

博 士 学 位 論 文

Doctoral Thesis

内容の要旨

及び

審査結果の要旨

Thesis Abstracts

and

Summaries of the Thesis Review Results

第17号

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はしがき

博士の学位を授与したので、学位規則(昭和28年4月1日 文部省令第9号)第8条の規定に基づき、その論文の内容の要旨及び論文審査の結果の要旨をここに公表する。

学位記番号に付した「甲」は学位規則第4条第1項(いわゆる課程博士)によるものであることを示す。

Preface

On granting the Doctoral Degree to the individuals mentioned below, abstracts of their theses and the theses review results are herewith publicly announced, in according to the provisions provided for in Article 8 of the Ruling of Degrees (Ministry Of Education Ordinance No.9, enacted on April 1, 1953)

The Chinese character, “甲”, at the beginning of the diploma number represents that an individual has been granted the degree in accordance with the provisions provided for in Paragraph 4-1 of the Ruling Of Degrees (what in called “Katei Hakase,” or the Doctoral Degree granted by the University at which the grantee was enrolled.)

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Thesis Title 論文題目	Style-Preserving Handwritten Character Synthesis 個人性を反映する筆記体文字生成
Thesis Review Committee Members 論文審査委員	University of Aizu, Associate Prof. Jungpil Shin (Chief Referee) University of Aizu, Prof. Qiangfu Zhao University of Aizu, Associate Prof. Jie Huang University of Aizu, Prof. Minetada Osano 会津大学上級准教授 慎 重弼 会津大学教授 趙 強福 会津大学上級准教授 黄 捷 会津大学教授 小佐野 峰忠

Style-Preserving Handwritten Character Synthesis

Thesis Abstract

Synthesizing handwritten-style characters is an interesting issue in today's handwriting analysis field. The purpose of this study is to artificially generate training data, foster a deep understanding of human handwriting, and promote the use of the handwritten-style computer fonts, in which the individuality or variety of the synthesized characters is considered important. Research considering such two properties together, however, are very rare. In this paper, a handwriting model is proposed to synthesize various handwritten characters while preserving the writer's individuality from a limited number of training data, using a statistical approach. To support the model, two limitations of conventional dynamic time warping techniques are presented and their solutions are discussed: one of the limitations is that aligning corresponding points is not available for more than two handwritten characters, the other is that unintended matching occurs frequently when DTW is used for online handwritten characters. The proposed model is verified in single- and multiple-stroke characters, such as Arabic numbers, lowercase English letters, and Japanese Kanji letters. Synthesized characters are evaluated in three ways. First, they are analyzed visually using the selected samples, and the relationship between the training and synthesized characters is explained. Second, the personalities and varieties of all the data are evaluated using a conventional writer verification method. Third, a questionnaire is developed and administered to evaluate the subjective responses of the users regarding the personal styles of the synthesized characters. The results prove that the proposed model stably synthesizes personalized characters by being invariant to the number of training data, whereas the variety increases gradually as the data increase.

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Interaction Methods for Recording and Recollecting Personal Experiences

Thesis Abstract

The aim of this study is to solve several technical and usability issues arising in “life logging,” the recording of a person’s life through wearable and ubiquitous computing technologies. Three personal informatics applications have been developed and are presented here. Smartphones and networked portable computers as ubiquitous and powerful communication devices are used as the main tool for data collection, prototyping, and experimentation. Special consideration has been given to build systems that are practical for memory archiving, i.e. can be used throughout the day comfortably and continuously. First, a system that recognizes and records the physical activities of a person is introduced. Data from wearable motion sensors is collected by a mobile application that classifies pretrained gestures in real-time using feed-forward neural networks. The system is tested both for its accuracy and recall capabilities using the *F1-measure*. Results show high recognition rates for distinguishing among six different motion patterns. Various applications are considered that can benefit from the recognized activity. Second, a social media capture tool is presented. Significant events are detected based on a subject’s emotional arousal level measured by changes in heart rate and statistical analysis of heart rate variation using a wireless heart rate monitor. The system uses peer-to-peer networking among a group of people, where a collectively significant event triggers a broadcast event to capture and record media. This collaborative capture works as a mirror that reflects one’s significant moments as perceived by one’s peers, introducing a previously unexplored approach to life logging. An initial usability experiment shows the performance of the system in a practical scenario. Finally, a semi-passive photo reviewing tool for consolidating memories of experiences utilizing personal photo libraries provides a technique for human memory augmentation. A form of spaced repetition algorithm is used to create visual journeys which link photos together around a user-chosen central theme. Systematically reviewing images from positive personal experiences can be useful to remember significant events, as well as to balance out stressful events in our lives. Spaced repetition systems have been used in fact learning, but it is the first time they are presented in life logging applications. An online study has been carried out that confirms the effectiveness of the proposed system.

Keywords: personal informatics, mobile computing, reality mining, social multimedia computing, activity recognition, on-body sensing, HCI systems

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Thesis Review Committee Members 論文審査委員	University of Aizu, Prof. Daming Wei (Chief Referee) University of Aizu, Prof. Ryuichi Oka University of Aizu, Prof. Qiangfu Zhao University of Aizu, Associate Prof. Wenxi Chen 会津大学教授 魏 大名 会津大学教授 岡 隆一 会津大学教授 趙 強福 会津大学上級准教授 陳 文西

Computer Algorithms for Measurement of QT interval Prolongation in Electrocardiogram

Thesis Abstract

QT interval and the corrected QT interval are pivotal markers of the ventricular repolarization duration (VRD) and have therefore been used for the diagnosis of long QT syndrome (LQTS), short QT syndrome (SQTS), and drug-induced QT prolongation. The manual measurement is time-consuming and vulnerably depends on readers' experience and expertise (even for highly trained cardiologists). Owe to the rapid improvements in computer-assisted automatic ECG diagnostic technique within the last several decades, dozens of methods for measuring the QT interval have been developed. How to select an optimal-automatic technique for QT prolongation measurement is still a critical issue for researchers. A new approach is proposed in this study. The performances of this newly proposed method and several existing methods are evaluated in detail with both artificial and clinical ECGs. Using artificial ECGs gives the following advantages: (i) the location of Q-wave onset and T-wave offset in each cardiac cycle can be specified exactly as the —true || reference; and (ii) the signal-to-noise ratios (SNRs) of the simulated ECGs can be reset to any level by adding artificial noise. A huge number of clinical ECGs are also tested to confirm the dispersion between the automatic annotations of the algorithms and the manual annotations of cardiologists.

In clinical applications, relative and stable change in QT interval is more important than the absolute QT interval measurement in people with normal QT interval. Therefore, to the QT prolongation assessment, this newly proposed approach was tested on a —Thorough QT || (TQT) study in Japan (test with 37 health volunteers in two weeks by taking moxifloxacin and placebo), and compared with existing detection methods. For all the 2 dual-delta QTs, i.e., $\Delta\Delta QT$, $\Delta\Delta QTcB$, $\Delta\Delta QTcF$, $\Delta\Delta QTcE$, we got the mean differences from -1.29 ms to 1.79 ms for all these methods introduced in this study.

Name 氏名	Li, Huakang 李 華康
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Sound Localization for Robot Position Identification and Navigation

Thesis Abstract

Mobile robots in a real-life setting would benefit from being able to localize the target to help track down an interesting event in the environment for humanoid communication. Comparing with the most popular vision system, sound-based localization has advantages in poor lighting condition and detecting objects out of visual field. And the auditory system of mobile robots is able to complement and cooperate with vision system. The general problem of sound source localization has been an active area of research for many years, and finds application in most array processing algorithms. One characteristic of small array (distance at most 15 cm) is their emphasis on estimation only azimuth and one target. At the same time, the performance decreases with increasing reverberation.

This dissertation summarizes several contributions to the areas of sound localization for robot position identification and navigation.

A robot self position identification method with visual and sound beacons is introduced for the fast localization. The system uses a LABO-3 robot equipped with a spatial microphone array and a CCD camera in the head for sound and vision detection. Wireless network is constructed for data transmission between the mobile robot and PC server for the transmission of detected information and steering control messages.

To localize multiple sound sources, we use the arrival time difference with the inter-aural phase difference. Based on the model of precedence effect, arrival temporal disparities obtained from the zero-crossing point are used to calculate time differences and suppress the influence of echo in a reverberant environment. To integrate spatial cues from different microphone pairs, we introduce a mapping method from the correlation between different microphone pairs to a 3D map corresponding with azimuth and elevation of sound sources direction.

To simulate the binocular ears localization system, a system using AIBO robot equipped with two microphones is introduced. Arrival time differences to the microphones are used as localization cues. To overcome the ambiguity of front-back confusion, a three-head position measurement method is proposed. The robot position can be identified by the intersection of circles restricted by the azimuth differences to different loudspeaker pairs. By localizing three or four loudspeakers as sound beacons setup on known locations, the robot identifies self position in the horizontal plane. Finally, a mobile robot navigation system which can complete the navigation task in a wide range of in-door environment is introduced. With the sound direction detection and sonar obstacle avoiding approach, the robot moves towards the target.

With the increasing of distance, the accuracy of sound localization decrease, and several beacons are required to estimate the position.

Therefore, we propose a specially designed sound-visual landmark to identify self-position. First, the robot localizes the direction of sound beacon. Consider the obstacles, the landmark

is high mounted. Thus, the adjusting pre-measure ATDs are proposed to reducing the errors caused by the elevation of sound beacons. Then, the robot turns the camera to the specially designed sound-visual landmark with the visual detection. We use the double edge detection approach to eliminate interference from the environmental noise. As the camera is a mechanical movable assembly, we controls the camera to obtain the center matching image by the stepwise approach to reduce the image distortion caused by positioning error.

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Two-dimensional Algorithms for Pixel-wise Matching of Images and Their Applications

Thesis Abstract

Recognition and retrieval of patterns such as audio, image and video information are very important for computers that are expected to recognize the world automatically.

The basis of information retrieval and pattern recognition is to segment objects and match each pattern found. The category of methods called spotting can solve pattern matching and object segmentation simultaneously, but they have limits for multidimensional queries. We propose two-dimensional spotting algorithms for recognition and retrieval of patterns with faster implementations. Previous work for this method, called 2D continuous dynamic programming (2DCDP), was presented by Nishimura et al. in 1997, and our proposal extends their work utilizing the relationships of 2D alignment. We also explain how to reduce calculation and memory cost and parallel implementation. The experimental results show that the proposed method can precisely match more than 95% of nonlinearly deformed test data, and it can be applied in many applications that require information retrieval and pattern recognition.

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Effective Methods for Composition of Contexts to Provide Situation-aware Services

Thesis Abstract

One of the most important research topics in pervasive computing is context-aware services, which provide a user personalized services adapted to the user's context, such as current location and time, properties and favorites of the user, and available facilities or information around the user, etc.

Situation awareness is a particular kind of context awareness, where the user situation is described in more detail by combination of sensor data with spatialtemporal information. Representing, detecting, and managing the contexts/situations are some important issues in context/situation-aware systems.

Composition of contexts is a useful method for these works, since it can detect a context by automatically composing small pieces of information to discover service.

However when applying the existing composition methods to current context/situation-aware services, they show the following shortcomings that (1) there is no explicit method for representing composition of multi-user' contexts and multi composeable smart objects, (2) there is no flexible reasoning mechanism based on similarity of contexts, so that they can just provide services exactly following the predefined context reasoning rules, and (3) there are some problems in the current conflict resolutions, i.e. the current priority based resolutions are static and thus not flexible and there is no effective conflict resolution for a numeric action of a smart object, e.g. changing volume of a TV, temperature or brightness of a room.

To solve the above problems, several methods are proposed in the thesis.

(1) A two-stage composition method by using context similarity is proposed for danger-aware systems. The first stage is composition of the useful information to represent the context for a single user. The second stage is composition of multi-users' contexts to provide services by considering the relation of users.

Finally the danger degree of the detected context is computed by using context similarity between the detected context and the predefined context. We implement the system in an indoor ubiquitous environment, and evaluate the system through two experiments with the support of subjects. The experiment results show the method is effective, and the accuracy of danger detection is acceptable to a danger-aware system.

(2) A smart-gate based composition method is proposed to coordinate the work of multiple smart objects and solve conflict problem. The smart gate has uniform interface to communicate with multiple smart objects, and modules to coordinate the work of multiple smart objects and resolve conflict of services.

Moreover, two novel policies are proposed in the smart gate for solving the conflict problem. One is a dynamic user priority based policy. The other is a compromise policy to minimize the required tolerance of users. Finally, we evaluate the proposed method through an experiment. The experiment result shows that the composition method works well and effective for

resolving conflict problem.

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