Real-Time Audio Visualiser

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Objective and Requirements

The objective of this project is to implement a real-time audio-visualiser using the course-provided FPGA board. The system will capture audio signals, process them to extract frequency information and output visual patterns on a VGA display. The requirements of the project are:

- Capture audio input through a connection.
- Implement digital signal processing to separate frequency components.
- Display frequency bars on the VGA display.
- Ensure real-time performance with clear and responsive visuals.

We intend this project to be an **advanced project**, meaning that we will submit a performance analysis along with the final project abstract.

Solution

We intend to develop the project together using the DTEK board and a VGA to HDMI cable to visualise the content on-screen. First, the audio input is sampled and digitised. Then, the data is processed using FFT modules on the FPGA to convert the input time-domain signal into frequency-domain data.

The frequency-domain data is mapped to visual elements like vertical bars or waveforms (undecided as of writing this draft abstract), which are then displayed on a VGA monitor connected to the board. Everything in this project, as it stands, will be implemented using C and hardware modules such as audio input modules and FFT modules.

Verification

We intend to verify the program by extensively testing inputs using known input signals like pure sine waves with varying frequencies and confirm that the visual outputs match expected frequency bands. We will then proceed to test with music to ensure bars respond in real-time with an acceptable latency.

Contribution

We intend to divide the work equally. While currently undecided, as it stands, Anirudh will work on the VGA controller, visualisation logic and design the graphics output while Sachin will implement the pipeline for audio sampling and FFT processing.

Both of us will collaborate on testing, debugging and writing the abstract.

Reflections

In the final abstract, we will discuss and reflect on the project.