DIGITAL OSCILLOSCOPE DESIGN

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ABSTRACT

In this project, a real-time digital oscilloscope system based on FPGA has been designed. Oscilloscopes, which play a significant role in various industries such as science, engineering, and biomedical fields, are used to visualize voltage changes as a function of time. Similarly, this system has been developed to perform tasks such as debugging and signal analysis. Behind its simple interface and user-friendly operation with different modes lies the collaboration between the FPGA and Raspberry Pi, enabling high-speed data transfer and processing for accurate measurement and analysis.

AIM

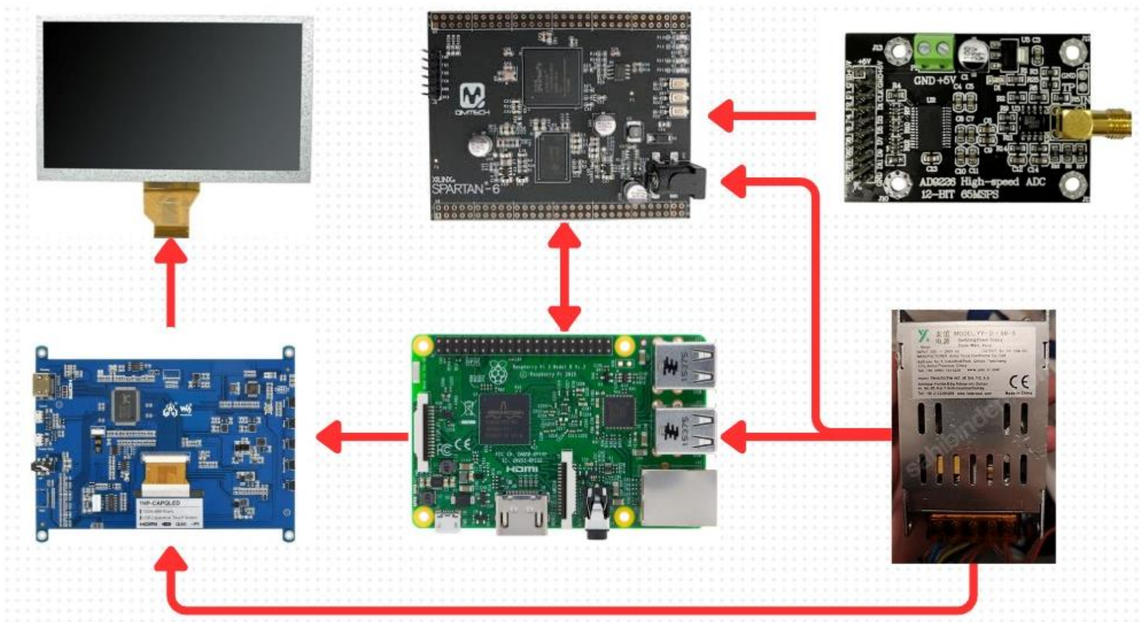
The aim of this project is to design an oscilloscope—one of the most essential measurement tools in Electrical and Electronics Engineering—using an FPGA board and VHDL, in order to gain deeper experience with signal analysis. This design focuses on high-speed data acquisition and processing, providing a practical platform to enhance hands-on knowledge in this field.

DESIGN REQUIREMENTS

Features such as the trigger function in oscilloscopes, frequency measurement, the ability to analyze signals within a specific time frame, high-speed sampling capability, and a user-friendly interface are included in the system.

METHOD

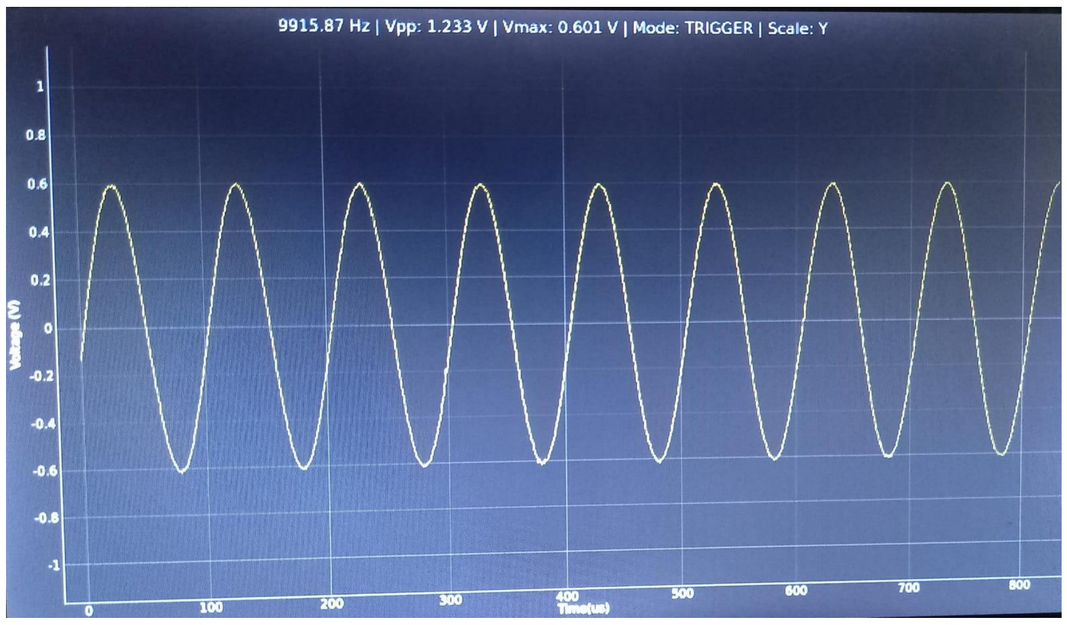
In this project, the AD9226 ADC module, Spartan-6 FPGA board, Raspberry Pi 3A+, LCD screen, and its interface module were used. The Spartan-6 FPGA was implemented using VHDL, while data analysis and display interface were implemented on the Raspberry Pi using the Python programming language.



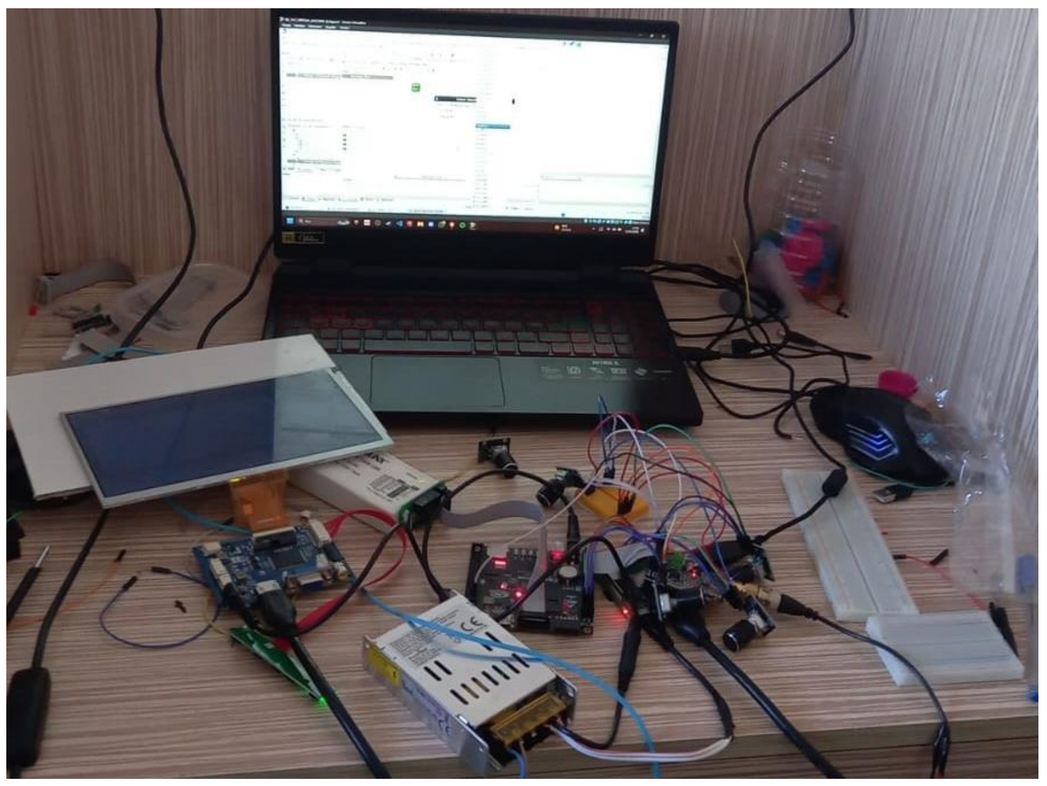
RESULTS & RECOMMENDATIONS

A Digital Oscilloscope enables signal measurement, frequency analysis, determination of maximum and peak-to-peak voltages, a stable waveform display using the trigger function, scaling in time and voltage domains, and inspection of signal data at a specific moment.As a recommendation, additional trigger modes such as rising and falling edge detection, phase measurement, and a more user-friendly menu interface can be implemented in future versions.

Oscilloscope Interface



Experimental Setup



Final Design