MOBILE MAPPING CAR

Preanalysis: choice of components

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Content

1 Introduction:

In this document we are going to explain the choice of the different devices in our project, and why we think that this components are the most useful for our implementation.

The steps taken for the election were:

- Performance and features
- Ease of use
- Price

The characteristics of the components have been selected according to our needs. All the components have been provided by the university and we tried to choose within the possibilities to get all of them.

2 Microcontroller selection:

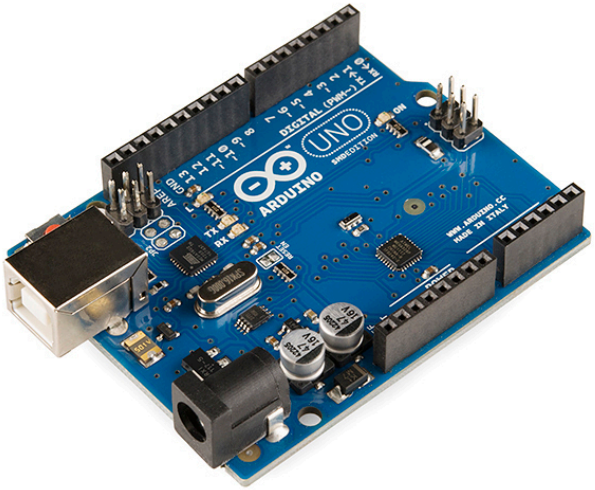
This choice is one of the most important in the project. The board is responsible for the control of all the sensors and engines, and communication with the smartphone.

In the choice we have to keep in mind the great number of I/O we need and another system to communicate this board with the main smartphone.

2.1 Arduino UNO:

This was our first choice; the price of this board is $25 approximately.

The memory and the ports that are able to create PWM signals are sufficient, but we need more pins to connect four ultrasonic sensors and this is why we need to check other options.



2.1.1 Characteristics

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

https://www.arduino.cc/en/Main/ArduinoBoardUno

2.2 Arduino MEGA 2560:

Analyzing this board, the most important advantage is the great number of ports that we can use to connect other devices.

Also the memory capacity is higher than the previous board.

Its price is about €35.00.

2.2.1 Characteristics

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
Length	101.52 mm
Width	53.3 mm
Weight	37 g

https://www.arduino.cc/en/Main/ArduinoBoardMega2560

2.3 Conclusion:

In the previous two tables we compare “Arduino UNO” and “Arduino MEGA 2560”. Both boards’ features are very similar but, in our project, we are forced to choose the second one because it is the microcontroller with a greater number of I/O pins, 15 of them are PWM. This is very important to control our engines.

We will also implement a significant number of ultrasonic sensors and different interfaces, so the Arduino Mega 2560 is the best choice because it is the one that has more memory.

Relating physical characteristics, we do not have any difficulty, because our car has a big platform where we can mount different devices without problems and our engines are powerful enough to obviate weight.

In relation to price, the second one “Arduino 2560” is the most expensive but we don’t have problems buying one because the university has provided us one.

3 Sensor selection

We are going to compare the two sensors that we have found searching via internet. One is from the original Arduino Company and the other one is a typical sensor used in other robotic projects and microcontroller projects.

They are compatible with our board and can satisfy our measure needs correctly.

3.1 SEN136B5B

Power Supply (DC - V)	+5
Working Current (mA)	15
Ranging Distance (cm)	3 – 400
Resolution (cm)	1

Effectual Angle	<15°
Measuring Angle	30°
Trigger Input Pulse width (µs)	10
Dimension (mm)	43x20x15
Price (€/Kr)	12/89.55

http://profesores.fi-b.unam.mx/m3615m/datasheet-sen136b5b.pdf

3.2 HC-SR04

Power Supply (DC - V)	+5
Working Current (mA)	15
Ranging Distance (cm)	2 – 400
Resolution (cm)	0.3
Effectual Angle	<15°
Measuring Angle	30°
Trigger Input Pulse width (µs)	10
Dimension (mm)	43x20x15
Price (€/Kr)	1,89/14,13

https://docs.google.com/document/d/1Y-yZnNhMYy7rwhAgyL_pfa39RsB-x2qR4vP8saG73rE/edit

3.3 Conclusion:

In the previous tables we can see the comparison between two different sensors we were thinking about using. First we searched for some cheap but reliable sensors and we had to choose between these two eventually.

It can be seen that, even though the HR-SR04 ultrasonic sensor is far cheaper than the SEN136B5B (the official from the Arduino page), the HR-SR04 has better qualities than the SEN136B5B regarding ranging distance and resolution.

In conclusion, we made the obvious choice, the HR-SR04.

4 Static or in-motion measurement

We have two possible approaches on how to measure distances and plot the map. We can either measure while the car is moving or make all measurements from a static position.

In-motion:

- This way the measurement process would be much quicker as we can get data as we go and we could also access any part of the room, even plot different connected rooms at once. In the other hand, this way requires to keep track of the car's position in relation to its starting point and we would need to manipulate accelerometer data. Accelerometers are not quite precise, and the error grows exponentially when integrating that data.

Static:

- This way the process will be slower and we could have some blind spots. The good points about it are that the precision and ease of implementation are noticeable bigger. We also reduce all the noise and erroneous echoes.
  For this form of measurement we will implement a little servomotor to rotate a structure with the sensors mounted on it, in this way we will obtain all the points always from the same reference position.

Taking into account all this factors, we will go for the ***static measurement*.**

5 WLAN vs Bluetooth

We at first hesitated on the nature of the communication we could make between the smartphones and the car. Two main wireless ways to do it were the best possible choices to help us: Bluetooth and WLAN. We thought at first point that Bluetooth would be better because it is more local. However, with the amount of data we wanted to share between the devices it made more sense to use the WLAN connection instead. The Wi-Fi technology has also more range.

6 WLAN-Module:

To communicate between the phone and the microcontroller we use a WIFI
Shield. The shield is also from the Arduino brand. It fits exactly with the header pins of the Arduino 2560 board. The Arduino 2560 Mega and the shield are connected with an SPI bus system.