# Luci

## Human seeker robot in hostile environments

PROJECT SPRINT #1.
DATE: 14th April 2021

Martí Caixal i Joniquet
Ricard Lopez Olivares
Hernán Capilla Urbano
Bruno Moya Ruiz
Marc Garrofé Urrutia

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## Project description

*This robot's aim is to seek people whose situation is not favorable in hostile environments. It searchs, avoids obstacles, detects humans in environments where people can't afford to get in (such as gas, smoke, or buildings on fire) and notifies the emergency units.*

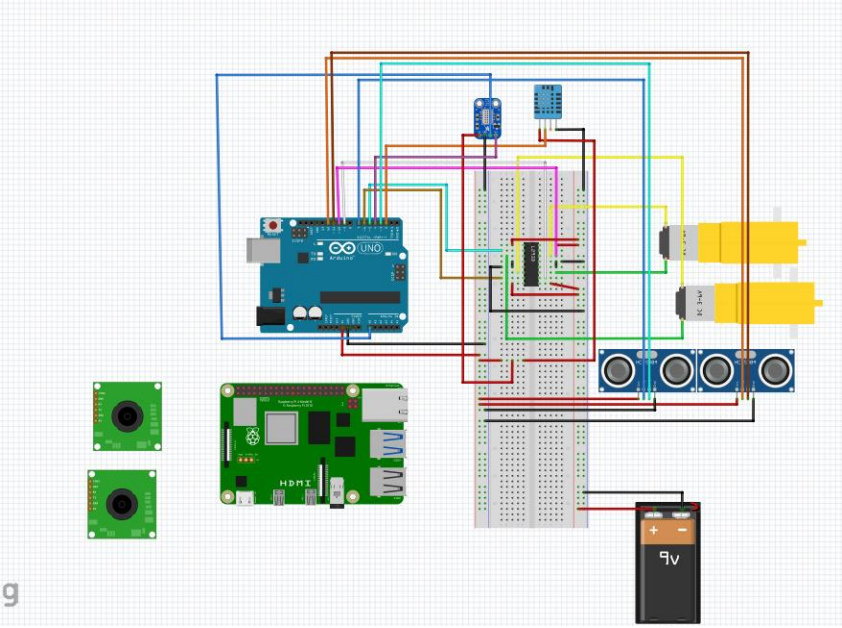
*"Luci keeps you safe, from environments where you won't be safe."*

## Electronic components

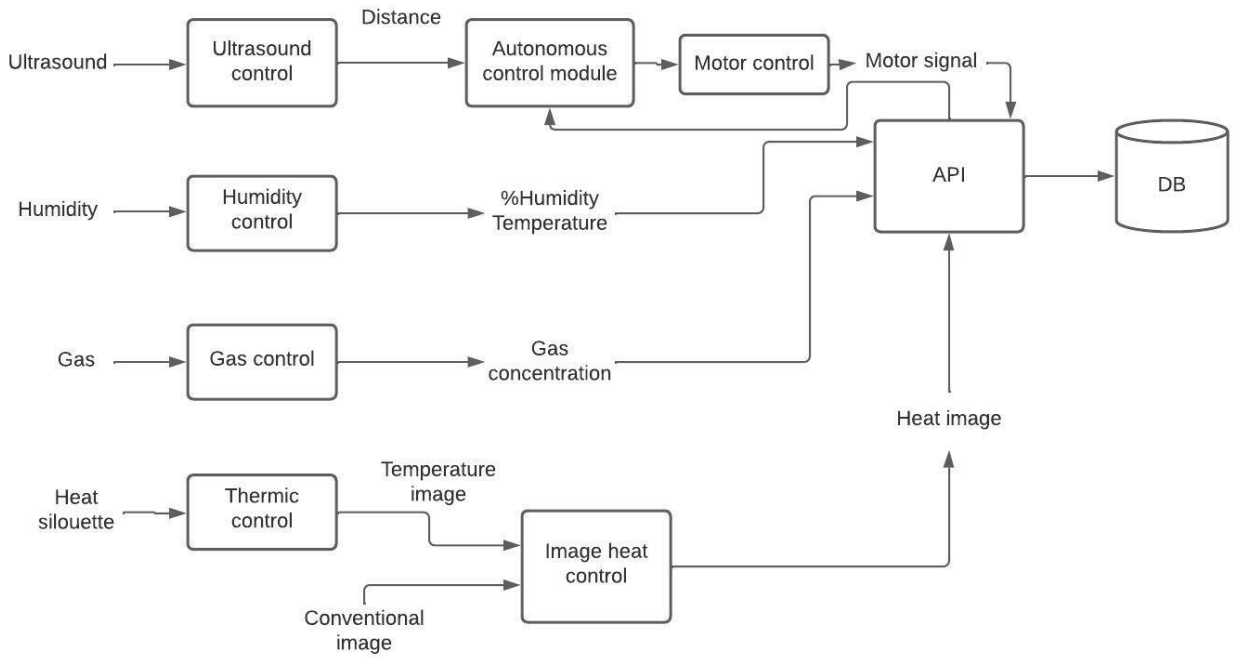
This is the list of the used components:

- *Raspberry Pi 3 B+*
- *Gravity: Gas sensor*
- *Ultrasound HC-SR04 distance sensor*
- *Arduino UNO Rev.3*
- *Motor Kit: DAGU 140rpm*
- *9V battery cable*
- *MLX90640 Thermal Camera Breakout*
- *Webcam C160*
- *Temperature/Humidity sensor*
- *Power Bank 5000*
- *L93B Quad Push*

## Hardware Scheme



## Software Architecture



## Amazing contributions

*Mixing Compting Vision + Robotics with the purpose of analyzing normal images and thermic images to get the results.*

*Adaptive robot to different environments such as gas, fire, smoke, etc.*

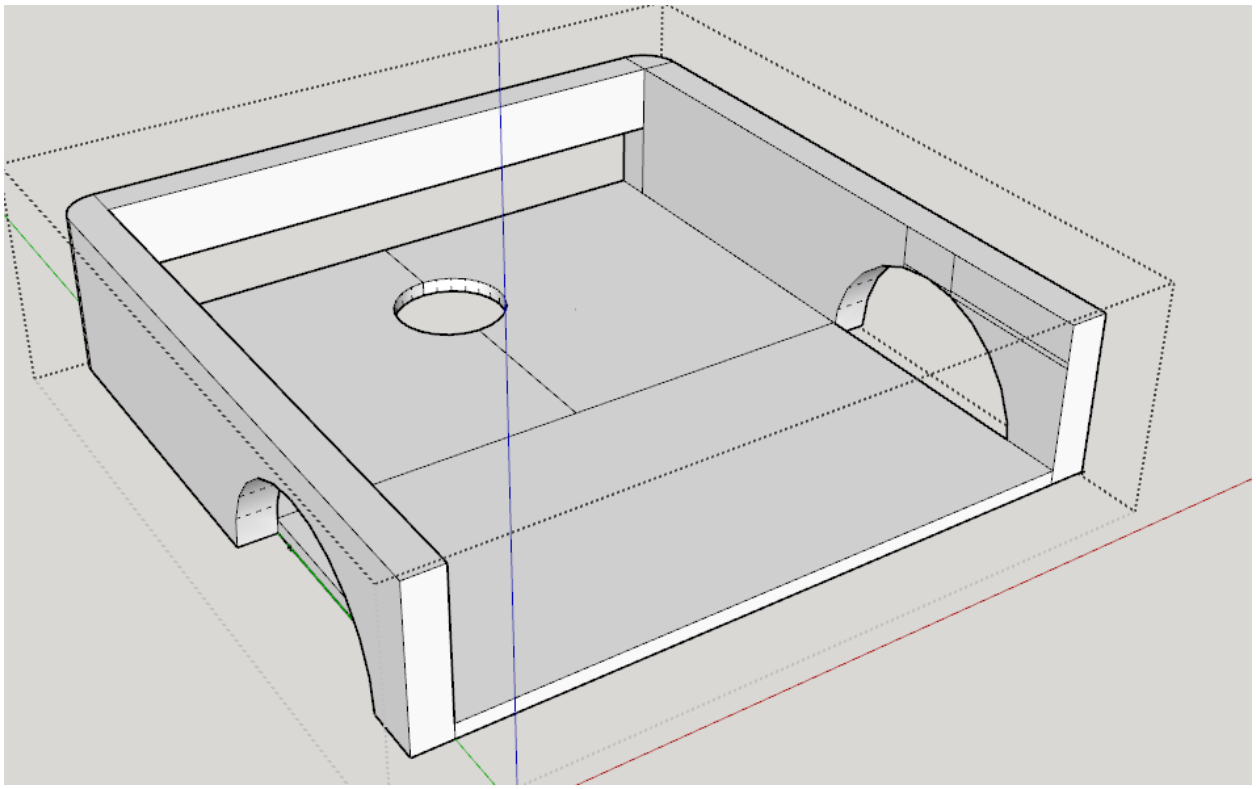
*Not only detects but notifies.*

*Not only notifies but it also indicates the path that has followed the robot plus the obstacles that have found on its way.*

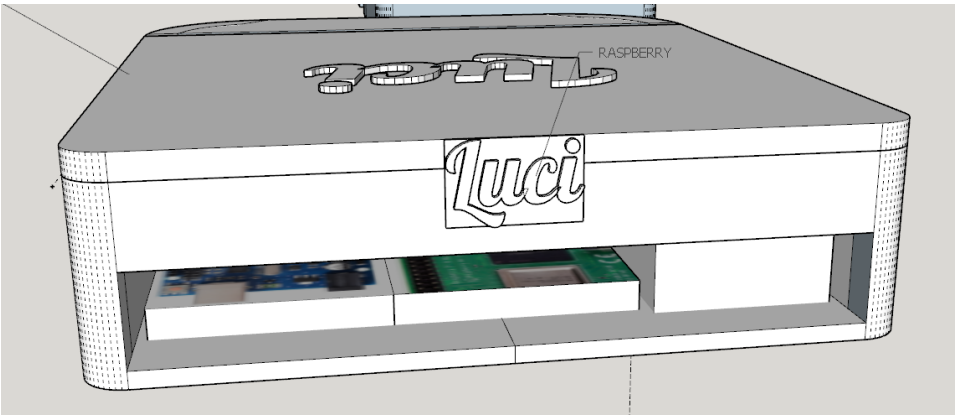
## Extra components and 3D pieces

- *Design 3 pieces*
  First we have the base of the robot. This one presents the part for puting the motors and wheels, also with all the essential elements like Arduino or Raspberry.

- Here we can see it empty:



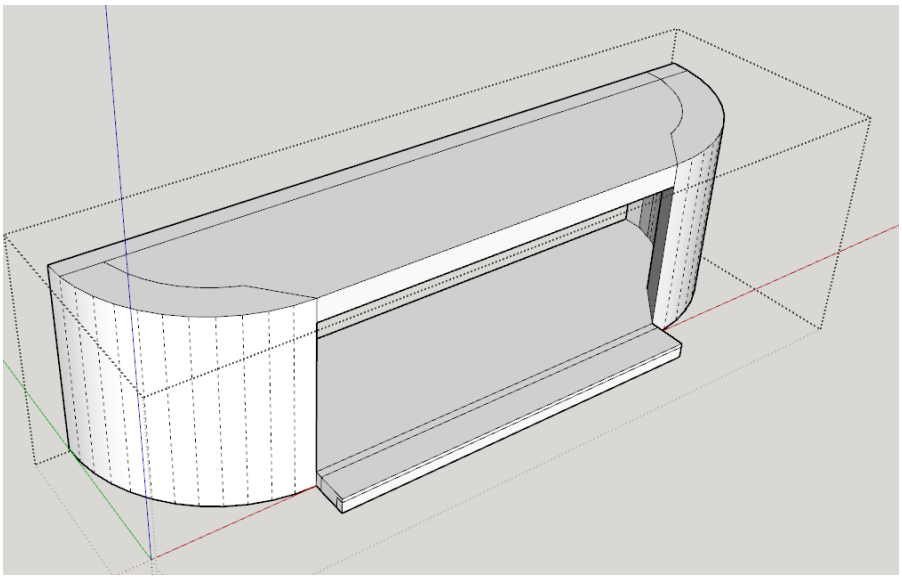
- The idea of this rectangular format at the end (which is not definitive) is to install all the electronics and in this way to be able to connect the arduino to the computer with the cable, so with the batteries witouth having to take them off. The hole is currently very Big, once we have all the electronics we will try to 'measure' and so the cables do fit in perfectly without having a hole on the back.




Next, we have the front part. Here it was necessary to chop the robot in parts due to the  the fact that the idea is that everything can be printed on the 3D printer, but apart from that, it presents its benefits.

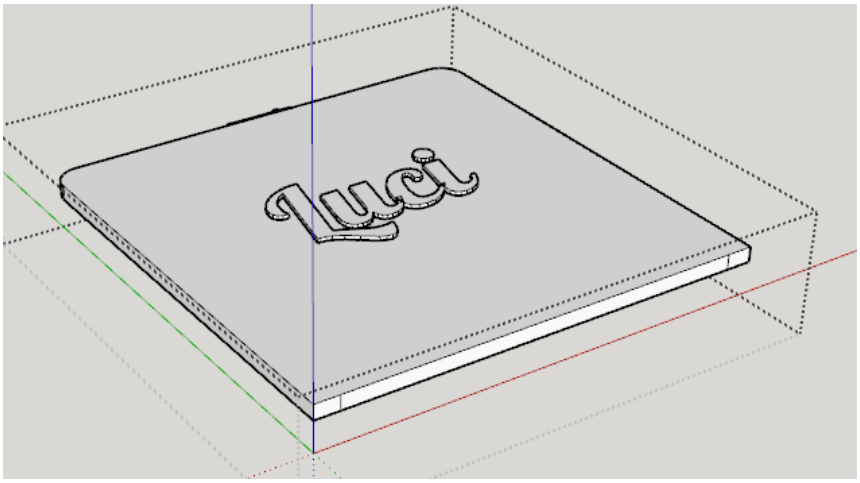
First of all, it is on where  all the sensors and the cameras of the robot will be. Having it separately in a module allows the installation or customization of the module to remain effective without having to modify  all the robot chassis. Once all the sensors are plugged in, their cables will go back to where the Arduino and raspberry are.

Attempts have been made to distribute all things so that the robot has a uniform weight around the entire structure, and that it is as small in height as  possible so that it can enter more hostile places.



Finally, we have the cover, which allows us to close the whole system in a homogeneous structure and why not, beautiful, without all the electronics visible and protected at the same time.

The general idea of everything was to make it a versatile and modular robot, to be able to tractor problems individually and also to fit everything in the printing base of a 3D printer.



## Foreseen risks and contingency plan

| **Risk #** | **Description** | **Probability** (High/Medium/Low) | **Impact** (High/Medium/Low**)** | **Contingency plan** |
|---|---|---|---|---|
| 1 | Camera not stable | Médium | Low | Stabilize the image sequence although the the FOV would be reduced |
| 2 | Faulty thermal camera | Low | Medium | Refund it and ask for a new camera if possible. Otherwise we would just use the default pi camera for computer vision |
| 3 | Cannot merge both images (normal and thermal camera) | Medium | Medium | Images would be needed to be treated separately. The predictions would likely be worse. |
| 4 | Wheels don't move smoothly | Medium | Low | The robots would just not move smoothly. If it too much, some smoothing could be created by adding a chicken rubber around the wheels. |
| 5 | Not enough CPU/GPU power | Medium | Medium | Instead of getting the desired 20fps, we would have a lower fps and probably would not be able to use it in real time. |

| | | | | |
|---|---|---|---|---|
| 6 | Not enough torque from the motors to move the robot | Low | High | More powerful motors would be required. Another option could be using extra gears to increase torque, but the speed would be decreased. |
| 7 | Don't know how to connect Arduino and Raspbery pi together | High | Low | We would first try to do it on a PC with a simulator following some tutorials. Once we get to understand it, we would try to do it again now with the physical components. |
| 8 | 3D printed parts are not good or do not fit together with one another or the other electrical components | High | low | If the error is low, we could just file down the edges. Otherwise, some new parts would be to be printed. |

# References

This project has been inspired by the following Internet projects:

URL Link 1: https://www.eltiempo.com/tecnosfera/novedades-tecnologia/firebot-el-robot-que-ayuda-a-prevenir-incendios-forestales-103122

URL Link 2: https://github.com/gritmind/image-processing-for-fire-detection

URL Link 3: https://makersportal.com/blog/2020/6/8/high-resolution-thermal-camera-with-raspberry-pi-and-mlx90640