A LOW-COST ARCHITECTURE OF AUDIOMETER BASED ON DIRECT DIGITAL SYNTHESIZER

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Abstract
In this paper we purposed a new architecture of audiometer. By utilizing the direct digital synthesizer (DDS), pure tone testing signals could be generated more precisely than other existing techniques. A microcontroller was used to receive the stimulating commands from PC and then send appropriate control signals to the DDS and the log attenuator. All components were assembled with compact size and low cost.

Keywords: audiometer, direct digital synthesizer.

1. Introduction
Audiometers are utilized as a basic testing apparatus for human hearing. Two testing methods, pure-tone stimulating and speech hearing with/without noise masking, are used. Pure-tone testing is more fundamental, and is intended for the measurement of sensitivity and hearing threshold level of the required frequency. Pure-tone stimulating signals can be generated by either analog or digital circuits. Digital circuits that are much well for frequency precision are adapted by more and more audiometers [1-3].

2. Methods
The system block diagram is illustrated in figure 1. A single-chip of direct digital synthesizer (DDS) (AD9850, Analog Devices) was utilized to generator pure sinusoidal signals. Its frequency was controlled by a microcontroller (AT89C52, ATMEL). The microcontroller received the stimulating parameters from PCs via RS-232, including frequency, amplitude, and stimulating modes. At each specified stimulating periods, the microcontroller changed the frequency and amplitude if necessary by sending controlling signals to DDS and a log attenuator (DS1807, DALLAS).

3. Results
The architecture could achieve the following specifications that satisfied the general requirements of the audiometer.

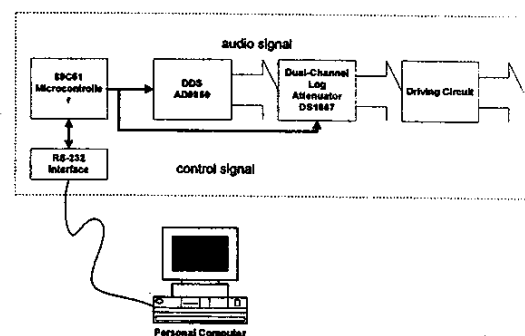|	
Frequency Range	1~20000Hz
Signal Level	0~90dB (Full Range)
SNR	>70dB

Figure1. System block diagram

4. Discussion
To generate high precision and flexible pure-tone signal, digital signal processor (DSP) must be used and thus the system would be more expensive and complex. In the study, we propose a new architecture of the audiometer based on a direct digital synthesizer (DDS). DDS is a novel technique to generate high precision sinusoidal signal and is originally used in communication applications [4]. In our system, we used a single-chip DDS as the pure-tone generator to implement a low-cost, high precision audiometer.

Reference
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