Run Chicken Run: Physical metaphor augmented wearable movement-based interaction

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ABSTRACT

This paper presents our prototype Run Chicken Run which is a game platform where user can interact with a hacked electric toy "E-chicken" through physically metaphorical movement. By wearing input devices on elbows and then flapping arms, user can control the pace of movement of the E-chicken. In this way, the user interacts physically with the toy and socially with other players as well. To enable this, the game platform employs low-cost, readily available sensors, wireless modules, and microcontrollers.

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INTRODUCTION

This research technologically enhances interaction with physical toys in a novel way. Children's play patterns have changed over the last 20 years. Computer games, mobile phones, Game boys and MP3-players, are taking over the market for toys. Children have become more inactive and their play is less demanding on their own physical involvement and stimuli of the senses [2]. Most of these applications and systems give users feedback through screen-based visual output. To play the game, users need to focus on the screen, thus they overlook the physical surroundings. This will eventually reduce communication with the physical environment as well as other people. The lack of physical active and social communication plays an important role in inducing obesity among children [5]. However, direct physical interaction with the world is a key component of cognitive development in childhood. [1] With focus on encouraging children to play more actively, physically and socially, Run Chicken Run takes another step through technologically improving the existing physical artifacts and the enabling physical interaction between artifacts and users. It also shows a unique opportunity for the traditional toy industry.

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WEARABLE MOVEMENT-BASED INTERACTION

Human bodily movement is a subtle and expressive means for communication and interaction. It is often claimed that increased physicality enriches the user experience [4]. Wearable device translates physical body movement into a component of the game play. Sensors such as accelerometers can capture the motion data of the specific part of body to which they are attached. Instead of traditional input device such as mouse and key-board, wearable device worn on user can get rid of hand-hold input device. Hence, wearable movement-based interaction allows user to interact with both artifact and other people simultaneously, which contribute to the structure of a social game platform. Run Chicken Run takes some of the wearable movement-based interacting characteristics and applies it to interact with a hacked artifact through physically metaphorical movement.

PROTOTYPE AND IMPELEMENTATION

The game platform prototype Run Chicken Run consists of two components, the Wing and the E-chicken. In order to make the E-chicken run, users are asked to wear the Wings on their elbows and simulate a chicken by flapping their arms (Figure 1, left). The Wing captures the acceleration of user flapping motion and translates frequency and intensity into RF pulse, which will be sent to the E-chicken immediately. In this way, the pace of the E-chicken is positively relevant to the performance of the user. The faster the user flaps his/her arms, the faster and further the E-chicken runs. With the same starting point, children can compete with their friends and parents to see whose E-chicken runs faster and further (Figure 1, right). Since Run Chicken Run requires no other equipment and is battery-powered, the platform is mobile, portable, and almost without place limit.

Wing

The Wing is a wearable device worn on user's elbow, which captures user's flapping movement and communicates with the E-chicken. The Wing contains an MMA7260QT 3-axis accelerometer, an 8051-compatible microcontroller, and an nRF24L01 2.4GHz wireless transceiver. All above modules operate in low voltage (2.2V -

3.6V), which makes a 3-volt lithium battery enough for power supply.

Each user's flapping motion can be quantitatively distinguished by frequency and intensity. We define flapping arm up and down once as one cycle. And frequency is described as the accumulated number of cycles in a certain period. When user flaps arms, the Wing detects circular motion in the Y-Z plane (Figure 1, left), rather than simply up-and-down motion. For this reason, we define the quadratic mean value of acceleration as intensity to measure user's performance. Accordingly we collect data from the Y and Z pin of the accelerometers to obtain the quadratic mean value of acceleration. Moreover, when calculating frequency, a threshold is required to distinguish valid motion data from irrelevant movement (e.g. initial settings for the Wing). Each period, the running time of the E-chicken is proportional to the frequency (i.e. number of flapping cycles). Finally, the RF transceiver interprets frequency as RF pulses, triggering the E-chicken.

E-chicken

The E-chicken is a hacked electric chicken with the ability to function upon receiving RF pulses sent from the Wing, in which the same RF wireless transceiver is employed. The motor of the E-chicken is controlled directly by the data pin of the RF transceiver, and operates on RF transceiver's receiving data. The speed of E-chicken can be controlled in terms of different running time.

PHYSICAL METAPHOR

A suitable rationale for entering the world of metaphors is described by Lakoff: "Metaphors may create realities for us (especially social realities). A metaphor may thus be a guide for future action. Such actions will, of course, fit the metaphor. This will, in turn, reinforce the power of the metaphor to make experience coherent. In this sense metaphors can be self-fulfilling prophecies." [3]. It might be difficult to learn a certain movement pattern or movement command language. Metaphors create meanings of movement and make physical interaction easy and reasonable to understand. Children will gain engaging experiences from playing with physical metaphors. Physical metaphors require another awareness to realize physical movement. In this prototype, users intuitively gain awareness of how to play from the physical metaphor of E-chicken's movement.

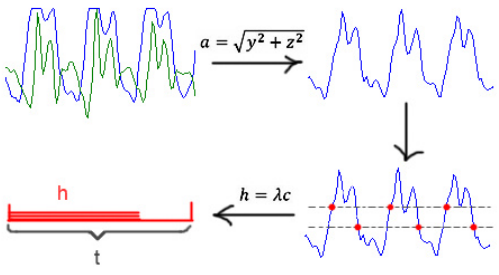

Figure 2: Algorithm of calculating running time.

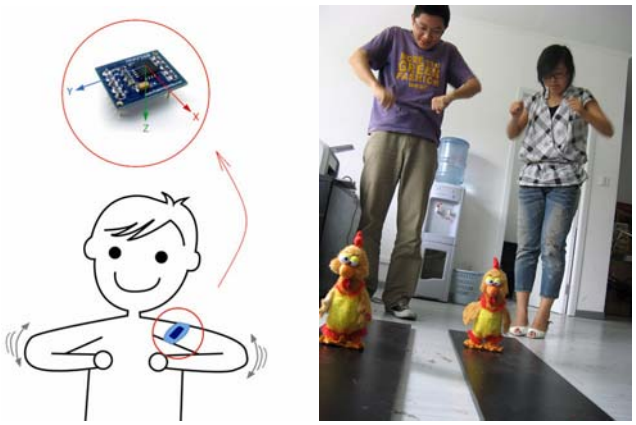

Figure 1: left - user simulate the motion of chicken flapping; right - users compete with other player.

CONCLUSION AND FUTURE WORK

This paper presents a novel interaction form in which physically inputting metaphorical movement and physically returning the feedback occurs. With added components, the traditional electric toy becomes an interesting game platform for all ages. The platform is also a supporting example of wearable movement-based interaction.

For future work, we plan to evaluate Run Chicken Run in child users and explore its potential in toy market.

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