A Multi-Agency Collaboration and Coordination Hub (MACCH)

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ABSTRACT

We present an on-going research work in the context of the MACCH project, which primarily focuses on creating geospatial data visualization software for use on collaborative and interactive tabletops or wall displays. This project aims to enhance operations within a mobile command centre used by a local organization in Waterloo called REACT. The mobile command centre acts as a hub, connecting local emergency medical, fire, and police services. We present a general overview of the project, and discuss the interactive display for data visualization in the REACT command centre.

Index Terms: K.6.1 [Management of Computing and Information Systems]: Project and People Management—Life Cycle;

1 INTRODUCTION

Waterloo Regional REACT (REACT) is a volunteer-based emergency services organization, operating continuously since 1972, that has a clear three-part mission: 1) to provide a safety umbrella to participants and members of the public at community-sponsored events; 2) to provide effective and reliable volunteer support to emergency services in times of need; and 3) to provide specialized emergency support equipment and trained volunteer operators to emergency services for use in times of need. REACT is a unique organization that provides an opportunity for the proposed research to have a direct and significant impact on the community in the Regional Municipality of Waterloo, the community-based organizations that REACT supports, and various emergency service agencies such as police, fire, and emergency medical services (EMS).

(a) (b)

Figure 1: (a) REACT's mobile command center (b) Interactive Wall Display

A critical piece of specialized emergency support equipment provided by REACT to support community-sponsored events and regional emergency service operations is the mobile command centre, shown in Figure 1, which acts as a hub for REACT members as they monitor the event, providing assistance and support to the organizers and the public when necessary. A desk in the command centre functions as the communications and dispatch area, allowing a REACT supervisor to communicate with event organizers, emergency service agencies and REACT members in the field as the event progresses. This communication and coordination role is a key function of REACT. In fact, the community-sponsored events supported by REACT have served as the starting point for the proposed research. Since June 2010, the project team has observed over 35 hours of command centre use over seven different community events and has interviewed several key REACT personnel. These data and initial observations have formed the basis for a proposed technological solution.

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The overall objectives of the project can be summarized as follows:

- Study the current collaboration and coordination mechanisms used by REACT and other first response personnel in the REACT command centre and in the field during community events and emergency incidents.
- Develop interactive computing hardware and software user interface technologies to provide command centre personnel with improved access and ability to share dynamically updated situational information.
- Develop novel mobile computing interfaces to provide field personnel with improved access to dynamically updated situational information.
- Develop practical situational awareness and operational effectiveness metrics that measure the impact of providing dynamically updated situation information on: 1) command decision making and multi-agency coordination, and 2) in-field effectiveness.

Overall, our aim is to develop alternative methods of enabling REACT and emergency service personnel to access and share situation information during community events and emergency incidents using new interactive computing technologies. We hypothesize that these technologies will be easier to learn and use, and will facilitate collaboration and coordination through improved information sharing.

2 INTERACTIVE DISPLAY

The first phase of the project is to develop suitable surface computing hardware and software interfaces to support the communication and coordination activities that take place in the communications area of the REACT command centre. Literature that investigates the use of interactive surfaces shows that this type of technology enhances collaboration between users as well as task awareness ([6], [7]). Based on preliminary observations of REACT command centre interactions, as well as contextual inquiry used to analyze the work inside the REACT command centre [3], we determined that a significant portion of event operations (typically 90+% of the time) is coordination activities conducted by command personnel as they communicate with REACT field members. The software interface planned for the first phase of the project, called MACCH 1.0, will enable command personnel to access and share digital mapping information from mapping sources, similar to Google Maps, using an intuitive direct-touch interface. Additionally, the software will 'pull' GPS tracking information from each field member and display it on a vertical interactive interface using visual icons. The use of a vertical display in general makes it easier and more practical to share information [9]. In the REACT project, due to space limitation, a vertical display is more convenient, especially in the cases of more than one commander handling the event or in group meetings. A screenshot of the software interface showing geospatial information is shown in Figure 1 (b). As the command centre is an operational unit that may be called out for emergency incidents at unexpected times, a physical mock-up of its communications area will be built and used to design and test potential hardware and software implementation before they are installed in the command centre. This phase will also involve the development of situation awareness and operational effectiveness metrics.

3 Software Architecture

In this section, we present a simplified version of the software architecture (Figure 2) that will be applied in the MACCH project.

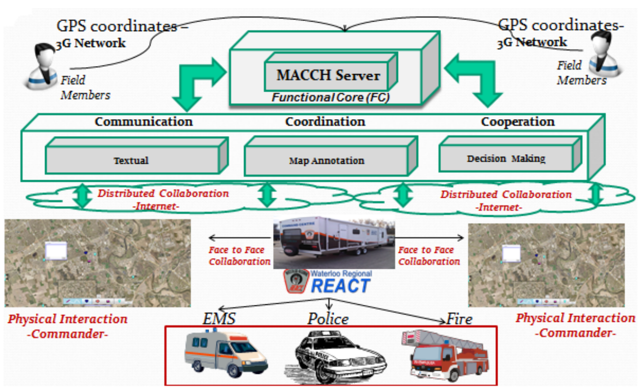

Figure 2: Groupware Architecture for MACCH

We rely on the Arch model [1] that aims to separate the physical interface from the functional core of a system. However, in contrast to the Arch model where the functional core (FC) is a dead-end component (implements static domain functionalities), our FC is connected to the internet in order to receive GPS coordinates from REACT field members. Furthermore, we rely on Dewan's model [4] that structures a groupware system into a variable number of layers, where the highest layer corresponds to the kernel of the system and the lowest layer represents the material level. In this case it is an interactive vertical display on which the mapping software will be installed. We rely on the Clover model [8] that structures the components of the system according to the 3C model defined by Ellis [5], where a groupware has the following structure:

- Communication: Which can be implemented as a simple textual communication between the commander and the field members.
- Coordination: Giving means to the commander to interact with the map on the interactive display by annotating, for example, potential trajectories that field members must perform. This mechanism enhances coordination between REACT members.
- Cooperation: Which is performed by efficient decision making supported by access to the GPS coordinates of field members. In our research, we investigate the impact of providing these GPS coordinates in order to enhance the decision making of REACT commanders in the mobile command centre.

Our choice of the relying on the 3C model to decompose the functionalities offered in our system has many advantages, one of which is the functional breakdown that will result in a greater modularity which reduces the complexity of the system's implementation. For example, it would be easier to add a new service or functionality that offers a video stream mechanism without affecting existing services in the system. Also, the functional core of the software architecture is connected to the internet in order to receive GPS data information stored in a remote database, which constantly updates the information on the display for more efficient tracking of field members. More details about the software architecture can be found in work by [2].

4 Conclusion

The objective of this project is to investigate the suitability of large-format surface computing technologies in the REACT command center, and of providing dynamically updated positioning information to command centre personnel to support collaboration and coordination during community events and emergency incidents involving the REACT command centre. The work presented will help the local emergency based organization in the region to have more effective supervision of community-sponsored event to better ensure the safety of the public. This will be accomplished through supporting faster decision making, and hence a more efficient problem solving. We believe that this work is the first initiative to investigate the use of large interactive displays in the context of community events in the region.

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