Wildlife Net-Gamekeepers using Sensor Network

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ABSTRACT
Wildlife lies in vast and wide areas where human gamekeepers work as protectors. The task of recognizing poachers in protected areas is tedious, tiring, and requires huge manpower and computational overhead. A fully automated system cannot accurately identify every such poacher. This paper proposes a conceptual system based on sensor network, which will provide amusement for cyberspace gamekeepers while protecting the wildlife. For this, the sensory data from the park is mapped to a game-like virtual environment. Cyberspace gamekeepers will access the system and play the game. While playing, they will help to conserve the wildlife in national parks by pattern recognition of intruders in the game. The sensor network in the proposed system will use microphone, accelerometers and wireless transmission system.

Categories and Subject Descriptors
K.8.0 [**Personal computing**]: General—Games; C.2.3 [**Computer Systems Organization**]: Computer- Communication Networks—Network operations

General Terms
Management, Design, Experimentation, Security, Human Factors, Performance.

Keywords
Game modification, Network Monitoring, pattern recognition, nature conservation.

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1. INTRODUCTION
Develop consciousness about the loss of biodiversity in national parks is an issue that has been put in the table by most of the countries in the world. Still, recent studies show continuing loss of wildlife. The 2006 Red list of threatened species shows 16,000 plants and animals sliding toward their demise [1]. A threat to the wildlife is poachers, who without any qualms hunt rare or unique species.

National park rangers have been working hard to protect wildlife. It is quite difficult even for the skilled rangers to find sporadically appearing poachers in the vast area that they have to cover. Rangers need help from automated devices to do an even better job.

A system named TrailGuards has been tested in the project Human Detection Sensors for Wildlife and Environmental Law Enforcement Wildland Security [2]. It consists of weatherproof and concealable network sensors that detect metallic objects. The sensor requires a minimum fixed infrastructure to function continuously for ten years without maintenance [3]. On detection of any metal, the sensor sends an alert via wireless network. Since intruders and rangers are the only metal bearing beings in protected parks, rangers can locate poachers. This system cannot detect clever poachers armed only with non-metallic traps to catch animals alive.

A military system called Unattended Ground Sensor [4] has been deployed in battlefields for detecting, classifying and reporting target information. The sensors have very rich capability in signal processing to detect targets. And, they are connected via wireless links to a remote control center where spotters are watching the sensor output to identify targets. It would be a good solution for the poacher detection problem if only it costs much less. The current system consumes much power, money, and officials' effort [5]. It needs something that replaces the power-consuming facility and the human labor.

Video games are a way for expressing interior desires of human beings and video games sometimes reflect how someone wants to model his or her reality. Harrop and Armitage [6] presented a striking idea to transform the network administration tasks against cyber attacks into a first person shooting game. Their system employs the human mind's pattern recognition capability to detect anomalies on the network. The player is rewarded with the fun that the game gives. In that way, the labor of system administrators is transformed into the fun of game players.

Folding@home [7] is another clever idea to collect the voluntary computing power from the personal computers all over the world to solve the difficult problem of finding out new medicine. A vast number of small facilities can solve a big problem.

Those two ideas suggest a promising substitute for the power-consuming facility and the human labor for the protection of wildlife: voluntary gamekeepers from all over the world play the game to hunt intruders. In this paper, a proposal is being presented where people in cyberspace will carry out the task of recognizing and locating intruders in the national park, while they are playing. The game includes pattern recognition tasks of detecting movement of intruders through the national park. It is an automated system in a broad sense where voluntary human computing power is included.

The remainder of the paper is organized as follows: Section 2 introduce a system scenario and the gaming arena is described in Section 3; while rangers panorama is described in Section 4 with an prototyping in Section 5 and finally Section 6 shows the conclusions and future work.

2. DATA CAPTURE

Figure 1 shows a possible scenario of the national park from where data will be captured and used by the system. Sensor nodes are distributed in a national park to detect vibration and sound. Poachers, rangers or natural objects such as animals and leaves may generate an event. In case of any suspected events, nodes record and transmit data via the network. Nodes in the network carry data through the network to the system base station as it is illustrated in the lower half of Fig. 2.

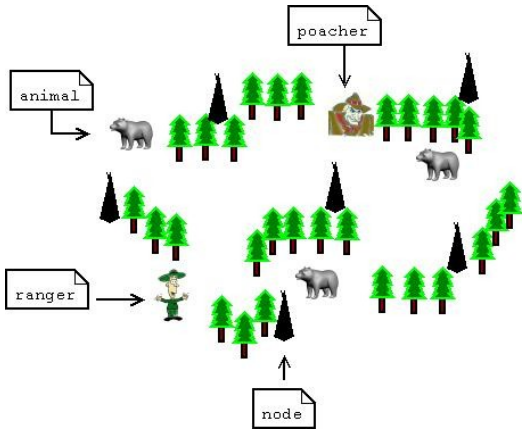

Figure 1. National park scenario

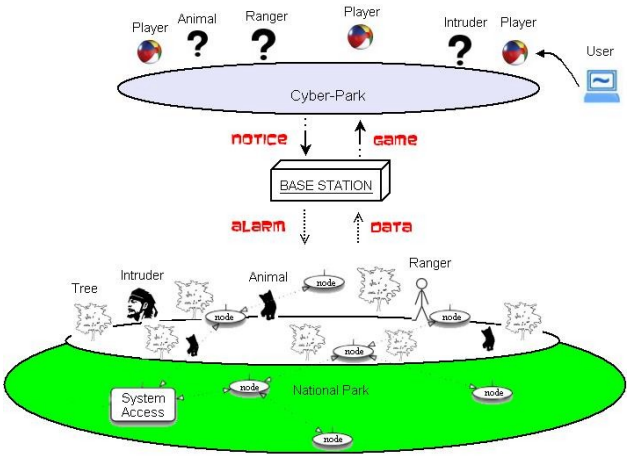

Figure 2. Overall system design

The base station processes data sent by nodes and transmits data to online gamekeepers as a means of gaming environment.

3. GAMING ARENA

A gaming arena is proposed, where recognizing and locating intruders protects the national park.

Players represent gamekeepers in the cyberspace. They continuously wait for warnings from the system or they just pick a suspended node. The system in the base station sends a warning message if movement has being detected by a sensor node. Each node is displayed on the map allowing players to see the location of friend or foe (poacher), see Fig. 3. The map eases poacher detection. Gamekeepers will not only depend on the warning for the movement detection by the system. Also, they listen to sound generated from the national park in real park, as the sound may not be recognized through movement detection. They just need to choose a node (see "choose mote" in Fig. 3) and then, they will start tracking intruders in the neighborhood of the node.

To avoid the game to become too boring it is spiced up with computer-generated events, as intruders will not always be at the protected area. The system creates computer-generated intruder sound randomly and mixes it with the audio signal captured from the national park. If the player (gamekeeper) detects an intruder, the player clicks the poacher button (see reddish pink button in Fig. 3). Gamekeepers get a reward (points) for the detection of intruders when they spot a poacher. At the same time, the system eventually sends an alarm to rangers. A computer-generated intruder does not trigger an alarm to rangers. However, detecting a real intruder (poacher) based on sound and/or movement trace will reward the gamekeepers double than detecting computer-generated intruder. Remember that, a user can choose any node in the network for surveillance purpose (see Fig. 3). After players get a warning about intruders presence detected by the system, they can choose either it certainly is a poacher or it is a false alarm. In case of false alarm, they click false alarm button (blue button in Fig. 3).

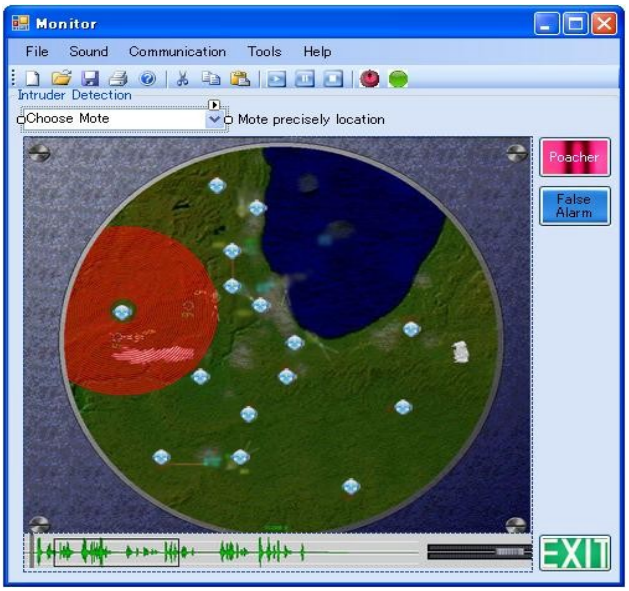

Figure 3. A mock-up snapshot showing captured sound and the sensor network distribution for the cyberspace gamekeepers

4. RANGERS PANORAMA

The scarcity of park rangers makes them a precious human labor resource. Rangers who work with this system will be alerted of intruders, tourist or other rangers being in the park from the base station. Rangers will be equipped with mobile stations moving around the park for control and maintenance. Because rangers at the base station have the ranger patrol schedule, they can ignore some intruder alerts when they know a colleague is there.

5. PROTOTYPING

Data capture is crucial for a real implementation of the system. By taking a standard network programming the rest of the modules in the system are implemented. Network nodes will use a multi-hop communication for sending data to the nearest sensor node and to another, and eventually to the base station.

For node sensing device, the system employs LIS3LV02DQ (included in Fig. 4) from ST Micro. It has a 3-axis linear accelerometer; an interrupt threshold can be set and used to awaken the sensor from power down. This feature permits to save energy. LIS3LV02DQ includes direction detection and the accelerometer is quite sensitive.

Figure 4. Sensing node device

Figure 5. Access point

The receiver uses a PIC18F2X1X/4X1X chip (inside the box in Fig. 5) with different oscillator options, allowing users a wide range of choices in developing application.

A prototype in a small-scale experiment is on the way to be implemented in Ibaraki University, Japan.

6. CONCLUSION

This paper presented a conceptual proposal to protect the wildlife in the national parks around the world by exploiting the leisure time of cyberspace gamekeepers. It also looks at technical details, requirements, architecture to overcome possible issues and future developments.

7. ACKNOWLEDGMENTS

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8. REFERENCES

[1] R. Black, “World 'needs new wildlife body”’(PDF), July 20th, 2006, Environment correspondent, BBC News, Retrieved April 16th, 2007, from www.ieb-chile.cl/pdf/BBC%20News%20200706.pdf.

[2] S. Gulick, Wildland Security, April 2007, New York, College of Environmental Sciences and Forestry, Retrieved April 16th, 2007, from http://wildlandsecurity.org.

[3] Zeeya Merali. “Invented for the military, used to defend wildlife”, December 8th 2006, New Scientist, technology section, issue 2581, page 30-31.

[4] J. Pike, Unattended Ground Sensors (UGS), April 24th 2005, GlobalSecurity.org, Retrieved April 16, 2007, from http://www.globalsecurity.org/military/systems/ground/ugs.htm.

[5] T. Bruns, R. O'Connell, Jeffrey Wells and M. Dapper, “Unattended Ground Sensor Systems for Homeland Defense”, Nova Engineering Inc., 2003, Cincinnati, USA, P. 5.

[6] W. Harrop, G. Armitage, “Modifying first person shooter games to perform real time network monitoring and control tasks”, in NetGames 2006 2006 and 5th workshop of network and system support for Games 2006, Singapore, October 30-31, 2006.

[7] S. Larson, C. Snow, M. Shirts, “Folding@Home and Genome@Home: Using distributed computing to tackle previously intractable problems in computational biology”, Computational Genomics 2002, Richard Grant, Ed. Horizon Press.