論文内容の要旨

Abstract of Dissertation

論文題目

A Study on Capture and Retrieval of Life Log by a Wearable System
（ウェアラブルシステムによるライフログの取得と処理）

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Experience is valuable in our life time. Nowadays, many people like to record their experiences by using digital media devices which is more efficient than ordinary writing a diary. We can capture digital media to keep in digital memory directly. In order to record personal experiences effectively, we attempt to create a wearable system to capture our experiences continuously. Due to the development of personal computer and digital media devices, we have implemented the wearable video system to record our experiences from the user's view point. The system is able to capture continuous video contents by a wearable video camera and record environmental contexts including location by GPS receiver, movement by motion sensors and physiological data by body sensors which we called this system as a "life log system".

In this research, we focus on capture and retrieval of personal experiences by a wearable system. We develop a life log system which acts as a personal digital memory for capture and retrieval of personal experiences. The system has two stages including capture and retrieval. In the capture stage, life log data is captured by using the wearable life log system which includes a wearable video camera, a microphone, motion sensors, a GPS receiver and body sensors. We apply these wearable sensors to record some useful features for processing in the retrieval stage.

In the experiments, the wearable system has been used to capture our experiences in daily life for more than two years. The system is used in various situations such as working, shopping, meeting, traveling, dinning, etc. We could find many interesting parts of our experiences from the life log video. Video data is recorded in MPEG format that its capacity is about 1 GB/hour. Totally, we record the video data almost 500 GB and keep them in a server. In real life, it takes a long time and it is almost impossible to watch all these video experiences. Thus we attempt to find the efficient retrieval techniques to recall these experiences from life log video.

In the retrieval stage, we develop the video retrieval and navigation system to extract the key events from the life log video. Since the life log video is recorded continuously and has no shot or scene as other structured videos. We have to consider the practical methods to retrieve and navigate the experiences from life log data. User interfaces are designed to help people to recollect some desired events more comfortable than ordinary approach by key frame extraction and indexing techniques as a navigation system. We propose the retrieval techniques based on life log contents and contexts including audio visual and environmental data from wearable sensors. Firstly, we apply GPS data to extract some key events in traveling scenes including spatiotemporal sampling based on distance and time, speed detection and directional change detection. We find that these methods are useful to extract some key events in traveling scenes such as slowing down the speed and changing the direction. However, it has a limitation to use GPS data alone that the signal cannot be received inside the building and some obstructive location. Secondly, audio visual contents from life log video are analyzed to extract the key events with user's voice. It is advantage to acquire some information such as scenes with voice annotation and talking scenes. In the experiments, we assume that talking scene should contain some faces during talking period. We identify the talking scene by a basic face detection based on skin color. Body media armband, including physical and physiological sensors, can examine some physical activities. We also employ the body sensors to analyze physical and physiological data to extract the key events in life log video. The environmental change detection is proposed

by using features from body sensors. Physiological features including heat flux, skin temperature and motion data are analyzed to detect the environmental change. Image processing based on histogram difference is used to ensure the accuracy. This technique is benefit to separate life log video into different environments that we can observe the scenes when user is moving from one place to another place.

To extend the scope of experience representation, we also develop a media integration system to represent personal experiences. The retrieval scheme is flexible to retrieve personal experiences in form of wearable video, ordinary digital video, digital photo, physiological data, and electronic document in hierarchical order. We evaluate the system using subjective and objective evaluation. Each function is evaluated individually to see its efficiency. The overall system is evaluated by comparison with the other system in various aspects.

Additionally, we realize Memex which was predicted by Vannevar Bush in 1945. We demonstrate an integration of our life log system and MyLifeBits system for continuous and discrete recording and retrieval of personal experiences. SenseCam, a passive capture camera is used to capture some parts of experiences. We also apply SenseCam sensor data to index the key frames of life log video. The relationship of life log video and SenseCam image is demonstrated. The system integration shows that our life log platform can gain the advantages for capture and retrieval of personal experiences.