Situational awareness and visualization in a cyber environment and a C2 system of dismounted soldiers

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ABSTRACT

This paper presents a work in progress in the field of Situational Awareness (SA). The research areas include cyber warfare and C2 systems of dismounted soldiers complimented with implemented demonstration systems. The level of SA can be measured in different ways in order to gain quantitative data. Visualization of the current situation is the focal point of the research. We used Mica Endsley's theory of SA and methods such as the Situational Awareness Global Assessment Technique (SAGAT) [1] and the System Usability Scale (SUS) [2] to achieve a better understanding of the required level and components of SA. We implemented testing environments for providing a common operational picture for the warriors in cyber and land force situations as well as a system for supervising the state of the critical infrastructure by means of a cyber environment. These environments were tested in training events and the participants presented multiple questionnaires and scenarios in order to measure the effectiveness of the visualization. The demonstration environments were built to support the Joint Directories of Laboratories (JDL) model [3], which correlates well with Mica Endsley's model of SA [4, 5]. The presented demonstration environments were implemented for proof of concept purposes and not for operational use.

1. DISMOUNTED SOLDIERS

A core element in this research is the created Mobile Urban Situational Awareness System (MUSAS) [6-8]. The core function in this system is the created information fusion environment. As in the cyber environment, the land forces C2 system consists of a vast amount of heterogeneous sensors. The produced information must be placed in a common informational model and presented to the user so that it supports SA.

The entire system is closed such that it does not need any external service, and information transfer with the mobile devices is organized by a tactical 5GHz WLAN solution. The MUSAS environment is implemented using only commercial off-the-shelf products [6].

Figures 1 and 2 present the user interfaces of the dismounted soldier as well as the platoon leader's view, which is also used at the company level. The system provides key components of SA to the users, such as symbols on top of a raster or satellite map and the danger situation of different spaces in the vicinity, by using layers and colors. Mission information can also be integrated into the screen. The system is able to support hierarchical presentation of information. This means the possibility of restricting certain components and maps for the users in the field in a dynamic way. If we compare the SA needs of a company commander to a dismounted soldier, the needs will vary dramatically. In the case of the dismounted soldier, the screen might be off and the device operates as a mesh node, whereas the platoon leader needs information on both own and surrounding units as well as the mission status. Currently, the planning for SAGAT tests is ongoing. During the field testing, a short introductory video [9] was created.

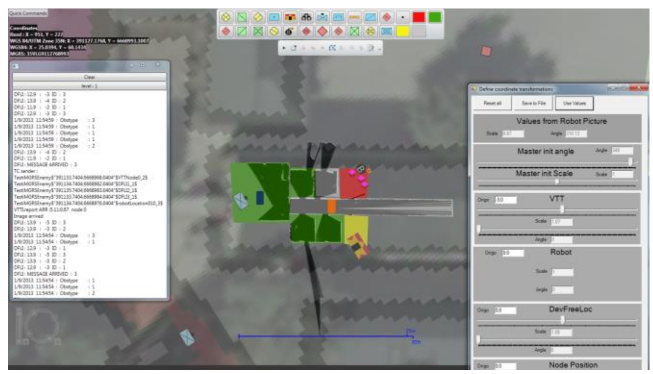

Figure 1 – Platoon leaders' screen

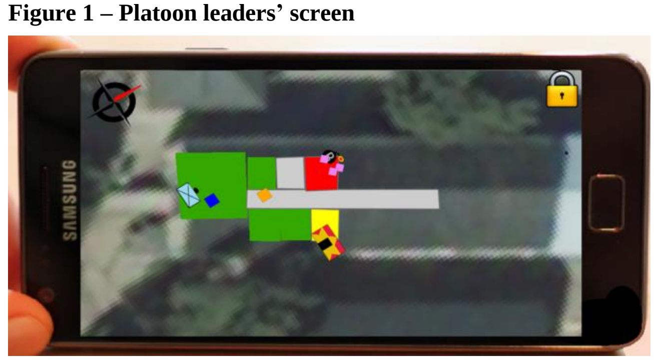

Figure 2 – Warrior's handheld display

2. CRITICAL INFRASTRUCTURE

In the field of SA of critical infrastructure the Situational Awareness of Critical Infrastructure and Networks (SACIN) demonstration environment was implemented [10, 11]. This environment is used to evaluate the concept as well as the testing environment for the SA tests. To date, the SAGAT and SUS have been conducted, but more tests are planned. Figure 3 presents the operator's desk in this environment.

Figure 3 – operator's screens

The critical infrastructure is a complex part of society that consists of multiple sectors and sensors. Although these sectors are usually administered independently, they are functionally interconnected and interdependent. This research examines creating and sharing a common operational picture that involves all the actors as well as the decision-making process and levels of different actors.

3. DIFFERENCES AND CONCLUSIONS

There are multiple practical differences in terms of the environments as well as users. In addition, the education of the target group affects the results. When exploring the results of the SA tests, we must take into consideration the different scenarios of the actors. Even the environment of the cyber warrior is different from that of a dismounted soldier; nevertheless, the main goal is the same effect on the opponent using the right means and according to the rules of engagement. A fundamental need for both actors is a comprehensive SA as this provides the basic information for making the right decisions at the right time. An obvious fact is that the environment can differ (presented in Table 1), but this does not necessarily mean that the block building the SA differs dramatically. By enabling a hierarchically scalable user interface, it is possible to direct the attention of users to important events and reduce stress levels.

Table 1. Differences in environments

	Cyber	**Dismounted**
Threat	Symbolic	Physical
Freedom of action	Based on logical systems and rights	Based on geographic area, location, and mission
Decision making	Only systems under control or operations	Own troops or individual decision
Environment	SA environment	Terrain
Stress	Medium	High

In the cyber environment, the creation of SA is highly focused on various user interfaces provided by the computers or proprietary applications created for this purpose. The difference in traditional warfare is the lack of inputs to multiple senses, which are normally in use; in addition, the stress levels during the action might vary. For this purpose we implemented questionnaires of stress levels, which were filled out by the end users multiple times during the training events.

4. REFERENCES

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