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A.	Miki Sato et al.; "A single-chip speech dialogue module and its evaluation on a personal robot, PaPeRo-mini", 2009 IEEE International Conference on Acoustics, Speech and Signal Processing, April 19 – 24, 2009.

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11. Miki Sato et al.; "A single-chip speech dialogue module and its evaluation on a personal robot, PaPeRo-mini" was published in the 2009 IEEE International Conference on Acoustics, Speech and Signal Processing. The 2009 IEEE International Conference on Acoustics, Speech and Signal Processing was held from April 19 – 24, 2009. Copies of the conference proceedings were made available no later than the last day of the conference. The article is currently available for public download from the IEEE digital library, IEEE Xplore.

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Executed on: 1/6/2022

DocuSigned by:
Gordon MacPherson
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EXHIBIT A

A single-chip speech dialogue module and its evaluation on a personal robot, PaPeRo-mini

Publisher: IEEE

Miki Sato ; Toru Iwasawa ; Akihiko Sugiyama ; Toshihiro Nishizawa ; Yosuke Takano **All Authors**

Abstract: This paper presents a single-chip speech dialogue module and its evaluation on a personal robot. This module is implemented on an application processor that was developed... **View more**

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Abstract:

This paper presents a single-chip speech dialogue module and its evaluation on a personal robot. This module is implemented on an application processor that was developed primarily for mobile phones to provide a compact size, low power-consumption, and low cost. It performs speech recognition with preprocessing functions such as direction-of-arrival (DOA) estimation, noise cancellation, beamforming with an array of microphones, and echo cancellation. Text-to-speech (TTS) conversion is also equipped with. Evaluation results obtained on a new personal robot, PaPeRo-mini, which is a scale-down version

Keywords

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during robot utterances, respectively. These results are shown to be comparable to those obtained by PaPeRo.

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SECTION 1.
INTRODUCTION

Speech dialogue systems have been receiving particular attentions as a user interface for a wide variety of interactive applications, such as robots and car navigation systems. These applications are generally controlled by voice co mmands from a distance. A given co mmand is processed by a speech recognition system to generate a corresponding operation. It is also necessary to transform text information into an audible form by using a text-to-speech (TTS) conversion system. However, it is still challenging to perform off-microphone speech recognition, where the microphone is placed at a distance from the talker [1]. The target signal is seriously interfered by other signals and the ambient noise in noisy environments. Therefore, noise robustness is essential to speech recognition systems in the real environment.

To reduce undesirable influence by the ambient noise and the interference, signal-processing functions have been used for preprocessing the noisy speech. Among these functions are estimation of the direction of arrival (DOA) [2], [3], noise cancellation [4], beam-forming with a microphone array [5], and echo cancellation [6]. DOA estimation identifies the direction of the voice co mmand so that the microphone directivity is steered towards the speech source. An adaptive noise canceller (ANC) and a microphone array (MA) reduce undesirable influence which cannot be sufficiently offset by the directional microphone. An acoustic echo canceller (AEC) suppresses an echo that is a part of robot speech leaking in the microphone signal and contaminating the voice co mmand.

In robot applications, these functions are generally implemented by software on a platform based on a personal computer (PC) [7]. It is sometimes necessary to share computational power with other applications on the same platform. Considering that a larger number of complex applications are required on a robot, it

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