

Automatic Detection of Very Early Stage of Dementia through Spoken Dialog with Computer Avatars

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Abstract—This paper proposes a new approach to detecting very early stage of dementia automatically. We develop a computer avatar with spoken dialog functionalities that produces natural spoken queries. As initial analysis, audio visual data of spoken dialogues from 18 participants are recorded, and features of the number of token, type token ratio, the number of fillers, speech rate, and pauses before new turn are extracted. The results of the analyses showed that support vector machines (SVM) can classify two groups with 0.84 (> 0.70) detection performance.

I. INTRODUCTION

Dementia is broadly defined as deterioration in memory, thinking and behaviour that decreases a person’s ability to function independently [1]. The detection of dementia is challenging, especially in its very early stages [2]. Previous works have attempted to detect dementia from their speech and language attributes [3], [4]. However, most of them used non-interactive data such as picture description task and narrative¹.

This paper proposes a new approach to detecting very early stage of dementia automatically. We develop a computer avatar with spoken dialog functionalities that produces natural spoken queries referring to Mini Mental State Examination (MMSE), Wechsler Memory Scale-Revised (WMS-R) and other related questions.

II. SPOKEN DIALOG WITH COMPUTER AVATARS

We used MMDAgent² as a computer avatar. The system works on a regular laptop, which processes the audio input. The system was adopted to elderly people by displaying subtitles and slower speaking rate. We briefly describe the dialogue procedures as follows:

- Self-introduction: The system introduces him/her-self.
- Gaze: The system displays a small dot on a computer screen, and users are directed to gaze the moving dot.
- Reading: The system displays a document, and users read aloud the sentence.
- Q&A: The system asks a total of 8 queries. The first three queries are fixed (referring to the MMSE), and the other five queries are randomly produced.

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¹<https://talkbank.org/DementiaBank/>

²<http://www.mmdagent.jp/>

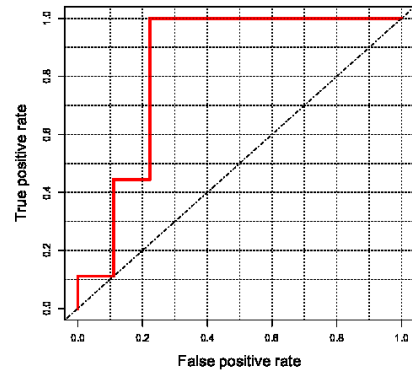


Fig. 1. ROC curve.

- Retelling: The system read aloud a document of the WMS-R, and users retell the sentence.

III. INITIAL ANALYSIS

We recorded audiovisual data of spoken dialogues from 18 participants (9 very early stage of dementia and 9 healthy controls). We extracted features of the number of tokens, type token ratio, the number of fillers, speech rate, and pauses before new turns from the answers of the three fixed queries. Here, we denote values of pauses before new turns as time between the end of the avatar’s question and the start of the user’s answer.

As shown in Fig. 1, we confirmed that SVM with sigmoid kernel classified two groups with 0.84 (> 0.70) detection performance as measured by areas under ROC curve.

IV. CONCLUSION

We proposed a new approach to detecting very early stage of dementia through spoken dialog with computer avatars. As initial analysis, we found that our system has possibilities to detect very early stage of dementia.

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