🧾 🎯 **Project Title:** **THE PROJECTING AN AUTONOMOUS ROBOT OF THE RESCUE MAZE CATEGORY**  
📅 **Project Timeline:** **August 2019 – October 2021**  
🎥 YouTube Demo: [Link: https://youtu.be/3sTD7d\_HzC4](https://youtu.be/3sTD7d_HzC4)  
📦 GitHub Source Code: <https://github.com/IvanSicaja/2019.08.01_GitHub_The-Projecting-an-Autonomous-Robot-of-the-Rescue-Maze-Category>   
----------------------------------------------------------------------------------------------------------------

🏷️ My Personal Profiles: ⬇︎  
🎥 Video Portfolio: To be added  
📦 GitHub Profile: <https://github.com/IvanSicaja>  
🔗 LinkedIn: <https://www.linkedin.com/in/ivan-si%C4%8Daja-832682222>  
🎥 YouTube: <https://www.youtube.com/@ivan_sicaja>  
 ----------------------------------------------------------------------------------------------------------------

### 📚🔍 Project description: ⬇︎⬇︎⬇︎

### 💡 App Purpose

To design a **rescue maze mobile robot** with autonomous **navigation, victim detection, and package delivery**, capable of operating in **unpredictable rescue environments** with robust AI-driven perception.

**Key Robot Capabilities:**

* **Autonomous character recognition (OCR)**
* **Autonomous color recognition**
* **Partially autonomous drive in the maze** (need a lot of testing and calibration for fully autonomous drive and labyrinth mapping)
* **Thermal victim recognition**
* **Package delivery**
* **Ability to master a climb of 25 degrees** (all-wheel drive, strong grip)
* **Independent axle maneuvering**
* **Remembering positions (encoders)**...

**🧠 How It Works**  
The project is very complex and demands knowledge in different areas (**3D modeling, 3D printing, advanced programming skills in different languages, researching ability, expert knowledge of every electrical component working principles, image processing, cause-and-effect analysis...**)  
The brains of the robot are **microcontroller Teensy 3.5** and **Raspberry Pi 4B**.

The robot is also equipped with:

* **2x optical camera**
* **2x thermal camera**
* **6x IR lidar sensor**
* **1x color sensor**... (more can be found at GitHub in my publication paper: *The projecting an autonomous robot of the rescue maze category.pdf* -> Caption 4.3)

**Optical character recognition:**  
In this project, we trained a **Convolutional Neural Network (CNN)** on an image examples with the Python module **TensorFlow**. Images are converted into **.CSV file** because of speeder processing. The input image is filtered with different filters (**Grayscale, Gaussian Blur, Threshold, Binary, Dilatation**) in order to speed up image processing (replace three color channels with one channel, **RGB -> grayscale**). Reduce noises (the dust on the live video capturing). Getting smooth and sharp character edges is the most important characteristic for successful character recognition. The trained model accuracy is **77.54%** which is a target because we want to get high reliability and avoid CNN overfitting.

**Object detection:**  
Developed the custom script with the Python computer vision module **OpenCV** which filters the character that should be recognized from the other objects in the robot's surroundings. The script works on the principle of **character height and proportion**, together with the **dynamic noise filtering**.

**Maze mapping:**  
Maze mapping is done in my Python module **Turtle**. Every maze field is properly recognized by the robot's **distance and color sensors**. After all maze fields are mapped, they are sent to the backend and the shortest path is calculated by the artificial intelligence searching algorithms such as: *Breadth-First Search, Depth-First Search, A Algorithm*\*...

**Hardware choosing and connecting:**  
The entire process of choosing **hardware platforms, supported protocols, and hardware capabilities** is done. E.g. the **video camera** must have a corresponding **focal length** otherwise it will be useless, **framerate, resolution, additional light source**, **motors** should have expected speed, **distance sensors** should be precise and able to work in a maze, **robot brain** should be able to do high computation payload and support Python…

**Frame design and 3D printing:**  
Entire robot is **3D designed** with **Fusion 360 CAD/CAM** software and **3D printed** with the **Ultimaker 3+** 3D printer with corresponding **filament, density**, etc.

**Developing mechatronic code:**  
**Arduino** is used to control all **sensors and actuators** on the robot except the **camera** which is controlled by **Raspberry Pi 4B** computer.

### ⚠️ Note

Achieving fully **autonomous drive** and **labyrinth mapping** requires extensive testing and calibration.  
I would especially like to thank **Mirko Pezo** and **Stjepan Mikulic** for their exceptional contribution to the development of this project .

### 🔧 Tech Stack

**Python, Convolutional Neural Network (CNN), OpenCV – Computer Vision, Pandas, TensorFlow, Keras, scikit-learn, Git, Linux, Fusion 360, 3D design, 3D printing, Arduino, Raspberry Pi, Teensy, Visual Studio Code, Turtle (Python), AI Search Algorithms (BFS, DFS, A\*)**

### 📣 Hashtags Section

**# #AutonomousRobotics #RescueMaze #RoboticsEngineering #AI #ComputerVision #OCR #ObjectDetection #PathPlanning #CNN #TensorFlow #OpenCV #EmbeddedSystems #RaspberryPi #Arduino #3DPrinting #Fusion360 #Mechatronics #AutonomousNavigation #MachineLearning**