IP CODEC delivers efficient speech encoding/decoding

Overview

One of the growing difficulties of product development is the time devoted to the production of software, with demands for ever higher performance levels typically leading to increases in software size. As a result, companies such as Toshiba are now actively developing software IP that, by providing high quality 'building blocks' for commonly used functionality, can actually shorten the time a customer spends on software development. This leaves engineers free to concentrate on the more application-specific elements of their designs. Such IP solutions can be seen in a variety of areas including USB drivers, voice recording drivers and TCP/IP protocol drivers. At the same time, developers are under pressure to reduce component count and to run software using the most cost-effective processor technology available. This means that, unlike the 'middleware' typically targeted at RISC microprocessors, there is a growing demand for small and efficient IP targeted at relatively low-cost CISC microcontroller solutions.

Target applications:

Security systems, toys, remote control via phone, elevators, home appliances, museum guides, car radio, ...

Speech IP solution:

- Middleware developped by Toshiba
- Compression, storage and decompression of voice messages
- Using MCU's ADC input and DAC or PWM output

Customer key benefit:

- Removes the need for a dedicated IC
- Reduces the system cost (bill of material)
- Easy development

Speech encode and decode

A number of different techniques are used to synthesis speech. These techniques can be grouped into two categories, namely wave encoding and synthesis by analysis.

The algorithm used in waveform encoding is relatively simple, making it easy to produce the required analysis and synthesis. PCM (Pulse Code Modulation) is the most common method of encoding an analogue voice signal into a digital bit stream. PCM works by first sampling the amplitude of the voice conversation in a process known as PAM (Pulse Amplitude Modulation). This PAM sample is then coded into a binary number consisting of zeros and ones. The voice signal can then be switched, transmitted and stored digitally. In addition to the standard PCM method outlined above, a number of companies have produced their own derivatives.

Toshiba, for example, has developed its own process known as the 'half speech' algorithm. This original and proprietary technology is based around a process that compares the last voice data with the current voice data and then takes the difference between the two. As the name implies, a key benefit of the Toshiba algorithm is that this difference can be expressed by half the data size. This, in turn, means that less memory is required, the end result being that the speech CODEC software IP can easily be implemented in a Toshiba 8-bit microcontroller.

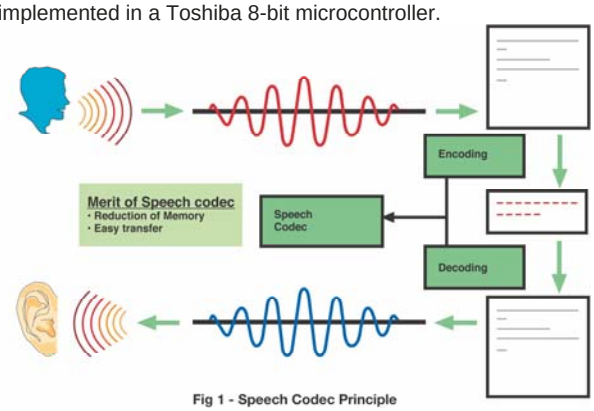

Fig 1 - Speech Codec Principle

Figure 1 outlines the principle behind speech CODEC IP.

Speech IP

One of the aims of using speech software IP and a microcontroller rather than a dedicated speech hardware IC (DSP) is to reduce the number of components and bill of materials (BOM). Examples of application areas for such speech CODEC IP are many and varied, and include household electrical appliances, electronic toys and alarm devices.

To date, the addition of speech recording and playback functionality to a product has been achieved through the use of a dedicated speech IC. In the majority of cases the application will also feature a microcontroller for system control – for instance to control a keypad or a display – meaning that the solution comprises a minimum of two chips.

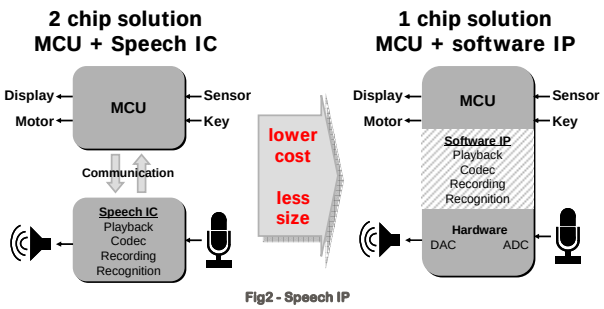

Fig2 - Speech IP

TOSHIBA

Reference board

In order to help the designer to evaluate the sound quality of the Toshiba proprietary speech CODEC and to simplify the development of applications using this IP, Toshiba has created a dedicated reference board.

This board has a number of elements that will speed the evaluation and prototyping of applications including key input, an LCD display, and connections for a microphone and an external speaker for speech recording and speech output respectively. An RS-232C interface provides the connection to a host PC, while a NAND E2PROM is available for data storage.

Using the reference board, developers can conduct the following demonstrations and evaluation tests:

• **Demonstration of speech quality evaluation.**
The standard PCM output speech sound and the compressed speech sound using the speech CODEC can be compared. Speech quality can also be checked at sampling frequencies of 8MHz, 6MHz, and 4MHz.

• **Demonstration of time signals**
Simple time signals can be synthesised and output by combining several speech data components.

• **Demonstration of recording/playback**
Speech data can be recorded/played back for 10 seconds using PCM and 1/2 compression techniques. Up to five segments of speech data can be recorded.

• **Demonstration of speech data output using PWM or DAC**
Digital-to-analogue converted speech data can be output using either PWM or DAC.

• **Demonstration of PWM speech data output with or without a filter**
PWM speech data output attenuated by a filter can be checked.

• **Demonstration of speech data transfer between reference board and PC**
The speech data recorded on the reference board can be transferred to a PC, and the data processed in the PC can be transferred to the reference board.

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