

Serious Game Development for Vocal Training Session in Speech Therapy

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ABSTRACT

Objective: This study was intended to develop serious games for vocal training session in speech therapy, which consists of voice continuity, loudness, and pitch training modules. **Background:** Serious games have started to be used in many purposes including health treatment. In speech therapy, serious games can help to maintain patient's motivation and commitment. **System Feature:** Various games were developed for each module to keep patients' interest. Therapists may determine variables such as duration, repetition, targeted loudness, and pitch levels of a game according to patients' capabilities and disorder levels. In order to help therapists examine patients' performance and evaluate their speech improvement, our application was equipped by database. **Discussion:** Clinical tests to evaluate the clinical effectiveness of our serious games on vocal training therapy is needed. We intend to compare patients' speech improvement using speech therapy with serious games to conventional speech therapy.

Keywords: Speech therapy, Serious game, Vocal training

1. Introduction

According to American Speech Language Hearing Association, people with speech disorders are unable to produce speech sound correctly or fluently. They have difficulty in pronouncing sound, articulation, and stuttering when they speak. Speech disorders can be classified to Apraxia, Dysarthria, Stuttering, Voice Disorder, Orofacial Myofunctional Disorder, and Speech Sound Disorder. Speech therapy for vocal disorder purpose consists of training muscle movement, controlling rate of speech, and improving breath support.

Conventional speech therapy has limitations, both in patient and therapist point of view. Existing speech therapy has limitations in maintaining patient motivation and attention during the session. Therapists also found difficulty in organizing the therapy result to be analyzed. Moreover, speech therapists have to face

various speech disabilities with different levels of severity as well. (Glykas et al., 2004). Therapy parameters have to be easily controlled by a therapist, depending on patient needs (Glykas et al., 2004).

Serious games have started to be applied in many areas including health. Voravika Wattanasoontorn, et al. (2013) grouped serious game purpose for health into health monitoring, health detection, treatment & therapy, and rehabilitation. A.A. Navarro-Newball, et al. (2014) developed video game supported speech therapy named "Talking to Teo" which was designed for Colombian Spanish. Game for therapy has positive response from the patient and therapist because it can maintain attention and enthusiasm. However, some games still have problem in term of flexibility of its difficulty level adjustment. Suzanne N. King, et al. (2012) developed entertainment video game for voice therapy and found that the game was too difficult for the user.

This study was intended to develop serious games for

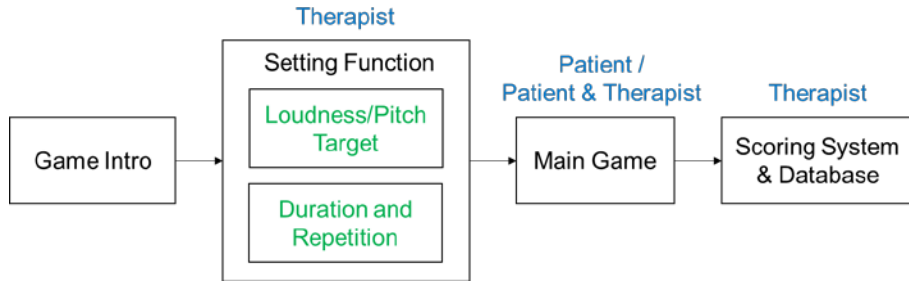


Figure 1. System Architecture

vocal training session in speech therapy. We developed an application consists of the game in three different categories: voice continuity, loudness, and pitch training modules. Those games are designed for Korean patient.

2. Serious Game Development

2.1 System architecture

The proposed serious game was developed as a tool for both patient and therapist in speech therapy session. The aim of this program is building a motivating and effective speech therapy for the patient. Proposed

application is not aiming to substitute the speech therapist, but to help the therapist in planning, executing, and evaluating the therapy session.

Our system provides three categories of vocal training game, which is continuity, loudness, and pitch. The patient may conduct a therapy session with therapists' guidance. The system records the result of each session. The therapist may determine variables of the games according to patients' capabilities and disorder level. Therapist may access database to assess patients' improvement.



UserName	Date	Level	Duration	Repetition	Score1	Score2	Score3	AverageScore
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1 User	2015/09/15 21:0...	Easy	5	3	42	52	42	45.2999992370606
2 User	2015/09/15 21:0...	Easy	5	3	8	0	61	23
3 User	2015/09/15 21:1...	Easy	5	3	0	0	44	14.6999998092651
4 User	2015/09/15 21:3...	Easy	5	3	100	0	100	66.6999969482422
5 User	2015/09/15 21:3...	Easy	5	3	10	78	10	32.7000007629395
6 User	2015/09/18 12:4...	Easy	5	3	40	13	13	22
7 User	2015/09/18 13:4...	Easy	5	3	40	14	6	20
8 User	2015/09/20 11:4...	Easy	5	3	100	38	31	56.2999992370605

Figure 2. Scoring & Database System

2.2 Therapy requirement

Continuity game requires players to make voice continuously. Continuity training might help improvement of controlling how long they need to make voice. For continuity games, the therapist may adjust duration (how long patient needs to make voice continuously). The therapist can also determine the repetition (how many times games will be conducted). Before the game is played, therapist may adjust minimum loudness target easily by comparing with real time voice recorded.



Figure 3. Nail Art Game (Continuity Training)

The purpose of loudness training is to train player produce a certain level of voice intensity. The loudness range target can be determined by the therapist. Besides that, the therapist may set duration, which determines how long a patient needs to make certain voice loudness.

Pitch training games are presented to help patient to increase their accuracy and precision in producing a particular level of pitch. Producing and controlling the voice pitch is important for intonation in speech. Need to be considered that the therapy patient may vary in age and gender, which means each user may have different pitch range. In pitch game, the therapist might choose a pitch range, which patient needs to train. Three pitch range choices provided according to normal pitch used in speech.

2.3 Application development procedure

Application development begins with game scenario development. Various game scenarios are provided for each game category in order to overcome boredom in



Figure 4. Voice Target Setting



Figure 5. Duration & Repetition Setting

playing one scenario all the time. Different scenario ideas were developed, including sports, traditional Korean games, as well as modern-theme inspired games. We present five different scenarios for each game category. Each scenario was developed under the guidance of medical doctors from Medical Device Clinical Trial Center, Chonbuk National University Medical School.

After the scenario development was done, we proceeded to design and programming phases. Design phase covers the development of characters and objects needed in every game. Game establishment was conducted using Unity3D game development engine and C# programming language. However, it is difficult to have a perfect system only in one straight flow of work, therefore, trial and revision phase is absolutely needed. This cycle of development process repeated several times until we come up with the game, which will be proceeded for clinical testing.

3. Discussion

This study aims at making a serious game for speech therapy, which has the features needed by both of patient and therapist to conduct an effective therapy session. More specifically, the game was intended for vocal training session in speech therapy. Designing serious game for speech therapy should consider the difficulty level and appropriate material. The difficulty level of games can be adjusted according to patients' capabilities and disorder level.

Using serious game in speech therapy session will help maintain patients' motivation. Various game will keep patients interest to conduct therapy.

Clinical test to evaluate the clinical effectiveness of our serious games on vocal training therapy is needed. We intend to compare patients' speech improvement using speech therapy with serious games to conventional speech therapy. Besides that, we can compare our serious games with other existing serious games for speech therapy.

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