

# Lucas Cassiano P Silva

bachelor in **Science and Technology**

This portfolio is meant to be a showcase of my creative works, showing projects that were developed during internships, in international and Brazilian laboratories, volunteer work, and individual projects, as well. In order to keep this portfolio compact, I have chosen to highlight only the more relevant works.

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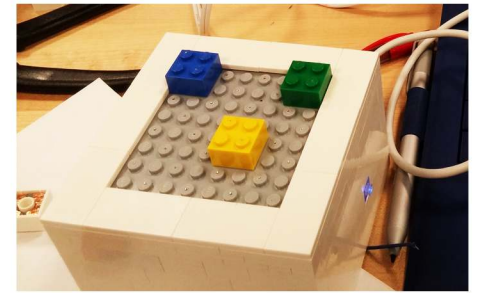
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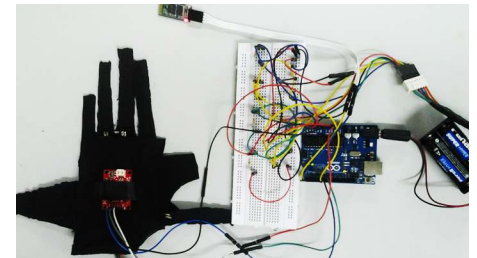
A stackable Tangible Interface based on LEGO  
MIT - Media Lab - Changing Places  
Advisor: Ira Winder, Kent Larson  
Team: Marc Teyssier, Juanita Devis  
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Low cost Dataglove for Virtual Applications  
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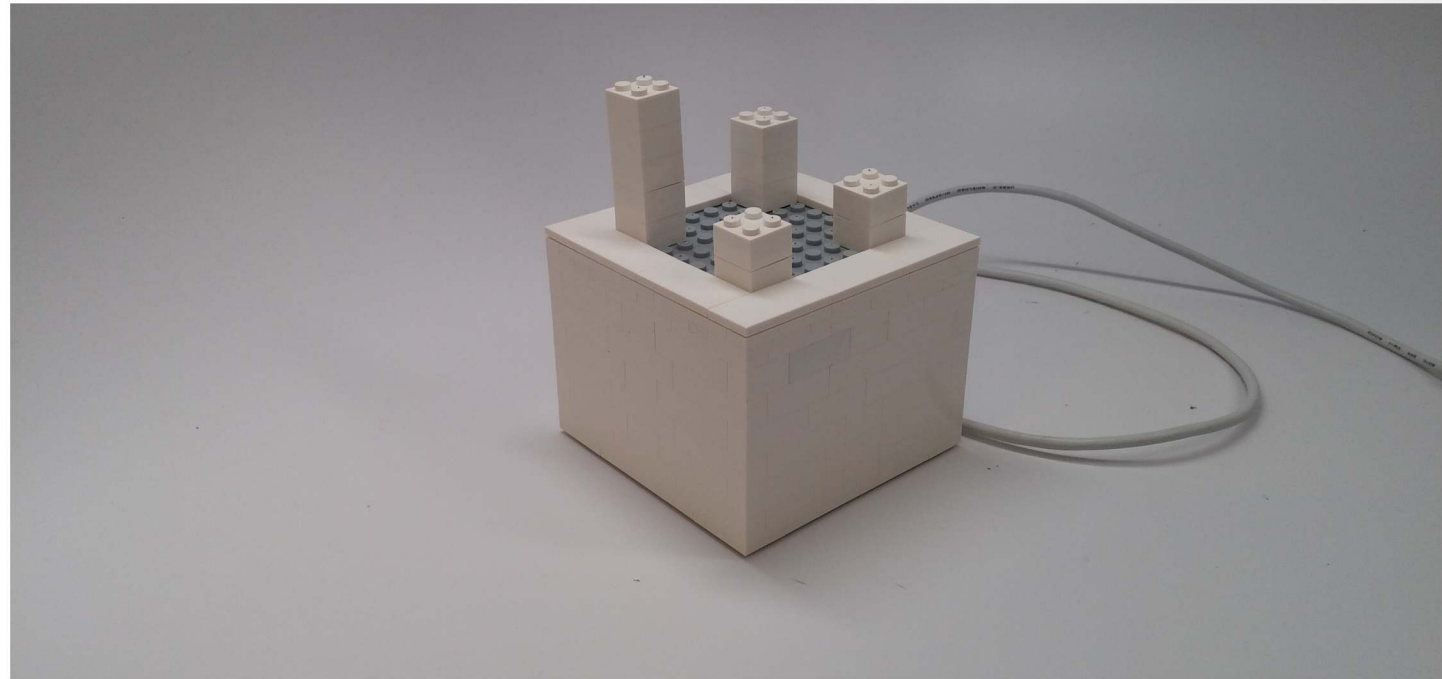
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# Cubio a stackable tangible interface based on LEGO



Developed at **MIT - Media Lab**, under coordination of **Ira Winder**<sup>1</sup> from **Changing Places** and also developed by **Marc Teyssier**<sup>2</sup> (**Fluid Interfaces**), Cubio is a tangible interfaced, initially designed to work as a tool for CityScope, where the user could create Buildings using legos and apply this design at the larger CityScope Table (figure 1) developed by Ira Winder.

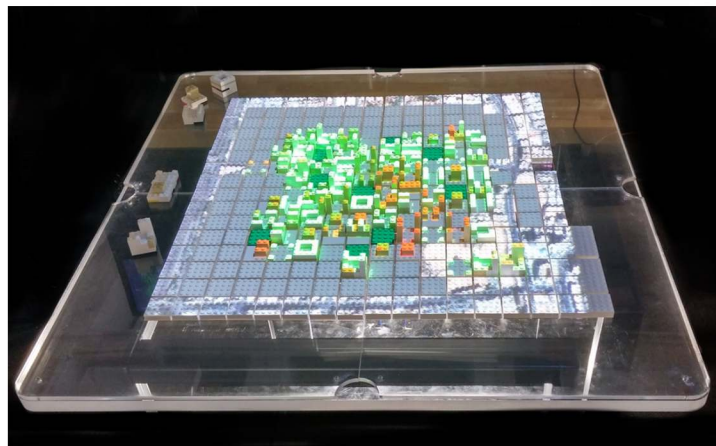
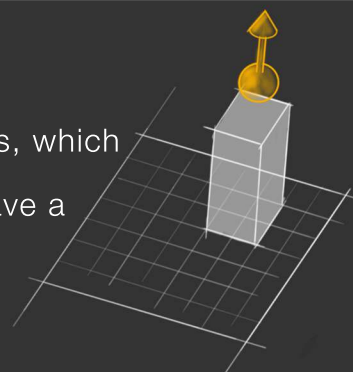


Fig 1. CityScope Table Prototype

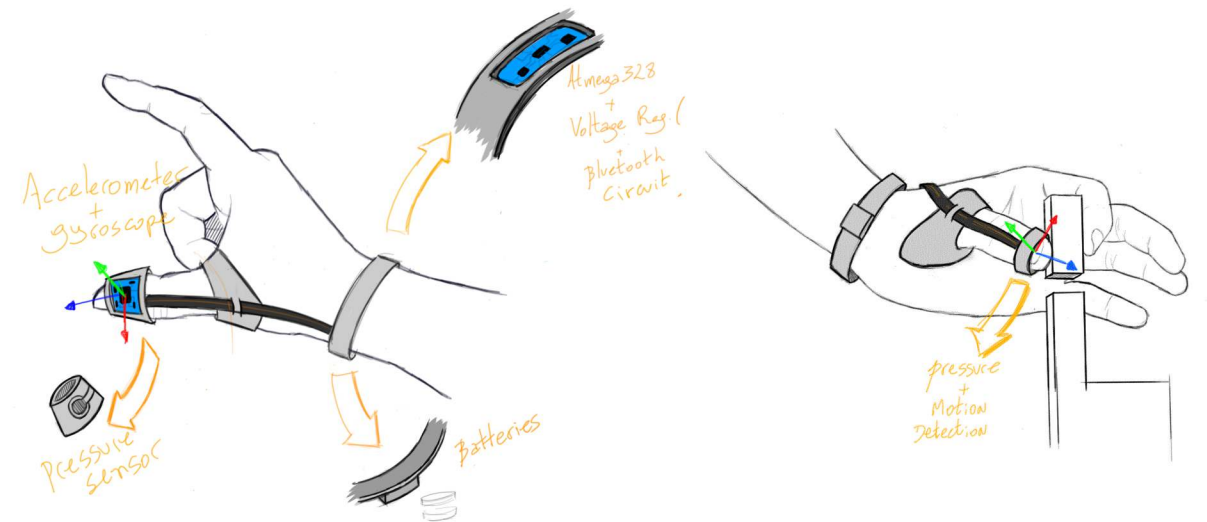
Using this table, each grid point has a X,Y and ID associated. However the height of the buildings (Z Axis) has to be pre-set manually, on software. Then my goal was to find a way to track all those three axis, plus the Z axis. The initial ideas where pretty far from the final concept. On the first concepts we where focusing in track the User's hand position, instead of the cubes.

## New Axis, New experience

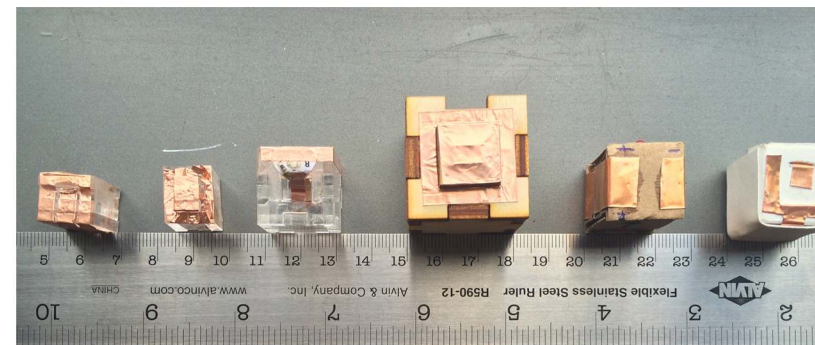
The Z axis allows the system to have real-time topology changes, which means more freedom to the user to create new buildings and have a feedback of it's impact in the city, all this during run-time.



# Cubio concepts



The very first concept versions were designed to track the hand of the user instead of the blocks, however doing this, to track multiple users would require a lot of data analysis/filtering. Thus we changed the approach to smart cubes, which have simple and low cost inner circuits (a resistor) in order to track it's position and ID.



The smartcube design was a challenge it-self, we tried few materials, using **laser cutting** to create trials, ranging from 5x5mm to 3x3cm, studing about which size was more confortable to the user handle. Later we changed this cubes to the ones developed by Marc Teyssier, due to its reability in physical connection.

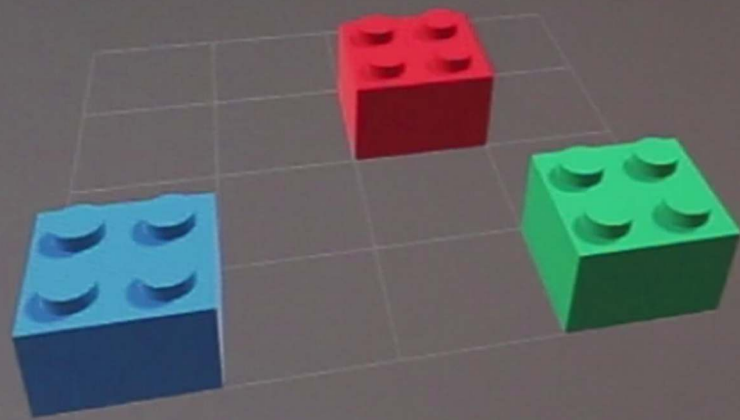
The **Grid System** was designed to be portable, low cost, and also easily connectable with **Processing (Java)** and Unity 3D (C#), so it could merges with previous software used by CityScope project, and should embbed all the active circuits, i.e. microcontroller and sensors, as well. To make the connection, we developed an API in C# for Unity and another in Java for Processing, both are based on a Serial Connection, via USB.



Table Grid Desktop Concept



# Cubio

 a stackable tangible interface based on LEGO

Both final versions of the grid and the cubes were build based in **LEGO**, for the cubes we hacked 2x2 lego bricks, approached developed by Marc Teysier. A small piece was **3D printed** to hold the resistor inside the LEGO brick.

The grid kept the Arduino Based circuits, reading the resistance of each grid position, currently a 4x4 grid. In order to track different IDs we changed the the resistors values inside each block.

This prototype version can read a voxel environment up to 4x4x25 blocks. A paper about this project was accepted and will be presented at **TEI**, 2016.





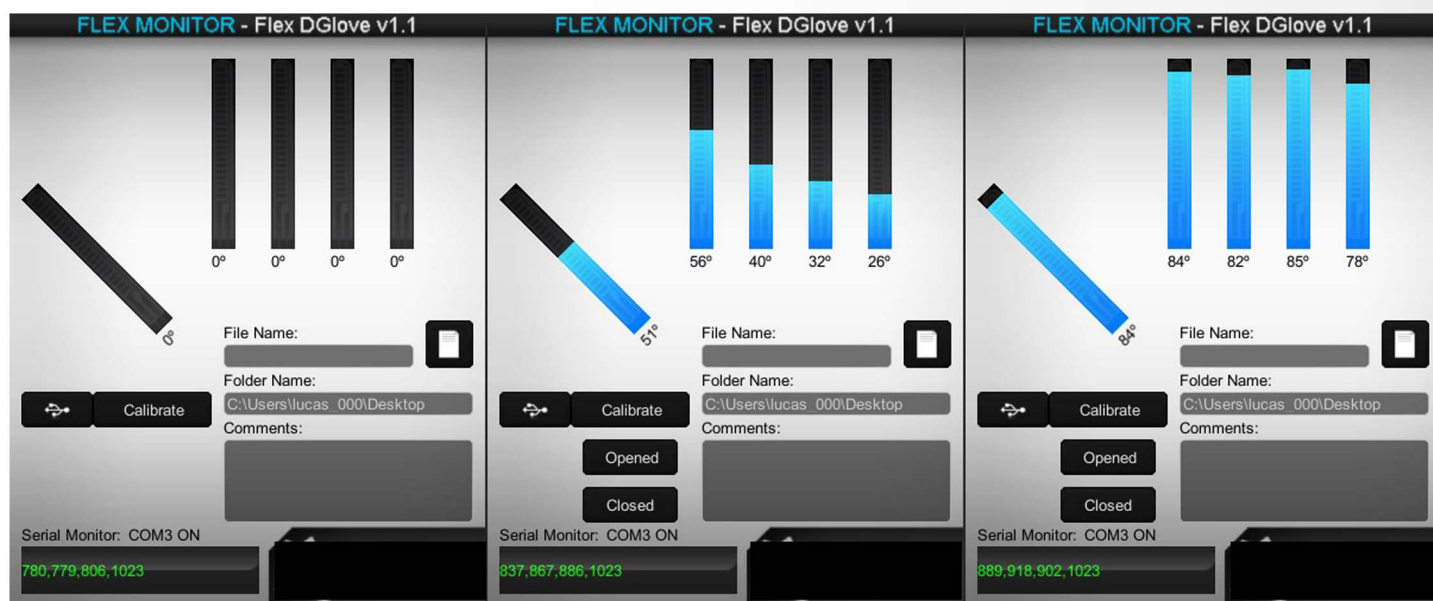
# FlexDGlove

a low cost Dataglove for virtual applications



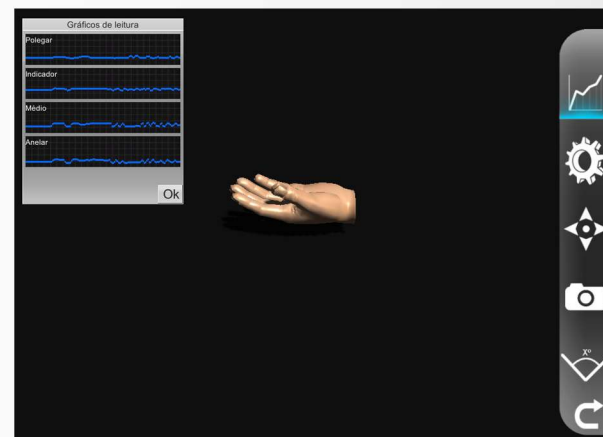
Started in 2013 by Dr. Rafael Aroca (rafaelaroca@ieee.org) and Dr. Rummenigged Dantas(rudsondant@gmail.com), professors at Universidade Federal do Rio Grande do Norte, FlexDGlove is a low cost dataglove designed to interact with simple virtual reality applications. The hardware was based on **Arduino** and flex sensors, while the software was totally based on **Unity 3D**.

Later we added more sensors and features, part of software development is now opensource, as can be seen on the opensource section of this portfolio.



Sometimes, when developing some new hardware piece there is the need to develop tools in order to make the development process easier and/or faster. During the hardware development we made few software tools, e.g. the **FlexDGlove Monitor**, which was made in **C#** using Unity3D. This tool helped during the development of the calibration algorithms, it reads the data from a serial connection with the Embedded Arduino.

After implementing our connection and calibration algorithms we developed the first demo: a hand simulator. This way the users could have a visual output of their movements and check the accuracy of fingers-movement track. At this point we also added an IMU (inertial measurement unit) to also track hand's rotation.



We also developed a plugin for Unity to enable RealTime chart generation, this way the user could have the 3D simulation (scene) alongside the data analysis.

# Kayak Supremo

a game for physiotherapy rehabilitation

After few prototypes we developed a version with a more ergonomic design. We also changed the circuits, developing a PCB (using **Eagle**) to be embedded on the glove, this way we could have a cheaper and smaller circuit.



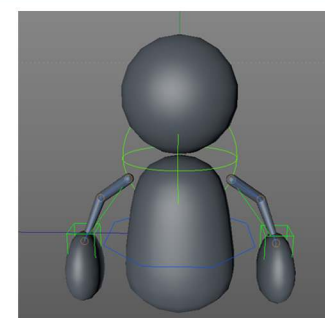
This glove version was used as an input (finger flexions and hand rotation) and output (vibration motors) for **physiotherapy rehabilitation of patients that survived stroke**. The design makes it easy for the physiotherapist to put and take off the glove from the patient's hand during therapy sessions.

For this glove we also developed an integrated game in Unity 3D, named "**Kayak Supremo**"\* this game aims to make the player open and close his/her hand in order to control the avatar (a kayak).



The game assets were modeled and animated using **Cinema 4D** and **Blender**, as can be seen on **figure 1**. The map is a river with several obstacles where the boat speed is increased during game play, so the user needs to interact using the glove in order to avoid the obstacles, if an obstacle is collided, the glove vibrates, giving a feedback to the player.

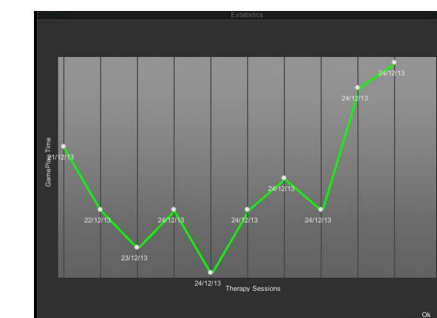
We also developed a data analysis window, inside Unity, so after each gameplay the physiotherapist could have a feedback about the user's improvement.



**Fig 1. Avatar Rigging**



**Fig 2. Unity Scene**



**Fig 3. Data Analysis**

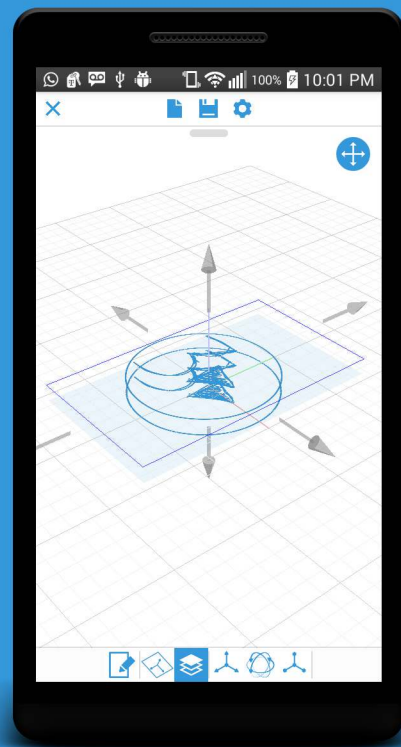
\*gameplay: [www.youtube.com/watch?v=y1uD8iBV2Tc](http://www.youtube.com/watch?v=y1uD8iBV2Tc)



# Sketch 3D

 android app for 3D drawing

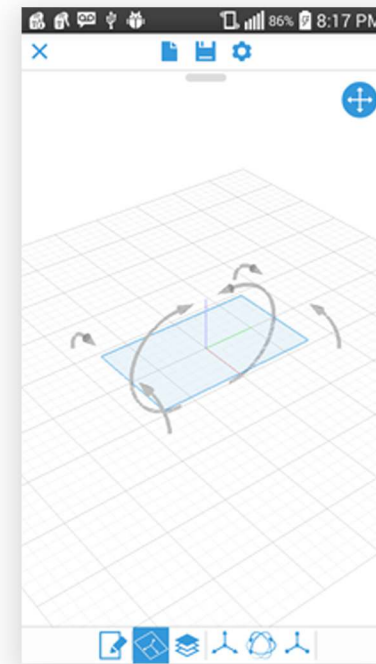
Some Ideas just need a new perspective



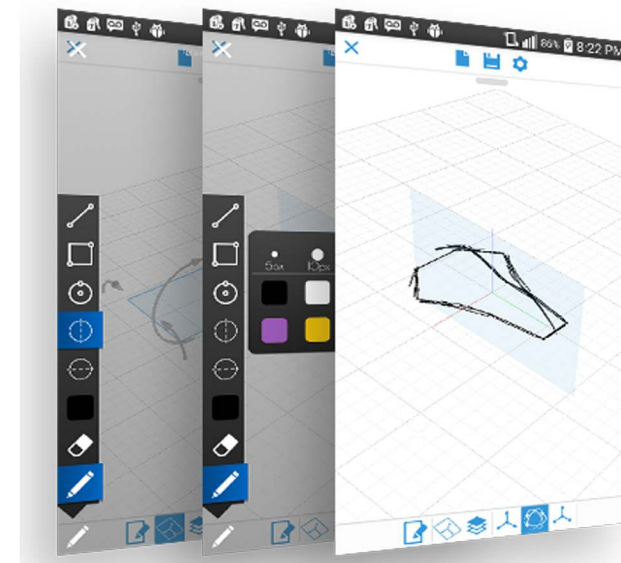
Sketch 3D is a native **Android** App developed entirely by me, in 2014, as a study project. The app was made using Java, all based in **Open GL ES 2.0**, using Android Studio as IDE.

500  
downloads

With more than 500 downloads, and a 4.0 stars review, Sketch 3D focus in allow the user to draw in 3D planes, which can be moved, rotated, edited or deleted.



Using a Color Selection Algorithm, the user can selected previously created planes and move them in order to create different sketches, giving a 3D view for multiple 2D drawings.



Sketch 3D is currently on version 1.5, and available for free download at Google Play store.

Just Scan the QR Code below.





# CaS Computer Language based on Color and Shapes



One of the main features of Arduino is it's easy to program when compared to other microcontrollers, e.g. PIC, that often needs Assembly to be programmed, allowing people that is not exactly a expert in programming to create awesome projects. Now imagine if you don't need to learn a complicated computer language with a lot of variables, methods and so on.

CaS Language is the concept of an **abstract computer language** based on colors, shapes and the positions of elements on a grid (figure 1).

## Abstract Code for everyday use by anyone


	<pre>for(int i=0; i&lt;5; i++) {   digitalWrite(pin1, HIGH);   delay(1000);   digitalWrite(pin1, LOW);   delay(1000); }</pre>	<p>CaS is also designed to be <b>Arduino Compatible</b>, i.e. it also generates an .ino code as an output code. Thus you can use CaS on your next DIY projects or merge it with your current works.</p> 
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Fig 1. CaS Code and Arduino Generated Code

The very first CaS Editor (we can call it an IDE) version was developed using **JavaScript, CSS** and **HTML5**, however due to the new UI editor on **Unity 3D v5.0+** made the development more easy. So the current stable version is running over Unity and is a both **Mobile and web app**. I still studying how some data structures should behave in this abstract concept.

## Future implementations



One of the next possibilities is to merge this project to **Cubio**, so we could design the language input to be three-dimensional, e.g. we could define variables values stacking blocks vertically.

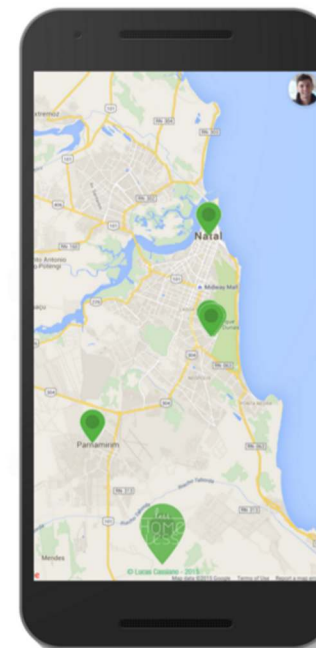


# LessHomeless web app to help homeless people

LessHomeless is a webapp meant to be a tool to connect homeless people to people that want to help. The app working is pretty simple, there are two types of users, the ones that will inform (add to the database) that a homeless person needs help (providing



photos of the situation and its position, "homeless person needs lunch today"), the other user type is responsible to solve the situations, both users are logged in using Facebook accounts and there are scores/ratings inside the app, so we can keep in control the type of content of the situations reported by users.



The app was developed using **PHP, HTML5, CSS3, JavaScript, Google Maps API** and **Facebook Graph API**. The app is already online and connected with a **SQL Database**.

This project was first idealized as a Resarch Paper for an English course at MSOE (Milwaukee School of Engineering) in Wisconsin, US, by the end of 2014. It was mean to be only a theoretical project about homelessness problem in Brazil, however the possibility to implement the project (indeed, the free-time to do it) was only achieved at Brazil, during a course at Universidade Federal do Rio Grande do Norte. The project was helped by other two students: Jaime Dantas and Ramon Fava, both from the Bachelor in Sciences and Technologies, by November 2015. The current version is still on alpha and it only has test data, not real homeless situations, however we plan to test with real problems on the future.



Soon, LessHomeless will be OpenSource, most of the documentation is done to be published.