Foram Trivedi - 23B1269
Saniya Khinvasara - 23B1268

Sine Wave Reconstruction

Regeneration of Continuous Sine Wave Using ADC-DAC Interface via SPI Protocol

Explanation:

In this task, we had to digitize a continuous sine wave signal using an ADC, transfer the digital samples to an FPGA via SPI, and then reconstruct the analog signal using a DAC. This process was done in the following steps:

1. **Sampling the Sine Wave with the ADC**:

   The analog sine wave (0-2V range) is sampled by the ADC. The ADC converts each sample into a 10-bit digital value, representing the instantaneous amplitude of the sine wave at each sample point.

2. **Transferring Samples via SPI**:
   - The SPI protocol is used to send each 10-bit sample from the ADC to the FPGA. Since SPI transfers one bit per clock cycle, each sample requires 10 SPI clock cycles for complete transmission.
   - A control signal, CS (Chip Select), is used to manage each sample transfer. CS is toggled (pulled high and then low) before each new 10-bit sample transmission begins.
3. **Storing Digital Samples on FPGA**:

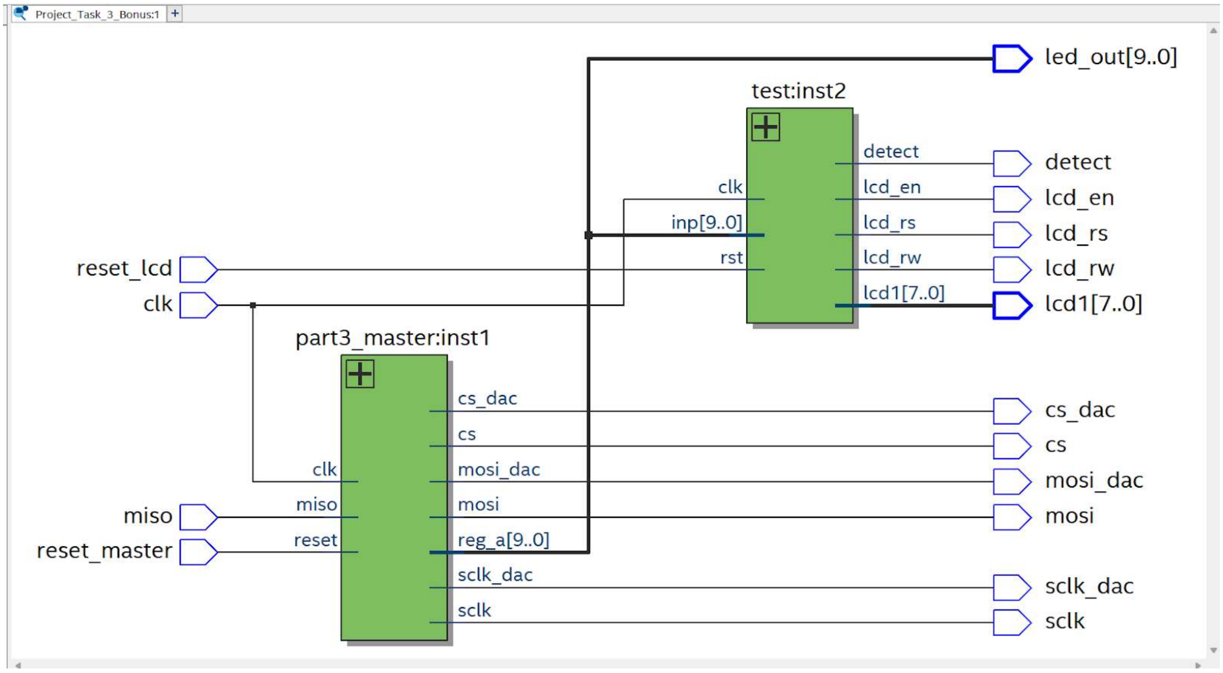
   Each 10-bit digital sample received from the ADC is stored in a register within the FPGA. This temporary storage holds the value before it is sent to the DAC.

4. **Reconstructing the Sine Wave Using the DAC**:
   - The FPGA sends each stored 10-bit sample to the DAC, again using SPI, where the DAC converts it back into an analog voltage level.

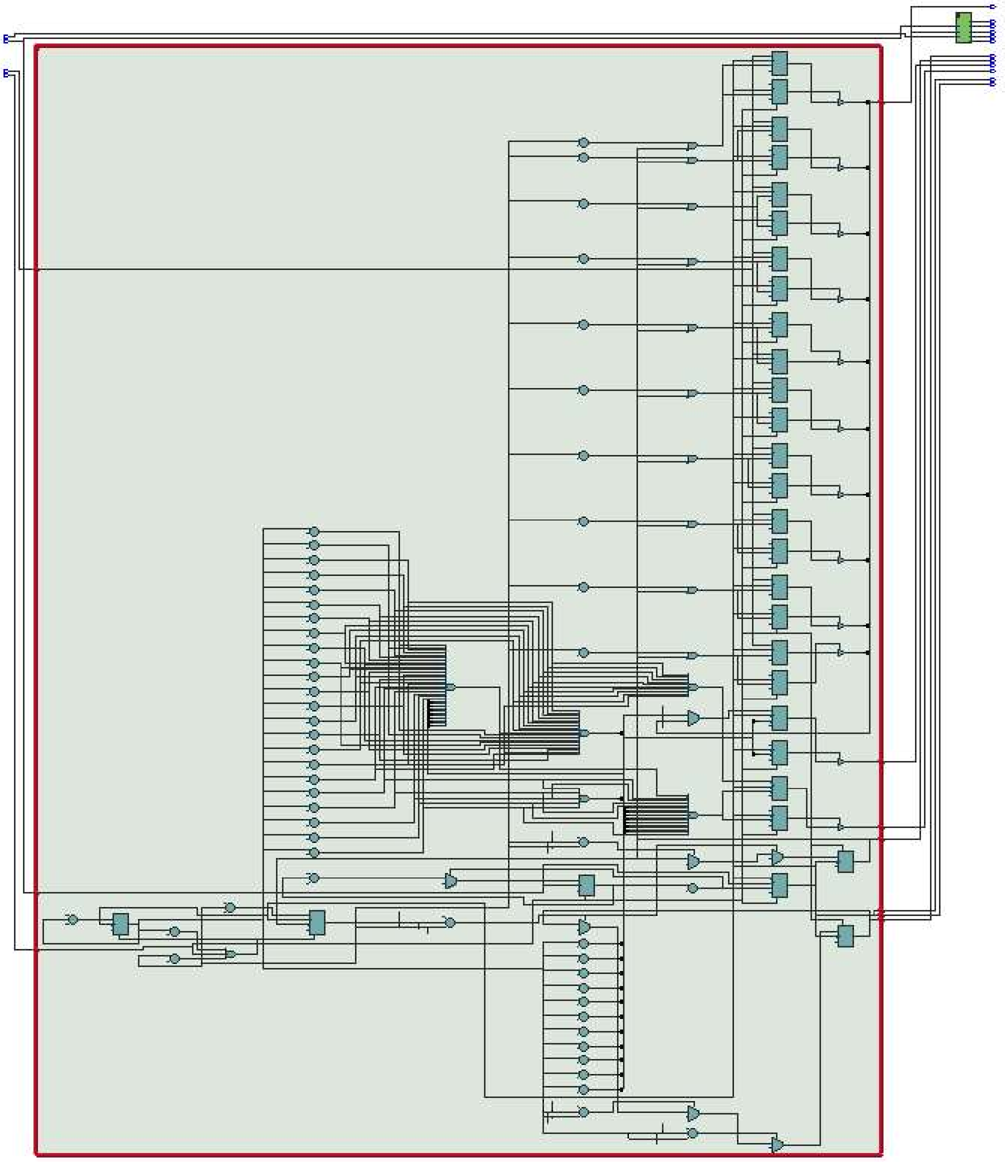
- This reconstructs the original sine wave, as each sample is output as an analog value corresponding to the sampled input sine wave.

5. **Displaying the Reconstructed Waveform**:
    - We visualized the DAC output on a Digital Storage Oscilloscope (DSO) to verify that the reconstructed waveform closely matches the original sine wave.

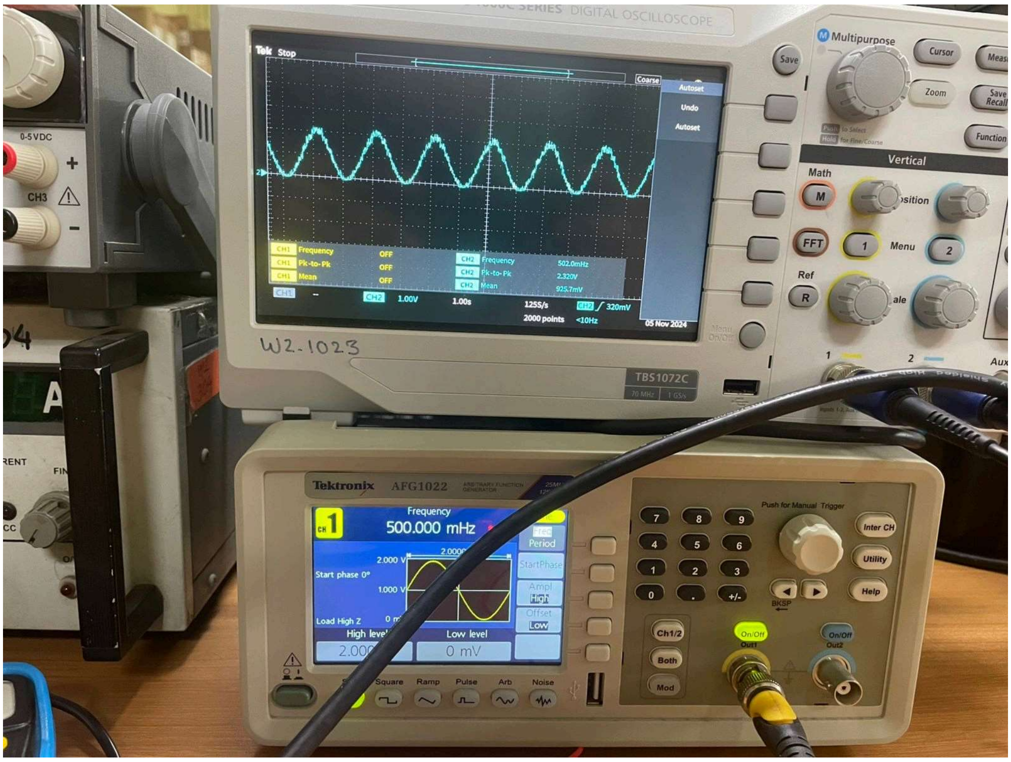
Overall Netlist:

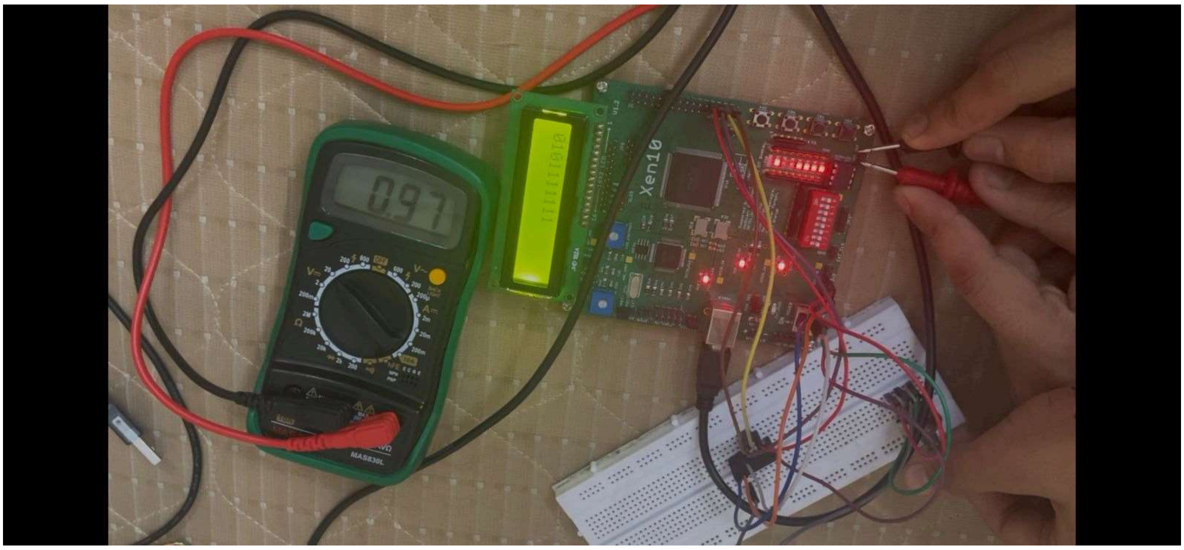


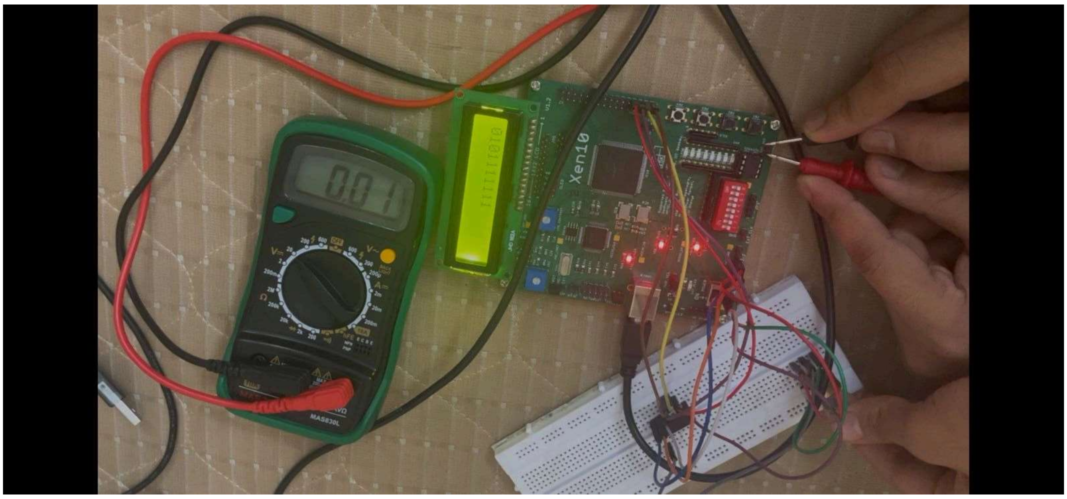
Master Netlist:

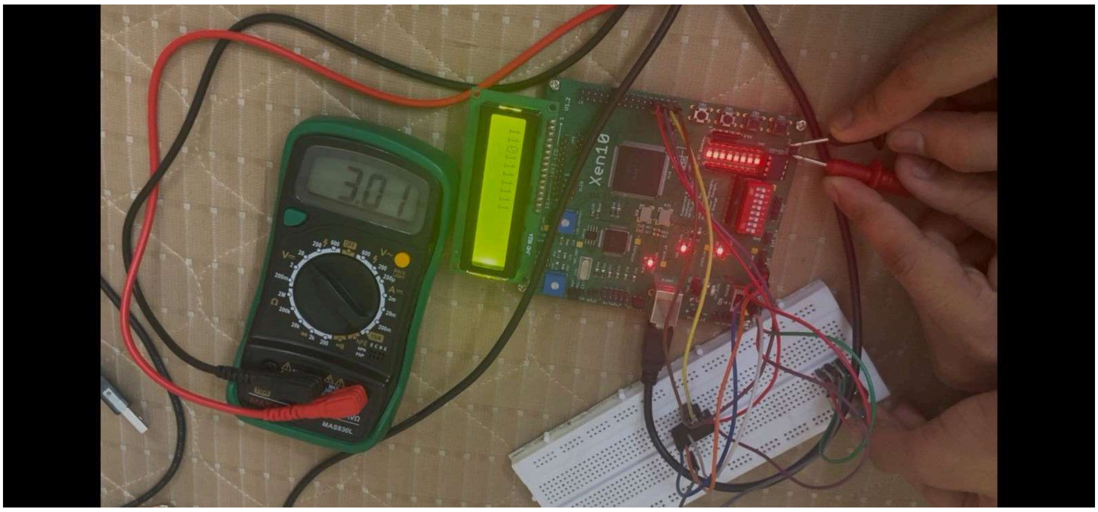


Picture of the DSO Output Waveform and measurement using DMM:









Work Distribution:

We wrote the code, made the circuit, and drafted the report together.