Instant Learning Sound Sensor: Flexible Environmental Sound Recognition System

Yuya Negishi
Graduate School of Information Science
Nagoya University
Japan
negishi @ el.itc.nagoya-u.ac.jp

Nobuo Kawaguchi
Graduate School of Engineering
Nagoya University
Japan
kawaguti @ nagoya-u.jp

***Abstract*—We propose a smart sound sensor component for building context-aware systems that can instantly learn and detect events from various sound information with a time series signal. Using the proposal instant learning sensor, a developer of a context-aware system and ubiquitous service can easily utilize a real world sound, like an event trigger to control appliances or for a detailed presence service, without a signal processing programming.**

Keywords-component; sound recognition; context-awareness

I. INTRODUCTION

Context aware systems are beginning to play an important role to support human activities in the real world. As the way to obtain the context information into the system, a lot of input devices such as accelerometer, pressure, temperature sensor are used, and small network devices with these sensors are developed such as Mote[1]. There are also some researches and systems using signal processing with a time series data from sensors to obtain context information. However, in signal processing, the design of the recognition algorithm of a complex pattern is not easy, because an analysis of a feature quantity requires a lot of time. It is hard for anyone to utilizing real world sounds for building a context-aware system using a life sound recognition. In this paper, we propose an instant learning sound sensor, which can learn sound pattern instantly on the site that a user wants to detect as an event.

II. DESIGN OF INSTANT LEARNING SOUND SENSOR

For easily utilizing real world sounds as events, we designed the proposal system, which has (a) event learning phase on sensor configurator and (b) event detection phase on sound sensor device, and following three features.

(1) Instant Learning: A user only records the target event sound, then the configurator automatically analyzes the sound, and chooses the most appropriate algorithm and parameters to extract a feature quantity. Finally, it generates a lightweight recognition program for sound sensor devices. (Fig.1)

(2) Simple Device: The generated program is possible to run on low cost devices such a micro-DSP chip. The system makes the programs as light as possible.

(3) Smart Sensor: Sensor can process the signal by itself. It is possible to cooperate and distribute with other devices easily.

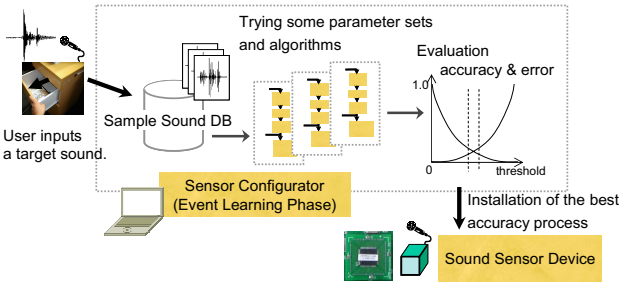

Fig. 1. System Overview

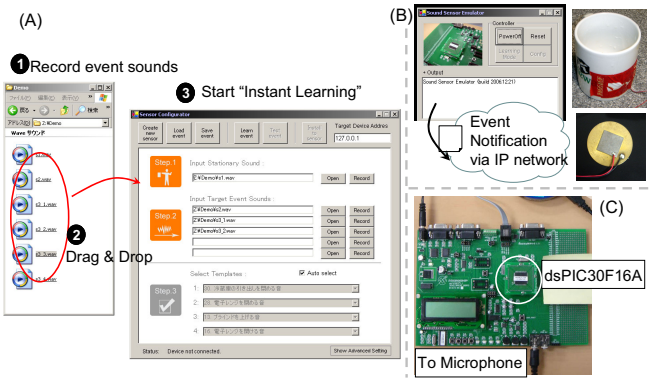

Fig. 2. (A) Sensor Configurator, (B,C) Sound Sensor on PC and dsPIC

III. PROTOTYPE IMPLEMENTATION

Based on the above design, we implemented the first prototypes of the sensor configurator and sound sensor on PC and Microchip dsPIC as a small and low cost device. We use a cheap piezoelectric device as a microphone. Fig.2 shows screenshots and pictures of prototypes. Actually, we evaluated an accuracy of recognition process automatically generated by "Instant Learning". As a result, the accuracy of recognizing sounds of opening a window shade is 96.9%, opening a drawer is 83.3%, and writing on clipboard is 85.6%.

IV. CONCLUSION

Thus, by using the proposal system, user is only required to input target event sounds, and it automatically generates recognition processes for small and low cost devices. Then, they can build context-aware systems utilizing a real world sound as rich context information, without a signal processing programming.

[1] Crossbow Technology, MOTE, http://www.xbow.com/Products/Wireless_Sensor_Networks.htm