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Hiveopolis - Honey Harvester System

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Abstract : Traditional means of harvesting honey are often stressful for honeybees. Each time honey is collected a portion of the colony can die. In consequence, the colonies' resilience to environmental stressors will decrease and this ultimately contributes to the global problem of honeybee colony losses. As part of the project HIVEOPOLIS, we design and build a different kind of beehive, incorporating technology to reduce negative impacts of beekeeping procedures, including honey harvesting. A first step in maintaining more sustainable honey harvesting practices is to design honey storage frames that can automate the honey collection procedures. This way, beekeepers save time, money, and labor by not having to open the hive and remove frames, and the honeybees' nest stays undisturbed.This system shows promising features, e.g., high reliability which could be a key advantage compared to current honey harvesting technologies.Our original concept of fractional honey harvesting has been to encourage the removal of honey only from "safe" locations and at levels that would leave the bees enough high-nutritional-value honey. In this abstract, we describe the current state of our honey harvester, its technology and areas to improve. The honey harvester works by separating the honeycomb cells away from the comb foundation; the movement and the elastic nature of honey supports this functionality. The honey sticks to the foundation, because of the surface tension forces amplified by the geometry. In the future, by monitoring the weight and therefore the capped honey cells on our honey harvester frames, we will be able to remove honey as soon as the weight measuring system reports that the comb is ready for harvesting. Higher viscosity honey or crystalized honey cause challenges in temperate locations when a smooth flow of honey is required. We use resistive heaters to soften the propolis and wax to unglue the moving parts during extraction. These heaters can also melt the honey slightly to the needed flow state. Precise control of these heaters allows us to operate the device for several purposes. We use 'Nitinol' springs that are activated by heat as an actuation method. Unlike conventional stepper or servo motors, which we also evaluated throughout development, the springs and heaters take up less space and reduce the overall system complexity. Honeybee acceptance was unknown until we actually inserted a device inside a hive. We not only observed bees walking on the artificial comb but also building wax, filling gaps with propolis and storing honey. This also shows that bees don't mind living in spaces and hives built from 3D printed materials. We do not have data yet to prove that the plastic materials do not affect the chemical composition of the honey. We succeeded in automatically extracting stored honey from the device, demonstrating a useful extraction flow and overall effective operation this way.

Keywords : honey harvesting, honeybee, hiveopolis, nitinol
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