BrambleBee: An autonomous robot to pollinate bramble plants

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BrambleBee, the precision pollination robot. Credit: Gu et al.

Natural pollinators, particularly honey bees, are disappearing at an unprecedented rate. This poses serious risks for agriculture, the economy, and the sustenance of humans and animals. Bees are the

primary pollinators of a vast variety of crops, so their disappearance could compromise the work of food producers, ultimately reducing the amount of food available on the market.

Researchers at West Virginia University (WVU) have recently developed an autonomous robot inspired by bees, which can pollinate bramble plants within a greenhouse environment. BrambleBee, presented in a paper pre-published on arXiv, uses state-of-the-art localization and mapping techniques, as well as other tools that enable visual perception, path planning, motion control, and manipulation.

"One of the major issues concerning current agricultural production is crop pollination," Yu Gu, one of the researchers who developed the robot told TechXplore. "Thirty-five percent of the global crop production volume, approximately $577 billion a year, relies on the service of pollinators. However, the recent decline of honey bees (i.e. colony collapse disorder) has greatly threatened productivity. From both economic and food sustainability points of view, there is an urgent need to seek alternative pollination systems."

To address this problem, Gu and his colleagues have designed a prototype precision pollinator robot to pollinate bramble, blackberry and raspberry plants, in a greenhouse environment. Their project is funded by the National Institute of Food and Agriculture (NIFA), an agency of the U.S. Department of Agriculture (USDA), under the National Robotics Initiative.

BrambleBee, the precision pollination robot. Credit: Gu et al.

"BrambleBee first obtains up-to-date information about flower cluster locations and pollination readiness by making an 'inspection pass' of the greenhouse," Gu explained. "As BrambleBee drives around, nearby flower clusters are detected using the on-board camera. The locations of the detected clusters are then recorded into a map of the plant rows."

After this initial inspection phase is complete, Bramblebee decides where it will move to pollinate flowers. It reaches this decision by balancing the number of reachable flower clusters that are ready for pollination and minimizing the distance driven. The robot then plans paths to efficiently reach these locations avoiding any obstacles on the

way.

"Once parked at a pollination location, BrambleBee scans the plant and builds up a more detailed map," Gu said. "It will then use the manipulator to access each flower that needs pollination."

In constructing their bramble pollinating robot, the researchers were partly inspired by the ecology and behaviour of bees, particularly mason bees, which collect pollen for their offspring. For instance, just like bees, BrambleBee first finds flowers and then keeps track of their location, using this information to plan the best path to reach them.

In addition, BrambleBee's pollination mechanism, attached at the end of its robotic arm, acts in a similar way to that of bees. The robot manoeuvres this mechanism using precise motions, distributing pollen into pistils without damaging the flowers. "The project allows the development of a complex autonomous robotics system that can work in a common agriculture setting," Gu said. "The precision localization, evaluation, and manipulation of small and delicate plant parts provides fundamental capabilities for enabling a variety of other precision agriculture applications such as automated irrigation, fertilization and harvest, monitoring plant damages, as well as weed and pest control."

The precision robotic pollination system created at WVU is the first of its kind. In future, it could help growers to solve short-term pollination challenges and could even be adapted to develop new agricultural tools for harvesting, pruning, and fruit picking.

"We will now focus on improving the autonomy of the robotics pollination system and evaluating the efficacy and efficiency of this new pollination method," Gu said.

More information: Design of an Autonomous Precision Pollination

Robot. arXiv:1808.10010v1 [cs.RO]. arxiv.org/abs/1808.10010

Abstract

Precision robotic pollination systems can not only fill the gap of declining natural pollinators, but can also surpass them in efficiency and uniformity, helping to feed the fast-growing human population on Earth. This paper presents the design and ongoing development of an autonomous robot named "BrambleBee", which aims at pollinating bramble plants in a greenhouse environment. Partially inspired by the ecology and behavior of bees, BrambleBee employs state-of-the-art localization and mapping, visual perception, path planning, motion control, and manipulation techniques to create an efficient and robust autonomous pollination system.