Development of a Low-Cost Articulated Arm 3D Printer

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3D printers are becoming more accessible, but are still expensive to achieve high precision in a large build volume. As an alternative to traditional Cartesian 3D printers, which have a large frame and expensive linear motion components, using an articulated arm for the motion platform can reduce costs. The goal of this project was to design an affordable articulated-arm 3D printer, constructed from 3D printed parts and easily sourced components. Autodesk Fusion 360 was used to design the mechanics and a commercially available 3D printer was used to fabricate the parts for the prototypes. An Arduino Mega microcontroller and a Ramps 1.4 IO board was used for the electronics. To make the 3D printer compatible with standard Cartesian based software, inverse kinematic equations were derived and a postprocessor was written in Python to transform the coordinates. A sensitivity analysis was performed on the equations to identify critical software values necessary for accurate printing. Original calibration algorithms were developed to help obtain these critical values accurately. The algorithms were tested on the device and an analysis of the accuracy, with and without calibration, was performed. The analysis demonstrated the effectiveness of the calibration algorithms. After several revisions, a fully functional articulated-arm 3D printer was created for about $100 in plastic and components. A smaller version is in development that further decreases the cost to $40. This research could help make 3D printing more accessible around the world for consumer, small business, and educational use.

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