Autonomous Anthropomorphic Robotic Arm to Monitor Plant Growth in a Laboratory

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Abstract

An autonomous anthropomorphic robotic arm was designed, fabricated and programmed for monitoring of plant tissue grown in a modified *in vitro* clonal plant propagation system being developed by The New Zealand Institute for Plant & Food Research. The custom fabricated aluminium robotic arm uses a vertical linear ball shaft and high speed stepper motors to provide arm joints movements enabling the arm to swivel 180 degrees horizontally. Sensors located at the end of the arm are used to monitor plant growth and the immediate growing environment. This includes a compact colour zoom camera on a pan and tilt mount for image capturing, red, green and blue (RGB) colour sensors to monitor leaf colour as well as temperature, relative humidity and carbon dioxide sensors. The robotic arm is capable of reaching over multiple trays (600mm x 600mm) of plantlets. Captured plant tissue images are processed using innovative algorithms to determine tissue or whole plant growth rates over specified time periods. Leaf colour sensors provide information on tissue health status when compared to predetermined optimum values. Custom software fully automates the operation of the arm and the data capture, allowing the arm to return to specified sites (i.e. individual plantlets) at set time intervals to identify subtle changes in growth rates and leaf colour. This allows plant nutrient levels and the immediate environment to be regularly adjusted in response to continuous sensing resulting in optimised rapid growth with minimal human input.

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