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Speech Synthesizer Design

Our project will take in text and convert it to speech. A program will run on the FPGA that will take in text and decode it into the different phonemes used in the English language. It will also examine the syntax of the text and determine stress and intonation. Using that, we will do calculations and generate parameters to be used in the speech generation model.

We are considering two different methods to get the input text.

1. Input text will be hard-coded into the program directly
2. Text will be sent to the program using the serial port

We also have a couple different variations of the project that we were considering. Our first idea involved a program running on the FPGA, sound files stored in SDRAM, and hardware connecting the digital audio waveform to the audio CODEC on the board. This structure is shown in the block diagram on the third page.

However, since accessing the SDRAM memory would be very complex, we decided not to use the SDRAM to store sound files and our second idea removes that part from the project and involves a hardware vocal tract model. This is a model of the human vocal tract implemented in hardware. A block diagram of one version of this is on the next page – many different implementations can be found in various research papers. By using a hard-wired vocal tract model, we will implement the speech generation using control parameters derived from the text. These parameters will be taken from the phonemes generated by the text and the stress and intonation of the text based on syntax. The computations and calculations used to determine these parameters will be found in the program code running on the FPGA. The VTM will produce a digital waveform of the speech, and this waveform will then be sent to the audio CODEC, which will take in the bit stream and convert it to two audio signals that will exit out the LINE OUT output.

Hardware Vocal Tract model[1]
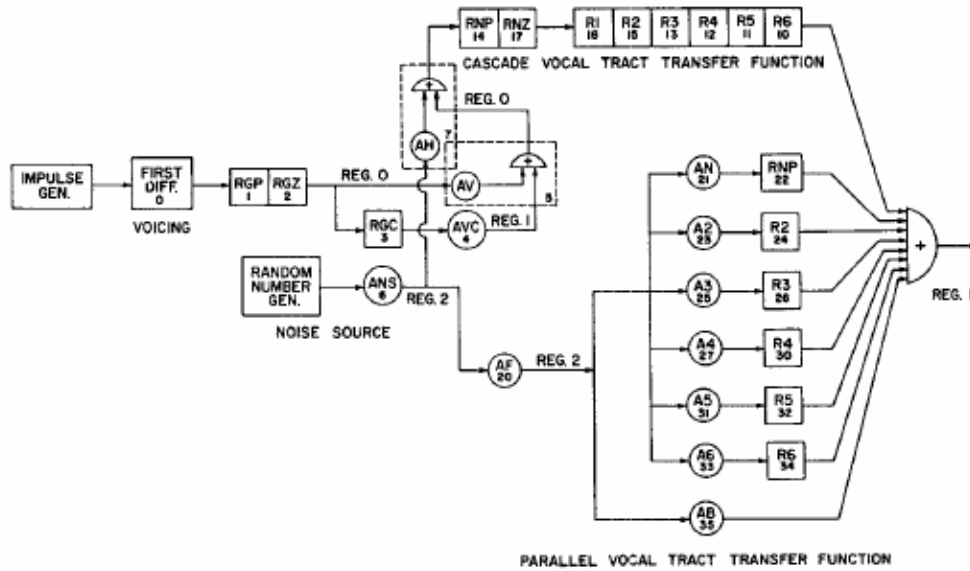
1. G. E. Kopec and G. S. Miranker, "Programming a Microcoded Processor for Speech Waveform Generation," in *IEEE Proceedings* (Cambridge, MA, 1978).

Speech Synthesizer Block Diagram

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Phonetic Library Access

Text to Speech Program Code

Audio Output

Text Input