Custom Robot Arm-Based Trowel Direction Determination on Wall Corners Using Deep Predictive Learning

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I. 3D Printing Workflow

- Step 1: **Loading Filament**

  To begin, insert the filament spool onto the spool holder and ensure it is free from tangles. Next, feed the filament into the extruder, using the printer's touchscreen interface to guide the filament through the hot end. Before inserting the filament, make sure to heat the hot end to the recommended temperature for your chosen filament, typically around 200°C for PLA. This ensures smooth extrusion and prevents any blockages when starting your print.(usually **200°C for PLA**).

- Step 2: **Using the Printer's Interface to Prepare for Printing**

  The Bambu Lab P1 comes with an intuitive touchscreen interface that allows you to easily navigate settings, initiate prints, and adjust configurations. To prepare for printing, you will first need to slice your 3D model using slicing software like Bambu Studio. Once sliced, save the resulting G-code file onto a microSD card and insert it into the printer's card slot. Through the touchscreen, navigate to the file you want to print and select it to begin the print process. The interface will also allow you to monitor the print, adjust settings, or pause the job if needed.

  You can download Bambu Studio here: Bambu Studio Download

  Additionally, you can transfer files to the printer via Wi-Fi. However, this requires creating an account, and since the printer is from mainland China, you will need a Chinese phone number to set up this feature.

- Step 3: **Printing Settings**

  In Bambu Studio, you can modify various settings such as temperature, print orientation, and support structures. For detailed guidance on how to use Bambu Studio, refer to its documentation available at: Bambu Studio Documentation.

Adjusting these settings will help optimize your print quality depending on the material and model type.

- Step 4: **Start the Print**

  Before starting the print, make sure the print bed is clean and free from any debris. Applying a thin layer of glue to the bed can provide better adhesion for the print. Once everything is set, initiate the print from the touchscreen. The printer will begin by heating the extruder and the print bed. It's recommended to observe the first few layers to ensure proper adhesion and correct extrusion of the filament.

- Step 5: **After the Print**

  Once the print is finished, allow the print bed to cool down before carefully removing the print from the bed. If necessary, use a spatula to help remove the print without damaging it. After removal, wipe the bed with a clean cloth to remove any residual filament or debris, ensuring the bed is ready for the next print.

- Step 6: **Maintenance and Troubleshooting**

  Regularly check and clean the extruder nozzle to ensure it remains free from clogs. If a print fails, cleaning or replacing the nozzle may resolve the issue. However, make sure to turn off the printer before performing any maintenance. For further troubleshooting related to print failures or other issues, refer to its documentation available at: Bambu Studio Documentation.

  By following these steps, you can ensure smooth operation of the Bambu Lab P1 3D printer and maintain the quality of your prints.

II. Using CAD software for designing robot arm

- Step 1: **Setting up the workspaces**

  The first step in the design process is to set up the workspace in your CAD software. Make sure to configure the units of measurement, selecting either millimeters or inches depending on your 3D printer's requirements. This ensures that the designs are correctly scaled for printing.

- Step 2: **Sketch the Base Shape**

  Start by sketching the basic design of the robot arm components on the coordinate plane (usually referred to as the XY plane). You will use various tools available in the Wireframe menu, such as Rectangle, Line, and Circle, to create the foundational shapes of the parts. At this stage, you are working in a 2D space, establishing the outline and the basic layout of your robot arm components.

- Step 3: **Extrude the Shape**

After completing the 2D base shape, you'll need to use the Extrude tool to convert the 2D design into a 3D object. The extrusion process adds thickness and volume to the parts, turning them into solid models. These 3D objects represent the individual components of the robot arm, and this is the form that can be exported for 3D printing.

This guide outlines a basic workflow that I use primarily in Mastercam software. However, you can apply this same workflow to other CAD software like Creo or SolidWorks; the overall process remains the same, though the user interface and terminology may vary slightly.

III. Simple Guide on Arduino Design

- Arduino Uno Rev3

  Arduino Uno Rev3 is a versatile microcontroller board. It is ideal for a wide range of projects like robotics, home automation, and sensor interfacing.

  How to connect:

  + Power Supply: Connect your Arduino to your computer via a USB cable, which powers the board and also allows data transfer.
  + I/O Pins: The board has 14 digital I/O pins, 6 analog inputs, and several other pins for power, ground, and communication

- PWM Driver (PCA9685)

  The PCA9685 is an I2C-controlled PWM driver, often used for controlling multiple servos or LEDs. It can control up to 16 PWM devices (such as servos) using just two pins (SDA and SCL) for communication.

  How to Connect:

  + Connect the SDA (data) and SCL (clock) pins from the PCA9685 to the corresponding I2C pins on the Arduino (on the Uno, these are A4 (SDA) and A5 (SCL)).
  + Connect the power and ground pins from the PCA9685 to the 5V and GND pins on the Arduino.
  + Connect the VCC pin of the PCA9685 to an external power source.

- Controlling Arduino Circuit

  The official Arduino Integrated Development Environment (IDE) is used to write code and upload it to the Arduino. You can download it from the official Arduino website: Arduino IDE. Write your code in the Arduino IDE using a simplified version of C++. After writing the program (also known as a "sketch"), click the **Upload**

button in the Arduino IDE. This will compile the code and transfer it to your Arduino board via USB. The Arduino board will execute the uploaded program automatically once transferred.