

CrowdSenSim Mobile Crowd Sensing Simulator

University of Luxembourg

CrowdSenSim Simulator

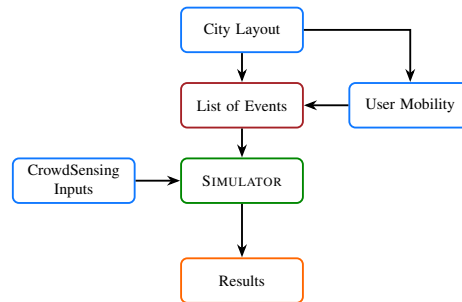
User Manual

The CrowdSenSim Team

September 22, 2017

Introduction

CrowdSenSim is a discrete-event simulator supporting pedestrian mobility able to emulate crowd sensing data collection in a real scenario. This is the architecture of the simulator:



The main features of the proposed simulator are:

1. **Scalability:** CrowdSenSim was designed to give us the possibility to host a large number of participants, in the order of tens of thousands users moving in a wide geographical space. Each of them is a data contributor and can use for that several IoT and mobile devices.
2. **Realistic urban environment:** CrowdSenSim exploits realistic urban environment. The simulator is able to use any city layout, downloading the city map thanks to the OSMnx package .
3. **User mobility:** CrowdSenSim uses an uniform mobility algorithm. Each participant is allocated in a certain point in the city and walks towards a destination in a ray of 1 km with an average speed uniformly distributed between 1 m s^{-1} and 1.5 m s^{-1} . The participants contribute data while walking. When the period of walking ends, they stop moving and contributing with their devices.
4. **Communication technologies:** Mobile devices are equipped with lost of communication technology. CrowdSenSim allows to use all the device systems including 3G/LTE, WiFi and Bluetooth. Each system has a different cost to bear in mind during the scenario setting.

CrowdSenSim, released under the General Public License Agreement. Its code is totally implemented in C++.

Getting Started: Download and Installation

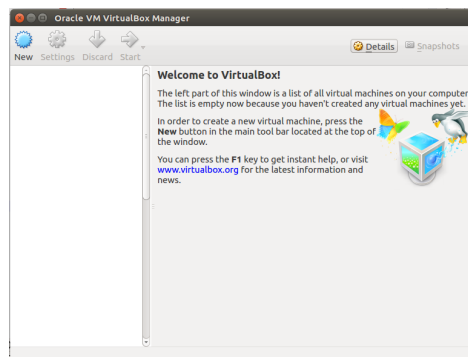
First of all and install *VirtualBox 64bit* from this link <https://www.virtualbox.org/wiki/Downloads>. Then download CrowdSenSim from this web-page <https://www.crowdsensim.com/>

[//crowdsensim.gforge.uni.lu/download.html](http://crowdsensim.gforge.uni.lu/download.html). The *CrowdSensim-VM.ova* is the file useful for the installation through *VirtualBox* or *VMWare Player*. It is also possible to download the source code from here <https://crowdsensim.gforge.uni.lu/download.html> and start running simulations from your own machine. In order to use the source code some requirements are needed, a list of them is present in the download web-page

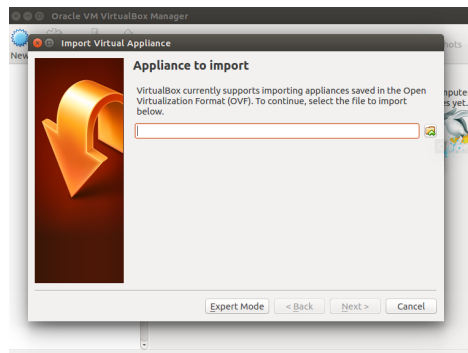
To install the VM:

After *VirtualBox* is installed, open it and proceed with the following:

1. Click on *File* and then *Import Appliance* or press *CTRL+i*:

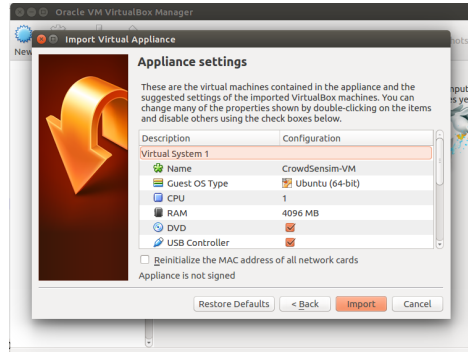


2. Choose *CrowdSensim-VM.ova* that you have downloaded before:

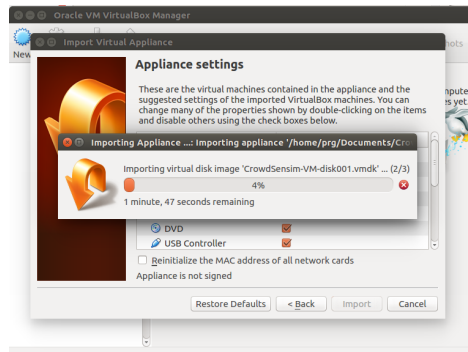


Click *Next*.

3. Select the resources assigned to the VM, the most important setting is the amount of ram (default is 4096 MB), in order to simulate big cities (Rome,New York,Tokio...) give more ram.

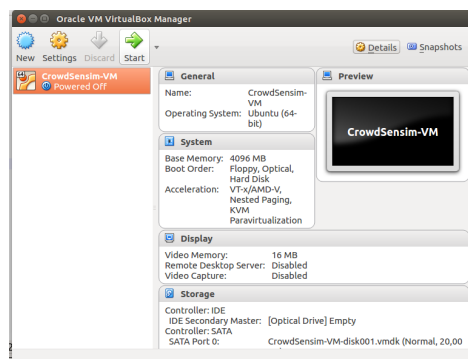


Then click *Import*.



It will take some minutes.

4. When it is finished click *Start*



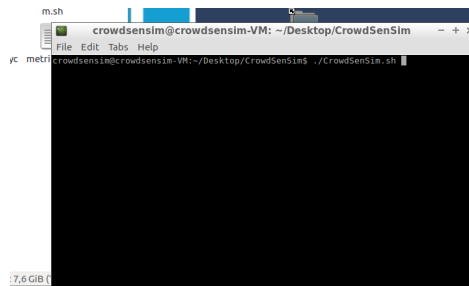
Enjoy CrowdSenSim. The *password* of the created VM is **crowdsensim**, Fix it in your mind.

Simulation Setup: my first simulation

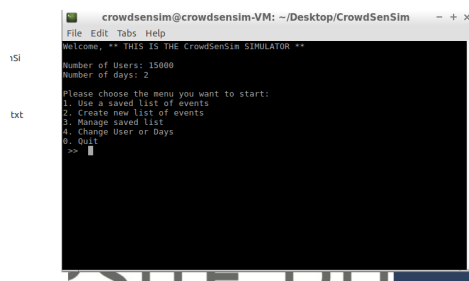
In this section it is explained how to start a simple simulation. If the installation is successful, the VM desktop will look like this:



1. To start the simulator go inside the CrowdSenSim folder.
2. Then press *F4* to open a terminal window inside this folder.
3. Finally write the next terminal command, `./CrowdSenSim.sh`



Now you have to see something like this.



You have different options:

1. Use an already saved list of events, which is a file with all the moves of each users.
2. Create a new list of events, from a new city with the specified number of users and number of days.
3. Delete an already saved list of events
4. Change the number of user or days for the next creation of a new list

To start a simulation select 1 or 2.

1. Selecting this option you will see a roster with all the saved list of events and the corresponding number of users and days, to load one of them just enter the corresponding id number and then press enter.

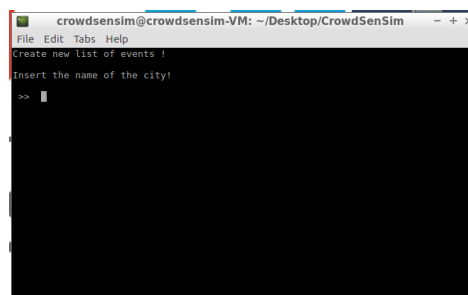


```

crowdsensim@crowdsensim-VM: ~/Desktop/CrowdSenSim
File Edit Tabs Help
List of Events already saved :
0 . city: luxembourg_city number of user: 5000 days 2
1 . city: torino number of user: 10000 days 1
2 . city: Venice number of user: 15000 days 2
b, Back
->

```

2. Selecting create a new list you have just to enter the name of the city , and the simulation will start with the already saved number of users and days



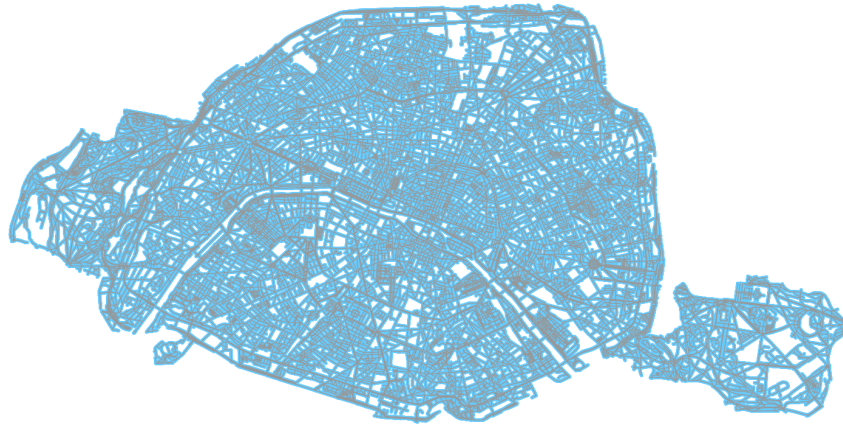
```

crowdsensim@crowdsensim-VM: ~/Desktop/CrowdSenSim
File Edit Tabs Help
Create new List of events !
Insert the name of the city!
->

```

After the download of the map, it will be asked to you if you want to save the new list.

Then CrowdSenSim will ask you if you want to save and print the Graph map of the selected city. In this example we printed out Paris.



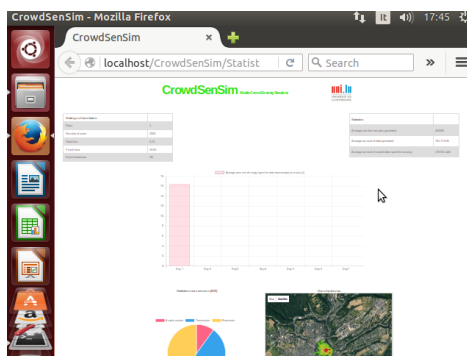
Simulation Results

At the end of the simulation are presented, in the open *terminal*, the output results divided by day.

```
Terminal
crowdsensim@crowdsensim-VirtualBox: ~/Desktop/CrowdSenSim
**Allocate users**
**Reading default list of events**
**Start simulation**
**Compute statistics**

-----DAY-----      1
-| Printing System Statistics per Sensor
-| Printing System Statistics per Sensor
Accelerometer: num. samples 103533000 - data 148.11 MiB
Temperature: num. samples 376860120 - data 718.80 MiB
Pressure: num. samples 325093620 - data 620.07 MiB
-----
-| Printing per-user Statistics (2000 users)
Avg number samples generated: 402945 - std: 186640 - std err: 4174.44
Avg amount of data generated: 761.71 KiB - std: 352.82 KiB - std err: 7.89 KiB
Avg amount of current drain spent for sensing: 178.551 uAh - std: 84.7190 uAh - std err: 1.89466 uAh
Avg amount of energy spent for data transmission: 16.3585 J - std: 7.57708 J - std err: 0.169471 J
-----
```

Lastly, all the simulation information, are reported in a local web-page.



The table in the top left part of the web-page contains the *Settings of simulation*, in our case the pre-configured settings.

The table in the the top right part contains some simulation *Statistics* as *Average number samples generated*.

In the bar chart, there is the *Average amount of energy spent for data transmission per-user (J)* statistic, ordered by day.

In the pie chart in the bottom left part the are reported all the information regarding the *Statistics users sensors (MB)*.

Lastly in the *Google Heatmap* are reported the city antennas use during the simulation. More in detail, more an antenna is used by users more red is represented.

This is a very simple simulation pre-configured and gives us a brief explanation of what CrowdSenSim is and how it works. Our advice is to try different scenario in order to understand the enormous prospective of CrowdSenSim.

All information regarding how to change scenario settings and how all simulator parts work are present in the *README.txt* files contained in *CrowdSenSim* directory in the *Desktop*.

Have fun!