A video game for improving self-efficacy and changing life-style of obese child

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Abstract
Changing lifestyle and improving self-efficacy are two effective factors in weight loss. Self-efficacy is as a key factor in increasing physical activity. Appropriate lifestyle is another important factor for obesity treatment. In this paper we focus on increasing self-efficacy and changing lifestyle of obese children with the aim of video game. Thereby, a video game has been designed and developed for this purpose. The proposed video game tries to achieve these two factors by preparing challenges for the player to choose the appropriate food for meals and forcing her/him to do specific body exercises. The assessment of the game on a group of children showed their enthusiasm for doing sports activities and influencing their lifestyle.

Key words: video game, lifestyle, self-efficacy, weight loss, physical activity

Introduction

Over the past century, obesity has become a worldwide problem, especially in industrialized countries. However, recently it has been recognized as a global threat by the World Health Organization [1]. Becoming obese is due to excessive food intake, not enough physical exercise, and genetic susceptibility [2]. Obesity leads to many possible diseases, and if not controlled, it may cause in irreparable damages such as: stroke, heart disease, blood lipids, high blood pressure, diabetes, and mental disorders [3]. There are several ways to deal with obesity including:

- Change of lifestyle and
- Improve in self-efficacy.

Lifestyle includes features, habit patterns, and behavioral characteristics of individuals. To change lifestyle, one should make changes in food habits and amount and intensity of physical activities. This way of life affects the most important part of every human's life, i.e. health.
Self-efficacy means that a person believes in his ability to succeed in a particular behavior, such as physical activity [1]. A review of the relationship between self-efficacy and various health behaviors has shown that self-efficacy is a reliable predictor of the success in weight control programs, and those who experience a large weight swing often have lower self-efficacy [4]. The use of intervention techniques such as self-efficacy promotion programs will have positive effects on encouraging adolescents to choose healthy food and help prevent obesity and overweight. Lifestyle changes are also one of the best ways to reduce illness, mortality and also improve the quality of life [5].

In this paper, we design and implement a video game which tries to increase the self-efficacy and showing the appropriate lifestyle to the player. Approaches of increasing self-efficacy which have been considered in our game are as below:

- Creating mastery experiences: To create a mastery experience, you need an environment which gives players the chance to overcome obstacles on their way toward reaching goals. During the game play, some obstacles should be designed to simulate such conditions [6].

-Allowing vicarious experiences of mastery: Offering role models in serious games can help improve self-efficacy. Games aiming at self-efficacy should be as similar as possible to the user, so that the user can gain an individual experience of mastery through others [6].

-Providing social persuasion :People gain more motivation to overcome barriers and challenges in the way of achieving a goal, when they are convinced that they have capabilities required for mastering the situation of reaching goals. Serious games create situations in which the positive feedback of the user, to reach even the smallest learning or behavior goals, is maximized as they prepare a supportive context for learning [6].

Background

Bern, Berry and Petry (2012) showed that self-efficacy can predict success in weight loss. They showed that a change in self-efficacy during weight loss can predict weight loss significantly [4].
Several studies have concluded that self-efficacy beliefs are a prognostic indicator of a wide range of behaviors, including

weight control, dietary intake, exercise, and smoking cessation. Thoria and Goli (1997) showed that university students with significantly low self-efficacy, gained a lot of weight over the past two years [4].

Studies by Bremen and coleeagues (2006) aimed to investigate the relationship between eating behavior, self-efficacy, and eating disorder symptoms, showed low confidence in the ability to control eating when experiencing negative emotions [4].

In a study by Lyou et al. (2004) with the aim of explaining the relationship between self-efficacy and nutritional behavior in lipid use, as well as the study by Deniz et al. (2012), it is emphasized that nutrition educators also need to pay attention to the role of self-efficacy as an important indicator in nutritional behaviors [4].

In 2011, the student had to create a daily checklist for food behaviors. Each student was obliged to complete a daily checklist of dietary habits and report to the researcher on a weekly basis. This study showed that the understanding of self-efficacy is a means of maintaining and promoting behavior, and education can have an impact on the eating behaviors' self-efficacy [5].

Proposed Video Game

In this paper, we propose a game with the aim of weight loss by affecting lifestyle and increasing self-efficacy. The game consists of several levels:
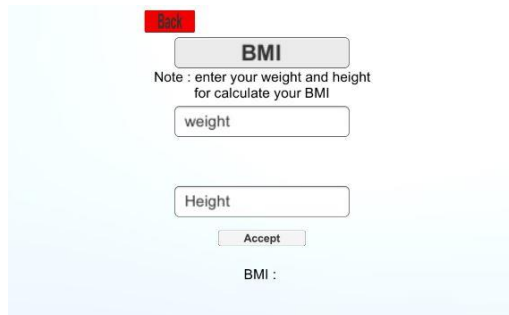

Fig. 1. Get weight and height and calculate BMI

Before starting, the child's Body Mass Index (BMI) is obtained to determine if he/she is obese, slightly overweight, or has an ideal weight. The child should enter his/her weight and height, and according to his/her weight and height, we calculate the BMI.

In next stage, we will inform the child of diseases that are caused by obesity, and we will provide the audio and visual explanations for illnesses. With this step, we create more mastery experiences.

Fig. 2. Visual explanations for illnesses

In the third stage, the child is asked about good and bad habits, and we encourage him/her if he/she chooses the right ones. With this step we create more mastery experiences and provide social persuasion.
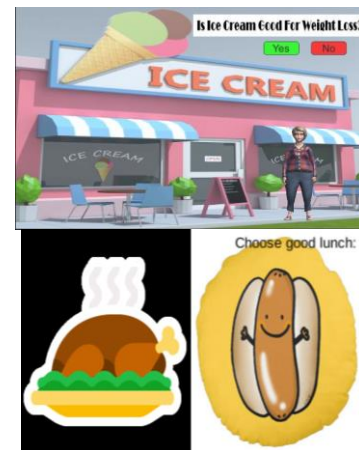

Fig. 3. Asking about good and bad habits

In the fourth stage, each child gets exercises that are proportional to the BMI. These activities are simple with short duration, and its time increases day by day i.e. it gets harder. Sports activities include:

- Dumbbell bicep curl as shown in Fig. 4.
- Front raises muscles worked as shown in Fig. 5.
- Jumping as shown in Fig. 6.
- Jumping Jacks as shown in Fig. 7.
- Walking as shown in Fig. 8.

Fig. 4. Dumbbell bicep curl snapshot

Fig. 5. Front raises muscles worked

Fig. 6. Jumping

Fig. 7. Jumping Jacks

Fig. 8. Walking

To understand whether these sports activities were performed, we use the mobile phone's accelerometer. If the value exceeds the threshold, we realize that the child is doing the exercises and will encourage him. Otherwise, it means that the activity is not performed and the child is warned. With this step, we create more mastery experiences and provide social persuasion.

The position and the acceleration of the mobile device are measured by XYZ coordinate values provided by the accelerometer as shown in Fig. 9. The XYZ coordinate represents the direction and position of the device at which acceleration occurred. Typically, gravity is also included in the values provided by the accelerometers [7].
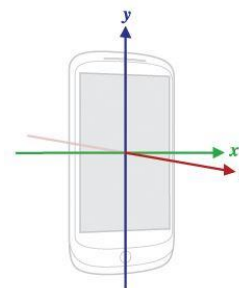

Fig. 9. XYZ coordinate values provided by the accelerometer

The child's BMI is asked periodically in order to determine possible weight gain.

Implementation
The game is implemented using the Unity Engine v.5.6.0. The engine is able to generate apk files for Android phones and tablets. The game's interface is implemented using the UnityEngine.UI library. First, the user is informed about his/her BMI by entering his/her weight (in Kg) and height (in meter). After pressing start, the game's character is displayed based on the user's BMI. In other words, if the user is overweight, he/she sees an overweight character in the game. To find out if the user performs the assigned exercise, the device's accelerometer is read using the UnityEnginer library. If acceleration exceeds a threshold, the user is rewarded. The threshold was identified through trial and error on the game's output. Finally, the user receives his/her daily score after performing the tasks.

Evaluation
The evaluation of this device by applying on a limited number of cases reflects the child eagerness to use it and carry out its activities for weight loss. Children is treated in two groups. One group will experience the normal course of the treatment and the other will play this treatment game. At the end of the one-week treatment process, their weight changes measured. The results show about 0.5kg weight loss during one week which demonstrates the success of the proposed treatment game.

Conclusion and suggestions
Child and adolescent are affected very quickly, and with great encouragement and self-efficacy, they can be very impressive. By the proposed game, we want to make their weight loss easier and entertain them indirectly by affecting important weight loss factors, such as lifestyle changes and self-efficacy. In the future, we will include other weight loss support factors to the game and add more physical activities to it.

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