# Expert System Control of Plant Growth in an Enclosed Space

An adjustable environment optimizes growth while minimizing consumption of resources.

Stennis Space Center, Mississippi

The Expert System is an enclosed, controlled environment for growing plants, which incorporates a computerized, knowledge-based software program that is designed to capture the knowledge, experience, and problem-solving skills of one or more human experts in a particular discipline. The Expert System is trained to analyze crop/plant status, to monitor the condition of the plants and the environment, and to adjust operational parameters to optimize the plant-growth process. This system is intended to provide a way to remotely control plant growth with little or no human intervention. More specifically, the term "control" implies an autonomous method for detecting plant states such as health (biomass) or stress and then for recommending and implementing cultivation and/or remediation to optimize plant growth and to minimize consumption of energy and nutrients. Because of difficulties associated with delivering energy and nutrients remotely, a key feature of this Expert System is its ability to minimize this effort and to achieve optimum growth while taking into account the diverse range of environmental considerations that exist in an enclosed environment.

The plant-growth environment for the Expert System could be made from a variety of structures, including a greenhouse, an underground cavern, or another enclosed chamber. Imaging equipment positioned within or around the chamber provides spatially distributed crop/plant-growth information. Sensors mounted in the chamber provide data and information pertaining to environmental conditions that could affect plant development. Lamps in the growth environment structure supply illumination, and other additional equipment in the chamber supplies essential nutrients and chemicals. The illumination is also designed to support plant-health imaging di-
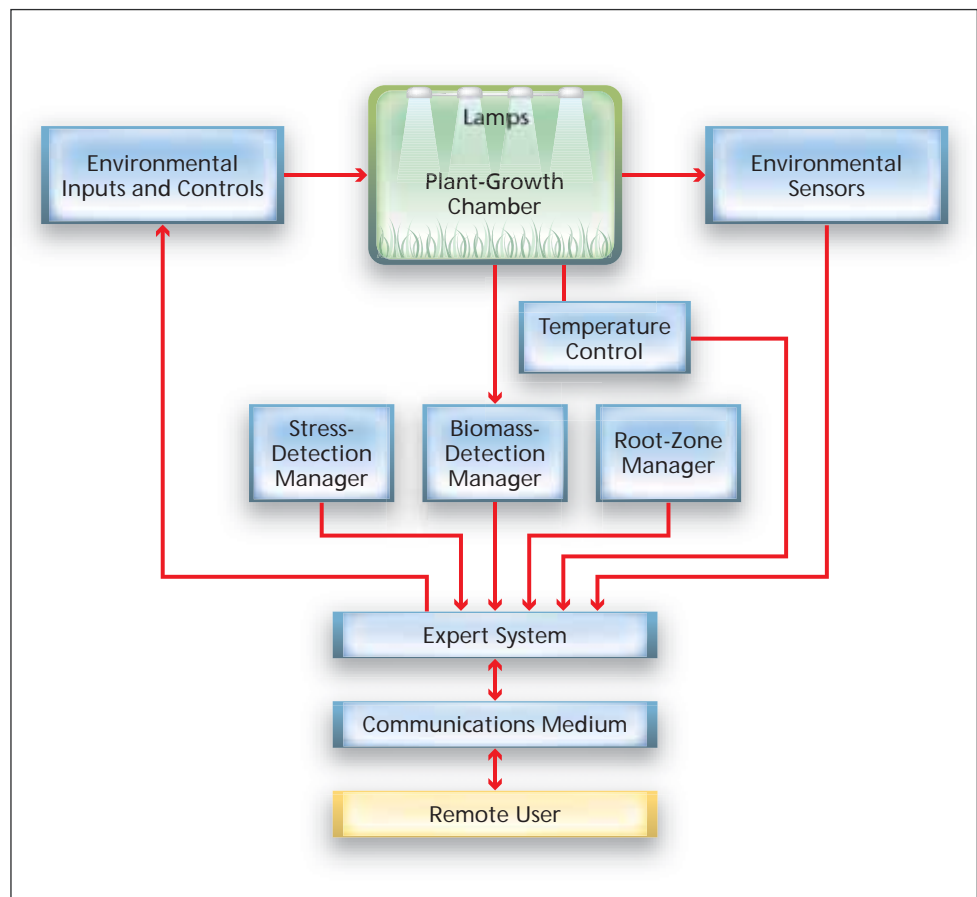
The **Expert System** adjusts inputs in response to image data and other sensory data, and controls the environment so that optimum plant-growth conditions are maintained.

agnostics. Real-time data collected from the various devices enable monitoring capabilities. The Expert System processes the information provided by the imaging and sensor subsystems (see figure). In response, the spatial and temporal patterns of light and the supply of nutrients adjust to maintain optimal performance. The system includes a communication link to a remotely located user via a distant interface, so that the Expert System is accessible and activity within the growth chamber can be assessed and/or overridden when and if necessary. Future applications of the Expert System include biopharming technological applications on Earth and bioregenerative Advanced Life Support Systems in space.