Automatically-Guided SHO-GI System

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Abstract: Japan has already become an aging society. It is also expected that foreign tourists to Japan will be increased more and more. A traditional Japanese board game, SHO-GI, which is known as Japanese chess, is a suitable tool for promoting universal communication between Japanese and a person from abroad and between a young generation and elderly people. As the course exercise of the project based-learning (PBL), we started to design and develop an automatically-guided SHO-GI system for beginners and foreigners. The system consists of microprocessors, pieces with individual register as a unique ID, an intelligent and stylish SHO-GI board, which can electrically detect the assignment of the pieces, and the piece management software on the host computer. It guides how to move pieces and forbidden move, so that anyone can enjoy SHO-GI game even if a user does not know the details of SHO-GI rules. The automatically-guided SHO-GI system was re-designed using the advanced machining techniques beyond the course exercise in order to improve the stability and robustness against unexpected piece movement. In this presentation, we would like to introduce the detail of the system and demonstrate the system behavior practically. We expect that universal communication can be achieved with the proposed system.

1. Background and Purpose

Japan has already become an aging society, and the aging rate reached 27.3 % last year. There is also a serious problem that a young generation is hard to frequently communicate with elderly people. In 2020, Olympic and Paralympics games will be held in Japan, so inbound tourists must be increased for a couple more years. Foreigners have interests in Japanese cultures as well as beautiful scenery and a wide variety of cuisines. Japanese traditional customs attract frequent travelers, although they had interests in Japanese pop cultures including animation, TV game, and music.

We did a questionnaire survey at elementary school on Fukuoka, Japan. Over two hundred students filled in the questionnaire. The first question was that did you play with grandparents? 63 % of the students answered yes. The second question was that what kind of game did you play? SHO-GI was the most popular game both for the elementary school students and their grandparents. Next, we asked whether the elementary school students could play SHO-GI? 56 % of the students answered that they understood the rule and could play SHO-GI. Finally, we asked students, who did not know the SHO-GI rule, whether you wanted to play SHO-GI if you understood the rule of SHO-GI. It was found that 69 % of them would like to play SHO-GI with grandparents.

Then, we have decided to design and develop an automatically-guided SHO-GI system as a tool for achieving universal communication. It is a challenging issue in the viewpoint of both hardware and software development. A prototype was built only by undergraduate students, and a sophisticated system was completed with the support of technical staffs in Kyushu Institute of Technology.

2. Concept and Idea

The automatically-guided SHO-GI system is designed as an

electronic tool for prospective players, who do not understand the rule. Once a player picks up a piece, all possible grids where the piece can move are lighten by LEDs under the SHO-GI board. The rule of the piece movement is stored in a microcomputer, so that a player does not need to remember the rule in advance.
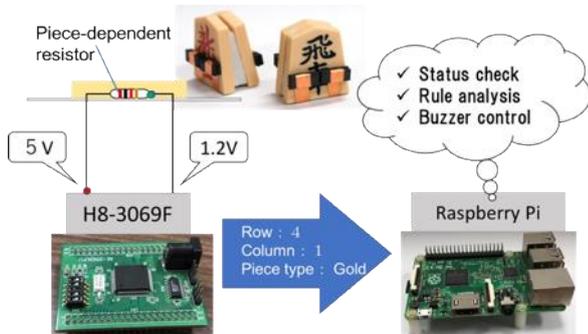

Fig.1 Concept of the proposed SHO-GI system.

3. Design and Functions

In the initial plan, we compromised on the development of three-by-three reduced-sized SHO-GI system in order to reduce the complexity of the system. However, we tried to design and develop nine-by-nine full-sized system. To accomplish our goal, collaborative work was indispensable, although we initially assigned an individual task to each member of our team.

The automatically-guided SHO-GI system consists of hundreds of electronic parts and wires, and those are manually soldered as shown in Fig.2. Automatic guidance using LEDs is achieved depending on the voltage alternation caused by the piece-dependent resistors. A microcomputer recognizes the piece movement, and a Raspberry Pi controls LED flashing. When a player checks the opponent's King, the system draws the players' attention by ringing the buzzer sound. The opponent has to get out of check. If the King cannot be defended, it is a defeat. The system informs that the game is over by repeating buzzer sounds and flashing LEDs.

To build design-conscious and user-friendly system,

(a) Beginning of system development

(b) Prototype system with hand soldering

(c) Re-designed system with printed circuits

Fig.2 Procedure of system development.

appearance design plays an important role. The appearance design must be closely related both to hardware and software development. Due to our mutual collaboration, we could complete the system.

4. Problems and Future Work

In this project, an automatically-guided SHO-GI system has been developed as a communication tool regardless of generation, nationality, and experience. This system guides how to move each piece, and also instructs forbidden move kindly. A player does not need to remember the complicated rule in advance. We expect that universal communication can be achieved using the proposed system. Future works include performance evaluation in realistic situations with a wide variety of prospective users.