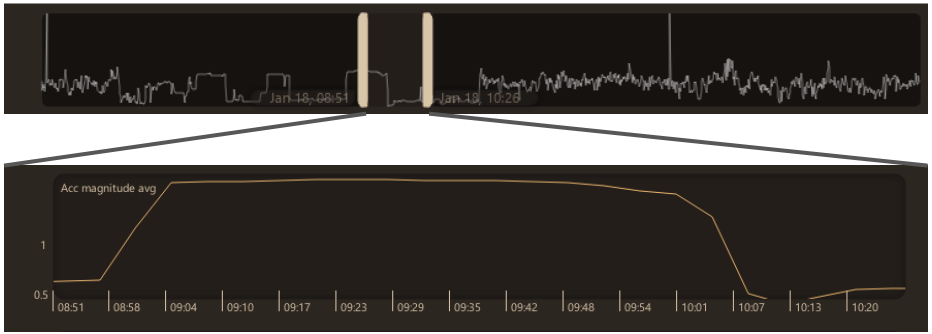
1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart

Basic requirements



1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. **Switch between UTC / local time using time zone information**
    a. **Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.**
    b. **Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.**

Basic requirements



example

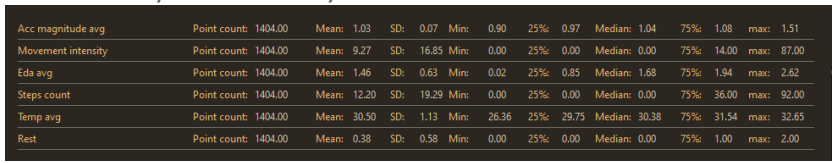
1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. **A widget required to be designed, e.g. a time box, to explore different regions of data with different granularities.**

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. A widget required to be designed, e.g. a time box, to explore different regions of data and with different granularities.
    b. Aggregation. Data *can be* gathered and expressed in a summary form for analysis.

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. A widget required to be designed, e.g. a time box, to explore different regions of data and with different granularities.
    b. Aggregation. Data *can be* gathered and expressed in a summary form for analysis.
    c. Basic statistical analysis.



Acc magnitude avg	Point count:	1404.00	Mean:	1.03	SD:	0.07	Min:	0.90	25%:	0.97	Median:	1.04	75%:	1.08	max:	1.51
Movement intensity	Point count:	1404.00	Mean:	9.27	SD:	16.85	Min:	0.00	25%:	0.00	Median:	0.00	75%:	14.00	max:	87.00
Eda avg	Point count:	1404.00	Mean:	1.46	SD:	0.63	Min:	0.02	25%:	0.85	Median:	1.68	75%:	1.94	max:	2.62
Steps count	Point count:	1404.00	Mean:	12.20	SD:	19.29	Min:	0.00	25%:	0.00	Median:	0.00	75%:	36.00	max:	92.00
Temp avg	Point count:	1404.00	Mean:	30.50	SD:	1.13	Min:	26.36	25%:	29.75	Median:	30.38	75%:	31.54	max:	32.65
Rest	Point count:	1404.00	Mean:	0.38	SD:	0.58	Min:	0.00	25%:	0.00	Median:	0.00	75%:	1.00	max:	2.00

example

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. A widget required to be designed, e.g. a time box, to explore different regions of data and with different granularities.
    b. Aggregation. Data *can be* gathered and expressed in a summary form for analysis.
    c. Basic statistical analysis.
5. **Data query**

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. A widget required to be designed, e.g. a time box, to explore different regions of data and with different granularities.
    b. Aggregation. Data *can be* gathered and expressed in a summary form for analysis.
    c. Basic statistical analysis.
5. **Data query**
    a. Allow users to filter and viusalize data under certain conditions.

Basic requirements

1. A Data Loader to load sensor data for visualization and exploration
    a. Allow users to select and visualize data between different participants.
    b. Allow users to specify the interested data streams to be imported.
2. A visual panel to show the multiple time series
    a. Synchronized across series
    b. Allow to choose the appropriate type of chart
3. Switch between UTC / local time using time zone information
    a. Coordinated Universal Time or UTC is the primary time standard by which the world regulates clocks and time.
    b. Local time is the time observed in a specific locality, which can be derived by the UTC and time zone information.
4. Data navigation
    a. A widget required to be designed, e.g. a time box, to explore different regions of data and with different granularities.
    b. Aggregation. Data *can be* gathered and expressed in a summary form for analysis.
    c. Basic statistical analysis.
5. Data query
    a. Allow users to filter and viusalize data under certain conditions.
6. **UI design**

Principles of User Interface Design

- **Minimize actions** – Minimize action means steps per screen. The tasks and actions are streamlined so that they can be done in as few steps as possible. The interface should be designed keeping in mind to maintain the steps as few as possible for performing any tasks.
- **Consistent** – make sure elements in a user interface are uniform. They'll look and behave the same way. This helps constantly prove a user's assumptions about the user interface right, creating a sense of control, familiarity, and reliability.
- **Proving useful feedback** – The user should be provided with feedback for every action. This keeps the user informed and helps them to know whether some action was successful or not.
- **Clarity** – Content should provide the user with clarity. There should not be anything which confuses the user, as it becomes an obstacle for the user in interacting with the application.

Demos


Data Visualizer - Physical Tracker App
Import Data
Clear Data
Index
summary.csv
Subject
310
Device
iOS
Date Range
01/17/2020 11:49 PM
01/19/2020 12:16 AM
Standard Time
Save
Navigator
1.4
1.2
1
/18/2020
01/19/2020
Graph
Acc magnitude avg
Acc magnitude avg
1.5
1.4
1.3
1.2
1.1
1
01/18/2020 07:00 PM
01/18/2020 09:00 PM
01/18/2020 11:00 PM
01/19/2020 01:00 AM
01/19/2020 03:00 AM
01/19/2020 05:00 AM
Eda avg
Eda avg
4
3
2
1

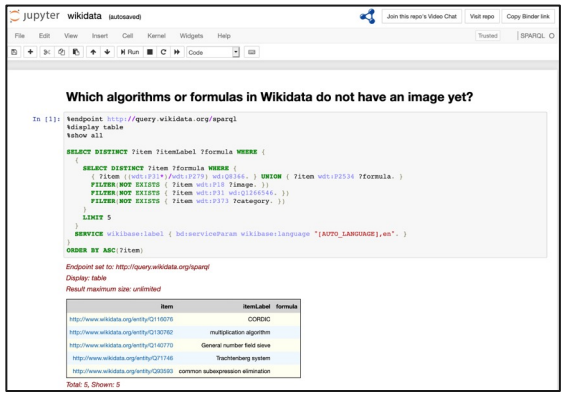
Bonus points

1. A database for **easy accessing, managing and updating** the raw data, the aggregations of data and immediate analytic results.
2. Advanced analysis
    a. Correlation analysis for different varaibles.
    b. Visual analysis or pattern mining. For example, the baseline estimation for studying the normal behavior and abnormal events for these sensor signals. Or using statistical hypothesis testing methods to analyze certain proposed assumption, like how is the eda signal looking like in sleep versus daytime and if exists significant difference between them.

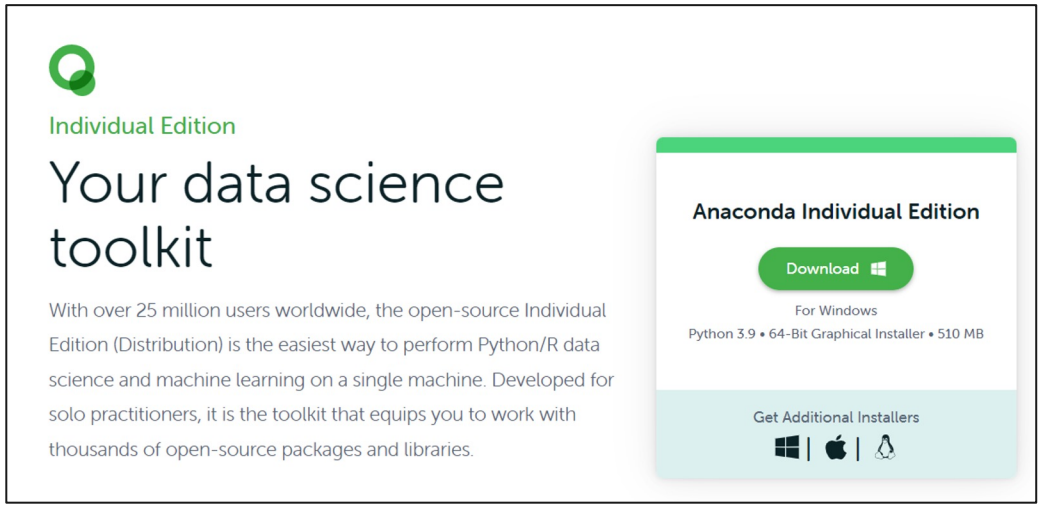
...

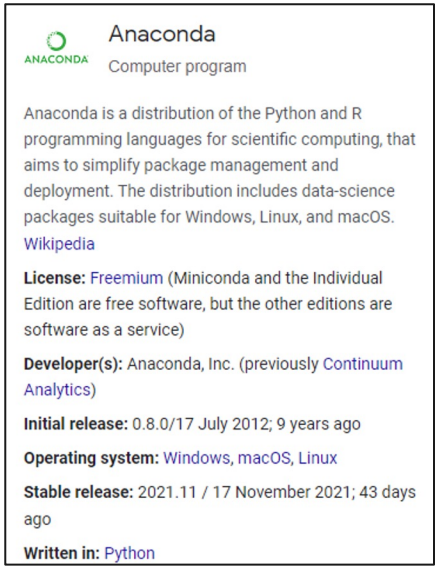
Our technology

- Open source
- Syntax is intuitive and easy to learn and use
- ***Interpreted*** language, rather than a ***compiled*** language

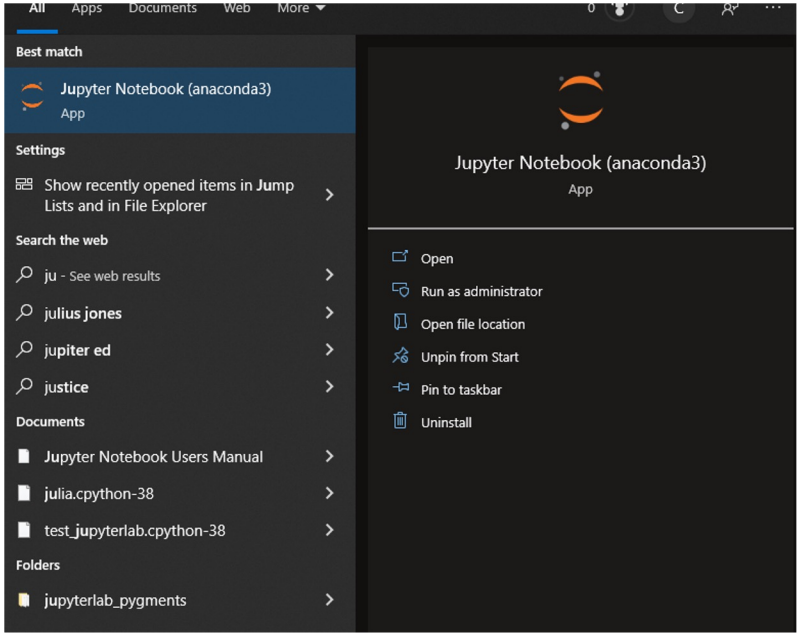


1. Install Anaconda
   https://www.anaconda.com/products/individual





1. Install Anaconda
2. Open Jupyter notebook



1. Install Anaconda
2. Open Jupyter Notebook
3. download, explore and execute Lab1-Introduction-to-Python.ipynb (provided in BB)
    - **Objectives**:
        i. *Get familiar with Python*
        ii. *Get familiar with Jupyter notebook*
        iii. *Try modify/change the code in the notebook to generate new results*
        *(most of the code segments are self-explanatory, and please **try it yourself**)*

(no submission is needed, this is a pre-lecture hands-on lab)