

ABSTRACT

Multi-touch devices make user-friendly and intuitive operations possible as technology advances. In some cases, gestural operations are efficient in terms of performance time and error due to simplicity, and intuitiveness. However, the fact that gestural operations may require more attention and effort than single-touch operations limit its application in vehicles. Despite of advantages of gestural operations, specific limitations exist. First, a well-known optical parallax phenomenon may cause touch bias due to the gap between the interaction plane and the image plane. Secondly, at the shoulder height, motion biomechanics results in the least amount of movement errors. The error increases as the hand points away from the body's center. Being both input and output devices simultaneously, multi-touch screens are often not installed in a location where the chance of making errors is minimized. The precision of touch-based operations will be demoted on the unsuitable installation and the influence is expected to be more pronounced on gestural operations than on single-touch ones. The goal of this study is to compare single-touch and gestural operations using car radio and air condition systems as cases.

A simulated driving environment was established to conduct a fundamental experiment where multi-touch interfaces were compared with single-touch interfaces. Three different installations of a multi-touch screen in the vehicle at high, middle, and low positions were tested in the simulated car cabin. Both objective and subjective assessments were also conducted. Users' effectiveness and efficiency were measured. Meanwhile, user satisfaction and perceived ease of use were reported using the Device Assessment Questionnaire (DAQ) along with an interview to collect the participants' subjective responses.

Based on the experimental results, the participants' performance in terms of accuracy was better with the single-touch operation in the low installation. On the other hand, the subjective results showed that the single touch operation in the middle installation was preferred. Then, the gesture operation in the high installation was the most difficult and fatiguing operation. Finally, the gesture operation was more intuitive than the single touch operation. Therefore, there is potential for the gesture operation to become a better choice for operating In-Vehicle Information System (IVIS) if its implementation can be improved.

Keywords: touchscreen, gesture, interface design, in-vehicle information system.

INTISARI

Perangkat multi-sentuh memungkinkan pengoperasian yang mudah digunakan dan intuitif seiring kemajuan teknologi. Dalam beberapa kasus, operasi gestural (multi-sentuh) efisien dalam hal waktu kinerja dan kesalahan karena kesederhanaan, dan intuitif. Namun, fakta bahwa operasi gestur mungkin memerlukan lebih banyak perhatian dan usaha daripada operasi satu sentuhan membatasi penerapannya di kendaraan. Terlepas dari keuntungan operasi gestural, ada batasan khusus. Pertama, fenomena *optical parallax* dapat menyebabkan bias sentuhan karena adanya gap antara bidang interaksi dan bidang gambar. Kedua, pada ketinggian bahu, biomekanik gerakan menghasilkan kesalahan gerakan yang paling sedikit. Kesalahan meningkat saat tangan menunjuk menjauh dari pusat tubuh. Menjadi perangkat input dan output secara bersamaan, layar multi-sentuh sering tidak dipasang di lokasi di mana kemungkinan kesalahan diminimalkan. Ketepatan operasi berbasis sentuhan akan menurun pada instalasi yang tidak sesuai dan pengaruhnya diharapkan lebih menonjol pada operasi gestur daripada pada operasi satu sentuhan. Tujuan dari penelitian ini adalah untuk membandingkan operasi satu sentuhan dan gestural menggunakan radio mobil dan sistem kondisi udara sebagai kasus.

Lingkungan mengemudi yang disimulasikan dibuat untuk melakukan eksperimen mendasar di mana antarmuka multi-sentuh dibandingkan dengan antarmuka satu-sentuh. Tiga pemasangan layar multi-sentuh yang berbeda di kendaraan pada posisi tinggi, menengah, dan rendah diuji di kabin mobil yang disimulasikan. Baik penilaian objektif dan subjektif juga dilakukan. Efektivitas dan efisiensi pengguna diukur. Sementara itu, kepuasan pengguna dan persepsi kemudahan penggunaan dilaporkan menggunakan Device Assessment Questionnaire (DAQ) bersama dengan wawancara untuk mengumpulkan tanggapan subjektif peserta.

Berdasarkan hasil eksperimen, kinerja peserta dalam hal akurasi lebih baik dengan operasi satu sentuhan di low installation. Di sisi lain, hasil subjektif menunjukkan bahwa operasi satu sentuhan di low installation lebih disukai. Kemudian, operasi gesture di high installation adalah operasi yang paling sulit dan melelahkan. Akhirnya, operasi gestural lebih intuitif daripada operasi satu sentuhan. Oleh karena itu, ada potensi operasi gesture menjadi pilihan yang lebih baik untuk pengoperasian dengan melakukan pengembangan pada interface yang digunakan.

Kata kunci: layer sentuh, gestural, interface design, in-vehicle information system