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Abstract. "Remote Context Monitoring of Actions and Behavior in a Location
Through the Usage of a 3D Visualization in Real-time" is a software
application designed to read large amounts of data from a database and use that
data to recreate the context that events occurred to improve understanding of
the data.
Keywords: Multi3D, Visualization, Remote, Monitoring, Panda3D, Real-Time

1. Introduction

This prototype is the result of a long project development made at the Entertainment
Technology Center where work was done in conjunction with NEC and the
Universidad de Monterrey.

The goal of this project is to present huge amounts of data, not parse-able by a single
person and present it in an interactive 3D recreation of the events that the sensors
detected using a 3D rendering engine known as Panda3D.

While there is a lot of work in this field one of the unique angles of this project is the
type of data is designed to build the recreation from. This data is from NEC's

LifeLog system which tracks a wide variety of detailed information on what each employee in the monitored space does daily on a second to second basis.

Additionally, the data can be viewed from anywhere in the world, not just the monitored laboratory.

Fig. 1. Initial 3D shaded model for the Southern laboratory.

3. System Architecture

Our entire system is built on NEC's LifeLog system which is responsible for gathering the large amount of data that is needed for the software to operate. See Figure 4 below for a view of the ceiling with installed sensors.

Fig. 4. Ceiling of the South Laboratory with installed sensors.

Employee location is detected through the use of IR emitters on employees and receivers mounted on the ceiling, though approximately 25% of all location data is "8022" which is the code for a person who is not detected by any IR receiver on the premises. Ambient sound level data is collected by over 90 microphones installed in the ceiling.

All E-mails send to or from monitored employees are also stored, though addressees that are not monitored are stored only as "Company Employee" or "Recipient Outside Company".

Additionally, extensive information is pulled from the computer operations of each monitored employee. Statistics such as key presses, mouse clicks and mouse movements in the past second. Further, they track the currently active process running on the computer and the most recently accessed file. Even all of the currently running processes in the background. Finally they log all of the employee's internet access, though this last piece of information can be disabled by the employee. Finally, each employee has a wireless button that they carry with them that records when it was pressed and if pressed for more than one second, it also reports the duration of the press.

Also, while not related to people, 16 RFID readers are used to track the location of resources (e.g. books, laptops) which have RFID tags on them, as they move around the office. It also tracks which employee is using each particular resource.

The flow of information is quite simple, the LifeLog system polls the sensors for their latest information. It then takes this information, timestamps it and outputs it to a simplified YAML[1] format and stores this information on a server. Out program then connects to the server and requests the files required to view the time the user wishes to view, loads the needed information into memory in python data structures and displays the recreated events to the user.

Due to security restrictions at NEC, the data is only accessible locally or through a Virtual Private Network (VPN) connection. However, since the only remote action that is being performed with the software is reading data from the server, with less strict security measures, the software can function anywhere without the need for any special access permissions.

4. Experimental Results and Conclusion

While the system does use a large concentration of sensors in a small area and is generally very invasive, it does mean there are many promising opportunities for future research to improve on both the technology and software. While not ready for industry yet, with the inclusion of other research as well further improvement of the current software this seems to be a promising technology and may prove to be the next big step in combining multiple different information gathering technologies.

References

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