

Blind Burglar: The Auditory System

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ABSTRACT

The Blind Burglar system provides the user with a simulated experience of rummaging through a home and searching for coins. It outputs sound cues in response to the user's input of physically 'walking' on makeshift pads to navigate through the 'house'. The device itself consists of an Arduino board and makeshift pressure pads that detect input and translates that information into appropriate sound cues through Arduino IDE and Pure Data Extended. The Blind Burglar creates a goal that is achievable through fun interactivity the same way arcade games incorporate immersive techniques from similar devices.

Keywords

Auditory feedback, exergame, arduino, pure data, physical control, game

1. INTRODUCTION

The purpose of the device is to simulate movement throughout an area while utilizing sound feedback to notify the user where he/she is located. The system does not provide the user with any visual feedback; it forces its user to rely solely on sound. The system's sounds correspond to specific noise producing objects that are found within an ordinary living space. This challenges the user to interact with different objects and deduce their location within the house. For example, the user may walk into the bathroom. To notify the user of the change in the environment, the system's output will change from footsteps on hardwood flooring to footsteps on tiles. The user can attempt to interact with objects by simply stepping on the different buttons to create sounds that will either confirm or contradict their location. Examples of these interactive things include a shower or a toilet. The user is also given a list of clues as to where the stashed coins may be. It is his/her goal to explore the house and find them.

Movement throughout the simulated home is similar to moving along a grid: the user can move left, right, left-forward, right-forward, left-backward and right-backward. The user's control is a mat that consists of seven pads. The two front pads are located at the center of the top, with the right and the left pads placed on their respective side. The back pads are located under those pads. They each correspond to a respective, intuitive direction. The user will move in the direction of the pad that he/she stops on. A seventh pad is directly in the center. This

pad allows the user to interact with an object if that option is available.

2. BACKGROUND

Traditionally, video games create a sedentary environment for the user. Many systems utilize hand controllers that allow their users to give input and move their character through the world that is displayed on the corresponding screen. Several companies have created alternative games that promote physical engagement, these include: Dance, Dance Revolution, In the Groove and Wii Fit. These games, referred to as exergames, produce a different experience for users. The user is required to exert energy by standing and moving around in order to progress through the game. Since the user is required to physically engage with the control pad, the user is inadvertently practicing physical skills³. Users are able to strengthen their hand-eye coordination and exercise their bodies³. In addition to improving hand-eye, foot-eye, etc. coordination, users also improve their reaction time by trying to achieve the goals within the game³. By forcing users to exercise as they play fun, enjoyable games, exergames have made gaming more productive than the traditional hand controller games. These games essentially convince users that their cost to playing the game is worth the amount of fun that experience from exerting their own energy and time.

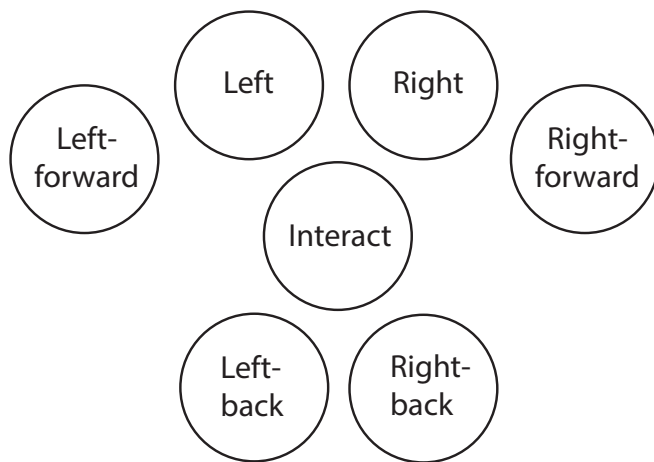
3. SYSTEM OVERVIEW

The Blind Burglar system consists of 7 makeshift pads, an Arduino board, Arduino IDE and PureData software. The pads act as buttons that receive user input. They are each made out of a folded piece of cardboard, aluminum foil, paper clips and napkins. The cardboard is the outermost layer that everything is in. The aluminum foil is attached to each sides of the cardboard with paper clips. A hole was cut in the middle of the folded napkins that lay in the middle of the aluminum foil squares. The napkins make the pads into switches. When the pads are stepped on the two sheets of aluminum touch, complete the circuit and transfer that information back to the Arduino. When the pads are idle, there is a gap between the two aluminum sheets and no data is transferred back to the Arduino.

When the buttons are pressed and the current is allowed to flow, information travels to the pins within the Arduino board. The program then determines which pad was pressed and correlates that with the direction that the

user moved in, it translates the steps into keyboard presses. The program utilizes boolean values to ensure that the Arduino only reads one key press at a time. Once a pad is stepped on the system cannot process another pad press until the initial press has been fully released. Also, after one pad is pressed, it will predetermine the directions of all of the other pads. This allows for each pad to have more than one direction. It removes unnecessary pads and results in easy, simple usability by requiring smaller turns.

Diagram 1: Blind Burglar Switch Setup



Within the PureData Extended program, the user is limited to an 8 x 8 grid space. The user can walk throughout this space while hearing a collection of sounds. The grid is divided into sections that have different types of floor material, resulting in the system playing footsteps on hardwood flooring, tile, or carpeting. The stepping sound is heard each time the user moves from one point to another on the grid. PureData reads those respective movements as keyboard presses that were translated from the mat. Certain points are interactive. Meaning, if the user is standing on it and pressed the interaction key, they will activate a sound cue from an item within the room such as a piano or microwave. The program also restricts the user from exiting the grid. If the user reaches the boundary and tries to exit, they will hear a 'thud' that results from bumping into a wall.

4. FUTURE WORKS

There are several unique components to the Blind Burglar that can be elaborated on to create productive systems. As mentioned previously, BB falls into the exergame category. Research done regarding these games has shown evidence of improving users' overall coordination, physical activity levels and ability to formulate appropriate responses quicker³. The systems do all of this while also entertaining its user, thus making it extremely effective.

Systems like this can be useful within healthcare settings to promote physical health. The environments include physical rehabilitation centers, gyms and schools, etc. It will be effective because it is an immersive game that allows players to use their bodies to navigate themselves through the game setting. In physical rehabilitation centers people who are experiencing difficulty with certain body movements will be able to practice those motions through repetition. In gyms and schools, users will be able to utilize these systems as innovative and fun motives to work out their bodies. These will be especially effective because younger generations are so attached to by technology.

The other unique aspect of the Blind Burglar is that it plays sounds in response to presses, making users rely on their touch and auditory senses. This can be useful in helping to train the auditory receptors of people who are hard of hearing. Research on this topic has been done at Harvard University with mice and human test subjects. The tests were designed as foraging games where the individual was only given auditory feedback in response to their navigation decisions¹. The users played this simulation for 30 minutes a day for a month. The results showed improvement in the user's ability to discriminate specific sounds from others¹. The users were able to distinguish quiet speech in a noisy environment¹. Much like their system, our system can be used to help improve the hearing as well. It can also be useful for people who want to train their reaction time to certain sounds and their ability to navigate through areas while relying on only sound.

5. CONCLUSION

The Blind Burglar is an immersive game that provides the user with an engaging atmosphere. The system consists of an foot pads that act as switches, an Arduino, Arduino software and PD software. Our system can be used in more physically productive ways to improve users' physical abilities. This includes improvement in hearing, physical coordination as well as physical coordination in response to sound cues and overall physical health.

6. REFERENCES

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