3D Printer and Phone Application

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Problem Definition

Current 3D printers require the user to manually upload a G-code file by an external storage device and initiate the printing process via controls on the printer.

Methodology

This 3D printer project was divided into 3 subsystems:

- Electronics – Main controller and Stepper Motor Controller Printed Controller Boards (PCBs)
- Microcontroller Unit (MCU)
- User Interface - Phone Application and Server

Integration between the subsystems were solved with the MCU being mounted directly to the main controller PCB and the phone application communicating to the MCU through the web-hosted server.
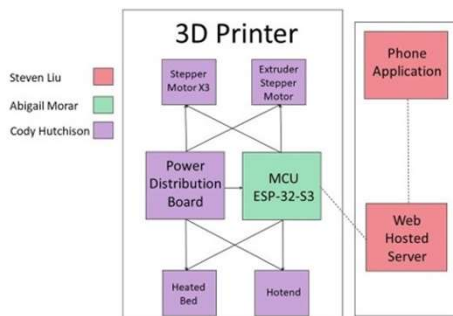

Figure 1. 3D Printer System Overview

Engineering Analysis

The mobile application, server, and MCU work together to provide an intuitive user interface and allow remote communication. While the MCU and PCB work together to perform all physical operations of the 3D printer. All user inputs are communicated from the application to the server, which provides a database and storage for handling all pertinent information that can then be read by the MCU. The stepper motor controller PCB provides control over the stepper motors on the 3D printer.

Item	Voltage	Current	Power
Heated Bed	23.680	8.500	201.280
Hot Head	23.921	1.700	40.666
Fan 1	24.028	0.064	1.538
Fan 2	24.028	0.047	1.129

Table 1. Main Controller PCB Data

	Voltage	Current	Power
X-Driver	2.456	0.224	0.550144
Y-Driver	2.5266	0.0225	0.056849
Z-Driver	2.5058	0.0303	0.075926
Extruder Driver	2.4881	0.0386	0.096041

Table 2. Stepper Motor Power Usage

The MCU analyzes and computes signals from the PCB to send information to the application. The MCU parses incoming G-code lines and relays heated component temperatures, extruder location, and fan and print completion status back to the user.

Outcomes

The printer communicates to the phone application via Wi-Fi and can be controlled remotely by the user. Control from the app includes setting extruder location, fan power, and heated bed and hotend temperatures. The MCU executes these commands and sends updates back to the app for real-time user verification. The application parses and uploads G-code files to the database as well provides user ability to start and cancel prints. The PCBs currently work as expected. This is the 2nd iteration of the designs and had to make a few minor corrections on main controller board by soldering wires as jumpers and isolating 3 separate pins from the ground plane.

Current Issues

The 3D printer will run through the G-code and attempt to print an item, but is currently only printing on one quadrant of the heated bed. Another part of the issue is the extruder isn't pushing enough filament out to properly print.

Impact

There are many benefits of having a 3D printer that is controlled by a phone application over a Wi-Fi network whether it's for commercial or consumer use.

- Gives access to the 3D printer to people who aren't technologically inclined
- Initiating print when away from the office, on a business trip, or working from home
- Permits printing while busy with other tasks around the house or office
- Allows a person to be more social and not confined to their home

References

1. Ender 3 Printer Manual
2. ESP32-S3 Datasheet
3. TMC-2130 Datasheet
4. IEEE 802.11-2020
5. Android Documentation

Acknowledgements