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DESIGN OF A SOUND LEVEL METER WITH GSM INTERFACE

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ABSTRACT
In this paper the hardware architecture of new sound level meter based on a Digital Signal Processor will be presented. This sound level meter can be operated remotely using public communication networks. One of the possible public networks to be used would be that of G.S.M., using the short message service provided.

1 - INTRODUCTION

Nowadays one of the most common tasks for an expert in acoustics is to evaluate the acoustic impact in certain areas of a city. This implies to move around expensive material and the people needed to handle it.
In order to lower down these high costs the design of a sound level meter that does not require continuous supervision for its operation is presented. This solution implies the possibility of operating the instrument remotely. Nowadays it is possible to do this kind of operations using the GSM network with a moderate cost if the short message service is used (SMS).
Therefore, to implement these characteristics the sound level meter has to have certain intelligence and processing capacity. The processing capability is implemented with a digital signal processor that also runs the one-third-octave frequency analysis algorithms needed for the sound level meter itself. In order to be able to do all these operations in real time with a single processor, a state-of-the-art DSP family has been chosen with high processing capability (TMS320C6XX from Texas Instruments).

2 - HARDWARE ARCHITECTURE.

Figure 1 shows the block diagram of the sound level meter. The instrument consists of the following blocks:

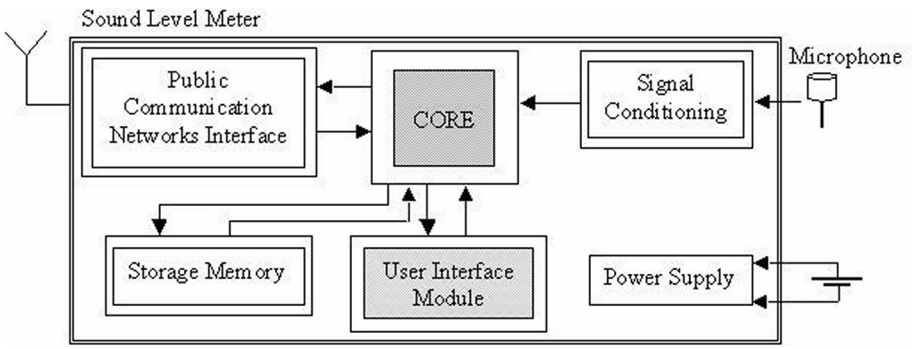

Figure 1: Block diagram of the sound level meter.

- Public Communication Networks Interface. This block is made of an appropriate modem for the communications network being used: GSM, PSTN, Trunking, etc. The communication between the modem and the DSP is done through a RS232 interface with AT commands.
- CORE This block has the DSP, and the CODEC that converts the analog signal from the microphone in digital format. It also holds all the circuits needed to interface with the modem, the user interface module and the storage module as well as all program and data memory (RAM and ROM).
- Storage Memory. It is made of a non volatile memory EEPROM that storage all the data recorded with the instrument.
- User Interface Module This module has a keypad and a liquid crystal display to enable the user configuring the instrument when in local mode operation.
- Signal Conditioning. This block adapts the signal levels from the microphone signal to the appropriate levels of the CODEC. It is made of several amplifiers and a polarization stage for the microphone.

3 - SOFTWARE ARCHITECTURE.

The ANSI S1.11 standard does not establish the method for designing a one-third octave band frequency analyzer [1], [2]. It specifies the characteristics of the filters used in such decomposition of a signal as to be considered in accordance to this standard. Thus the standard should be observed as a compound of characteristics that the filters should follow and not as a design reference. This is even clearer when observing the standard from a digital signal processing implementation point of view. The standard is mostly focused on analog implementations and only a few considerations are mentioned about digital implementations.
The algorithm here used implements a one-third octave band frequency analysis with a filter bank implementation conforming to extended range type 2 characteristics from ANSI S1.11. Thus the analysis covers the frequency range from 20 Hz to 20 KHz in 32 bands. The structure of the algorithm is the one shown in figure 2 [3], [4].

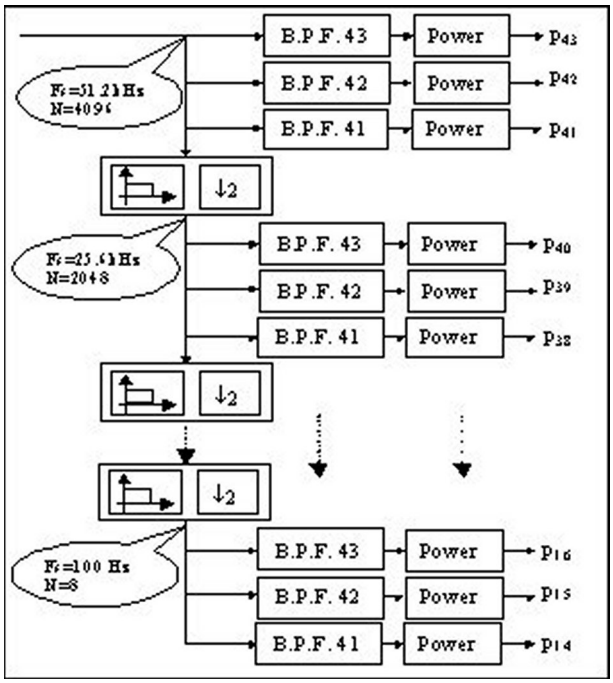

Figure 2: Algorithm structure.

The algorithm is a multirate implementation that searches minimum number of operations and thus minimum execution time. With this purpose the filters use the minimum number of samples needed in each band. As it is seen in the figure the frequency range is divided in octaves and each octave is

processed in the same way. In the first octave (bands 43 to 41) a direct implementation of the filters is used. Thus the filters are designed with the acquisition sample frequency *Fs*. In the next octave the sample frequency needed would be one half of *Fs* so before proceeding to the filtering itself decimation by 2 is performed. After this decimation the data is filtered and power is computed at the output of the filters.

4 - CONCLUSIONS AND FUTURE RESEARCH

Once the prototype has been adjusted and manufacturing is in progress the use of a sound level meter as the one here presented will cut down costs of environmental noise studies. It is also a perfect solution for situations where sound level has to be measured and it is difficult or even impossible to have an operator in place. A situation of this type can be any high sound level experiment such as airplane related noise recording, military experiments, etc.

With an architecture such as the one here presented it is possible to integrate this instrument in the World Wide Web with the only extra effort of implementing a TCP/IP protocol. Therefore the integration of these kind of instruments in public communications networks would be very easy.

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