SUMMARY OF Ph.D. DISSERTATION

School Graduate School of Science and Technology	Student Identification Number	SURNAME, First name Kawashima, Hideyuki

Title

Abstract

This dissertation proposes (1) design methodology of a database system for applications that deal with sensor data and (2) an overload resolution technique.

The first proposition of this dissertation is the design of a database system KRAFT that provides high freshness, periodic monitoring, and timeseries processing of sensor data. I have designed KRAFT by considering that sensor data are used to recognize real-world continually. To realize high freshness of sensor data, I propose a Write Ahead-Logging(WAL) technique with a remote memory and an idempotent recovery technique. To solve memory shortage on a remote memory incurred by rapidly incoming log records, I have designed a fast check pointer mechanism and a memory management mechanism. To realize periodic monitoring of sensor data, I have designed a real-time scheduler based on FreeBSD KSE pthread scheduler. To realize time-series processing of sensor data, I have designed an expansion of the relational data model by incorporating an abstract data type that provides similar sequence retrieval operations.

I have evaluated how KRAFT provides high freshness, periodic monitoring and time-series processing of sensor data through experiments. As for high freshness of sensor data, I conducted an experiment with a monitor. Period of the monitor was 1 second and period of sensor data was 10 milli seconds. As a result of experiment, KRAFT could provide sensor data of which freshness is 5 milli seconds. As for periodic monitoring of sensor data, the KRAFT scheduler provides 279 times smaller gap between planned start time and real start time compared with the round robin scheduler. As for time-series processing of sensor data, KRAFT realizes similar sequence retrieval methods with the Euclidian distance and the DTW distance by using a SQL based language.

The second proposition of this dissertation is a light and imprecise WAL processing of sensor data to reduce load of a database system. By executing light and imprecise WAL processing with sensor data that are not read by periodic monitoring, this technique reduces heavy load. This approach has not been studied by any existing related work.

On a dedicated experiment system, the proposed method demonstrates 32 % better freshness of sensor data compared with remote memory WAL technique of which protocol is TCP.

From the results of experiments, this dissertation concludes that proposed studies have shown (1) design methodology of a database system for applications that deal with sensor data and (2) an overload resolution technique.