The Use of Microcontrollers To Create a Self-Regulating Environment That Can Sustain an Ecosystem in Extraterrestrial Conditions

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As global warming presents a long-term challenge to the Earth and aerospace organizations continuously expand efforts to explore and colonize other planets, the need for an effective means to sustain life in extraterrestrial conditions has never been greater. However, planets such as Mars present uninhabitable atmospheres with frigid temperatures and low pressures. This fully functional prototype addresses the challenge by creating a lightweight and relatively inexpensive autonomously regulated terrarium that controls various atmospheric conditions while periodically providing food, water, fertilizer, and light. A pressurized container was constructed from composite materials and fitted with various mechanisms consisting largely of solenoids, servos, and transistors. Additionally, software allowed for a microcontroller to utilize sensor data in activating the mechanisms when needed to manipulate atmospheric variables while displaying this data on a webpage. Using a vacuum chamber and dry ice to simulate Mars' atmospheric conditions, all three trials showed how the terrarium's internal oxygen concentration, carbon dioxide concentration, humidity, temperature, and pressure remained hospitable and relatively consistent. Additionally, all organisms within the terrarium survived. When individually tested, every periodically controlled mechanism functioned to its full capacity. These results demonstrate the successful operation of the terrarium and its ability to adequately sustain life despite uninhabitable external atmospheric conditions. This proves how methods and solutions employed in the prototype can reasonably be applied to larger-scale methods of sustaining life on other planets and in virtually any atmospheric conditions otherwise unable to support life.