conteXinger : A Context-aware Song Generator

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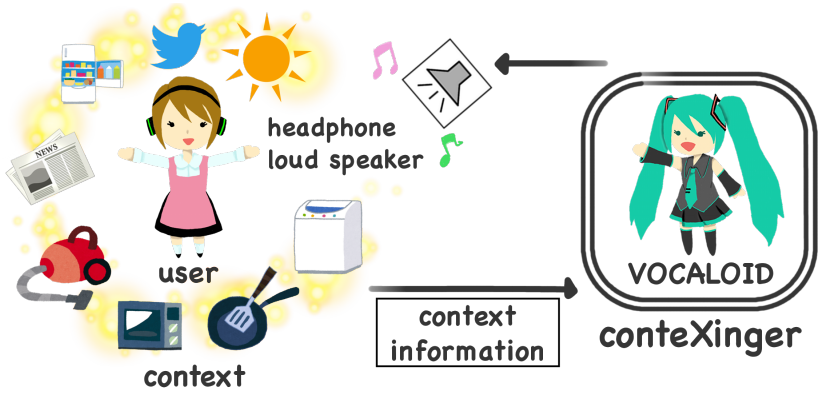

Figure 1: Diagram of conteXinger system

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Abstract
Daily work such as household chores are generally boring and monotonous and tend to be thought of as routine work. Work songs have been written and sung by workers to reduce their labor load. In addition, text-to-song synthesizer software such as Yamaha's VOCALOID is commonly used by a wide variety of computer music creators. We developed a real-time music synthesizer called "conteXinger" that sings lyrics based on the listener's context, including the use of home appliances (such as a vacuum cleaner, refrigerator, microwave oven, or dish washer), and Internet information (such as SNS messages, Web news, and weather reports). By presenting the synthesized music to a user through a home audio system or headphones, our system entertains users who may be bored from their everyday work routine.

Author Keywords
Context-aware music; VOCALOID; entertainment system.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

INTRODUCTION
In human history, work songs such as rice-planting songs, sawyers' songs, and wine brewing songs have long been

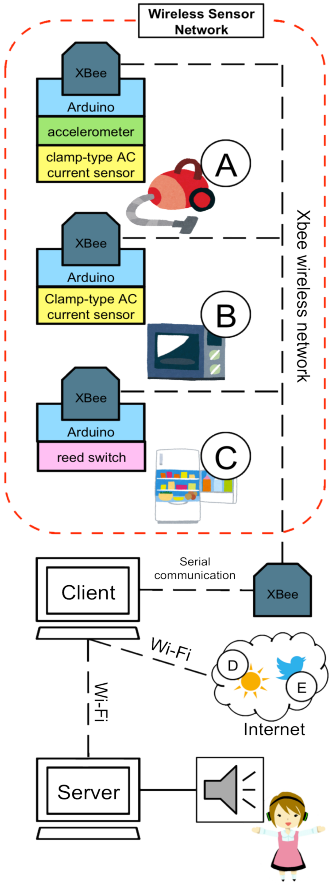

Figure 2: System composition.
(A)vacuum cleaner,
(B)microwave,
(C)refrigerator,
(D)weather report,
(E)Twitter.

sung. Work songs reduce fatigue and pain from labor, cheer people up, and exhilarate them. Even in modern daily life, we sing or hum songs while doing housework such as cleaning and cooking. In addition, we sing songs to cheer people up. Such songs are called rooters' songs.

Today, portable music players are ubiquitous and constantly getting miniaturized, and it is common for people to carry them anywhere and at any time, even while working or doing household chores. We can feel exhilarated or cheered up by listening to songs, especially when the lyrics of the music share a common theme with the activity we are involved in.

Recent text-to-voice technology makes it possible to sing any lyrics generated in real time. Furthermore, in research on ubiquitous computing, methods for recognizing the status (context) of people or objects using sensor and location information are commonly used. In a previous study [3], the acquired contexts have been used to adjust the suitable aural presentation of information, and in other studies [2], [1], the contexts taking place in a kitchen are used to make cooking more fun by playing sound effects related to cooking activities.

In this paper, we propose a system called conteXinger, which automatically creates a song depending on the context of daily activities. We also report our implementation of the initial stage of this system.

conteXinger

ConteXinger automatically creates a song by obtaining the user contexts from sensors embedded to detect daily necessities. The user's context from the Internet, such as Twitter replies or weather reports, is also used to generate songs. A generated song is sung by a song synthesizer (Figure 1) in real time. For the song synthesizer, we used VOCALOID[1] software, which is a widely accepted commercial product.

Music is generally composed for many listeners. However, listeners may feel a strong empathy when they find that a lyric closely matches their current circumstances. If the lyrics and melody of a song are composed by considering the listener's context, it will give the listener a stronger impression, enjoyment, and feeling of empathy, making life more exciting.

In a musical play, songs are particularly used to show the leading character's feelings, situations, and behavior. Our system is aimed at changing everyday life into a musical stage sung by VOCALOID, and to amplify the motivation to do routine work such as household chores. Users can feel like a leading character of a musical because the system sings songs that reflect their particular contexts. The concept of our system can also be applied to present cyberspace information in everyday life, by generating lyrics that include information from the Internet, including weather reports, email, SNS messages, and driver/pedestrian navigational information.

IMPLEMENTATION

We prototyped a system that automatically creates music containing a user context in an actual home using sensors embedded into three types of appliances (Figure 2): a (A) vacuum cleaner, (B) microwave, and (C) refrigerator. The system also uses the context from two kinds of Internet sources: (D) a weather report Website and (E) Twitter.

-Composition

This system is composed of a wireless sensor network, an Internet connection, and client and server computers, as

[1]A vocal synthesizer developed by Yamaha corporation.

Figure 3: Vacuum cleaner hardware.
Above: Accelerometer.
Bottom: Clamp-type AC current sensor.

shown in Figure 2. The context of each consumer electrical appliance is obtained by an Arduino microcomputer and XBee wireless module. A paired XBee module is also connected to the client computer. Using this wireless sensor network, the system does not hinder the user's housework with troublesome cables.

-Electric appliances
To obtain the vacuum cleaner context, we attached a current sensor and an acceleration sensor to a vacuum cleaner, as shown in Figure 2 (A) and 3. We used a clamp-type AC current sensor to the power line to detect the on and off state of the vacuum. The acceleration sensor was attached to the handle of the cleaner to detect the cleaning activities of the user. The user activities are classified into three types: swinging the handle at normal speed, swinging the handle at fast speed, and leaving the handle motionless to move obstacles such as chairs out of the way.

We also placed sensors on a refrigerator and microwave oven, as shown in Figures 2 (B) and 2 (C). A current sensor was attached to the power line of the microwave to detect whether it is in an on or off state, and a reed switch was attached to the refrigerator to detect whether the door is left open or closed, as shown in Figure 4.

-Internet
As shown in (D) and (E) of Figure 2, we obtain the weather report of the day through a weather API[2], and a Twitter message using Twitter4J[3]. The weather information and Twitter replies to the user are included in the lyrics of the generated songs.

[2]http://www.drk7.jp/weather/
[3]http://twitter4j.org/ja/index.html

-Client and Server
We used two computers, a VOCALOID server and a client, as shown in Figure 2. The client computer obtains the contexts from each sensor and from the Internet, and creates lyrics that correspond to these contexts. A melody is then added to the lyrics, and the song is sent to the server computer.

The VOCALOID program runs on the server computer. When the server receives a song that has been transmitted from the client, it starts the Windows Script Host to play the song back using VOCALOID's Job Plugin function.

MUSIC CREATION

The song is generated through one-by-one phrases, and is played with a drumbeat on the server. The method used to reflect the context in the lyrics depends on the type of context used.

-Lyrics
For contexts obtained from the appliances, several lyric candidates are prepared in advance for each context. Lyrics are generated by randomly selecting one of the phrases from the candidates that best match the current situation.

For the weather report information, several lyric candidates are prepared in advance for each weather keyword, such as "sunny," "rainy," and "cloudy," which are obtained from the weather API.

For the Twitter messages, because we expect that human-created text will create natural lyrics without the need for computer processing, the reply messages from the user's followers are used for the lyrics without modification.

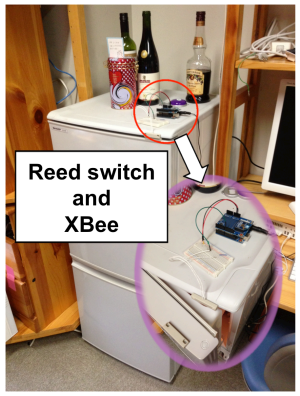

Figure 4: Refrigerator hardware. XBee and reed switch.

-Melody
The melody's key signature, interval, and note value are changed according to the context, allowing users to identify the context based on the difference in melody. The meter (4/4) and tempo (120) are fixed based on the VOCALOID specifications.

-Key signature
The key signature represents the difference in context types. For example, a weather report is assigned to F-Dur and f-moll. If the context is "sunny," conteXinger applies F-Dur to the song. On the other hand, if the context is "rainy," conteXinger applies f-moll to the song. Major and minor keys are applied to each context to represent the difference in the context.

-Interval
The method for determining the interval (sound transition) is identical for all contexts. The melody is limited to within one octave in the middle range to allow VOCALOID to generate easily dictated songs.

The first sound of the phrase is selected randomly. The succeeding sound is determined based on the following probability, that is, the second or third interval is adopted with a probability of 22.5%, while the fourth or fifth interval is adopted with a probability of 2.5%. This rule generates melodies with moderate intervals.

–Note value
A morphological analysis of the lyrics is used to determine the note value. As we consider that nouns, adjectives, and verbs are particularly important in lyrics, the first syllable of these words is placed to the accented beat of the music.

In addition, different note values are assigned to each context. We prepared two types of rhythm groups, a quick rhythm and a slow rhythm, and assigned each context to one of these groups, for example, a quick motion of the vacuum handle is assigned a quick rhythm, and a slow motion is assigned a slow rhythm.

CONCLUSIONS

In this paper, we proposed and implemented a song synthesizer that generates music reflecting the user's context of daily life. We are currently utilizing the contexts of a vacuum cleaner's on/off state and acceleration, the opening and closing times of a refrigerator door, the on/off state and running time of a microwave, Twitter reply messages, and on-line weather reports.

We believe that songs generated using such contexts can cheer the users up, and can be used to display information of daily life in an ambient manner. As future work, we are planning to support a wider variety of contexts and improve the melody creation mechanism to provide more enjoyable music that supports the everyday life and work of all users.

References

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