Design of a Compact Image Capturing Device

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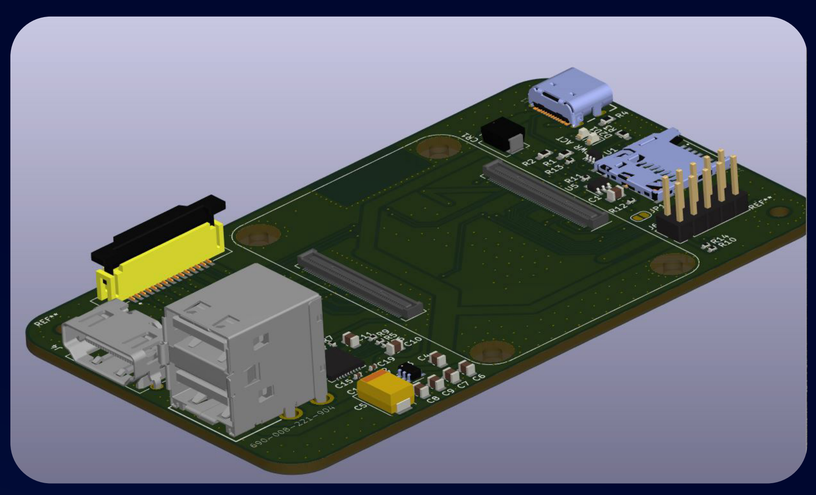
Introduction

The aim of this project is to design compact image capturing device using a system on module (Compute Module 4 [1]) and I/O board (PCB). The data captured by device will be sent to a client device via WiFi. The project involves designing of a PCB and coding of a software that is optimized to be memory efficient.

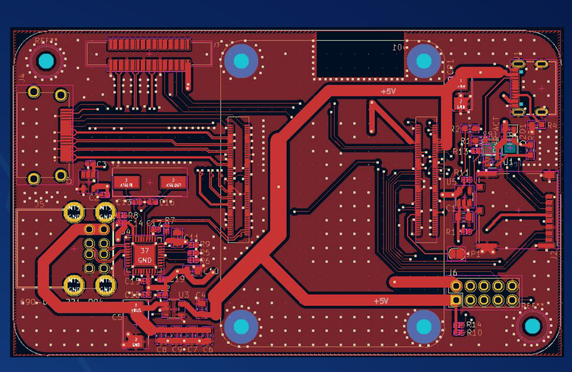
Although design is used for image capturing application in project, we designed PCB to be configurable in a way that it can be used in many other applications depending on user's manipulation of the system.



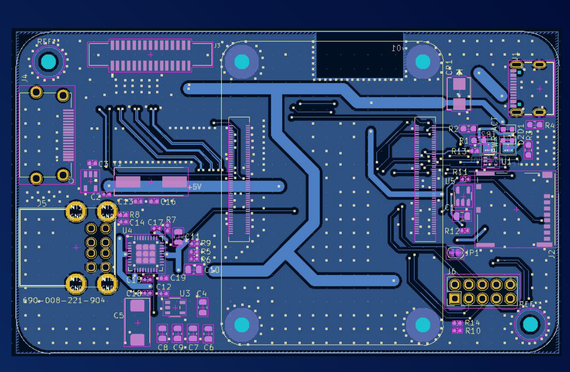
3D Model of PCB

Hardware Design

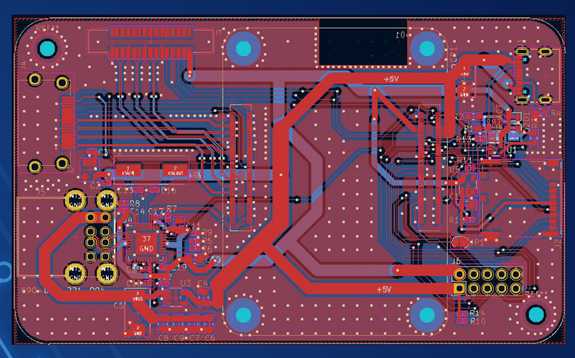
For designing PCB, an open-sourced EDA program KiCAD is used. To prevent EMI (electro-magnetic interference) and RF interferences caused by other signals, additional two inner ground layers are added to PCB. Therefore, 4-layer PCB design is used [2]. The alignment of components was optimized to make compact size of the design. Differential pair impedance is chosen according to USB2.0 and HDMI protocol. Thicknesses of power tracks are calculated according to the current values. We followed manufacturer's design constraints such as track width, via hole size, track spacing etc.



Front View of PCB Design (KiCAD)



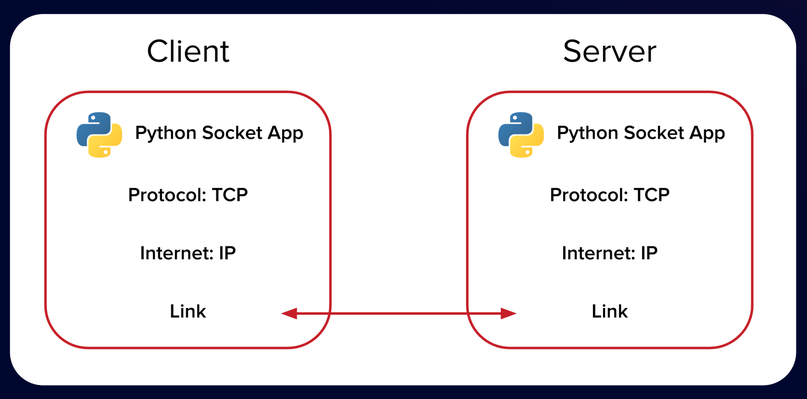
Back View of PCB Design (KiCAD)



Front-Back View of PCB Design (KiCAD)

Software Design

Socket communication is made using a TCP protocol to establish connection between server and client. Next step is to initialize the camera in server side. After that, the program waits for a button input to capture the image. The image is taken, it is converted into JPEG format by discrete cosine transform and then it will be sent to the server. The client takes the image and stores it. The device deletes each image after it's taken, for memory efficiency.



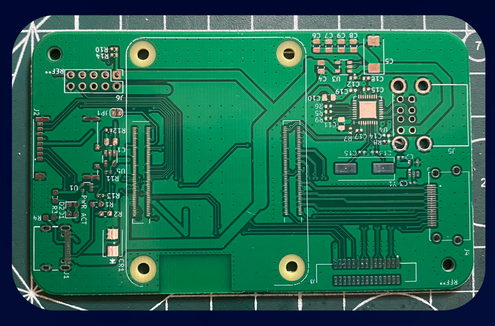
Socket Communication with TCP/IP

Application Areas

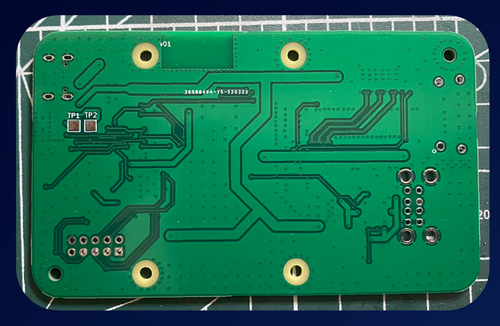
Design is open to improvements, and it is compatible which makes it usable in many innovative areas by user's choice. Design can be used in areas such as security systems, facial recognition systems, scientific studies, space technologies, medical applications etc.

Results

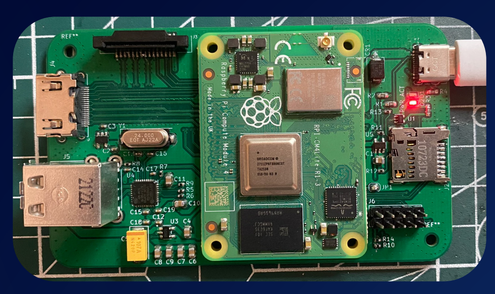
After the completion of PCB and software design, we made PCB assembly of the system.



Front View of the PCB



Back View of the PCB



Assembled PCB

References

[1] Adafruit, (2021-10-12), Raspberry Pi Compute Module 4 [Online]. Available https://datasheets.raspberrypi.com/cm4/cm4-datasheet.pdf

[2] Gerber Labs. (2020). 2-Layer PCB vs. 4-Layer Printed Circuit Boards (PCB), [Online]. Available https://www.gerberlabs.com/guides/2-layer-vs-4-layer-printed-circuit-boards/

[3] Jain Rach, (Nov 19, 2014), socket connect() vs bind() [Online]. Available https://stackoverflow.com/questions/27014955/socket-connect-vs-bind

Acknowledgements

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