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Implementation of the Golf Play Advice System with Reasoning Rules Using Mobile Devices

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Abstract

This paper is a study on implementation of the golf play advice system which provides advice to golfers through mobile devices. The system consists of a mobile unit consisting of a GPS receiver, a data transmitter and receiver, and a display unit, and a server unit composed of a database and advice generator. The advice generator that provides advices to the users, generates advices with IF-THEN rule-based reasoning method. The reasoning module utilizes golfer's personal records and various information in the database of the server unit. This system provides the advice to the users who play on the golf course through mobile devices, so that it is possible to provide various information similar to the screen golf using the computer simulating technology in the outdoor golf course.

Keywords: *Golf System, Advice System, Mobile Device, Reasoning Rule*

1. Introduction

Recently, as the active population of various sports has increased, the base of golf has been expanded to popular sport that a lot of people enjoys. Golf is more introverted than other sports, and in most cases, the learning process, such as the posture and movement of the golf swing, is done by self-help, senior assistance, and training by trainer. The best way to learn golf is to go to a real golf course and play golf repeatedly. In the case of the screen golf which can enjoy golf without going out to the field by using the computer simulating technique, the golfer can be helped to hit by displaying various information on the screen every time the golfer hits the golf ball. However, this information is not available on the outdoor golf course. Therefore, it is required to develop the technology that can provide the necessary information to the golfer who desires to receive the information to help the golf course in the outdoor golf course.

So far, much research has been published about golf. This includes: Research on golf simulations such as the movement of golf balls or golfers [4-6, 8], data collection through sensors [2, 3], and research on processing large amounts of data [1].

The system proposed in this study aims to provide users with advice on playing golf outdoors through mobile devices. In order to generate the advice, a database storing the golfer's personal records, course

information is used. Rule-based reasoning technique is introduced in the system and utilizes the database and status information. Rule-based reasoning is an inference method that reaches the conclusion through reasoning chain based on knowledge consisting of IF-THEN type of rules [7]. IF-part of a rule describes the condition of the database. When these conditions are satisfied, the THEN-part which indicates the next action is to be executed.

The rest of this paper is organized as follow. Section 2 shows the architecture and components of the golf play advice system that we implemented. Section 3 explains the operation flow of the system including advice generator with reasoning rules. Finally, section 4 is the conclusion of this paper.

2. Overview of the Advice System

2.1 System Architecture

Figure 1 illustrates the system that we have developed. The golf play advice system includes mobile devices and a server unit. The mobile device is connected to the server unit through a wired / wireless network and is also used to obtain position information of a golf ball using GPS (Global Positioning System) satellite. A mobile device can be a golfer's or user's mobile phone, golf caddy's mobile phone, or a mobile device provided by golf club. The position of the mobile device can be recognized by receiving the signal from the GPS satellite. If the golfer having the mobile device is in close proximity to the golf ball, the position of the mobile device can be regarded as the position of the golf ball. Satellite signals are not necessarily used at the time of acquiring the position information
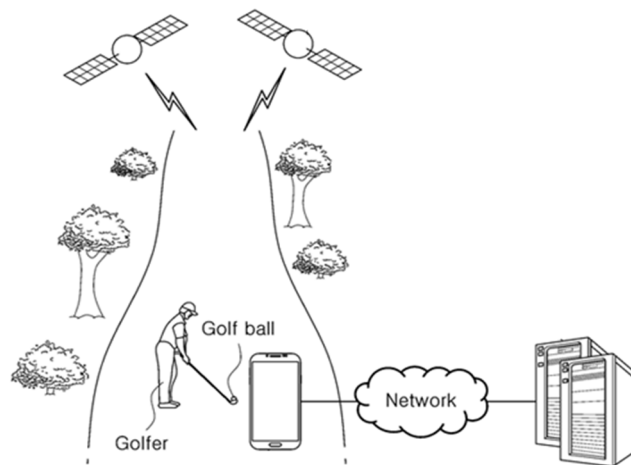

Figure 1. System Illustration

2.2 System Components

The mobile device proposed in this study consists of a GPS receiver, a data transmitter and receiver, and a display unit. The server unit has a database and an advice generator. The advice generating module may be configured in the mobile device. The system components are shown in Figure 2.

The advice generator is configured by connecting the mobile device to the server unit and then installing the software provided by the server unit in the mobile device. At this time, a separate database may be installed in the mobile device. If there is no separate database in the mobile device, the advice generating module can receive information directly from the database of the server unit.
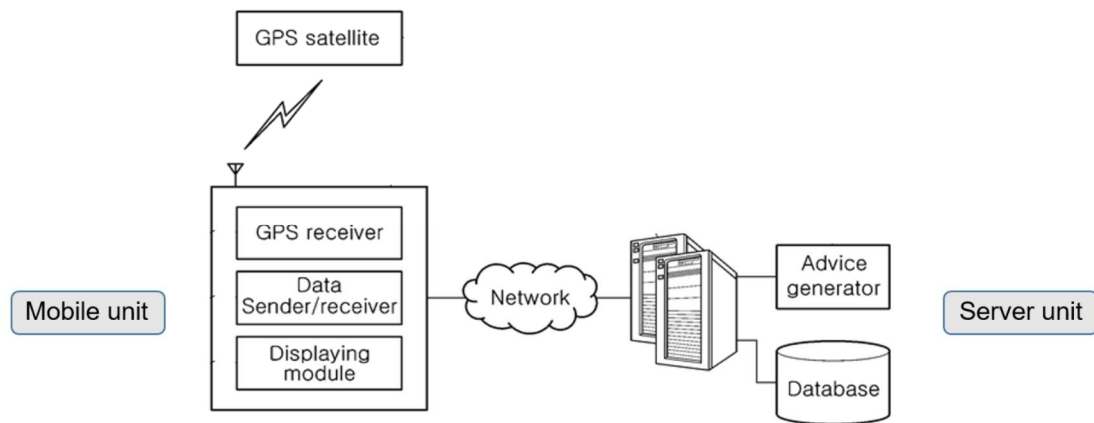
Figure 2. Components of Golf Play Advice System

3. Advice System Processing Flows

3.1 Overview
The processing flow of this system can be described as the following steps.
Phase 1. User request
Phase 2. Receiving satellite data
Phase 3. Golf ball position data acquisition
Phase 4. Golf ball status data acquisition
Phase 5. Advice generation
Phase 6. Offering advice

3.2 User Request
In the user requesting phase, a user (golfer) who wants to receive advice on golf play sends a request to provide advice. For example, after the user installs the software provided by the server unit in his or her mobile device and touches the advice request input key, the advice creation process is started. That is, the system operates as a demand driven type that obtains position information of a golf ball only when there is a request from a user and generates advice

3.3 Receiving Satellite Data
In the satellite signal receiving phase, the mobile device receives a satellite signal from the GPS satellite.

3.4 Acquiring Golf Ball Position Data
In this phase, the position information of the golf ball is obtained from the position of the mobile device. It is therefore desirable for the user to position the mobile device as close as possible to the golf ball.

3.5 Acquiring Golf Ball Status Data
In this phase, the golf ball status data is obtained based on the position information of the golf ball. This is obtained by the advice generation module. The status information of the golf ball is acquired at the moment the user makes a shot, and the golf ball status information can be automatically stored. The status information acquisition module can grasp the position and coordinates of the golf ball in the golf course currently played by the user using the course information database. The module obtains the status

information of the golf ball. The course information database includes golf course information, map information for an 18-hole golf course, coordinate information at each position on the map, and etc.

Examples of the golf ball status information include the distance between the golf ball and the hole cup, and the attribute of the topography where the golf ball is currently located. For example, as shown in Figure 3, the golf course currently played by the user may have the terrain attributes of green (G), rough (R), and fairway (F). When the golf ball is in the first position P1, the status information include the distance to the hole cup HC from the position of the golf ball, the fact that the golf ball now belongs to the topography of the fairway F property. When the golf ball is in the second position P2, the status information include the distance to the hole cup HC from the position of the golf ball, and the fact that the golf ball is currently located in the terrain of the rough R attribute.
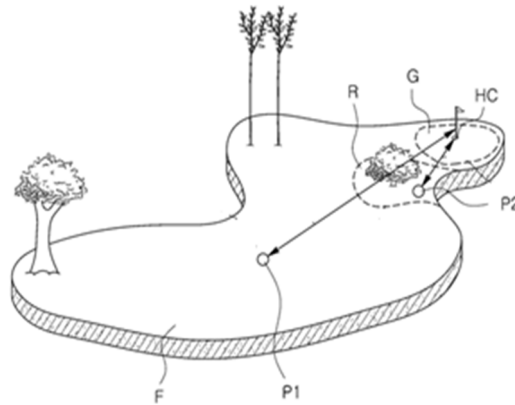
Figure 3. Maps

3.6 Generating Advice

In this phase, the system generates advice on golf play based on the status information of the golf ball that was acquired in the previous phase. The advice generation module is composed of a status information acquisition module and a reasoning module as shown in Figure 4.
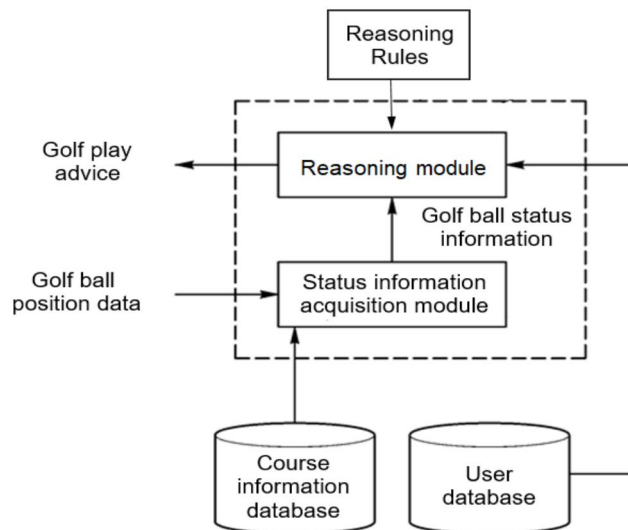

Figure 4. Advice Generation Module

The database constructed in the server unit is composed of a course information database and a user database. The course information database is mainly used for status information acquisition module which was explained in section 3.5.

The user database holds various record data for the golfer or other golfers who are also users of this system. For example, as shown in Figure 5, the user database is composed as follows: history of a user's past playing in the golf course, the record that the user has played in the screen golf course modeled as the golf course, user's level based on the record of the user's plays in the past. past record that at least one or more other golfers of the same level as the user have played on the golf course, past record that at least one or more other golfers of the same level as the user have played on the screen golf course modeled as the golf course, past record of at least one other golfer of the same level as the user.

The reasoning module of the advice generator receives the information of the golf ball obtained from the status information acquisition module and generates a golf play advice to be provided to the user by referring to the information of the user database. In order to advise you, the system finds the record of the golfer in the database in the following order. First, find out whether the golfer has played in the past enough times to generate advice by reasoning. If this information is not sufficient, then the system will refer to records of past plays on a screen golf course modeled on the golf course. If these records are not sufficient to generate the advice, then all the golf courses or all the screen golf courses that the golfer has played will be used. Next, if these records are not enough to generate an advice, or if the golfer is a beginner and there is no record, an advice is generated based on the record of the other golfers.
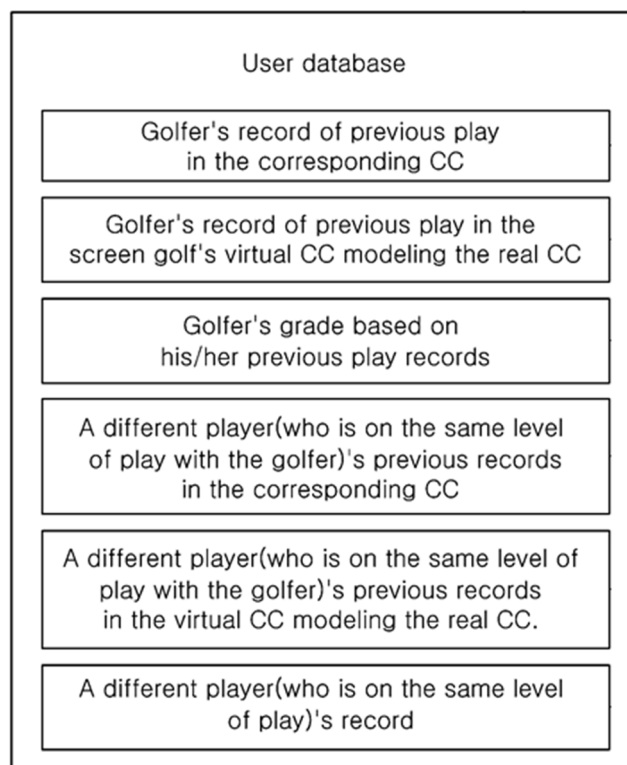
Figure 5. Structure of User Database

The reasoning module uses a rule-based inferring method to generate advice. Figure 6 shows examples of IF-THEN reasoning rules.

RULE: IF (exist(records on the currently playing golf course <g>))
    THEN (state = 1) AND (golf course = <g>)
        // status=1 means that the golf course to be referred is found. The found golf course is <g>.

RULE: IF (state = 1 is not true) AND
            (exist(records on screen golf of the same model of the currently playing golf course <g>))
    THEN (state = 1) AND (golf course = <g>)

RULE: IF (state = 1 is not true) AND
            (user's level = <x>) AND (currently playing golf course is <g>)
    THEN (state = 1) AND (golf course = <g>)

RULE: IF (state = 1 is not true) AND
            (input(user's level <x>)) AND
            ((exist(other golfer's records of level <x> on the currently playing golf course <g>)) OR
             (exist(other golfer's records of level <x> on the screen golf of the same model of the currently playing
                 golf course <g>)))
    THEN (state = 1) AND (golf course = <g>)

RULE: IF (state = 1 is not true) AND (there is no record)
    THEN (input(current golf course <g>)) AND (state = 1)

RULE: IF (state = 1) AND (golf course = <g>) AND
            (Currently the golf ball is in the bunker) AND
            (The golfer showed excellent shot results in the bunker at the golf course <g>)
    THEN (Goal: aggressive shot)

RULE: IF (state = 1) AND (golf course = <g>) AND
            (The golfer now plays in the par 5 hole golf course) AND
            (The level of the golfer is medium to low)
    THEN (Goal: to finish the course within 7 or 8 rounds)

    . . . . . .

Figure 6. Reasoning Rules

3.7 Providing Advice

The system provides the golf play advice generated by the reasoning module of the advice generation module to the user through the mobile device. Figure 7 shows example screens of the advice system. The advice is provided to a user through a virtual caddy (VC) displayed on of mobile device.

Figure 7. Advice Screens

4. Conclusion

In this study, we proposed a golf play advice system using mobile devices. This system mainly consists of a mobile unit and a server unit. The mobile unit is composed of GPS receiver, data transmitter and receiver and a display unit. User's mobile device is used to acquire the position information of the golf ball. The server unit communicates with the mobile device to configure the course information of the golf course. It consists of database and advice generator. The advice generator in the server uses the position information and the course information to determine the status information. And then, the advice system generates advice of golf play based on the status information. In generating advice, IF-THEN reasoning rules utilizing the database.

The golf play advice system proposed in this study provides advice to golfers playing on the outdoor golf course through mobile devices. Therefore, there is an effect that various information such as a screen golf course simulated by a computer can be provided in an outdoor golf course.

Acknowledgement

References

[1] Baughman, A. K., Bogdany, R. J., McAvoy, C., Locke, R., O'Connell, B. and Upton, C., "Predictive Cloud Computing with Big Data," *IEEE Computational Intelligence Magazine*, Vol. 10, No. 2, pp. 63-72, 2015.
DOI: 10.1109/MCI.2015.2437551.

[2] Hong, Y., Song, S. Jang, K. and Rho. J., "Smart Factory Platform based on Multi-Touch and Image Recognition Technologies," *The Journal of the Institute of Internet, Broadcasting and Communication (JIIBC)*, Vol. 18, No. 1, pp. 23-28, 2018.
DOI: 10.7236/JIIBC.2018.18.1.23.

[3] Hwang, C., Kim, H., Lee., J. and Jung, K., "A study on BSN data collection technique through mobile devices in a cloud environment," *International Journal of Advanced Smart Convergence(IJASC)*, Vol. 6, No. 2, pp. 82-88, 2017.
DOI: 10.7236/IJASC.2017.6.2.82.

[4] Merler, M., Joshi, D., Nguyen, Q., Hammer, S. Kent, J., Smith, J. R. and Feris, R. S., "Automatic Curation of Golf Highlights Using Multimodal Excitement Features," in *Proc. IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pp. 57-65, July 21-26. 2017.

DOI: 10.1109/CVPRW.2017.14.

[5] Shin, Y. and Wunsche, B. C., "A smartphone-based golf simulation exercise for supporting arthritis patients," in *Proc. of 28th International Conference on Image and Vision Computing New Zealand (IVCNZ 2013)*, pp. 459-464, Nov. 27-29, 2013.
DOI: 10.1109/IVCNZ.2013.6727058.

[6] Treu, G., Martens, J., Schicker, M., Breisinger, M. and Kupper, A., "Vs Golf - Developing Location-based Multi-Player Games," in *Proc. of 31st Annual International Computer Software & Applications Conference (COMPSAC)*, pp. 109-114, July 24-27, 2007.
DOI: 10.1109/COMPSAC.2007.238.

[7] Waterman, D., A Guide to Expert System, Addison-Wesley, 1993.

[8] Xiong, Z., Radhakrishnan, R., Divakaran, A. and Huang, T. S., "Audio events detection based highlights extraction from baseball, golf and soccer games in a unified framework," in *Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, pp. 632-635, Apr. 6-10, 2003.
DOI: 10.1109/ICASSP.2003.1200049.