Autonomous Robot for Weeding

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Abstract: This paper aims to introduce a demonstrator that we would like to present during the "demonstrator day". This demonstrator provides a robotic solution to the agricultural weeding problem.

Keywords: Autonomous mobile robot, Image Processing, Agriculture, Range data, Path Planning.

1. INTRODUCTION

Agricultural robotics is a topic that generates more and more projects, as the present technologies allow to deal with agricultural problematic. Those few years several robots have been developed:

- The Bonirob robot (Ruckelshausen et al. (2009)) that can be used for weeding by spreading locally chemical products over weeds,
- The Ladybird (Australian Center for Field Robotics) robot that is used to inspect plants and analyze them,
- The Vitirover robot (Sujaritha et al. (2016)) that mows between and under grapevines,
- The AGROBOT (Dario et al. (1993)) robot that automatically collects strawberries,
- The Oz (Naio Technologies) robot that can be equipped with several tools in order to do weeding and hoeing tasks,
- ...

As the legislation about the use of chemical products for farming is getting more and more severe (most harmful molecule will be forbidden - Ecophyto 2018 - Zahm (2011)), mechanical weeding or targeted used of herbicide are becoming strategical. That is, autonomous robots are becoming an interesting alternative tool for the farmers.

In this situation, the LARIS (System Engineering Research Laboratory of Angers) aims to develop an autonomous plate-form for weeding tasks. As it already exists several working robots (mechanically speaking) we decided to base our work over the Oz robot, developed by Naio Technologies (Figure 1). Thus, we have a working robust robot that we can adapt for our problematics.

The objective of our work is twofold: we aim to develop a robust path planning algorithm for the robot in the crops and in the mean time we aim to develop image processing algorithm so we can detect weeds while the robot is moving.

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Fig. 1. Oz Robot, developed by Naio Technologies.

2. PATH PLANNING

The Oz robot is equipped (among other sensors) of a LiDAR sensor (**Li**ght **D**etecting **A**nd **R**anging). This sensor gives the distance that separate the robot from the closest obstacle in several directions toward the robot. The problematic is then, how to identify the crop rows from the data point cloud. We tested several line ransacextraction algorithms in several cases to identify their advantages and disadvantages. We used the Oz simulator developped by Nao Technologies to do those experimentations (Figure 2). The objective beeing to have the most robust algorithm, regardless the situation (i.e. the nature of the farming).

In a simple context, using a RANSAC algorithm (Schnabel et al. (2007)) to identify the lines corresponding to the crops, we obtained the results presented in Figure 2.

3. VEGETABLE RECOGNITION

To be able to detect weeds inside the growing, we equipped the robot with a structure that receptions the camera pointed over the vegetables (Figure 3).

To detect weeds we mainly used a high definition RGB camera. The chosen approach is to detect the convenience vegetables: by deduction the remaining is weeds.

Figure 4 presents some preliminary results obtained by changing the color space. It appears that the saturation canal provides interesting results in both cases. However for some type of vegetables, where the color of the plants

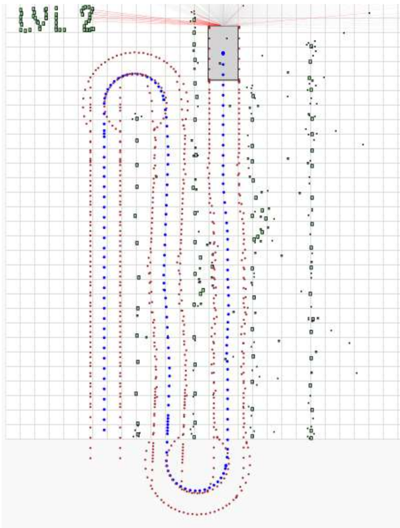

Fig. 2. Screen capture of the simulator (developed by Naio Technologies) we used to test our algorithms. The gray box represent the robot Oz, the green dots correspond to the crops and the red lines correspond to the LiDAR measurements. The red and blue dots correspond to the trajectory of the robot (blue for the center and red for the trajectory of its extremities.

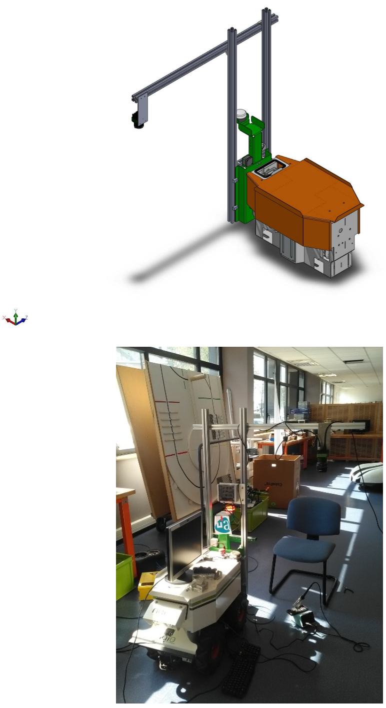

Fig. 3. The structure we developed to capt images over the crops.

is not different enough from the ground this may no be possible to identify the vegetables using RGB camera. Thus we need to identify other sensors.

4. CONCLUSION

We intent to present our results during the demonstrator day. We would like to make a demonstration of the robot

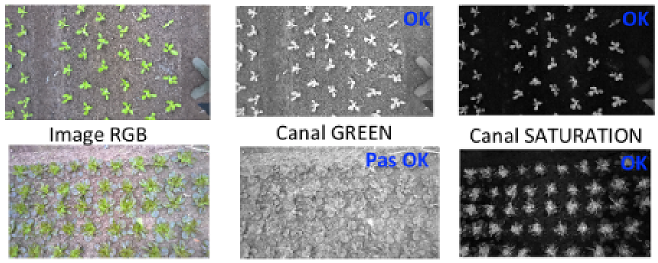

Fig. 4. Preliminary results detected crop using an RGB camera.

autonomously moving in an unknown field and drawing a map of that field while moving thought it. Furthermore, using the camera and the image processing algorithm we will be able to locate the weed in the generated map.

For this demonstration we will use an Oz robot developed by Naio Technologies that will be programmed with our path planning algorithm, our image processing algorithm and our structure that carries the camera allowing to have images of the top of the crops.

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