

CrowdSenSim Mobile Crowdsensing Simulator

University of Luxembourg

CrowdSenSim Simulator

Version 1.0.0

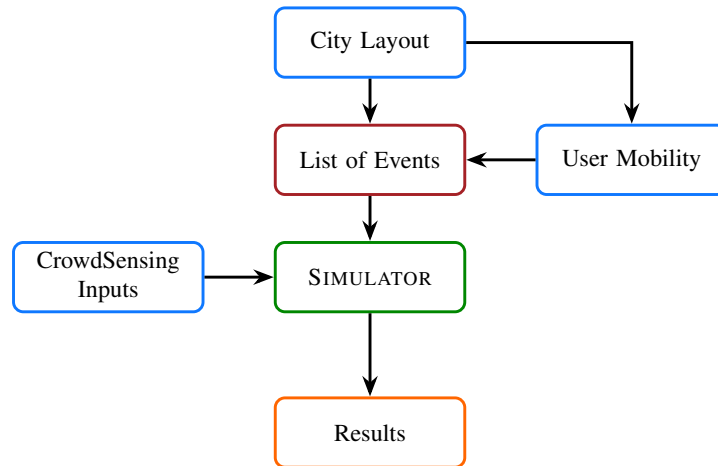
User Manual

The CrowdSenSim Team

November 15, 2016

Introduction

CrowdSenSim is a discrete-event simulator supporting pedestrian mobility able to emulate data generation and collection in mobile crowdsensing scenarios. The simulator relies on a number of independent modules illustrated hereafter:



The main features of CrowdSenSim are as follows:

1. *Scalability*: CrowdSenSim is designed to host a large number of participants, in the order of tens of thousands users moving in a wide geographical space.
2. *Realistic urban environment*: CrowdSenSim can exploit realistic urban environments. In the pre-configured scenario, the city center of Luxembourg city is installed.
3. *User mobility*: CrowdSenSim use an uniform mobility algorithm. Each participant is allocated in a certain point in the city and walks for a period of time uniformly distributed between [10,20] minutes 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 them devices.
4. *Communication technologies*: The devices support WiFi and cellular communication technologies. Each of them impacts differently on the energy consumption of user devices.

CrowdSenSim is written in C++ and released under the General Public License Agreement ([GNU](#)).

Getting Started: Download and Installation

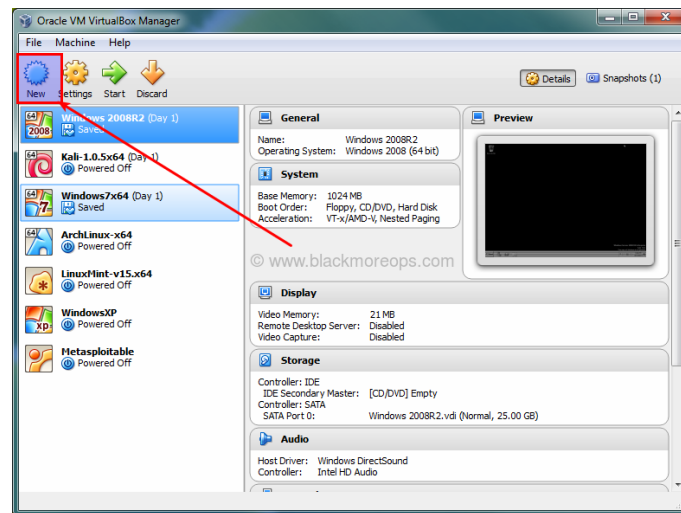
CrowdSenSim is provisioned in form of pre-configured Virtual Machine (VM) running Ubuntu. The VM is configured to run over the most common virtualization software such as [VirtualBox](#) or [VMWare](#).

The VM containing CrowdSenSim can be downloaded from:

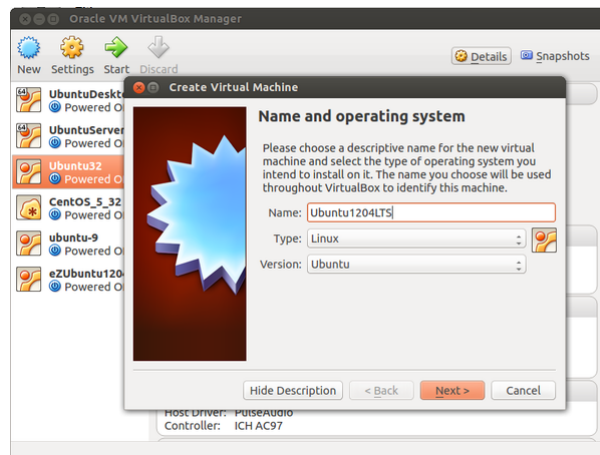
- <https://crowdsensim.gforge.uni.lu/download.html>

Once extracted from *crowdsensim-1.0.0.tar.gz*, the *CrowdSenSim-VM-1.0.0.vdi* file can be mounted on *VirtualBox* or *VMWare Player*. The VM also includes a pre-configured Eclipse environment, so it is the easiest way to download CrowdSenSim and start running simulations and/or modifying the source code. Now, assuming the user runs the simulator on *VirtualBox*, the installation can be finalized through the following steps:

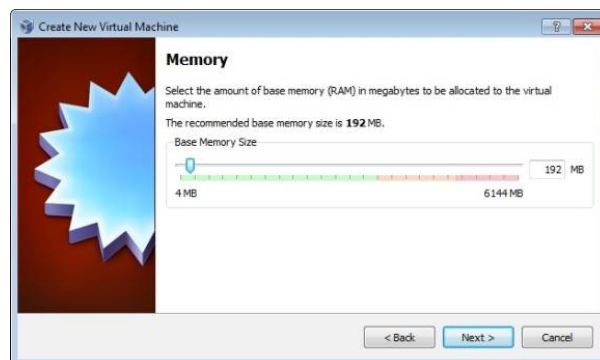
1. Click on *New*.



2. Choose a proper *Name*, *Type* and *Version* of virtual machine (VM). Then click *Next*.



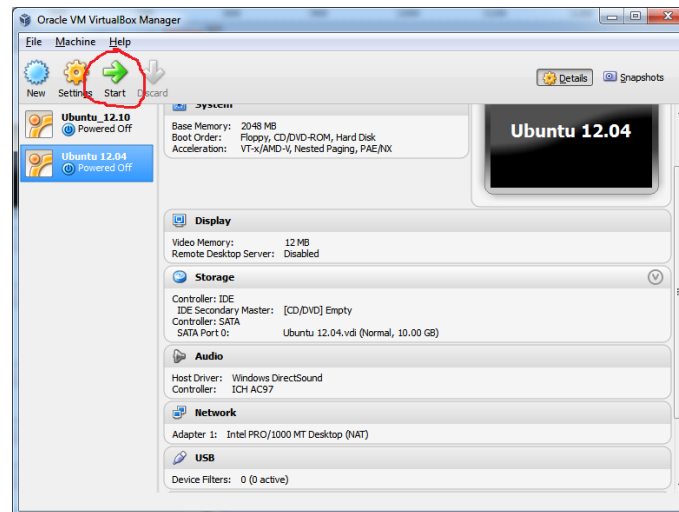
3. Select the memory amount base for the VM and click *Next*.



4. Select *Use an existing virtual hard disk file* and choose *CrowdSenSim-VM-1.0.0.vdi*. Then click *Create*.



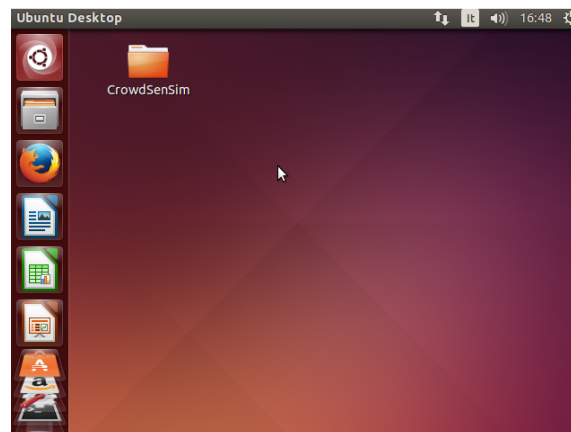
5. Click *Start* and enjoy CrowdSenSim.



The admin *password* is `crowdsensim` (please note: in *lowercase*).

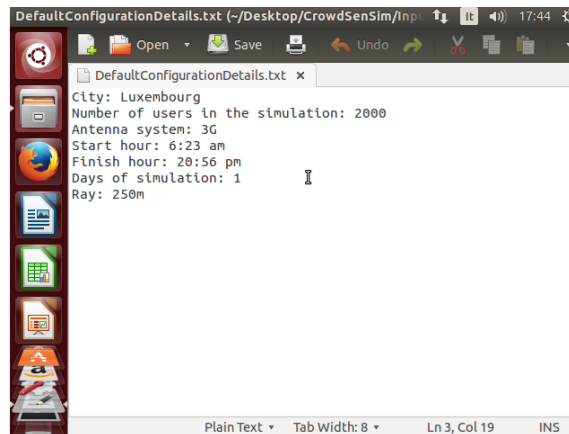
The first simulation

This section explains how start a simple simulation. After the successful installation, the VM desktop is in the form:



Hereafter it follows the procedure to launch the simulation with the *default* settings:

1. Open *CrowdSenSim* folder in the desktop.
2. The default settings are listed in the file `DefaultConfigurationDetails.txt`, which is located in the folder *Default*, within the *Inputs* folder:



3. Now open the terminal and move to *CrowdSenSim* directory with:

- `cd Desktop/CrowdSenSim`

4. To launch the simulation, use:

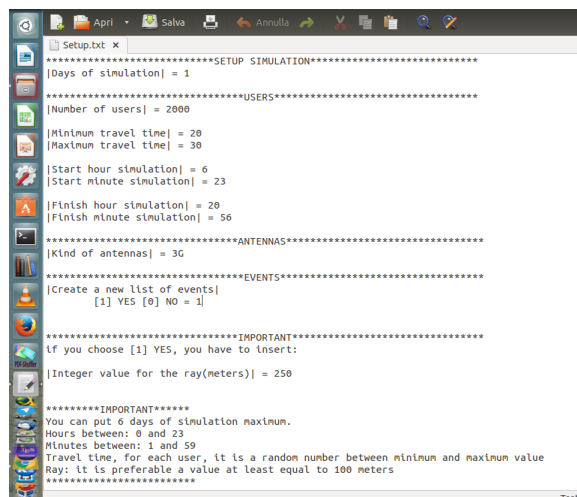
- `./CrowdSenSim`

Changing the simulation parameters

The previous example shows how to run the simulation with the pre-configured parameters.

In order to do modify the simulation settings, it is essential to understand which parameters come into play.

Open *Setup.txt* file contained into *Inputs* directory.



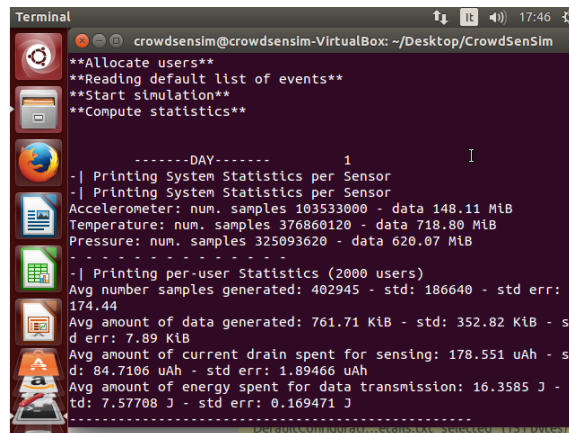
- Days of simulation: total number of simulation days
- Number of users
- Minimum travel time, Maximum travel time: travel time per user uniformly distributed between these values
- Start hour simulation, Start minute simulation
- Finish hour simulation, Finish minute simulation
- Kind of antennas: antennas system used allocated in the city
- Create a new list of events: it is possible choose to create a new list of events or using the default one.
- Ray: value in meters for the ray useful for *list of adjacent*

After having applied the changes, it is possible to start the simulation through terminal, as illustrated in the previous chapter.

In more details, each sub-directory of the main directory CrowdSenSim contains a *README.txt* detailing the information on parameters to change and the objective and operational flow of each module.

Simulation Results

Once the simulation ends, a number of statistics is shown in the *terminal*. Please note that the results are divided by day in this case.



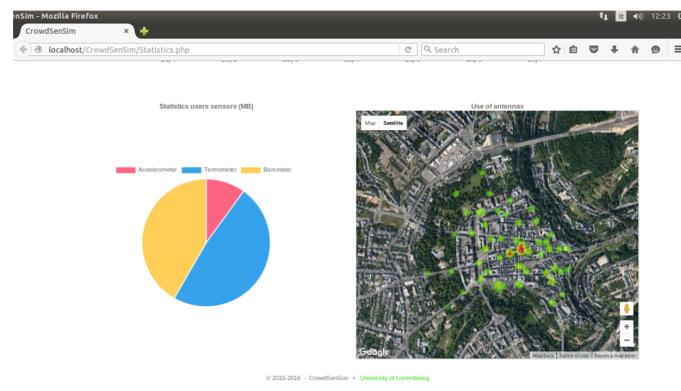
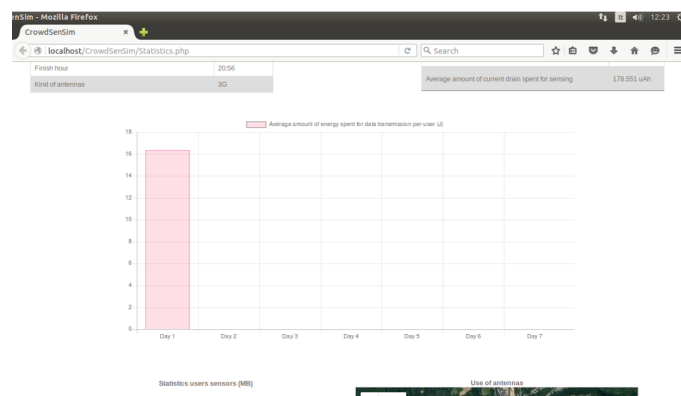
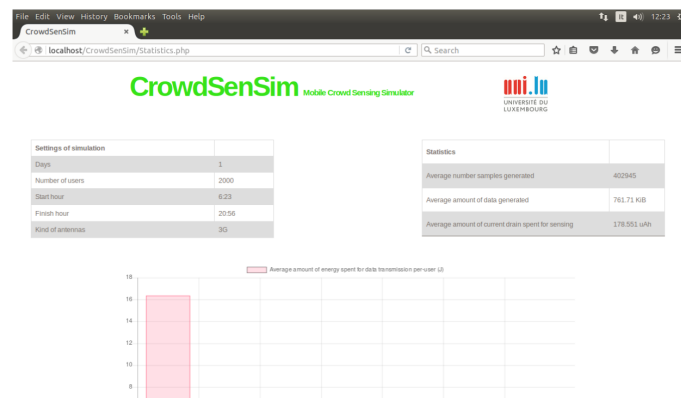
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Terminal
crowdsensim@crowdsensim-VirtualBox: ~/Desktop/CrowdSenSim
**Allocate users**
**Reading default list of events**
**Start simulation**
**Compute statistics**

-----DAY-----      1      I
-| 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: 4
174.44
Avg amount of data generated: 761.71 KiB - std: 352.82 KiB - st
d err: 7.89 KiB
Avg amount of current drain spent for sensing: 178.551 uAh - st
d: 84.7106 uAh - std err: 1.89466 uAh
Avg amount of energy spent for data transmission: 16.3585 J - s
td: 7.57708 J - std err: 0.169471 J
-----
Default configuration selected (121 bytes)

```

Finally, the statistics and output graphs are automatically shown in a local web-page.



The table in the top left part of the web-page contains the *Settings of simulation*, in this case the *default* settings.

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

The bar chart illustrates the *Average amount of energy spent for data transmission per-user (J)*, ordered by day.

The pie chart, in the bottom left part of the page, reports the information concerning the *Statistics users sensors (MB)*.

Lastly in the *Google Heatmap* are reported the realistic city WiFi Access Points used during the simulation. In more details, highly utilized WiFi AP are denoted in red, while lowly utilized AP in green.