



ECE6780-EMBEDDED SYSTEM DESIGN



PROJECT DEMO



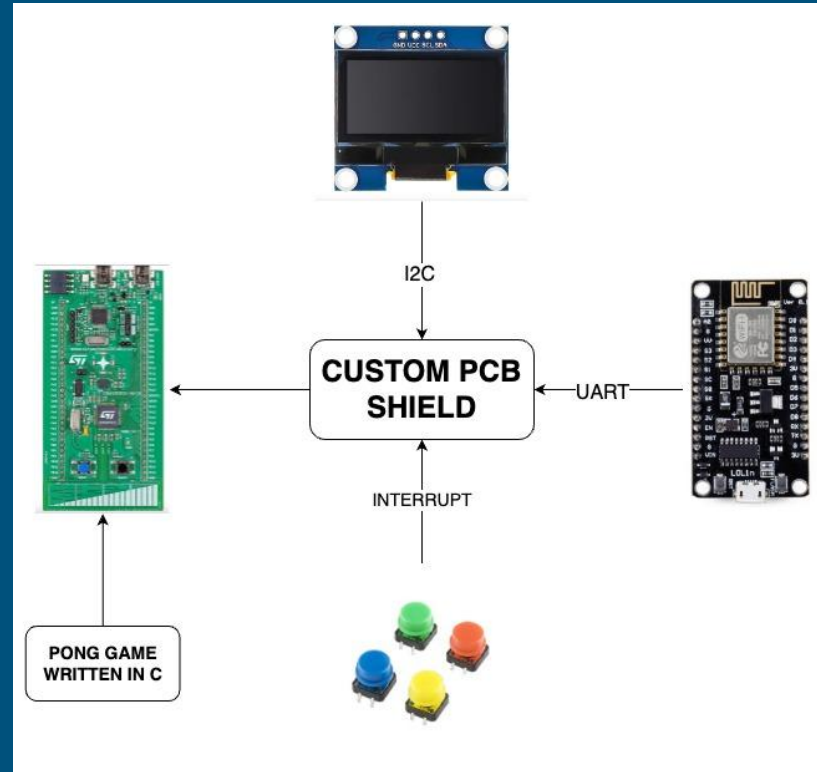
About

A Simple Game Console to play Ping-Pong.

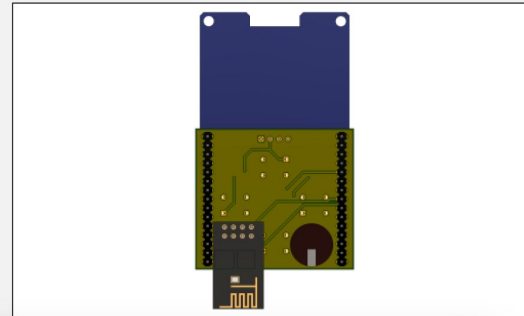
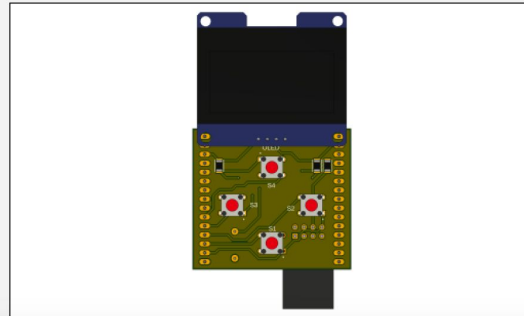
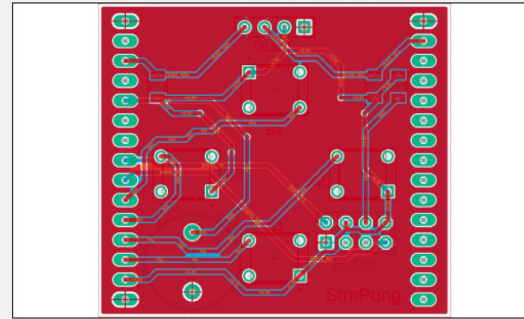
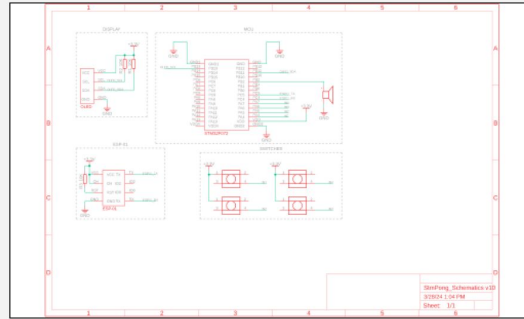
Designed a custom PCB shield to interface buttons, I2C display and a buzzer.

Written custom library for I2C display and ESP-01

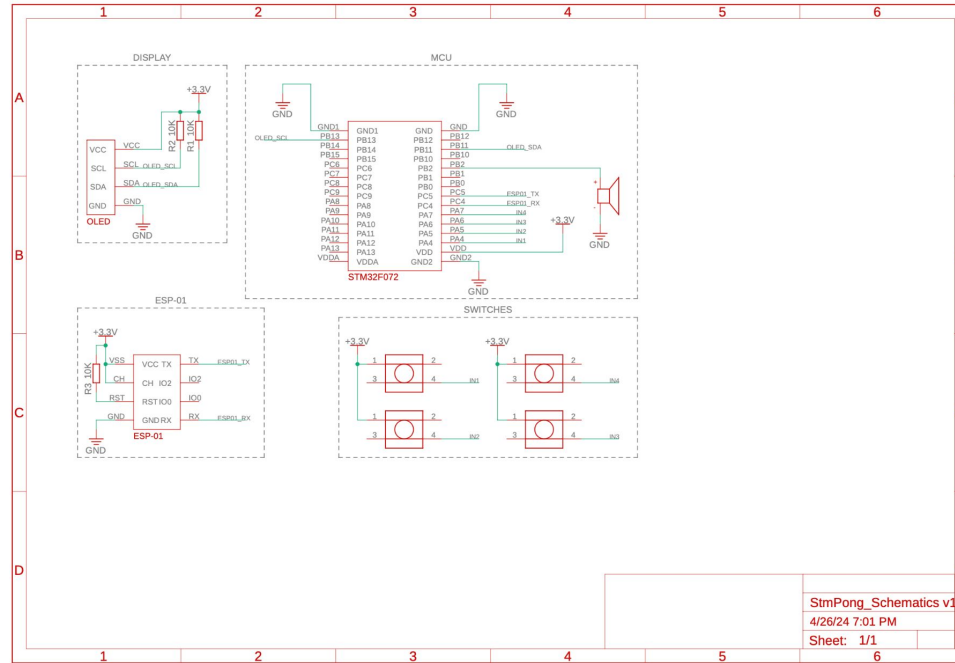
Functional Diagram



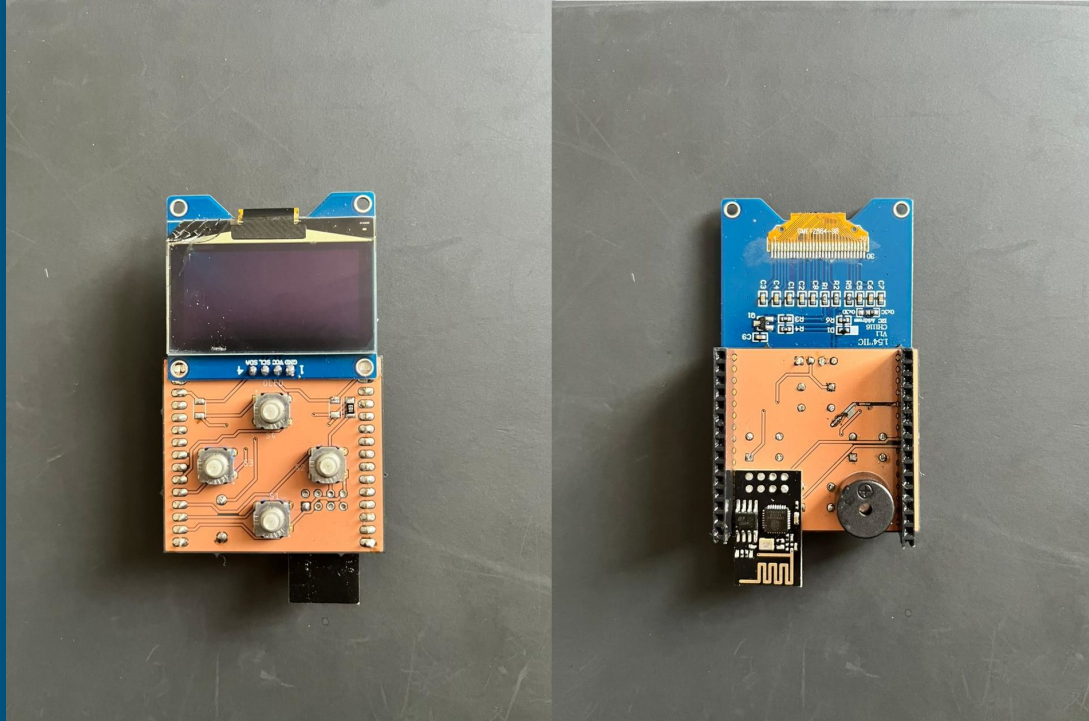
PCB Shield



Schematic



PCB Assembly



Concepts Used

Interrupts

Every button is interfaced with interrupt to ensure quick response in the game. The paddle of the player is controlled by two buttons and the other two buttons can be used for game status changing.

USART

USART 3 is connected to the ESP-01. Here ESP-01 is used as the USART to Wi-Fi bridge. Using this two STMs can communicate by simply using USART. USART 1 is used for debugging.

Concepts Used

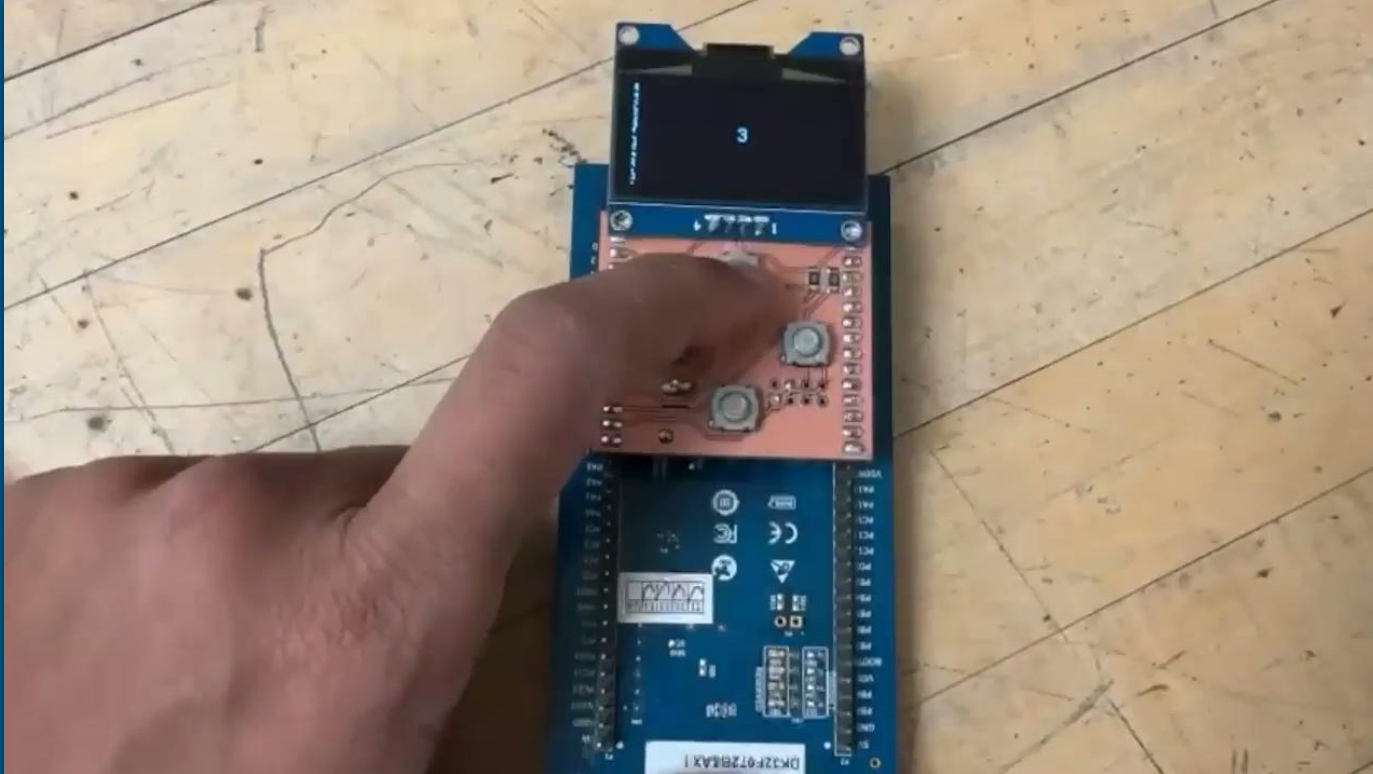
I2C

The OLED display works on the I2C protocol. It is connected to the I2C2 of the STM. I2C is configured in the Fast Mode so that the display can be ran at 30Hz refresh rate.

Timers

To make sure the display is running at 30Hz, Timer 2 is used. In Fact Timer is the heart of this project as it helps in syncing all the components. All the calculation and done within the 30Hz so that the display can be update every 1/30th of a second.

Demo



Challenges

Display

The display's datasheet was outdated which resulted in incorrect addresses. We connected the display to raspberry pi and used an I2C scanner to find the actual address of the display. We also used adafruit library to find the address of the registers in the display.

Insufficient Power

The display and ESP were working fine independently with the STM but when both are connected simultaneously we noticed that the display was not powering on. This is because we power the PCB shield from VDD which is not the power input but the output from the MCU. We solved this by powering the board from the actual 3v.

Challenges

Wi-Fi

We initially tested the Wi-Fi using ESP's AT firmware and it was working well. But, when the Wi-Fi and Display is made to work together we noticed that the latency of the AT firmware is more than 50ms, which is too high for 30Hz. We then planned to proceed with ESP Now firmware but due to time constraints we decided to stick with the single player game.

I2C Limitation

Due to unknown reasons, We can't send data of more than 128 bits through I2C. We tried to change the settings and modes but whatever we try, we were not able to send more than 128 bits of data. Later, we found that the limitation was not from the MCU but from the display itself as the NACKF Flag is triggered continuously after 128bit.

Conclusion

Overall, we had a great learning experience throughout the project. Though we choose a simple project, we wanted it to focus only on the Embedded Systems. This ensures that we focus mainly on the learned concepts, rather focusing on mechanical, electrical and other problems.

Thank You