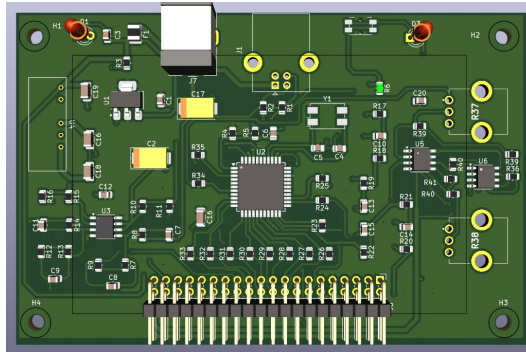


# ScopeX: Serial Protocol Decoder

# ScopeX : Serial Protocol Decoder

- Oscilloscope, Signal Generator and DC power supply which are essential components of an electronics lab is combined into one single board, which is working based on microcontroller, named as ScopeX
- ScopeX is a low cost, combined version of the above equipments with which we can do experiments even in home
- Our project's aim is to add serial protocol decoder functionality into ScopeX board, where we can troubleshoot serial communication protocols like UART, I2C, SPI, CAN
- Key features of the functionality include real time data capture, decoding and displaying data, timing analysis.



ScopeX: New Version

Project: Implementing serial protocol decoder in ScopeX

# Problem Statement

- Our project aim to develop and implement serial protocol decoder functionality into ScopeX
- Update GUI of current version appropriately to support this functionality
- Initially we will be considering protocols UART, I2C, SPI and later more protocols will be added

- Implementation of protocol decoder, GUI development
- protocols our project aiming: UART, I2C, SPI

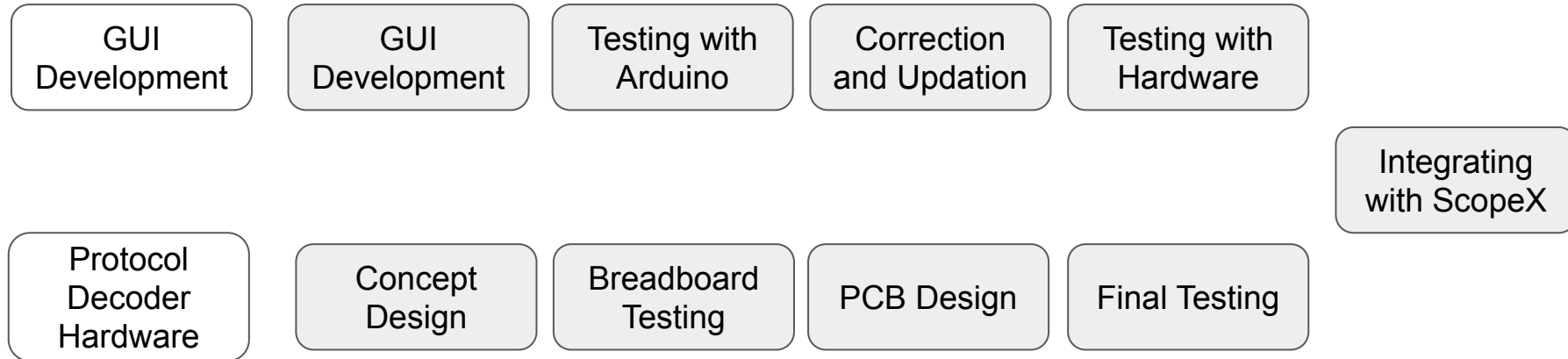
# Literature Review

- Reference [1] discusses about a low-cost serial asynchronous communication protocol analyzer based on ARM7TDMI microcontroller
- Reference [2] discusses about Altera FPGA based serial communication analyzer focusing on protocols: SPI, I2C and UART
- Reference [3] describes about a protocol decoder developed as a part of Analog Discovery kit. It have wide range of functionalities for protocol decoder
- Reference [4] is Saleae Logic analyzer which is another serial protocol decoder, including functionality of parallel logic analyzer

Microcontroller based logic analyzer can be developed  
Error Detection capabilities can also be included in the later version

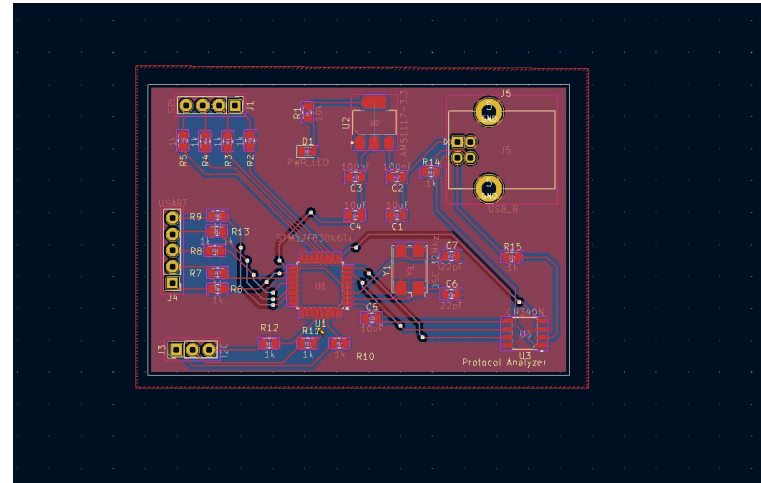
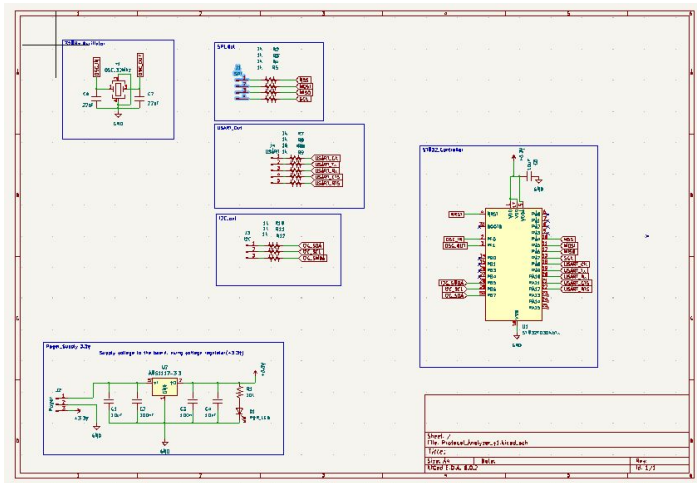
# Our approach to solve the problem

- We will be decoupling the Protocol Analyzer from ScopeX board and developing as an individual board
- After testing the board with all functional components, and GUI we will be integrating functional block of the board into ScopeX kit
- Initial development and testing of GUI will be done with arduino, parallely developing separate hardware
- At the end GUI will be tested with developed hardware



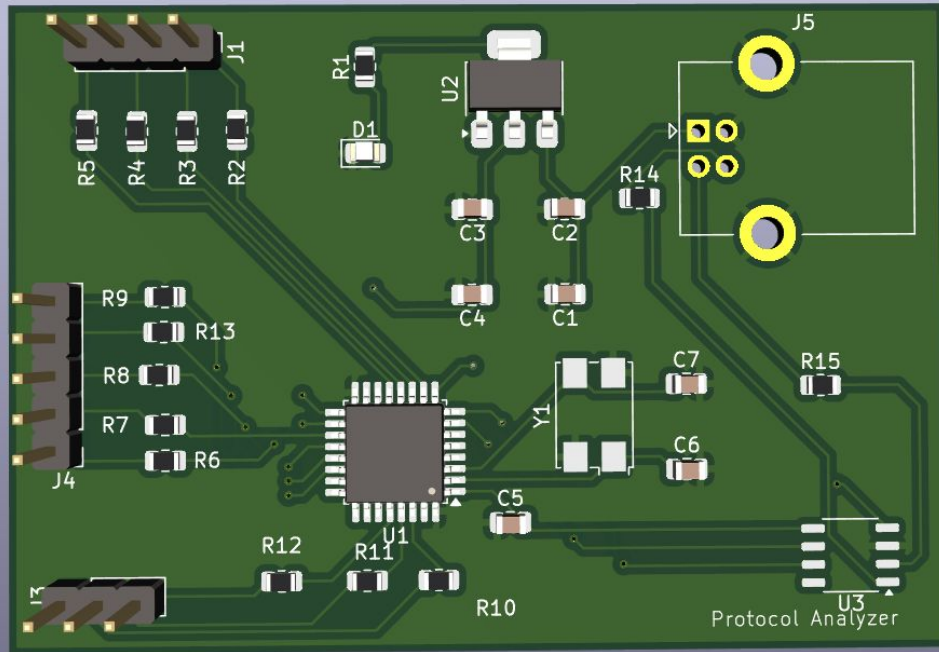
# Initial PCB Design

- Designed PCB for initial testing, with STM32 Microcontroller
- Some components have ordered
- Currently testing GUI functionalities with Arduino serial communication and digital pins



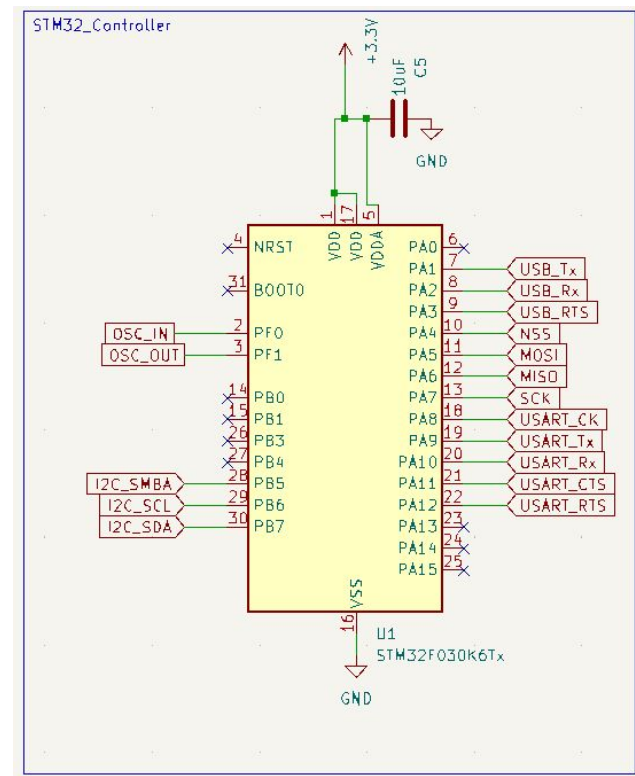
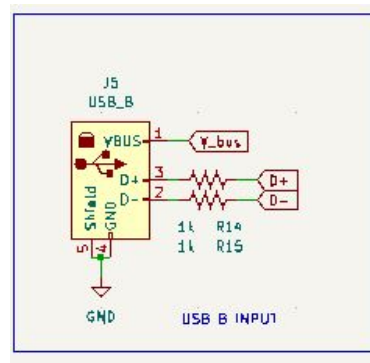
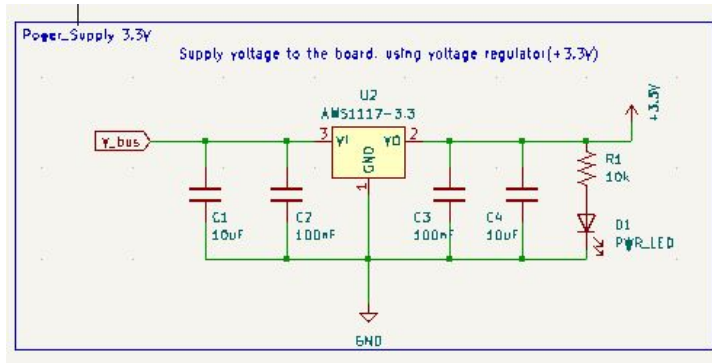
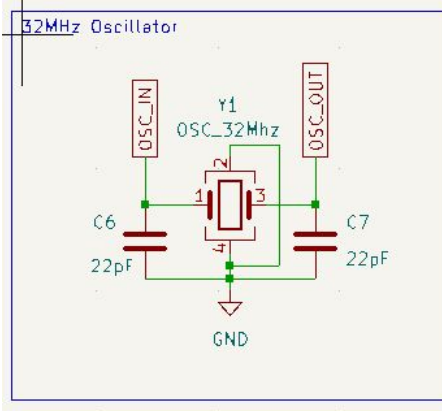
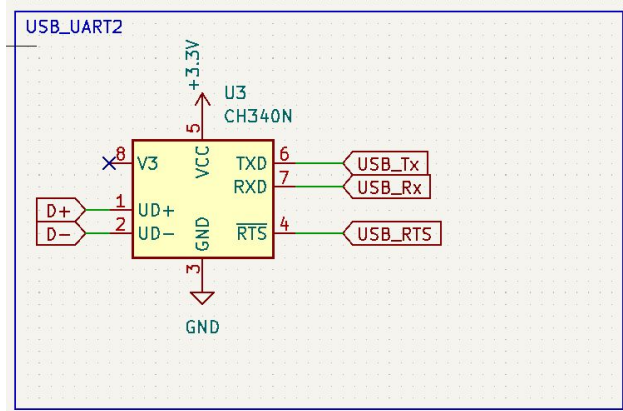
PCB was designed for testing

# Initial PCB Design



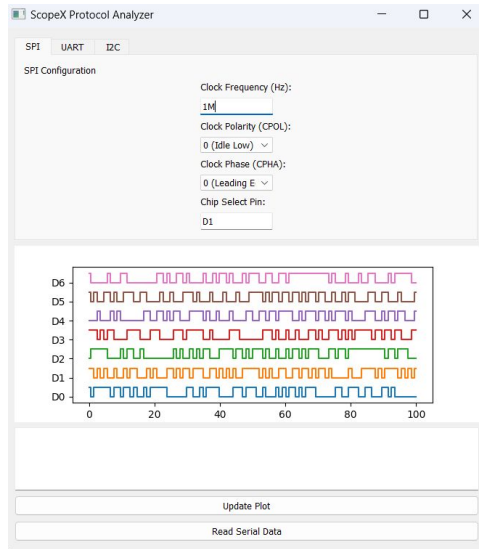
Compact sized PCB with  
10cm x 7cm have been  
made

# Sub Parts of PCB Design





# GUI Design



SPI



UART



I2C

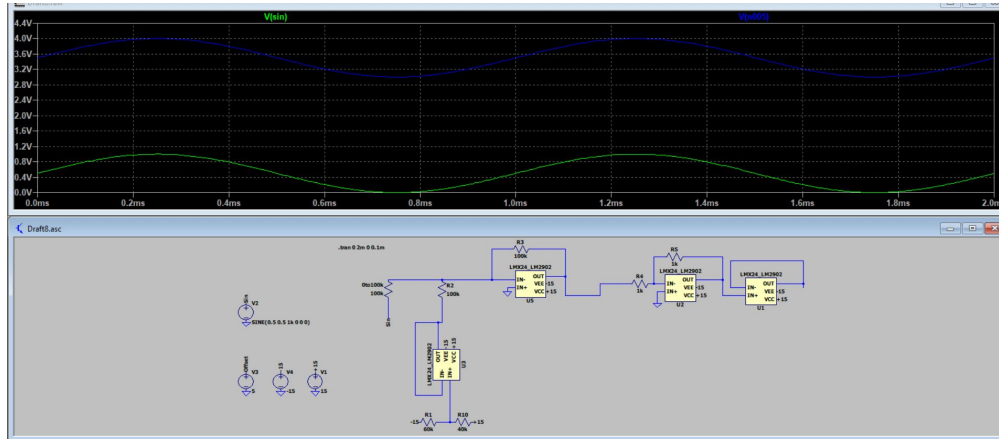
GUI's frontend part is developed,  
backend is yet to test with Arduino

\*Data plotted now is random graph, for frontend testing

# Testing and Debugging : New Version of ScopeX

- Design and implementation of independent offset gain circuit on new version of ScopeX
- New version of ScopeX was tested for its functionalities: Signal generator, Oscilloscope
- Corrections were made to the PCB Design

Offset-Gain Circuit was found to have problems, obtained simulated results of corrected version, but have demerits of using more Op amps



Testing of ScopeX new version board is done

Offset gain correction uses more Op amps,  
trying for another solution

# References

1. <https://research.ijcaonline.org/volume40/number7/pxc3877234.pdf>
2. <https://www.ijert.org/research/design-of-serial-analyzer-for-characterization-of-iot-devices-IJERTCONV5IS21016.pdf>
3. <https://www.instructables.com/How-to-Use-the-Protocol-Analyzer-on-the-Discovery-/>
4. <https://www.instructables.com/Open-Your-Eyes-Logical-Analyzer/>