gribot

Requirement for an open source agricultural robotics platform

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Table of Contents

Chapter 1. Introduction

We very often read articles or hear people speaking about precision farming and agriculture automation. However, we do have the feeling that, most of the time, agriculture automation projects mainly consists in improving the traditional way of doing things. As an example, the majority of farmers continue to use chemicals to control pests and weeds, and many of them continue to work huge areas of crops. These chemicals are not only expensive, but also toxic to our environment and our health.

Large areas of monoculture favor the development of diseases and the proliferation of insect pests, while reducing their predators. This way of working seriously damages biodiversity, the environment and the climate.

If we want to continue to live on our planet, preserve our environment and our health, we must quickly change the way we do things. However, changing our habits does not necessarily mean returning to the Middle Ages. We can use technology intelligently to help us in our change and ease our life.

That's why we decided to design an open source robotics platform, called *gribot*, that everyone should be able to build with a minimum of help. To this end, we publish all schema, models and software completely free of charge under GNU General Public License. We believe that the free publication of our work will accelerate the diffusion of the robotic gribot platform and thus reduce the impact on the environment.

We are firmly convinced that the future of agriculture depends on a reduction in the size of farms, cultivated plots, an increase in the diversity of cultivated plants, a decrease in the number of head of livestock, a serious reduction in the consumption of non-renewable energy, etc.

The objective of the *gribot* platform is to help the farmer, not to replace him, in his daily tasks, such as mowing grass in crops, weeding small cultivated areas, planting, harvesting, and many other tasks that we have not yet thought of.

This project is very ambitious in many ways. For example, some activities that we would like to automate are still in the research stage or not even studied yet. Agriculture may not always be a very sexy subject, but it feeds the world's population and therefore deserves a project of this ambition.

Although our target is agriculture, the *gribot* platform is not exclusively limited to this market. Grass mowing, for example, involves many other activities such as roadside maintenance, grassy surfaces in industrial areas, etc. Any idea for using *gribot* is welcome.

What gribot means ?

Perhaps you've wondered what *gribot* means. It is not a fantastic animal from the imagination of J. K. Rowling and encountering Harry Potter.

We were looking for a short name and not yet used as a domain name. After some time of brainstorming, cutting and mixing the words agriculture and robot, we found a**gri**culture ro**bot**, which gives gribot.

Project organization

The *gribot* initiative is built around a multicultural community of people motivated to improve our environment and to see this project succeed. All members of this community are passionate volunteers.

In the long run, we hope to be able to sell parts, kits and even complete robots to people who would not have the possibility to build everything themselves.

We will also consider collaborating with fab-labs or collective workshops, in order to allow everyone to acquire a *gribot* robot.

Chapter 2. Requirement

As mentioned in the introduction, we would like to build a robotic platform, but what is a robotic platform ?

For us, a platform represents a set of flexible robots, based on a common base, such as a common software, common electronics, standard tool holders, standards parts, etc. The *gribot* platform could, for example, allow the creation of a small mower robot, as well as a high clearance robot to work on mounds of crops.

This means that, in the long term, there will not be just one robot, but a family that, we hope, will allow great flexibility in working in agriculture.

In a first step, we will focus on a mower robot, allowing the maintenance of the grass in the crops, because it is a need that we quickly identified. However, as more needs are identified, or ideas emerge, we will document these needs.

Chapter 3. Mowing

As mentioned above, the mower robot will be the first element of the *gribot* robotic platform. There are several reasons for this choice: grass care in crops is unproductive, time-consuming and uses a lot of non-renewable energy unnecessarily. We estimated that maintaining the grass in one hectare of fruit trees consumed about 100 liters of fuel oil per year and required almost a week's work.

We also noticed that such a robot would be useful in many other places outside agriculture, such as roadside maintenance, grass mowing in industrial plots, community plot maintenance, in short, any grassy surface, not always very flat, requiring regular mowing.

The requirement for the mower robot are listed below.

- The robot should not exceed 60cm in width, in order to easily slip between fruit trees or vines.
- The height of the robot should not exceed 30 to 40 cm in order to be able to slip under fruit trees or vines.
- The robot should be able to maintain 20,000 m^2 (2Ha).
- The robot's working surface must under no circumstances be made by burying a wire, as is done for lawn care robots. An electronic means, such as GPS or other positioning system, will always be preferable.
- The robot must be able to move easily on irregular surfaces that may have holes about ten centimeters deep.
- The robot must be able to overcome obstacles of at least 10 cm in height.
- The robot should have an autonomy of at least 4 hours.
- The robot must be able to detect obstacles and calculate its trajectory in order to avoid them.
- The robot must implement a strategy to optimize its work in order to save its battery. A completely random trajectory is strongly discouraged.
- The robot must be able to climb slopes of 45°.
- Users and animals must not be allowed to come into contact with moving parts of the robot. For example, it is possible to detect a presence in the robot environment and to stop any moving parts.
- The robot must stop when someone approaches too close.
- Cutting elements (e.g. mower knives) must stop if the machine tilts too much.
- The machine must stop completely and go into alarm if it overturns.
- The machine must stop completely and go into alarm if it is blocked.
- The robot must be able to be controlled remotely, for example by means of a mobile terminal (smart phone).
- The robot must be protected against unauthorized remote access.
- Robot ownership must be tracked: if the owner sell his robot to someone else, a mechanism has to be put in place to track this transaction. All access right and ownership parameters have to be transmitted to the new owner.
- The robot must be able to be remotely activated or deactivated.
- The robot alarms must be transmitted to the mobile control terminal.

- The work surface and the zones to be avoided must be easily and if possible remotely configured, for example by drawing on a map.
- The robot must have a charging station.
- The robot must be able to return to its charging station by itself when its battery is discharged. The order of return to the charging station must take into account the battery capacity and the energy required for the return journey.
- When the robot is connected to its charging station, it stops all unnecessary electrical consumers.
- When the robot's battery is recharged, it must be able to automatically return or it has abandoned its work.
- The robot must have an autonomous charging station, powered by solar panels or a wind turbine, for example.
- The charging time of the robot battery should not exceed 4 hours when the charging station is connected to the power grid. However, a longer charging time, for example 6 hours, may be allowed on a stand-alone charging station.