Robotic mapping is a discipline related to computer vision and cartography which has the goal to construct (and use) a map and to localize itself and its recharging bases. [1] Mapping itself refers to the action to model the environment.

Robot mapping is related to state estimation, localization, SLAM, navigation and motion planning. [2]

* *State estimation* of a robot is a set of quantities (position, orientation, velocity) that fully describe that robot motion’s over time. [3]
* *Localization* is the process of determining where a mobile robot is located. [4]
* *SLAM* is an acronym from “simultaneous localization and mapping” and it refers to the simultaneously construct or updating a map of an unknown environment while keeping track of an robot’s location within it. [5]

One project regarding this topic is made by Matthew W. from University of Pittsburgh named: “ROOM MAPPING Arduino Robot with Unity 3D”. The project has three scenarios and can be found at the following link[7]:

1. The first scenario it allows the user to drive around the robot with a camera feed going back to the user computer. This can be done by using arrows from the mobile application.
2. The second scenario allows the robot to track anything that is put in front of the camera.
3. The last scenario it allows the user to drive the robot with the computer using the arrow keys. The app uses an augmented reality SDK to find the walls and ceiling which is send back to the computer, giving the user a digital representation of the environment.

For this project, the following components were used: Arduino, ESP-8266 Node MCU, I298N motor drive, mobile phone, Arduino wires, robot chassis, wheels, battery and the Unity application.

Arduino is used for controlling the motors of the robot, based on the commands received through wireless network.

ESP-8266 is a Wi-Fi microchip with full TCP/IP stack and microcontroller capability, which is used for the wireless communication between robot (Arduino), computer and mobile phone.

l298N is a dual H bridge which allows the connection between the motors and Arduino board.

Mobile phone is running an application made in the video game engine Unity 3D. The application is used for image processing and creating an AR (augmented reality). The augmented reality is used to give a better digital representation of the current environment, based on the ability to distinguish the walls and ceiling from the rest of the elements, since they have a big role in every room mapping system.

For the implementation of the first scenario, the unity application is used for controlling the robot which will make a TCP connection to the computer. The application is splitted in two parts: the server and the client part. The server part is being implemented on the computer and it’s using image processing algorithms, and the client part is being implemented on the telephone and it is using the camera to fetch the visual information from the current environment.

The second scenario uses Vuforia, which “*is a software platform for creating augmented reality apps*”. [6] The main advantages of Vuforia is that “*developers can easily add advanced computer vision functionality to any application, allowing it to recognize images and objects, and interact with spaces in the real world.”[6].* The scene is named the follow scene, because over here it is created a trackable object which will be used by the robot in order to follow it.

The last scenario is the mapping scenario, and uses Apple’s ARkit, to detect vertical and horizontal planes. This uses a script to send the name, position, rotation and scale of the generated planes to the computer, so the ARkit could instantiate them.

[1] - <https://en.wikipedia.org/wiki/Robotic_mapping>

[2] - <http://ais.informatik.uni-freiburg.de/teaching/ws12/mapping/pdf/slam01-intro.pdf>

[3] – State estimation for robotis – Timothy D. Barfoot <http://asrl.utias.utoronto.ca/~tdb/bib/barfoot_ser17.pdf>

[4] - <https://onlinelibrary.wiley.com/doi/full/10.1002/047134608X.W8318>

[5] - <https://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping>

[6] - <https://library.vuforia.com/articles/Training/getting-started-with-vuforia-in-unity.html>

[7] - <https://www.instructables.com/id/ROOM-MAPPING-Arduino-Robot-With-Unity-3D/>

<https://www.youtube.com/watch?v=SeNLUW79_-c>

<https://www.youtube.com/watch?v=4X_EjUZp2c0>