

Title: DropBot: Water Droplet Penetration Testing with a Custom Drone

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Soil hydrophobicity is a measure of how much a soil repels water and is a critical property which indicates an area's suitability for agriculture and environmental sustainability. To assess soil hydrophobicity, the Water Droplet Penetration Time (WDPT) test can be utilized by providing a standardized method to determine a soil's hydrophobicity. With the WDPT test, it is possible to autonomously determine a soil's hydrophobicity, allowing for consistent results with minimal labor. The DropBot is a custom-built drone which handles WDPT testing in a portable, maneuverable package capable of wireless communication and autonomous flight. To perform WDPT testing, DropBot is equipped with components to consistently release a single droplet of water and a camera and Jetson Orin Nano to detect and analyze water droplets in real time using machine learning. To suit various terrains, the DropBot is equipped with three robotic legs which are able to self-level itself in the case of uneven ground and a delta configuration robotic arm to adjust the level of where the water droplet is released from. For rapid testing of the DropBot's capabilities, an accompanying system, the DropLab has also been developed, providing a duplicate system without the same flight capabilities. With the DropBot and DropLab, soil hydrophobicity testing can be performed autonomously and efficiently while allowing for greater reach in less accessible areas.