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3: Human Spaceflight Mission Operation Management
- **Crew Life support system design**

Garuda UAV Swarm in Bhoomi Habitat

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ABSTRACT

Our motivation is to increase the habitable days for explorers/crew in extraterrestrial environments. Our idea sparked with the necessity to preserve houseplants without maintenance and we are inspired by Honeybee exploring a tilted window for navigation. We propose a Swarm robotics platform - Garuda to maintain a greenhouse in an extraterrestrial Habitat - Bhoomi.

We propose a novel replication algorithm for exploration and mapping of the habitat. From the Swarm drones, replica's are created at intersection to solve sub-problems and the drones return to the start point/ way point if goal is not reached. Information is stored in graph nodes and the replicated data is updated in individual drones on reaching the waypoint. Memory access is global read for instances and local write on reaching the waypoint. The graph is updated globally with delta information when an instance reaches the waypoint. We propose to test the Hypothesis to solve a Maze and to interpret the efficiency of the algorithm compared to other SLAM methods.

Vision sensors are used for monitoring and maintenance of greenhouse in the habitat. The device inputs side and top view images to the computer vision module and results are reported to Habitat controller. The functional parameters reported are live count of leaves, disease detection, growth measurement and soil moisture values.

Resource utilization for dietary requirements is provided by Bhoomi Habitat controller. Based on the number of Habitants, food sources are replenished with Garuda(UAV drone) carrying out a. Sowing of seeds, b. Spraying fertilizers c. water irrigation through a sprayer module attached to drones in the swarm. Human intervention is required for the harvest cycle, which we propose to handle with a Humanoid (Gaganyatri) as future scope.

This work shows the pipeline integrating the computer vision module, Replication method for navigation and the resource utilization module into the UAV swarm for Autonomous maintenance of Greenhouse.

Comments :

Demo website: <https://mangala.earth>

Project nominated for Global judging as part of Space Apps 2022 competition.

Bhoomi is a swarm robotics platform to build Habitats. Each robot in the swarm is independent and completes functional requirements autonomously. Multiple robots collaborate to complete a complex task. Robots consist of Rover(UGV), Quadcopter(UAV/), Humanoid(Digital twin). VR map model is generated by the Habitat Monitor system for real time visualization and tracking progress of robots. Each robot has a fallback position, for human operators to intervene for complex task processes.