

**EXCAVATION USING DECENTRALIZED SWARM
ROBOTS FOR OFF-EARTH HABITATION**

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March 2022

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Thesis Submitted In Partial Fulfillment Of The Requirements For The
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DECLARATION

I declare that this is my own research proposal and this proposal does not incorporate without acknowledgement any material previously published submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Signature:

Date:

I have read the proposal and it is in accordance with the approved university proposal outline. I am willing to supervise the research work of the above candidate in the proposed area.

Signature of the supervisor:.....

Date:

Abstract

Civilization has progressed over time as a result of exploration of previously undiscovered portions of the Earth and the subsequent exploitation of new resources. Humans will now explore and exploit new places beyond Earth, i.e. in space, as a natural continuation of this process. The Moon has been partially investigated, but it still needs to be fully explored and colonized. Mars and beyond will be the next phase. The establishment of outposts on these new space bodies will be necessary before they can be habited. But these extraterrestrial constructions are expensive, time-consuming, and risky. In this article building habitations by excavation is suggested and proven to be more convenient. Having many challenges in the physical excavation tasks, only a few researchers have been trying to innovate and improve excavation-related technologies. Amongst these, some have proposed adopting robotics in the aspects of excavation in the construction process but none has been tested practically. In our work, we try to introduce a novel approach for excavation using swarm robotics.

Behaviour of a robotic swarm is collective and aimed at solving a problem using the collective conduct. This is similar to the natural animal swarm behaviour of bees/ ants/ termites...etc. Even though there are many researches and developments done in the field of swarm robotics, the concept has not yet made its way into industrial environments. In order to colonize planets and moons, it is required to build a surface structure which needs to be a few meters thick to protect living beings from solar/cosmic radiation, meteoroid impacts, and extreme temperature variations. However, creating a structure with thickness of a few meters has been a research challenge for many decades due to practical limitations of developing them on off-earth.

This research proposes our approach **Cave Construction using Swarm Robots** acronymed as **CCSR**, a practical method to excavate the ground to create subsurface habitats using decentralized robot swarms. Our CCSR design uses vision, RFID, and orientation sensor data to decide action needed to be taken by the robot. Robots can do basic actions such as traversing, removing, and dumping regolith.

The swarm consists of a set of robots that are practical to implement, with limited visibility and limited communication skills. Having only the local view of the terrain, robots in the swarm excavate a given shape in 3D in collaboration with the other robots in the swarm. With the application of swarm concepts in an improved manner, the swarm is able to construct the given shape through excavation, displaying true parallelism which in turn will improve the construction time.

DEDICATION

To my grand parents for their dedicated partnership in the success of my life

ACKNOWLEDGEMENTS

I would like to send my deepest thanks to Dr. K.S.D. Fernando, who ignited my passion for research and provided help and wisdom at every step of the way of this research. Her guidance was unequivocally crucial to this work, and I owe a great deal of its success to her.

I would like to extend my thanks and appreciation to the staff members of the Department of Computation Mathematics, for their interest in, and consideration of, my research work.

Lastly, I would also like to express my heartfelt appreciation to all my family and friends, who supported me in this long endeavor and through all my life. Though they may not know it, the impact they have had upon me is substantial, and I would have never made it to where I am now without them.

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