# Electro-mobile Pronouncer Development

## Client Background and Business Requirements: :

The client is a professional vehicle consumer electronics manufacturer. It has close relationship with some large Japanese auto makers such as Toyota and Nissan.
The electro-mobile becomes more and more popular in Japan for its clean energy and energy efficiency. It has advantage in low noisy, but the pedestrians will not be alert to the low sound when vehicle is running, so that would be dangerous for those elders, children and hearing impaired people. The product is designed to simulate vehicle sound and can be regulated dynamically to alert the pedestrians, so as to solve the safety problems of electro-mobile sound. It has been released successfully and installed in Japanese vehicles.

## Beyondsoft Solution :

- Customized a new product applied to electro-mobile.
- The core technology of this project is PWM digital simulation of audio file. Conventional linear power amplifier can amplify the analog audio signal directly, but for digital signal, it must be switched into analog signal via D/A switching circuit first. The switched analog signal is easily affected by the outside. It would cause signal distortion and even worse after the amplifier. Digital power amplifier can switch digital signal into analog signal directly to drive loading equipment such as loudspeaker. This kind of audio power amplifier is low-powered.
- PCM audio signal is switched into PWM signal after sampling, interpolating and filtering. PWM signal is used to control on-off type of MOSFET power. Power transistors can generate PWM signal, of which voltage values are determined by supply voltage and current values are determined by load impedance and circuits. The PWM signal will be restored to the original analog signal through 20kHz low-pass. The output signal of modulator has different pulse width. Large pulse width represents large input signal energy. Actually modulator is used to switch one form of signal into another.
- In order to achieve high-efficient audio power amplification, the system is required to meet the



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following technical requirements:
(1)Linearizing modulation process helps reduce harmonic distortion in voice band.
(2)The system can provide precise clock signal during the signal conversion from PCM to PWM. Clock error might cause bigger non-linear distortion.
(3)The generated PWM signal is similar to the desired square signal.
(4)Stable power supply is required. Fluctuant power supply might cause output-signal distortion.

- Below, a chart of hardware modules. The major functions are specified below:
(1)CAN/LIN Decoding: In order to alert pedestrians, the product's voice can be auto-adjusted with vehicle speed, which is obtained through CAN/LIN decoding. The product has two interfaces like CAN and LIN to ensure the generality of different vehicle models.
(2)Tone Modulation Module: This is the core of function module. Reading audio file by PWM digital simulation of physical audio signal, the signal strength can be automatically adjusted according to vehicle speed and the same proportion amplitude.
(3)Audio Document Library: storing those sampled audio files.
(4)Power amplifier is used for amplifying audio signal and transmitting to the external horn.
- Below, a chart of software modules. The audio format is simple WAV format without decoding, which would reduce the difficulty of development. The challenge of whole software design is the development of PWM audio modulation. The generation methods of PWM signals have two kinds, one is counting by high-frequency impulse; the other is counting by delay cells. Through comprehensive consideration, we adopt counting by high-frequency impulse method to modulate audio frequency.

## Client Benefits: :

The project has brought a new shining point to high-end auto models, which has not only helped increase the sales volume, but also helped the producer enjoy higher popularity in automobile industry. Now it has owned a total membership of about 20,000.



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