

## 1 Title of assignment

# RiLey: Remote Inspection with Low-cost robots

## 2 Organization information

Company		Fontys Hogeschool Engineering	
Company :	Fontys University of Applied Sciences	Project duration	20 weeks (IPD, 3 <sup>rd</sup> /4 <sup>th</sup> year)
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Mechatronic Engineering		Mechanical Engineering	
	Construction and mechanics		Control systems
	Control systems		Production and Materials
X	Embedded systems		Energy and process
X	Robotics		Construction and mechanics
		Electrical Engineering	
			Analogue
		X	Digital/embedded
			Control
		X	Datacom/telecom

## 3 Preface

At the Mechatronics and Robotics Lab (Lectoraat) we are helping industry partners and the research community to overcome several robotics challenges, for that we participate in different founded projects at national or European level. The RiLey is such a project that is funded by the Taskforce for Applied Research SIA, or Regieorgaan SIA for short.

In this project, we want to investigate whether we can adapt a low-cost robot, which is intended to be controlled remotely, to perform autonomous multi robot environmental inspection. A small and cheap robot is extremely suitable for this application, could be used anywhere and can easily be taken with you. With affordable robots, it would also be possible with multiple robots to scan a large location faster.



The partnership for this project consists of several parties: a company that wants to put its product on the market (SITA Robotics), two technology partners (TMC and Avular) and Fontys as a research partner to come up with innovative solutions.

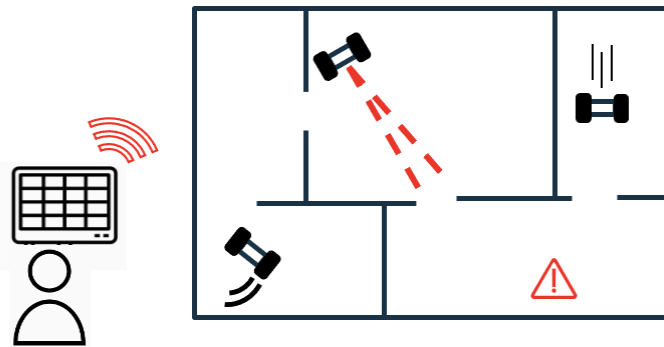
## 4 Problem description

One of the challenges is that the existing low-cost robot does not have the processing ability to perform the necessary sensor analysis and processing of the associated algorithms on the platform itself. For this we want to read all sensor data from the robot and send it wirelessly via to a server, this server will then do all the necessary data processing and send its analyses back to the robot, so that it can take any actions on this. The speed of data processing plays a major role in this.

An additional challenge will be how the robot can locate itself with a limited set of sensors in an (un)known environment. Where other robot systems mainly use more advanced sensors to make a scan of the environment, the SITA robot has only a few sensors available, mainly only a 2D video stream supplemented with data from an IMU. This localization will also have to be carried out on a remote system.

## 5 Assignment description

Can we use the existing low-cost SITA robot, which is intended for remote-controlled reconnaissance, for autonomous inspection without substantially modifying the system itself?



To answer this main question you have to perform some research and implementation:

### Requirements analyses

To get an overview of the current system in order to perform relevant developments and specifications

- you first should do some domain exploration and
- you should determine a use-case / scenario where the robot will operate in (together with the client). (e.g., scan a house for human activity)

### Research:

Determine the current status of the hardware and investigate the provided / needed technologies and solution.

- Determine if the provided technology is sufficient to perform the given task. Investigate the need and contribution of adding (smart) sensors, E.g., the use of a smart camera system (e.g. openmv-h7) or a small lidar could be beneficial for the project, investigate the advantages of the use of such a system and the possibility to be embedded it on the robot.
- Investigate several methodologies that can be used for optimal area coverage to scan a building (e.g. there are biologically inspired techniques, or think of wall following techniques)
- Investigate how the system can benefit from multiple robots performing the same task at once

### Design:

Modify the system based on your requirements and research findings

- Create a digital counterpart of the real robot, for this you need to make the URDF / 3D model of the robot that can run in ROS/Gazebo.
- Integrate the additional sensors on the real robot as on the simulated model.

### Experimenting:

This concept will be prototyped, and you will perform experiments in order to gain improved insight into the technical (im)possibilities.

- Implement the model in simulation and validate if it behaves the same as the real robot in the same scenario.

- Test and validate the added sensors
- Implement and validate the chosen scenario of the use-case
- Implement and validate the chosen building scan methods (single vs multi robot)

After there is improved insight, this input will be processed in a total system design. A Proof of Concept and thus a first demonstrator will be realized

## 6 Aim / objectives

Can we use the existing low-cost SITA robot, which is intended for remote-controlled reconnaissance, for autonomous inspection without substantially modifying the system itself?

Where your main focus is in exploring ways and technologies that are needed to answer this question.

## 7 Specifications

(if possible) what are the specifications (user requirements) for the outcome of the assignment/products (as specific as possible)

## 8 Preconditions

You will be provided with support and documentation of the SITA robot and the needed technologies.

There is a budget included in the funding for prototyping

## 9 Additional Information

Part of the solution will be in remotely analyzing and processing the video with Artificial Intelligence. The actual AI analysis is outside the scope of your project. One of the researchers/teachers will provide parts of this. But basic vision analysis and integration of the AI solution will be part of your project.

## 10 Final products of the project

What do you expect at the end of the project, for example:

- Demonstrator
- Technical documentation
- Project plan "plan of approach"
- Research documents
- Manuals/tutorials
- Mechanical drawing of the set-up (3D CAD solidworks)
- Electrical schematics
- Software documentation
- Demo videos of the working set-up
- Presentation

All information/resources of the assignment to be handed over to the client at the end of the project.