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Team Leader System Description

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Richland, Washington 99352

Team Leader System Description

Introduction

The purpose of the Team Leader project is to design, develop, and demonstrate an advanced, prototype computer system to support on-site inspections. This system is a highly portable field computer with on-line access to facilities information, real-time communications, positioning information, and an electronic notebook for data capture. The Team Leader System provides an inspection team with a suite of advanced communication, data gathering, and data analysis tools and can be implemented on many PC-based hardware platforms. Two implementations of Team Leader are the Team Leader Suitcase Unit (Figure 1) and the Team Leader Personal Unit (Figure 2). The Team Leader Suitcase Unit is a transportable system for on-site support in a vehicle or at a stationary location at an inspection site; the Team Leader Personal Unit is a wearable computer for in-facility or on-foot inspections. All implementations of Team Leader have the same basic functionality with unique capabilities based upon inspection needs. This is a collaborative Pacific Northwest National Laboratory¹ (PNNL) - Remote Sensing Laboratory (RSL) research effort and involves direct participation of private industry.

I. System Design

The Team Leader System is of modular design to accommodate user customization and future technology enhancements. Specifically, the modular design permits future hardware and software innovations to be easily incorporated in the system. The Team Leader system has been implemented on IBM-compatible computers running the Windows 95 operating system.

I.A Hardware Specifications

Important hardware specifications are:

- Rugged design and ease of maintenance
- Support for industrial standards
- Lightweight
- Expandable
- Portable with a long battery life
- High quality graphics display capabilities
- Support a wide variety of off-the-shelf hardware and software
- Reliable

The Team Leader Suitcase Unit is implemented on a standard laptop computer and can be housed inside a RSL-developed suitcase. This suitcase houses the computer and peripheral hardware for communication, positional information (GPS), and data capture. The Team Leader Suitcase Unit has exterior connectors for serial communication ports (RS-232) to allow easier integration of peripheral devices, such as sensors, into the system. In addition, the suitcase unit has a internal battery which can be charged by solar panels, car battery jack, or a 12 volt DC battery charger. Depending on mission requirements, the suitcase can also hold additional support hardware such as a portable printer or photographic scanner/digitizer.

The Team Leader Personal Unit is implemented on a state-of-the-art miniature wearable computer called the Mobile AssistantTM which was acquired at a reduced cost through a

¹ Pacific Northwest National Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under contract DE-AC06-76RLO 1830.

Figure 1: Team Leader Suitcase Unit

Figure 2: Team Leader Personal Unit

memorandum of understanding (MOU) with Xybernaut Corporation (formerly Tech International, Inc.). This computer is worn on a belt, along with peripheral data collection hardware and wireless communication. In addition, the personnel unit uses a miniaturized "heads-up" VGA binocular monochrome screen for display and has an integrated video camera.

PNNL experimented with a state-of-the-art high-luminance display touch-screen Pentium computer as a Team Leader hardware platform. Notebook computers have limited utility in full daylight because their display screens become unreadable. The new computer would allow an inspector to use Team Leader in bright sunlight using a pen as the interface to the computer instead of a mouse in a manner similar to using a clipboard.

Basic hardware components on Team Leader computers are Global Positioning Systems (GPS), PCMCIA cards, radio modems, and voice recording hardware. Peripheral devices that can be attached based on inspection needs are color digital cameras, miniature video cameras, bar code readers, and a variety of environmental and radiological sensors.

I.B Software Specifications

Specification for the software running on the Team Leader System are:

- Support for industrial standards
- Multi-tasking
- Ease of use
- Commercial off-the-self (COTS) software compatibility
- Good development platform
- Reliable
- Graphics support

The Team Leader System is composed of PNNL-developed software integrated with commercial software. The core of the system is ArcView which is a commercial software program that is highly customizable. The customized ArcView software provides high-level access to Geographic Information System (GIS) functions, extensive spatial databases, and sophisticated display capabilities. ArcView communicates with PNNL-developed software modules to control data capture by peripheral hardware and communications between other Team Leader systems. Where feasible, COTS software was used to integrate peripheral hardware and enhance the capabilities of the system. One of the key features of Team Leader is a custom designed user interface for simple and intuitive operation (Figure 3).

II. Functionality

Two primary types of functionality addressed by the Team Leader System are: field and reporting functionality. The Team Leader System allows inspection teams to use one system to perform the primary tasks of gathering and analyzing information in the field, communicating, and creating reports that document their findings. The development of the Team Leader System focused on the creation of the field functionality because much of the reporting functionality was available through commercial products.

II.A Field Functionality

Data Communications

With the Team Leader System, an inspection team can communicate with other field inspection teams and automatically send and receive newly collected digital information with those teams. As individual teams acquire data, the information about that data is transmitted to other Team Leader

Figure 3: Team Leader User Interface

systems with-in the Team Leader network, remote users can then request that data for further review. In addition to data communications, the Team Leader network supports both voice and video conferencing.

Desired features for the Team Leader communication system include: burst communications (only communicating when desired), secure communication, up to eight teams, voice capture, video capture, remote unmanned units (smart sensors), good range, miniature, reliable, fast, and not affected by environmental factors such as buildings. All of these features do not exist on any commercially available system. Wireless LANs (Local Area Networks) provide a great deal of functionality and extremely fast communication rates but have limited extent and ability to operate through buildings. Point-to-Point radio systems can operate over large distances but do not easily allow for communication between multiple teams at desirable communication rates.

To increase the flexibility and take advantage of the best communications mode available for a given situation, PNNL has developed the Team Leader Network, which has a standardized communications protocol and device drivers for different communications devices. This socket communications protocol allows the Team Leader system to communicate by: 1) Wireless Ethernet based LANs, 2) direct Ethernet connections, 3) both telephone and cellular modems, 4) direct serial connections, and 5) point-to-point radio modems. Currently the Team Leader Network has been implemented on two wireless spread spectrum devices: 1) a FreeWave wireless data transceiver for serial communication over long distances at a limited band width (10 Miles @ 9800 to 110 Kbaud), and 2) BreezeNet for Ethernet communications over limited distances at high band width (1/2 Mile @ 1-3 Mbits/second). Both the Ethernet based and serial communication

based components of the Team Leader Network allow sharing of data between Team Leader systems, however, the Ethernet based system also include voice and video conferencing.

Geo-Positioning

The Team Leader System collects real-time geo-positional information during an on-site inspection. An inspection team's location can be displayed on a reference map in real-time and, if desired, the location of remote inspection teams can be displayed. Inspection paths, along with date and time stamps, can be stored for later access. Dead reckoning systems that could provide locational information inside buildings, were not yet sufficiently developed to incorporate into the Team Leader System.

Data Management

The prototype Team Leader System stores and manages comprehensive inspection data sets and associated ancillary information. Data sets can include geo-positionally, rectified and registered air-photo and satellite images, geo-positionally registered rasterized maps, previous inspection paths, digital land cover features (such as buildings, roads, lakes), and a wide variety of ancillary information on the digital features (such as informational text files, photographs, sound clips or notes, and short video clips). RSL added the capability to automatically attach sensor data to a inspection team's position and sound an alarm if detection levels exceed a specified value. Data on the system can include reference materials, such as treaty information, inspection protocols, and digital copies of inspection report forms. CD-ROM technology can be used to store reference material and large photographic images. Users can access and add to the database easily.

Ancillary data collection has been automated to allow inspectors to attach data to digital land cover features, to a position selected on the map, or to the inspector's current position. Inspectors can collect digital data by using a variety of digital data collection hardware. File names, directories, and feature names are generated for the user to reduce the amount of data input required from the inspector.

II.B Reporting Functionality

The reporting functionality of the Team Leader System allows the inspection teams to perform pre- and post-inspection reporting requirements. Tasks that can be performed with the Team Leader System include preparing inspection plans, creating reports and memos, completing required forms, printing blank forms for distribution, and creating expense and other business reports. Important remote communication capabilities, such as accessing remote computers, fax, and email, can be accessed through the Team Leader System. The inspection teams can review data collection efforts, review historical missions, and plan current missions based on newly gathered information. Maps and paper documents can be added into the Team Leader database, if the required peripherals are accessible.

III. Industry Collaboration

The Pacific Northwest Laboratory has completed a letter of understanding with Xybernaut Corporation (formerly Tech International, Inc.). Through this agreement, PNNL will acquire additional hardware from Xybernaut Corporation which will provide Team Leader with enhanced Mobile AssistantTM capabilities. PNNL will provide Xybernaut Corporation with a demonstration application and collaborate on future hardware enhancements to the Mobile AssistantTM.

IV. Technical Presentations and Reports

In June 30, 1994, a paper entitled "PNL and RSL Conceptual Design for Team Leader" was delivered to DOE's Office of Research and Development.

In June 30, 1995, a paper entitled "Prototype Team Leader System Description" was delivered to DOE's Office of Research and Development.

On Sept. 28, 1995, the Team Leader development team presented demonstration of the prototype Team Leader to DOE Headquarters personnel.

On May 23, Betty Evans presented a paper entitled "Team Leader: An ArcView-Based Inspection And Data Collection System" at the Sixteenth Annual Environmental Systems Research Institute, Inc. User Conference. The paper is available on ESRI's world wide web site at: <http://www.esri.com/resources/userconf/proc96/TO50/PAP018/P18.HTM>.

Betty Evans presented a talk on Team Leader at a Wearable Computer workshop in Seattle on August 19. Dr. Tom Lundeen also attended the conference and participated in break-out sessions on technological enhancements for wearable computers.