Evaluating interaction with Popie using tilt gestures

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1. Introduction

Popie is a tool that facilitates entering Japanese text based on flow menu. Tilt gestures interface is a promising interface because of its fast and natural of usage. In this paper we consider the interaction with Popie [1] using tilt hand gestures. Then we studied the speed and accuracy of interacting with Popie using different objects and in different situations. The primary results of our previous research shows that interacting with Popie using a wireless sensor and full hand gestures could be worth [2]. Our experiments demonstrate that tilt gesture has a lot of possibilities to operate Popie remotely in a faster manner using tilt gestures.

2. Popie system overview

Conventional methods for text entry like keyboards have been used efficiently. Keyboards could sustain from the limitation of space to be hold. It should be hold in a stable state for efficient and fast input and the user should be hands free. Users would like to check their email, check train schedule and write on their PDA, write notes on move. In these situations, standard keyboard is not the best choice. Touch panels are one possible alternative for entering text using tap operations. However, it brings some problems when the touch panel display became bigger. Software keyboards have to be operated while users are standing beside the display, so they can make the tap operations, this cause a limitation for user freedom and put a heavy strain on people.
Popie originally operated by 3 steps: (a) User selects one of the basic 8 directions. (b) User chooses either to move right or left relatively or go to step (c). (c) User returns back to the rest area. If the user wants to enter the word "Gakusei", he should select appropriate constants characters which are KKSA, then select the word from the candidate words. Figure 1 shows original directions to enter the word "Gakusei" showed by arrows.

3. 3D accelerometer

Now days embedded accelerometers can be found in many devices, like PDA, cellular phones and other devices [3]. Using 3D accelerometers can be very useful to capture objects movements and also sense the orientation of movement by measuring the static accelerometer value that is applied over the x,y,z axis when users tilt the sensor.

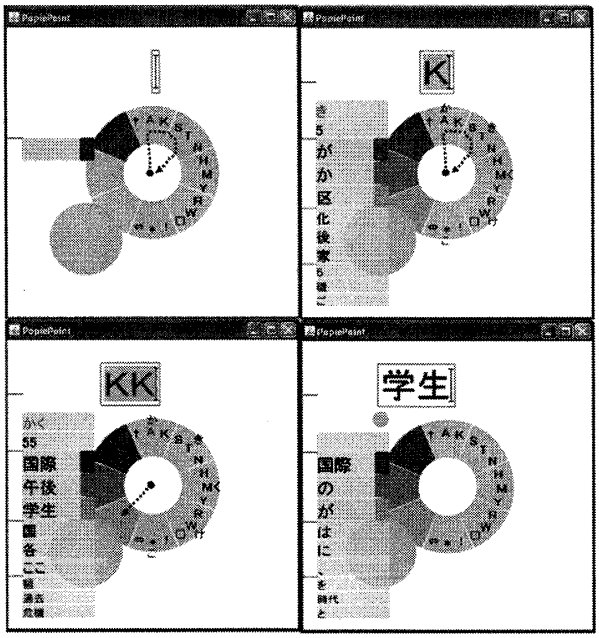

Figure 1, Original directions to enter the word "Gakusei" showed by arrows.

In our research we used a coin size small sensor that can be attached easily to various objects. Figure 2 a) shows the 3D accelerometer sensor and its corresponding axis. The sensor has a built-in 3D accelerometer, angular rotation rate sensor and temperature sensor. The embedded 3D accelerometer can sense up to ±2g, ±4g, 200 Hz.

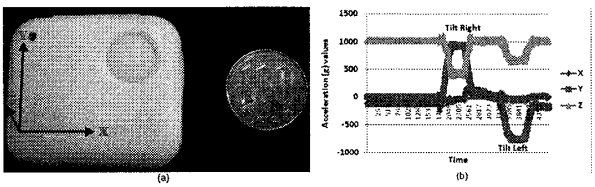

Figure 2, (a) 3D accelerometer sensor and its corresponding axis. (b) Right and left directions and corresponding x,y,z (g) values.

The sensor sends data as a pattern of signals that represent the tilt of the sensor. When the user tilts the 3D accelerometer sensor in any direction, the acceleration magnitude is loaded on the axis of doing the motion plus gravity value. Figure 2 (b) shows

tilting 3D accelerometer in the right and left directions and corresponding x,y,z (g) values.

4. Evaluation

It is required to measure two main features for Popie interaction. First, the speed of interaction in means of time to enter sequence of characters with Popie. Second, the recognition error rate. We name those directions as S0, ... ,S7 respectively. S8 is used as a selector tilt gesture. Figure 3 shows the basic 8 directions and steady selector.

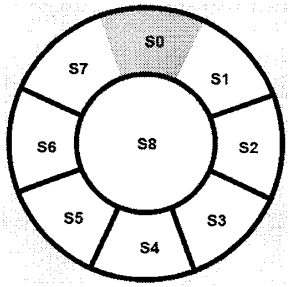

Figure 3, Pie menu with directions

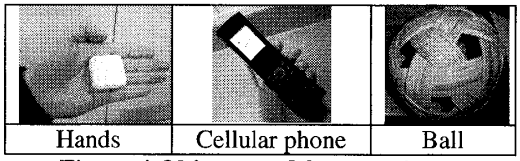

Figure 4 Objects used for experiments

We ask four users to conduct the experiment; they have to use 3 objects with tilting interface (Hands, ball, and Cellular phone). Figure 4 shows objects used in the experiment. We prepared predefined tilt gestures for every object, so user can interact after illustrating to him directions. The subject first asked to enter basic 8 directions from S0 to S7, and then he was asked to test the time to enter sequence of characters with Popie. We ask the user to enter the sentence "I am a student." in Japanese language "watashi wa gakusei desu. 私は学生です。" (7 Japanese characters). To enter this sentence using Popie the user need to enter 18 tilt gestures as follows: (S3, S1, S6, S3, S5, S0, S1, S0, S1, S1, S1, S0, S0, S7, S1, S1, S0 , S7, S7).

5. Results

We measured the accuracy rate for interaction, Subjects found it hard to imagine the directions for interaction while using the cellular phone. Moreover using the hand gestures and trying to enter basic and Popie directions it was very hard for users to hit targets. Subjects say that using hand gestures for interacting with Popie is painful cause we must make big and sharp hand gestures, which is not applicable anytime and make stress over our arms. Using the ball was easy to imagine by users and they can hit the targets with an accuracy of 100% for basic directions and 98% for entering the sentence. Table 1 shows accuracy rate percentage for basic 8 directions and entering text with Popie.

Table 1 Accuracy rate for basic 8 directions and entering text with Popie.

Accuracy Rate	Hands	Ball	Cellular phone	Hand gestures
Basic	97	100	93	91
Popie	99	98	92	81

We measured the time needed for entering basic directions; the ball was the fastest object to enter the 8 basic directions compared to hands and cellular phone. Subjects say that ball was easy for interaction as it has a logical mapping for directions that is intuitive and natural to be used. Table 2 shows the time in minutes, seconds for 8 directions and entering text with Popie. It can be observed that time needed to enter text using tilt interface is almost half the one needed using full hand gestures.

Table 2 Time for 8 directions and entering text with Popie.

Speed in m:ss	Hands	Ball	Cellular phone	Hand gestures
Basic	0:32	0:29	0:40	1:05
Popie	1:31	1:26	1:14	2:27

6. Conclusion and future work

The results show that using the accelerometers for interaction with Popie achieves about 7 characters per minute (cpm). The original Popie can input characters on an average of 12cpm on the first session. Tilt interface could be promising interface for fast and accurate interaction with Popie in situations that needs users to interact remotely with Popie. We need to conduct the eperiments with more number of users so we can get more robust results.

References

[1] Daisuke Sato, Buntarou Shizuki, Motoki Miura, and Jiro Tanaka, "Menu-Selection-Based Japanese Input Method with Consonants for Pen-Based Computers," , 2004, pp. 399-408.

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