As the frequency of landing on extraterrestrial bodies increases over the years, the potential for off-world exploration has also increased. From the iconic Touch And Go on the asteroid Bennu to Chandraayan 3 landing on the South pole of The Moon, we have successfully touched down on several different environments. This calls for the development of rovers that can efficiently traverse most, if not all such environments. This research paper introduces a novel robotic system designed to traverse a diverse variety of extreme environments inspired by the remarkable capabilities of marine flatworms. The Slugbot, drawing inspiration from the Velox robot, is equipped with adaptable rubber fins, effectively navigating terrains such as sand, ice, and water in its current version. The Slugbot's 3D-printed shell incorporates a range of sensors to gather crucial environmental data, while the control system coordinates the movement of 16 high-torque servo motors in a sinusoidal configuration.

This paper discusses the simulation and testing results of the traversal and navigation properties of the Slugbot in various environments. The primary objective is to evaluate and optimize the Slugbot for operation in low-gravity environments, making it adaptable to a wide range of space conditions. This adaptability will enable the robot to traverse polar ice caps, under-ice oceans, and sandy deserts, showcasing its versatility in extraterrestrial exploration. The Slugbot's exploration capabilities shall be fully autonomous, harnessing an AI vision sensor to discern the most favorable navigation paths through its surroundings. Ultimately, the project aims to enable the robot to reach areas that may be otherwise unreachable by any other methods, including conventional rovers,drones, hoppers, or remote sensing.

The equations governing the movement of the robot with respect to the 16 servos and the signals generated by the controllers have been identified, and simulations will be performed. We utilize a sandbox facility to test the traversal properties of the robot in sand with different traction coefficients and inclinations to identify the limits of the locomotion of the robot. Incorporating various sensors, such as the AI vision sensors, to map the surroundings to aid in navigation is discussed. In summary, this research presents an innovative approach to space exploration and navigation by developing a robot that draws inspiration from nature, particularly marine flatworms. The Slugbot signifies a significant advancement in creating adaptable and versatile robotic systems tailored for space navigation missions.