FCM: An Automated Flood Crisis Management System

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This research presents our progress of the second phase of City Administration System (CAS) (Rafi and Fazidin, 2001). It covers the terrain generation of Kuala Lumpur's Central Business District about 30km x 30km at 1 meter resolution using the latest stereoscopic satellite data and survey data from Mapping Department of Malaysia's Ministry of Science, Technology and Environment. CAS will be designed to have three main functions, namely: Flood Crisis Management (FCM), Architectural and Town Planning Management, and City Services and Administration. At a 1meter resolution, CAS will be able to predict, manage and visualise flash and major floods within the city with a very high degree of accuracy. It has been identified for CAS that there is a need to share information through collaborative environment in a more centralised manner that allows collective decisions, facilitates continuous updates, communicates effectively and permits the sharing of experiences and ideas.

Keywords: CAS; FCM; collaborative environment; sensor

1. Introduction

The City Administration System (CAS) project is a joint venture between Multimedia University (MMU) and Malaysian Center for Remote Sensing Malaysia (MACRES) and co-sponsored by Silicon Graphics Malaysia, City Hall of Kuala Lumpur and Ministry of Housing & Local Government. CAS is developed in a full three-dimensional (3D) city of Kuala Lumpur using the latest satellite data and geo-referencing the data via GPS (Global Positioning System) to the actual city. This model is used in three primary functions:

• City Administration: A system that allows 3D models to be interactively manipulated (i.e. alphanumeric and graphical data) by both individuals as well as by other team members in a collaborative manner for visualisation and GIS manipulation. (Rafi and Fazidin, 2003).

• New Project Development: A model that integrates remote sensing data with 3D computer models for city simulation purposes.

• Flood Crisis Management: An integrated application for Flood Crisis Management.

The second phase of this research, reports a detail technical finding of the Flood Crisis Management (FCM) System in particular the use of sensors and mobile devices via CAS.

2. Flood Crisis Management (FCM)

Research in Flood Crisis Management has been demonstrated by Srdanovic, Jovanovic and Lekic (1998) using Geographical Information System (GIS) technology known as 'hydroinformatics'. The key behind the system is it provides a natural environment where various collections of data can be managed, analysed and displayed based on the situation. On a similar ground, Fukui (2000) suggests that the need of an earth metaphor that captures vast quantities of geospatial data, and turns them into a multi-resolution, time-based three dimensional representation of the earth in real time is key. In the context of CAS, water level sensors were placed at strategic positions of the river and the emergency division is able to track and monitor the rise of water at different parts of the city in real-time. 3G (third-generation) devices were also associated to update on the latest information via Immersive Collaborative Environment (ICE) to discuss and decide the course of action in a collaborative manner. Highway bulletin boards and radio broadcasts will inform the masses of road cut-offs and diversion in order to avoid the public entering the flood areas. Meanwhile, gates to specific flood drains will be opened either manually or remotely to divert overflow water and monitor for possible blockage. Crisis handling like flood requires a high degree of efficiency in decision making and with CAS, the most important data can be accessed easily and quickly for better understanding of the situation. Haphazard handling of emergency situation can result in higher death toll and unwanted loss of properties.

3. CAS-FCM System Layout

The system layout of CAS-FCM is divided into 3 main parts namely input, process and output. Basically input refers to data sent in via sensors placed at the Klang River (a major contributor to the flood) and some of the big drains (e.g. monsoon drain) in the city. Data input also comes from City Hall officers via mobile devices such as General Packet Radio System (GPRS) hand phones. These officers are stationed in various positions around the city to monitor an impending flood occurrence. All data received from the different sources are then tabulated on several servers positioned close to the sources of input i.e. sensors and GPRS connections. These data is then transferred to a structured database system that consists of Static database, Active database and Dynamic database (Rafi and Fazidin, 2003). Static database refers to fixed items such as length of a drain, type of pavement tiles or name of a road whereas active database changes according to relative changes to other databases linked to it. Example of active database is road closures for a parade. Dynamic database changes over time that normally requires maintenance periodically and can be set as reminders to related division for action.

The sensors for the input system is designed locally taking into account the Klang River characteristics such as average water volume, acidity (PH value) of the water, contaminants in the water and average speed and directional flow of the water. The sensors will be mounted on the river-

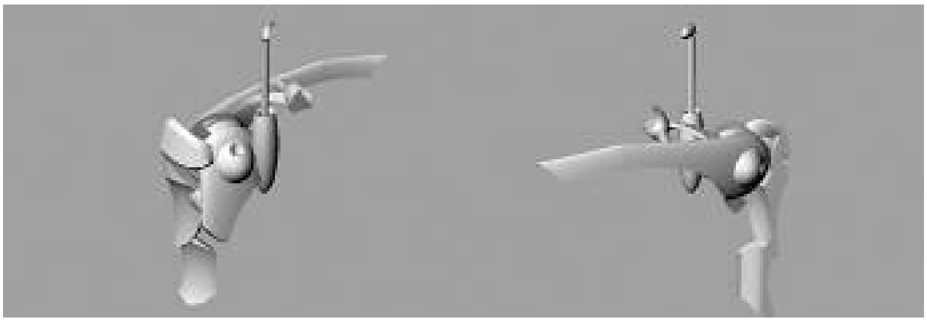

Fig 1: Design of the river sensor to collect data on water level, speed and direction.

bank and designed for minimum of maintenance (figure 1).

The sensors measure water level, speed and direction in real-time and send the data via Wi-Fi system to a vicinity server. The vicinity server also doubles up as a GPRS server receives the data including those fed by the officers on nearby site and then tabulate the data according to the structured database on the central server. One of the sensors is to be erected on the concrete embankment of the river and the other is to be buried into the riverbed at sections of the river without the embankment.

The data is recorded every half a second and transmitted via an improved design of the directional helical antenna to the receiving dish connected to a secondary server in the vicinity (Rafi and Fazidin, 2003). The high-speed wireless network is based on IEEE 802.11b network configuration with transmission radius of 500 meters at 2 Mbit per second transfer rate. From the secondary servers, each handling about 10 sensors, the data is collected on a primary server via the landline of a VPN provided by a local ISP. This expandable broadband network has the capacity of 500Mbit speed and can be encrypted and upgraded to an IPv6 protocol. The primary server is in turn linked to a high-end Virtual Reality system that collates the data from the sensors into 3D real-time and collaborative environment where the City Administrators can visualise, manage and mobilise help to potential areas of flood (figure 2).

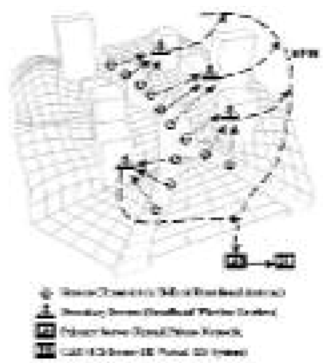

Figure 2: Transmission of data from river to ICE (Rafi and Fazidin, 2003)

4. Conclusion

Our second phase of City Administration System particularly Flood Crisis Management has demonstrated a positive impact to the users namely the city administrator and other professionals to act fast and efficient. The introduction of mobile device connected and updated via the system database enable the city administrator, especially, to identify flooding area ahead of time and to take further measure to alert the general public on the ‘flood spots’ and possible diversion to smoothen the traffic flow. The advantage to database driven information allows current city issues to be analysed for better planning in the future.

5. References

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