Autonomous Navigation and Environment Mapping for Robot Weed Detection

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Keywords— Autonomous robot, SLAM, navigation, ROS, weed detection

# Introduction

Weeding is a laborious job particularly for humans. Identifying weeds from the plants can be a difficult task, especially when the weeds and the plants have similarly shaped leaves, and/or colour. Once the weeds have been identified the person would have to manually spray the weed with herbicide or carefully remove the weed from the ground, both of which can be very time consuming and not at all profitable for the farmer [1]. By introducing robots to do both the weed identification process as well as spraying herbicides, a lot of time can be saved and the overall cost would be cheaper for framers.

The aim of the project was to create a system that could autonomously navigate a robot through a dynamic farming environment, while detecting weeds that were growing between the rows of crops and spraying the weeds with herbicide.

The objectives of the project were as follows:

1. To effectively detect weeds in the ground using image processing.
2. To make the robot autonomously navigate through the environment.
3. To implement an object avoidance system to ensure the robot does not collide into other objects in the field.

# Related Works

## Image Processing

Weeds are plants that are considered to be undesirable [2]. Depending on the type of weed and the crops that are growing, the image processing system needed to distinguish weed from crop can vary. If the weed has a different colour to the crops being grown then a simple filtering process would be enough to distinguish the crop from the weed, as the saturation, hue or intensity of the crop would differ to the weed.

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# Methodology

## Image Processing and Spraying

To achieve the first objective of having a weed detecting system, a simple image processing pipeline was implemented. When implementing the system, a weed was considered to be any plant in the row that was not the desired crop. The image processing portion of the system was implemented first, as this was the core aspect of the robot, since the robot would have to detect weeds before it can spray the weeds with herbicide.

In the gazebo environment there were three types of crops being grown (basil, cabbage and onion), each with different types of weeds growing between the plants. In the basil patch, the colour of the basil was distinctively brighter than the weeds that were growing in the rows. In the cabbage row, the colour of the weed and the colour of the cabbage different have enough variation to distinguish between the two, however the sizes of the two plants differed, as cabbages in the row were a lot bigger than the weeds that were growing around it. Finally, in the onion row, there were two distinctive regions, one region had little to no weeds in the row. However, the second region was covered in weeds, making them almost distinguishable from the onion crops.

To combat weeds which have a distinct colour to the desired plants, an inter plant weed detection method was implemented. This method of detection can identify weeds that grow between the plants. The method was implemented by extracting the image from the camera attached to the robot, filtering out the hue of the basil and the ground from the image, leaving only the weeds. Once an image with only weeds was obtained, the image was eroded with a kernel of 1 by 1 to remove small pixels that could have been identified as a weed by the system.

For times when a simple colour filtering process is not enough to isolate the weeds from the crops, other morphological methods of image processing has to be used. Once again the image is extracted from the camera, but this time the image is converted into a binary image.

* Move-base
* Velodyne to Laserscan
* Velodyne filtered

The concept of your system architecture and the choice of algorithms or components you made to develop your artefact.

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