Development of a Robotic Fleet for Agriculture

Fletcher Porter, me@fletcherporter.com
Gert Kauniste, gert.kauniste@aalto.fi
Oskari Hynninen, oskari.hynninen@aalto.fi
Yelin Hou, yelin.hou@aalto.fi

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Abstract

The abstract will state what problems we seek to solve, the high level of how we planned to solve them, and how successful it was. All in a single paragraph.

1 Introduction

Under the present threat of the climate crisis, it is the important challenge of our time to develop new technologies to reduce our overall emissions of greenhouse gasses [1]. One area where such improvements can be made is in the care of common reeds (*Phragmites australis*). Reeds are a plant that grow in wetland biomes around the world. They aren't typically cultivated for anything. It's even quite often that they are burned to get them out of the way of human activity. This is problematic both for that burning reeds produces greenhouse gasses and the ash left over from burning enters the wetland ecosystem, making water and soil more alkaline [2].

We propose that these wild reeds should be harvested and used as a resource for energy and raw materials. Studies by Köbbing et al and van der Sluis et al have shown that, not only are these applications possible, but they may even be favorable [2][3]. There are also environmental benefits in cutting down reeds in areas where they are an invasive species [4]. However, there are technical challenges to overcome for reed harvesting to become truly viable.

Principally among these challenges is the inherent difficulty of wetland environments. The ground is very soft, making driving tractors over it challenging. Even if that were to be overcome, these ecosystems are quite sensitive, so uncareful driving would be to their detriment. This can be mitigated by harvesting in the winter when the water is frozen, but care must still be taken [2].

To overcome this, we propose using many small, lightweight tractors so to minimize environmental disturbance while getting the reeds quickly. Employing many people to drive these small tractors may be economically challenging, so we imagine them as (at least semi-) autonomous robots. In one pass several robots cut down the reeds somewhat like a lawn mower, and in another, robots pick up the reeds that they harvested. These robots should be coordinated by a UAV drone that watches them from above and human operator to provide high-level instructions.

There's already been a lot of study into applying robotics in agriculture. Millard et al have proposed, but not implemented, a swarm robot system for harvesting cereal crops like wheat or rice [5]. Blender et al developed a swarm robot system where robots e.g. plant seeds as they traverse across a field and deployed a single-robot prototype system [6].

Kurita et al deployed an autonomous combine harvester in a rice paddy, a notably wet environment [7]. Rahman et al developed a means of plotting a robot trajectory through a field to minimize crop losses [8]. Akbari et al developed techniques for aerial triangulation, localization, and mapping, including for agricultural application [9]. Montoya-Cavero et al have developed a fruit-picking robot that uses computer vision to identify where to grasp and pull the fruits [10].

2 Methods

A description of the theoretical model of how our reed harvesting system will work. It goes through all system components, what they do and why, and why we architect our system the way we do.

3 Results

The details of implementing our system. What tools and facilities did we use, how did we test the system, did we have to deviate from the theoretical model and why.

4 Discussion

Did it work? What improvements could be made for future work on this topic? Could implementation limitations be lifted to allow improvement, or maybe even an architectural decision was flawed.

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