A Personal Health-Tracking System Focused on Social Communication for Motivation

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Abstract. Personal health-tracking technology which is to record and improve health is becoming popular. The personal health-tracking tools collect user's living data and analyze it, planning for user to change his unhealthy behavior. However, there is was a lack of motivation in the current personal health-tracking system because it mainly focused on individuals. The importance of others in health behaviors and in personal health-tracking was well-established but designer still focused on the individual. How to design a part which allows other users to take part in personal health-tracking technologies system is a new challenge. Our research aims to help people to reach the right audiences and guidance when they share health information to get the motivation to change their behavior to maintain health. We designed a system to help people to finish the process: record data, find friends and coach, change behavior, help others. We use Augmented Reality technology to make the communication and interaction smooth. Also, an Augmented Reality game part is designed in our system to offer people more motivation to change their behavior. Preliminary experiment was carried out to verify the system is effective in terms of providing people with motivation.

Keywords: Augmented reality · Motivation · Personal health-tracking

1 Introduction

Using personal health-tracking tools to keep health is getting popular. In personal health-tracking system, user inputs his food and exercise data which will be analyzed by the system. After that, a plan is made for the user. User needs to follow the plan to change his behavior.

Previous food tracking systems have often been designed to help people improve their behaviors. Researchers have also made more research and design focusing on positive interactions and experiences with food [1]. In the traditional personal health-tracking system, people focus on how to collect the data and how to analyze the data. The models still mainly focus on the individual. Recently, some research shows that focusing on the individual will have some problems [2].

Due to the focus of individual, people will struggle with how to present themselves to other people, and people will lack of motivation to change their behavior. So, some people turn to the social software to share their food photo and get motivation. But the

problem is that the social software is not designed for personal health-tracking, people need lots of efforts to use it for managing the health.

Our system is designed to solve this problem. The idea is switching the point from individual to social. Using Augmented Reality to support the environment (photo of food) to create a platform for people to communicate with each other and get motivation.

2 Related Work

2.1 Social Health-Tracking System

The importance of others in health behaviors and in personal health- tracking has been well-established. But the models the HCI community uses to understand and design for health-tracking tools still focus on the individual [3]. Andrea Grimes and Richard Harper observed that food could bring people together and have discussed the role of technology in human-food interaction [4].

Within our knowledge, there are some social health-tracking systems we could find about the social health-tracking system.

The paper [5] presents a social health-tracking system which focus on aging populations by creating a social net by fridge. They propose FridgeNet as a way of promoting social activities for these people—this social technology assists older people in re-establishing communication with their families, old acquaintances, and new friends. By automating and encouraging the sharing of dietary information, FridgeNet helps members of this population to establish mutual support in a virtual community. FridgeNet records personal food intake information and promotes communication and social activity among senior citizens. The system uses sensor-equipped processing units (tablets mounted on standard refrigerators) and a cloud service to store and propagate food information. The system automatically stores users' dietary histories and downloads the corresponding nutritional information. Similar to existing social networking websites, the system lets users post comments, pictures, and voice messages.

2.2 Gamification

There are some basic gamification elements in the gamification applications. Among these typical game design elements [6], are points, badges, leader-boards, performance graphs, meaningful stories, avatars, and teammates. We mainly use three of them: points, badges, leaderboards in the system.

Points are basic elements of a multitude of games and gamified applications. They are typically rewarded for the successful accomplishment of specified activities within the gamified environment and they serve to numerically represent a player's progress [7]. Various kinds of points can be differentiated between, e.g. experience points, redeemable points, or reputation points, as can the different purposes that points serve. One of the most important purposes of points is to provide feedback. Points allow the players' in-game behavior to be measured, and they serve as continuous and immediate feedback and as a reward [8].

Badges are defined as visual representations of achievements and can be earned and collected within the gamification environment. They confirm the players' achievements, symbolize their merits, and visibly show their accomplishment of levels or goals. Earning a badge can be dependent on a specific amount of points or on activities within the game. Badges have many functions, serving as goals, if the prerequisites for winning them are known to the player, or as virtual status symbols. In the same way as points, badges also provide feedback, in that they indicate how the players have performed [9]. Badges can influence players' behavior, leading them to select certain routes and challenges in order to earn badges that are associated with them. Additionally, as badges symbolize one's membership in a group of those who own this badge, they also can exert social influences on players and co-players, particularly if they are rare or hard to earn.

Leaderboards rank players according to their relative success, measuring them against a certain success criterion [10]. As such, leaderboards can help determine who performs best in a certain activity and are thus competitive indicators of progress that relate the player's own performance to the performance of others. However, the motivational potential of leaderboards is mixed. Werbach and Hunter [7] regard them as effective motivators if there are only a few points left to the next level or position, but as demotivators, if players find themselves at the bottom end of the leaderboard. Competition caused by leaderboards can create social pressure to increase the player's level of engagement and can consequently have a constructive effect on participation and learning. However, these positive effects of competition are more likely if the respective competitors are approximately at the same performance level [9].

3   Goal and Approach

3.1   Goal and Problem

In the traditional personal health-tracking system, designers usually focus on the data-collection and data-analyze. How to motivate user to change his behavior is not seriously considered. Some research shows that now the motivation in traditional personal health-tracking system is not enough [11]. Let's take MyFitnessPal's motivation ways for example [12]. MyFitnessPal is a popular personal health-tracking tool which has more than 100 million users. It uses two ways to motivate its user:

1. It will recommend user some victory stories. Some users read the victory story and get some motivation.
2. It offers user a forum. Users can talk about things about eating or body exercising.

Many health personal tracking tools are hard to inspire long-term adoption because of the lack of motivation. The lack of motivation also causes less behavior change of user [3].

So, the lack of motivation is a serious problem in the personal health-tracking system.

3.2   Approach

To motivate the user to change his behavior, the system must use something to motivate user. The input of user in personal health-tracking system is eating data and exercise data. According to the Characteristics of them, eating data is decided to use for social communication. And exercise data is for gamification part.

To design an augmented reality communication part, we must decide some framework. In terms of content used for communication, we have decided that the communication would be based on photo. Because photo-based data makes tracking easier and more engaging [13]. Using photos to record is appropriate than the traditional way where people share text or blog information.
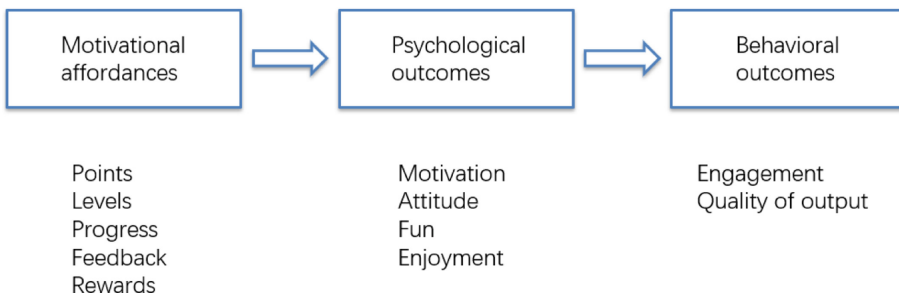
Augmented Reality technology is used in this part. To use our system, user needs to take picture for the food. And when user uses camera to focus on the food, AR system can start to work for user. AR makes the interaction smoother.

In terms of designing the game part, we must find some ideas to guide us how to design this part. The first idea is to not to make the gamification part alone. An alone game part in the personal tracking system is strange and unnatural. Combine the gamification with the social communication.

Personal tracking includes two kinds of data: food and exercise. Food data is photo-based, which is designed to use in social communication part. Then the exercise data will be used in gamification.

Make use of past and future selves in the game. Provide user with a representation of her past and future selves along her present self, in order to trigger behavior, change processes. Past can favor user reflection about the choices she made, the objectives she achieved and the transformations she produced on her own identity in time. Future can trigger behavior change strategies by presenting ideal states that the user can tend to. It aims at suggesting behavior change strategies based on the presentation of user's representations that embody her past and future states [14].

The Fig. 1 shows how the game motivates user to change his behavior in generally. Motivational affordances are provided for users. For example, points, levels, progress, feedback and rewards. These affordances can cause users' psychological outcomes which includes motivation, attitude, fun, enjoyment. Then it can make behavioral outcomes. We followed this model to design the gamification part in our system.

Motivational affordances	Psychological outcomes	Behavioral outcomes
Points	Motivation	Engagement
Levels	Attitude	Quality of output
Progress	Fun	
Feedback	Enjoyment	
Rewards		

Fig. 1. The model of how game motivates player

Provide meaningful rewards that incorporate some kinds of values for users. While aesthetic values can leverage the users' desire for appearing, and instrumental values can exploit their need of power and achievement, social values can trigger engagement based on the need of being recognized by others. Offering users valuable rewards to recognize their skills and contribution. Rewards, like points and badges, are not meaningful per se. They show that the user has done something in the system. And we need to tell user that something is meaningful, and the rewards are useful. How to find values that can give meanings to these representations should be one of the main aims of gamification strategies and how designing a reward system based on competence could enhance users' intrinsic motivation [14].

Group and cooperation encourage users to become part of a group and promote their identification in it, by fostering cooperation among members. People can communicate with others and get the feeling of the group. Feeling of attachment to a community can arise through common identity, whereby members feel connected to a group's purpose (Tajfel and Turner [15]), or from interpersonal bonds, when individuals develop relationships, such as friendships, with other members (Prentice, Miller, Light dale [16]).

4 Personal Health-Tracking System Focused on Social Communication for Motivation

4.1 Scenarios

There is Augmented Reality Communication part's user scene:

1. User uses this part for the first time. The system helps him to find new friends.
2. User invites one of the friends to be his coach.
3. User changes lots of unhealthy behaviors with the motivation from his friends and coach.
4. User becomes a coach of his friend.

In terms of game part, the scene is:

1. The system sets some Augmented Reality missions in random place.
2. User can get the information about the location of the AR mission in the application and can go to receive the mission.
3. After finishing the mission, user can get points. If user thinks the mission is not appropriate for himself, he can send the mission to his friends.

These are the things which link the two parts together:

1. The friend list is shared between the two parts.
2. The achievement point is shared between the two parts. More points make a higher rank in leaderboard of game part. More points give user a higher priority to show comment and share content in Augmented Reality communication part.

4.2   System Design

The system consists of two main parts: Augmented Reality communication part and game part. Augmented reality communication part is based on food data which input by user to motivate. And the game part is based on food data. The aim of game part is to support the Augmented reality social communication part. The Fig. 2 shows how the system works. Photo-based data and exercise data will be input by the mobile phone and take part in social communication and game. The server will store the data and control these two parts.
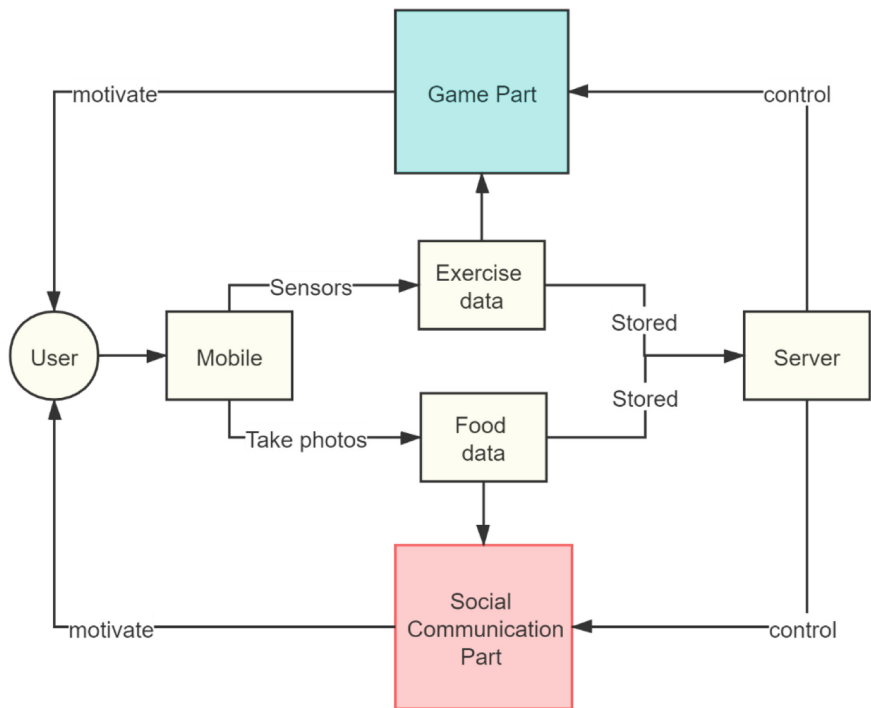
Fig. 2. System overview

Augmented reality social communication part is designed to motivate user to change his unhealthy eating behavior. User can take a photo of food at the start interface as shown in Fig. 3(a).

Then the Augmented Reality system will start to work. When user enters the main interface, as shown in Fig. 3(b). There are some Augmented Reality comments which are given by other users. The left part shows some Augmented Reality avatars. Each avatar presents one other user. The right part shows user's assistant. User can get guidance and information from her.
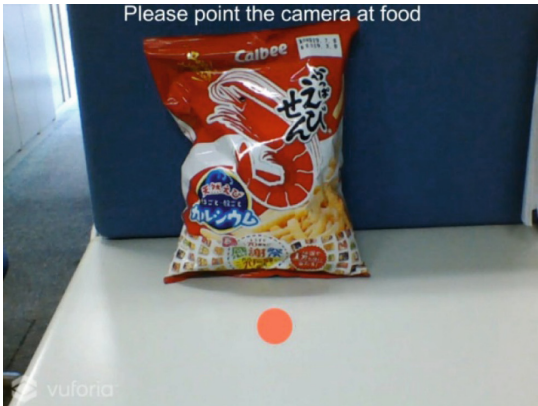
(a) Start interface

(b) Main interface

Fig. 3. Start and main interface in the system

User can click the Augmented Reality avatars to interact with other users. Figure 4(a) shows the examples of the interface with stranger. User can chat with her and get some information. Figure 4(b) shows the examples of the interface with friends. User can see the last picture which his friend took and give comment.

In the game part, the system will set some Augmented Reality missions randomly. As the Fig. 5 shows, the user can look over the map and find the mission card which is near the user. User can go around the specific place to find it.

| (a)Interact with strangers | (b)Interact with friends |

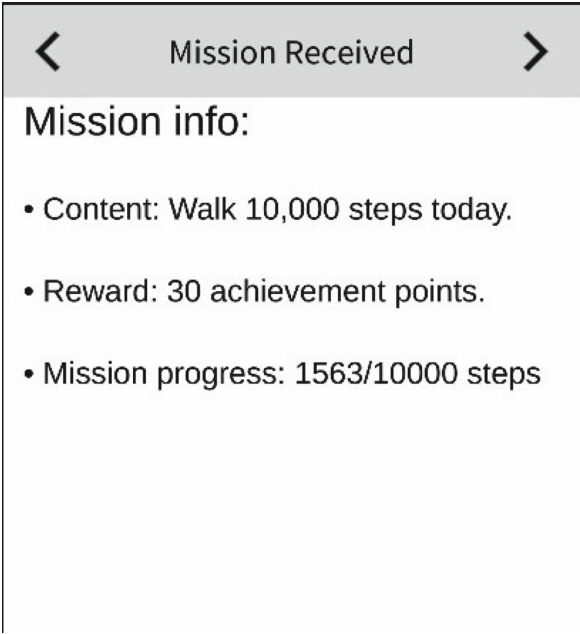**Fig. 4.** Interface with other users

Fig. 5. Get the mission location

The mission is attached in the Augmented Reality avatar (see in Fig. 6). User can get the detailed information about the mission in the application (see in Fig. 7). After the user get the mission, he will try to complete it. He can get some achievement points as rewards.
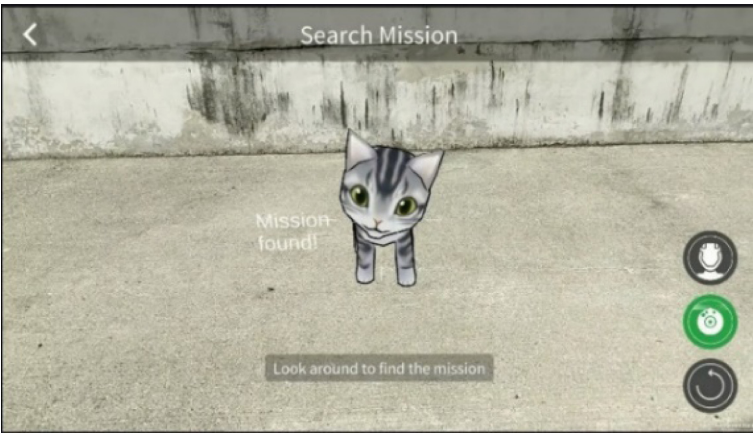
Fig. 6. Find the Augmented Reality mission

Fig. 7. The mission contents

Each area has its own leaderboard of achievement points every week (see in Fig. 8). User can know his rank among all the users in the specific area. Then he will know he should exercise more or exercise less next week.
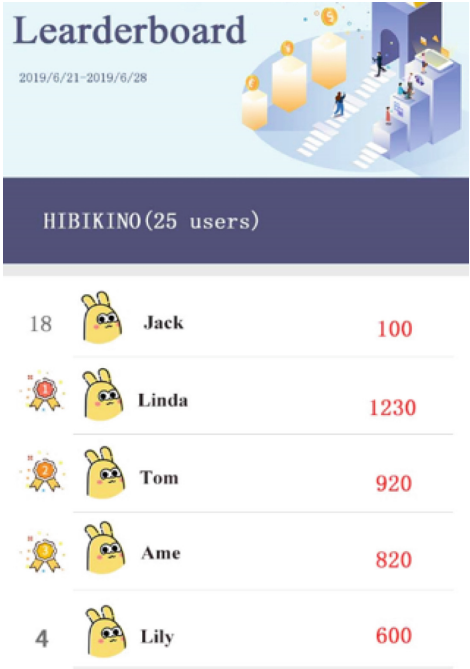

Fig. 8. Leaderboard of achievement points

4.3   Implementation

The Fig. 9 shows the framework of the Augmented Reality part. First, user take a picture for the food. Then the system starts to work for it. The picture is uploaded to the API URL to get information about the food which is in the picture. At the same time, the system will detect the border of the food and the platform in the picture. After these works are finished, system will show the Augmented Reality information to the user.

Object Service. In our system, we use google cloud vision API to identify the object. After getting the picture from the user, we send it to the target URL to get the detailed information about the object. Then we infer the data in our database about the object and decide which kind of information would be shown to the user.
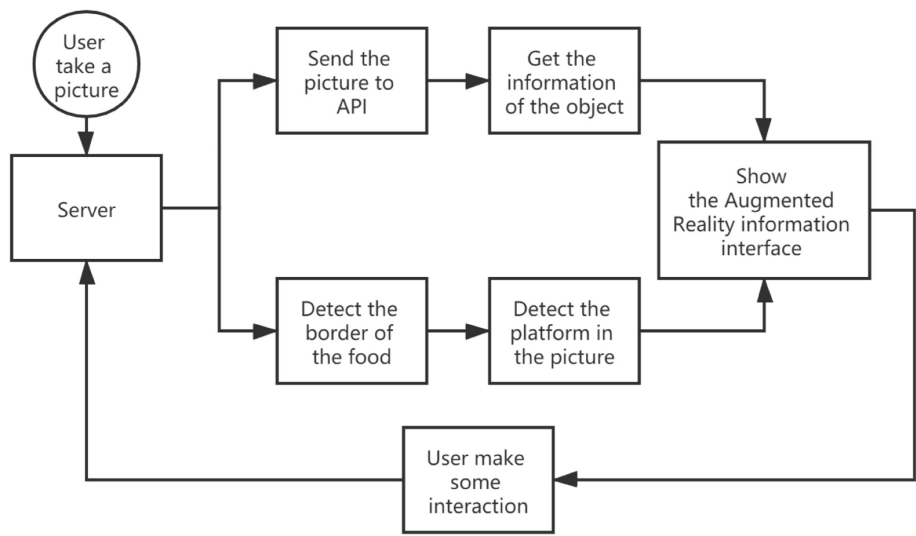
**Fig. 9.** Framework of the Augmented Reality communication part

Augmented Reality SDK. We use ARCore as the Augmented Reality SDK in our system. It helps us to do understand the environmental. ARCore looks for clusters of feature points that appear to lie on common horizontal or vertical surfaces, like tables or walls, and makes these surfaces available to our app as planes. We can use this information to place virtual objects resting on flat surfaces.

5 Preliminary Evaluation

We invited 10 participants to use our system, ranging in age from 20 to 25 and including 2 female and 8 males. All participants are given a brief introduction of the system. Each participant needs to use our system to record their eating and. During the process, they also will communicate with other users in the system. After that, the participant will be asked to fill in a questionnaire. The questionnaire has following 5 questions and these questions use the 5-point Likert scale. We plan to investigate the basic information of each participant and get their feedback. All the participants are asked to rate on a Likert Scale ranging from 1 to 5. The results are shown in Table 1 and Fig. 10.

Table 1. Answers statistics of investigative questions

Question	1	2	3	4	5
Q1: The system is easy to operate			2	6	2
Q2: The way of interaction is useful or interesting				3	7
Q3: The system is easy to make new friends		1	1	7	1
Q4: The rewards in the game part is enough?				3	7
Q5: The system can motivate you to change behavior				9	1
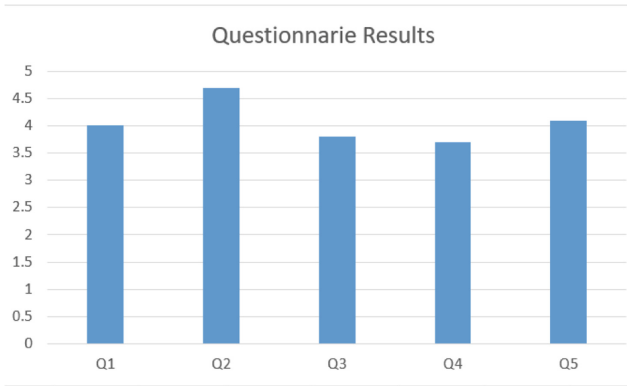
Fig. 10. Questionnaire results

Overall, we got a positive feedback through the preliminary user study. We also get some comments and suggestions from participants:

1. "You can find more beautiful 3D figures as the Augmented Reality avatars in the system. It will look better!"
2. "Maybe more factors should be added in the game part."
3. "The interaction of the system is a little bit complex, sometimes I don't know where to look at my current state."

6   Conclusion and Future Work

In this paper, we described a health-tracking system which focuses on motivating the user to change their unhealthy behaviors.

We took use of user's eating data and exercise data to create a social communication system. And we designed a game part to support it. Augmented Reality technology also is used to make the interaction more smoothly and attractive. We provided a user scene to show how the system worked. The scene contained four stages, where the user changed from the beginner to a coach. User in the system could make friends with the help of system quickly. Then user could interface with other users in the Augmented Reality environment when he took record of his eating data. Also, user could invite his friend to be a coach to give him more suggestions. The coach would get rewards as achievement points for motivation. Last step, the user became a coach to give his friends suggestions. During this process, the user changed his role: from beginner to the people who were coached, then became a coach for others. The game part also was designed to offer people more motivation to change their behavior. User could set the Augmented Reality mission in the place to communicate with other users. It was a chance for user to make more friends. The game part also provided achievement points to user as the motivation. Last, several experiments were performed to verify the system is effective in terms of providing people with motivation.

Our system is a new attempt about how to design a social health-tracking system. So, the system focused on how to create the platform for users to communicate with each other. And the guidance from the system is a little poor. Using the new technology like deep learning or big data to analyze the data which the user recorded and generate some specific suggestion is one kind of possible idea.

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