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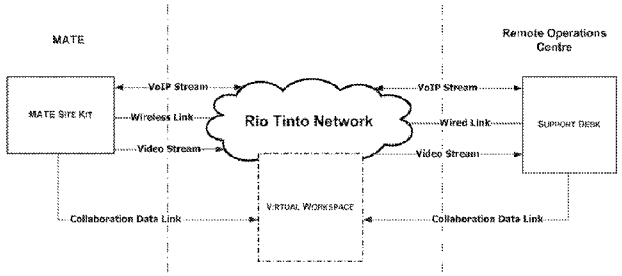


FIG.1

(57) Abstract: A remote assistance system and apparatus to provide technical assistance to mines and a mobile site apparatus that can be used as a part of the system that takes away the pressure to have skilled engineers at each of the mines, and moreover, has the potential to enable more efficient maintenance of plant and equipment at mines than is possible now.

REMOTE ASSISTANCE SYSTEM AND APPARATUS

The present invention relates to a remote assistance system and apparatus.

The present invention relates particularly, although by no means exclusively, to a remote assistance system and apparatus for a mine.

The present invention also relates to a mobile site apparatus for use as a part of a remote assistance system.

The present invention relates particularly, although by no means exclusively, to a mobile site apparatus for use as a part of a remote assistance system for a mine.

The present invention also relates to a method of operating a mine that comprises using a remote assistance system at the mine.

The present invention also relates to a method of operating a mine that comprises using a mobile site apparatus at the mine.

The present invention relates particularly, but not exclusively, to a remote assistance system and apparatus and a mobile site apparatus as a part of that system for carrying out maintenance of plant and equipment at a mine and the following description focuses on this application to a certain extent. It is emphasised that this is not the only possible application for the remote assistance system and apparatus of the present invention and the mobile site apparatus of the present invention.

A related company of the applicant operates a number of iron ore mines in remote locations around the world. Each of these mines includes substantial plant and equipment, such as excavators, haulage trucks, crushers, and conveyors to mine and process mined ore at the mine site prior to transporting the mined ore by train to shipping ports. The plant and equipment requires non-scheduled maintenance as a consequence of breakdowns. Currently, the staff at each mine includes skilled engineers and skilled technicians who carry out maintenance work on the plant and equipment. Down time of plant and equipment, for whatever reason, is a significant issue given the considerable pressure on mines to produce mined ore and the substantial loss of revenue as a result of any downtime. Employing, transporting and housing skilled engineers to work at remote mines are a significant challenge.

The present invention is a remote assistance system and apparatus to facilitate the provision of technical assistance to personnel at mines and a mobile site apparatus that can be used as a part of the system by the personnel at the mine which enables them to be instructed by a skilled person located remotely of the mine site in the provision of maintenance and other technical tasks. This has the potential to enable more efficient maintenance of plant and equipment at mines than is possible now. As indicated above, the present invention, and hence the benefits of the invention described in this paragraph, are not confined to mining applications and extend to a number of other industries, for example where monitoring and maintaining plant and equipment are required on site and involve skilled input.

The remote assistance system and apparatus and the mobile site apparatus of the present invention can

also be used for other applications at mines. The applications include mine planning applications.

The remote assistance system comprises setting up and operating a support centre that services a number of mines and is located away from the mines and staffing the support centre with skilled operators who work with operators at the mines, with each mine site operator having a mobile site apparatus that enables the operator to be in contact with the support centre.

The support centre is set up with support stations in communication with mobile support apparatus via a communications network, such as a Local Area Network (LAN) and/or Wide Area Network (WAN). The support station and the mobile support apparatus facilitate communications between the operators thereof so that the operator of the support station can assist the operator of the mobile support apparatus to perform maintenance or other tasks at a site remote from the support station.

The support centre is set up so that the operators have access to other operators at the centre (and therefore can take advantage of the skills and experience of these operators), a large number of sources of technical information (for example computerised databases and direct telephone or other connections to equipment suppliers). Each mobile site operator is equipped with (a) audio (b) visual, (c) data collaboration and (d) data display capabilities. For example, a mobile mine operator may be equipped with a headset that incorporates audio capabilities. By way of further example, the data display capability may be a screen positioned on the end of an arm extending from the headset at a location to one side of the eyes of the mobile mine operator. The system includes a capability to transfer audio, visual and "projected data", such as image and

video data, between the mobile site operator and the operator at the support centre.

In use, when a need for maintenance is identified, for example at a crusher at a mine site, a mobile mine operator carries out an initial diagnostic evaluation of the problem at the mine site and then, as required, physically inspects and carries out work on the crusher. A data transfer link is established between the mobile site operator and an operator at a support station at the support centre, whereby the support station operator is able to visually inspect the crusher with the mobile site operator via video and image data supplied from the mobile site apparatus. The audio link enables direct communication between the operators as the inspection continues. Depending on the circumstances, the support station operator is able to access information from sources of information available to the operator and to provide technical information to the mobile site operator. By way of example, the support station operator may directly contact equipment suppliers for real-time information. Depending on the circumstances, the support station operator can project (i.e. communicate) data, such as wiring diagrams, from the support desk to the mobile site apparatus so that the mobile site operator can view the data on the screen and carry out maintenance/repair operations on-site.

In the context of the mining application of the present invention, according to the present invention there is provided a remote assistance system for providing technical assistance to mines that comprises a support centre, one of more mines requiring technical assistance from time to time, a communications network link between operators in the support centre and mobile mine operators at sites at the mines at which technical assistance is required, and capabilities to provide the support centre

operators with audio and visual information from the mines via the mobile mine operators at the mine sites, and capabilities to provide the mobile mine operators with data that can be visually displayed to the mobile mine operators and other information aurally to facilitate technical assistance at the mine sites.

The advantages of the present invention include:

- Consolidating knowledge in a single location. The knowledge base at the single location may extend across multiple technical disciplines and provide an opportunity for a higher knowledge base from which to solve problems at a mine.

- Locating the support centre in a population centre where there is not the same difficulty employing and retaining specialist support as is the case with mines in remote locations.

The remote assistance system may be configured so that a support centre operator is the driver of the entire system and as such has access to all the software functionality of the system. In this situation, the mobile mine operators are, in effect, mobile extensions of the capabilities of the support centre operator. In this situation, the computer processing capacity of system apparatus carried by a mobile mine operator may be minimal.

The remote assistance system may comprise bidirectional voice communication, video communication, and data (information) collaboration between an operator at the support centre and a mobile mine operator.

Information collaboration may be achieved by setting up a "remote desktop" type connection. This means

that in any given situation a support centre operator and a mobile mine operator are able to connect to the same common virtual workspace. This workspace may be used to share documents, drawings and any other information required by the operator at the mine.

The remote assistance system may comprise unidirectional information transfer from a support centre operator to a mobile mine operator.

The unidirectional information transfer may comprise a support centre operator selecting a window of a data and image display screen at the support centre and transferring this window to a display screen carried by a mobile mine operator.

The support centre may be configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information. This feature facilitates subsequent analysis of the stored information.

The support centre may be configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information to thereby facilitate selective retrieval and display at the support centre at least the data and/or image signals during subsequent transmission of signals to and receipt of signals from the mobile site apparatus. This feature makes it possible to return to a previous session, for example a session relating to a particular piece of equipment, that could not be completed during the previous session, for example because it was necessary to source a replacement part or access external sources for advice. This feature makes it possible for the support centre operator to quickly review the history of the previous session. This is a particularly useful

feature where different operators are involved in the multiple sessions for the particular action.

According to the present invention there is also provided a support centre configured for communicating with a mobile site apparatus worn by an operator located remotely from the support centre, the support centre being configured for transmitting over a communications network at least voice and data signals to and for receiving over the communications network at least voice, data and image signals from the mobile site apparatus, the support centre being configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information.

The support centre may be configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information to thereby facilitate selective retrieval and display at the support centre at least the data and/or image signals during subsequent transmission of signals to and receipt of signals from the mobile site apparatus.

The support centre may be configured so that the support centre operator is the driver for transmitting and receiving at least the data and/or image signals.

According to the present invention there is also provided a mobile site apparatus worn by an operator located remotely from a support centre, the mobile site apparatus being configured for communicating with the support centre, the mobile site apparatus being configured for transmitting over a communications network voice, data and image signals to the support centre, and the mobile site apparatus being configured for receiving over the

communications network voice, data and image signals to the support centre.

In the wider context of the present invention beyond the mining industry, according to the present invention there is provided a remote assistance system for providing technical assistance that comprises a support centre, one or more sites requiring technical assistance from time to time, a communications network link between operators in the support centre and mobile site operators at sites at which technical assistance is required, and capabilities to provide the support centre operators with audio and visual information from the sites via the mobile site operators at the sites, and capabilities to provide the mobile site operators with data that can be visually displayed to the mobile site operators and other information aurally to facilitate technical assistance at the sites.

The remote assistance system described in the preceding paragraph may comprise the other features of the above-described remote assistance system for providing technical assistance to mines.

According to the present invention there is also provided a mobile site apparatus for a mobile site operator comprising the following components:

(a) a headset;

(b) a processing unit, for example in the form of a wearable computer;

(c) a hand-held camera unit;

(d) a display unit; and

(e) a battery pack.

The apparatus may comprise a backpack that supports at least the processing unit.

The display unit may be connected to the backpack, for example chest straps of the backpack, via a telescopic arm that is hinged at both the backpack and the camera unit to enable translational and rotational movement of the display unit.

The apparatus may comprise an additional fixed camera, which preferably forms part of the headset.

The apparatus may also comprise a laser pointer.

There may be one laser pointer associated with each camera. Each laser pointer may be directed so that the relevant camera will capture a laser dot created when a laser beam from the laser pointer illuminates a physical surface. This enables the mobile site operator to be able to readily indicate areas of interest to the support desk operator though the laser dot and ensures that the support desk operator is viewing the area of interest.

The apparatus may comprise a GPS, which is preferably attached to or incorporated in the processing unit and forms part of the backpack. Through transmission of GPS data the support desk operator is able to identify where the mobile site operator is working, and allows such data to be superimposed on a map viewable by the support desk operator.

According to the present invention there is also provided a method of operating a mine that comprises using the above-described remote assistance system at the mine.

According to the present invention there is also provided a method of operating a mine that comprises using the above-described mobile site apparatus at the mine.

According to the present invention there is also provided a system for providing technical assistance from an operator of a support station to an operator of a mobile support apparatus located remotely of the support station; the system comprising:

the support station and the mobile support apparatus,

the support station and the mobile support apparatus being in communication via a communication network;

the mobile support apparatus comprising wireless communications apparatus for wireless communication of at least voice and image data between the mobile support apparatus and the communications network;

the mobile support apparatus further comprising at least one processor for processing at least voice and image data received from the support station and for displaying at least the image data on a display of the mobile support apparatus and for playing at least the voice data through speakers operatively associated with the mobile support apparatus;

the mobile support apparatus further being adapted to capture voice data from a microphone operatively associated with the mobile support apparatus and to capture still and/or video image data from at least one camera operatively associated with the mobile support apparatus and to transmit the voice, still and/or video image data to the support station; and

the support station being adapted to receive and play the voice data and to receive and display the still and/or image data and to selectively store in response to operator input at least the still and/or video images against any one or more of time, date, location and

session data for subsequent retrieval and display on a display operatively associated with the support station.

The at least one camera may be operatively associated with a light source to indicate to the operator of the mobile support apparatus an area of a surface onto which said camera is focused. The light source may be a laser or alternatively a focused light beam.

The camera may be mounted to a head set of the mobile apparatus whereby an operator of the support station views an image consisting of at least part of a current field of view of an the operator of the mobile support apparatus.

The camera may be mounted in or onto a head set of the mobile support apparatus which plays voice data transmitted from the support station.

The mobile support apparatus may further comprise a hand held camera incorporating a light source, whereby an operator of the mobile support apparatus directs the light source to illiminate a location on a surface for which still and/or video data is to be captured by said camera for transmission to the technical assistance station.

The support station may be adapted to simultaneously display and store still and/or video transmitted by the mobile support apparatus.

A display that may be associated with the mobile support apparatus may be a passive display adapted to only receive data from the support station.

The support station may further comprise an image selection window for selecting an area of a computer

desktop on which the support station is operating and transmitting the image displayed at the selected area to a display of the mobile assistance apparatus.

The selection and transmission of image data from the desktop on which the support station is operating may enable the mobile support apparatus to operate substantially independently of process intensive software applications, such as Computer Aided Drawing (CAD) software packages.

The display of the mobile support apparatus may be adapted for the operator of the mobile support apparatus to zoom in and out of the image data received and to pan and scroll the image data received.

The present invention is described further with reference to the accompanying drawings, of which:

Figure 1 is a diagram that shows the high level connectivity of an embodiment of a remote assistance system of the present invention;

Figures 2-14 are perspective views of an embodiment of a mobile site apparatus (and the separate components of the apparatus) that can be used a s a part of the remote assistance system shown in Figure 1;

Figure 15 is a diagram that illustrates the interconnection of the components of the mobile site apparatus shown in Figures 2-14;

Figure 16 is a diagram that illustrates the WLAN and networking configuration of the remote assistance system shown in Figure 1;

Figure 17 is a diagram that illustrates the software communication for the remote assistance system shown in Figure 1;

Figure 18 is a diagram that illustrates the media site implementation for the remote assistance system shown in Figure 1;

Figures 19-21 are a series of screen shots of a display screen of a support centre operator.

The following description of the embodiments of the remote assistance system and apparatus and the mobile site apparatus shown in the drawings is separated into sections to make the description clearer.

1.1 Overview of the remote assistance system

With reference to Figure 1, the embodiment of the remote assistance system shown in the drawings comprises (a) an apparatus carried by a mobile mine operator at a mine (the apparatus is referred to hereinafter as "the mobile site apparatus" and labelled as "MATE Site Kit" in the Figures) and (b) a support station (hereinafter referred to as "support desk") manned by one or more skilled operators, for example located in a support centre servicing a number of mines at a location remote from the mines, for example in a major population centre several thousand kilometres away from the mine.

It is noted that the remote assistance system may be used in relation to a plurality of mines connected to a single support centre.

It is also noted that one support desk may be connected at different times to a plurality of mobile mine operators, each carrying a mobile site apparatus. With

this arrangement, the single support desk can support multiple remote locations at different times via individual sessions with the mobile mine operators.

Communication between a mobile site apparatus and the support desk is via a local area network (LAN) and a wide area network (WAN).

The remote assistance system has the following functionality between the mobile site apparatus and the support desk:

- Bi-directional voice communication between the mobile mine operator and an operator manning the support desk.
- Video communication between the operators.
- Data (information) collaboration between the operators.
- Mobility (wireless access) for the mobile site apparatus.

Voice and video communication is achieved using a real-time streaming protocol over a User Datagram Protocol (UDP) stream. Typically, video is only transmitted from the mobile site apparatus back to the support desk.

Information collaboration in the remote assistance system is achieved by setting up a "remote desktop" type connection. This means that both sides can connect to the same common virtual workspace. This workspace is used to share documents, drawings and any other information required by the operator at the mine site.

Alternatively, information collaboration may comprise unidirectional transfer of information from the

support desk operator to the mobile mine operator. This may be achieved by the support centre operator selecting a window of a data and image display screen at the support desk and transferring this window to a display screen carried by a mobile mine operator.

1.2 Hardware Design (Mobile Site Apparatus)

With reference to Figures 2-14, one embodiment of the mobile site apparatus comprises a number of discrete components, including:

- A headset.
- A processing unit in the form of a wearable computer.
- A hand-held camera unit.
- A display unit.
- A battery pack.

These components are packaged in lightweight, rugged casings that are worn in a back-pack style.

All major components are housed in anodised aluminium cases with a final system rating of IP67.

The block diagram shown in Figure 15 illustrates the main components of the system and the component interconnections.

1.2.1 Headset

The following components are integrated into the headset:

- Peltor SportTac noise-reducing headphones.
- Microsoft LifeCam NX-6000 video camera.
- A laser pointer.
- Speakers and a microphone.

For safety the laser pointer is designed to be activated from the headset only.

The microphone flap can flip back up to the rest position to protect the camera lens (if the system is not in use) and to provide privacy for the headset wearer.

1.2.2 Processing Unit

The core of the processing unit is an iBase IB882 single-board computer (SBC) with the following specification:

- Intel Atom Z500 processor running at 533MHz;
- DDR2 RAM with 1GB capacity;
- 8GB Compact Flash Memory;
- Dual Intel Gigabit LAN adapters;

The processing unit includes an input/output board that accommodates:

- Two SparkLAN WMIR-215GN 802.11n wireless LAN cards.
- A U-Blox NEO-4S GPS module.

The SBC has USB, PS/2, LAN and VGA interfaces for diagnosing issues with the processing unit that cannot be fixed remotely.

The processing unit has status LEDs that display:

- Power state (on/off).
- Hard-drive usage.
- WLAN usage.

The PCBs are thermally coupled to the inner casing of the processing unit to dissipate heat generated inside the enclosure.

The PCBs are shock mounted to the internal surface of the enclosure to protect the electronics from any jarring that it may receive.

1.2.3 Hand-held Camera Unit

The hand-held camera unit has the following components:

- Logitech Quickcam Pro 9000 camera.
- A laser pointer.
- An LED array.

The camera provides higher resolution video than the headset camera and as such the unit is useful for more detailed inspection.

The laser pointer and the LED array are designed to be activated by the operator only, via respective on/off buttons located on the rear of the camera unit.

The LEDs are provided to illuminate objects up to half a meter away in line with the optimal focus of the camera.

A flap is used to cover the LEDs and camera lens when the camera unit is not in use.

1.2.4 Display Unit

The display unit is an Apple iPod Touch 8GB that is housed in an anodised aluminium case. The case is attached to the chest straps of the backpack via a telescopic arm that is hinged at both the chest strap and the device end to enable allow for translational and rotational movement.

The casing allows access to the power button (top left hand side of the case) to turn on/off the device.

A protective film is placed on top of the screen that allow the operator uninhibited access the touch sensitive screen.

The iPod connects via USB cable to the processing unit, to allow the display to charge. It does not use this cable for connectivity.

The display unit connects wirelessly to one of the wireless cards on the processing unit for data collaboration.

1.2.5 Battery Pack

The battery pack is made up of 8 Lithium-ion rechargeable battery packs that will realistically charge to approximately 16Volts. The battery pack is capable of powering the mobile site apparatus for approximately 8 hours under normal loading conditions. The battery pack is charged via an external laptop-style power brick. Charge status LEDs are located on the top of the battery pack to display remaining battery charge levels. The battery pack has a screw on connector and cable to supply power to the processing unit. A simple rail mounted system is used to locate the battery pack on the frame and a screw on the bottom secures it in place.

1.3 Operating System

The mobile site apparatus runs a Microsoft Windows Embedded operating system (O/S). This has a number of advantages including:

- Reduced footprint.
- Support for read-only file systems.
- Full Win32 application compatibility.
- Support for .Net framework.
- Support for Windows Server Update Services.

The reduced footprint is required for the 8GB storage drives used.

The drive has limitations on the number of read/write cycles it can go through. Therefore, limits should be placed on the amount of I/O to the drive while

the mobile site apparatus is in operation. To facilitate such limits, the O/S has the capability to lock the file system and create a virtual space in the RAM where all I/O to the disk is performed. This means that once the file system is locked (at the initial device setup) any changes made in software cannot be saved, unless the write filter is explicitly switched off by an IT administrator/Engineer that is competent with the process.

1.3.1 Wireless LAN

The system has two separate but identical wireless adapters. For security and compliance, the cards fulfil some basic requirements, namely:

- Support for 802.1x.
- Protected Extensible Authentication Protocol.
- WPA with TKIP.
- Cisco Compatible Extensions version 4 or higher.

One adapter is used to connect to the wireless infrastructure at a mine and is used as a primary mode of communication. The card supports the 802.11n standard and therefore makes use of 3 quarter wave dipole 2.4GHz mini whip antennas.

The other adapter is used to relay information from the display unit to the LAN. This communication has significantly lower power requirements. Therefore, a cable antenna is located on the inner casing of the processing unit, which is connected to this adapter.

A GPS antenna module is similarly located on the inner wall of the processing unit, close to the mini whip antennas.

With reference to Figure 16, the following configuration is used:

- DHCP addressing for primary WLAN adapter.
- Static addressing for secondary adapter and display unit.
- Network Address Translation from WLAN 1 to WLAN 2.
- Access through site firewall (Ports: 23150 - 23157).

1.4 Software Architecture (End-to-End Application)

The remote assistance system is designed such that the operator at the support desk is the driver of the entire system and as such has access to all the software functionality of the system. The mobile mine operators are, in effect, mobile extensions of the capabilities of the support centre operator.

The software architecture conforms to a server/client type model, with a database incorporated for archiving purposes.

The three main components of the software model are:

- Server - located on the apparatus.
- Front End - located on the support desk workstation.

- Database - SQL backend server located somewhere on the network of the applicant.

The model shown in Figure 17 illustrates the relationship between these components and the role of the support desk operator in the remote assistance system.

1.4.1 Session Implementation

The software design includes sessions to enable archiving of specific data captured in a particular interaction.

Before commencing a call to a mobile site apparatus, the support desk operator creates a new session, using information such as the date, a short description of the issue reported, etc.

The session is then used to store data such as photographs taken, video recorded and any notes taken during the call.

All session data is uploaded to the database as it is incurred. This feature allows efficient data analysis across the whole mine network which may facilitate more efficient mine operation.

In addition, data for any stored session can be retrieved and displayed as required at the support desk. This feature makes it possible to return to a previous session, for example a session relating to a particular piece of equipment, that could not be completed during the previous session, for example because it was necessary to source a replacement part or access external sources for advice. This feature makes it possible for the support desk operator to quickly review the history of the previous session. This is a particularly useful feature

where different operators are involved in the multiple sessions for the particular action.

1.4.2 Contact List Implementation

In order to simplify the connection process, there is a contact list system at the software layer.

The contact list displays the status of a particular mobile site apparatus. The following table illustrates the possible states of a mobile site apparatus.

Table 1 Possible states of a mobile site apparatus

Status	Sub-state	Description
Online		Mobile site apparatus is: • Powered on. • Server application is running in a normal state. • A clear communication path exists between server and client
	Busy	Mobile site apparatus is currently in a call.
	Available	Mobile site apparatus is accepting calls.
Offline	None	Mobile site apparatus is any one or more of: • Not Powered on. • Server application is not running in a normal state. • A clear communication path does not exist between server and client

1.4.3 Audio/Video Implementation

Figure 18 illustrates the implementation of the media suite.

The media server is built into the server and similarly, the media client is built into the front end. Both ends have similar high-level implementations that comprise:

- An encoder.
- A decoder.
- Transmitter/receiver.

The encoders and decoders communicate directly with the audio/video hardware (microphone, speakers, etc), while the transmitter/receiver communicates via RTP over UDP/IP.

The encoder and decoder has been developed using the proprietary library StreamCoders MediaSuite.Net. They encode video to H.263/H.264 and audio to AAC/MPEG-4.

1.4.4 GPS Tracking Implementation

GPS data is output from the unit via a virtual serial port. The unit outputs standard NMEA GPS strings, which are interpreted by the server application, on the site apparatus, continuously.

When the support desk operator connects to the mobile site apparatus, the support operator requests the GPS data, which is transmitted as a string of data that includes:

- UTC time.
- GPS coordinate.
- Ground Speed.
- Height.
- Satellites in view & their signal strengths.

This data is then displayed on the support desk operator's screen along with a map location (such as Google Maps) - see following description of a display screen in the context of Figures 19-21.

1.4.5 Data Collaboration Implementation

The virtual workspace consists of a windows XP standard operating environment, which is located on a virtual server, that can be accessed anywhere on the network.

In situations where there is a plurality of mobile site apparatus at a plurality of mines, each display unit on the mobile site apparatus connects to a unique virtual machine, thus avoiding any conflict. The display unit has a VNC type client installed, with preconfigured settings - including workstation addresses, usernames etc.

The mobile site apparatus operator has "read-only" access to the machine, thus leaving the support engineer in charge of navigation of pages. The mobile site apparatus operator only has the ability to pan and zoom, when viewing documents.

The support desk operator has a VNC client installed on his/her workstation. The operator can use the client to connect directly to the virtual machine. Once logged in the operator is able to navigate to the required documents/schematics/system and display the information across the screen for both parties to view.

This collaboration can be selective in the sense that the operator can select windows of information displayed on his/her screen at the support desk and transfer these screens to the display of the mobile site operator.

Once the collaboration is complete, the mobile site apparatus operator disconnects his/her session while the support desk operator logs out of the workspace, thus terminating the session.

1.5 Display Screen

Figures 19, 20 and 21 are snap-shots of one example of a support desk operator's screen.

The Figure 19 screen snap-shot is a screen that an operator sees during the course of a session. The screen includes windows that provide video images and still images from the handheld and headset cameras at particular times in a session. The still images provide the support desk operator with a snapshot of the progress of a session. The screen also includes windows for (a) session "notes" to be made by the operator, (b) GPS information, and (c) session collaboration.

The Figure 20 screen snap-shot is a session start-up screen that enables a support desk operator to commence a session and commence information storage and facilitate session retrieval.

The Figure 21 screen snap-shot is a screen that provides basic information for a particular session

The above-described embodiment of the present invention is an effective and efficient system and apparatus for providing high level remote support to a mine site. In particular, the remote site apparatus is robust and convenient to carry.

Many modifications may be made to the embodiments of the remote assistance system and apparatus described above without departing from the spirit and scope of the invention.

By way of example, whilst the description and drawings of the embodiments refer to particular hardware and software, the present invention is not so limited and extends to any suitable hardware and software for carrying out the stated functions.

CLAIMS

1. A remote assistance system for providing technical assistance to mines comprising a support centre, a plurality of mines requiring technical assistance from time to time, a communications network link between operators in the support centre and mobile mine operators at sites at the mines at which technical assistance is required, and capabilities to provide the support centre operators with audio and visual information from the mines via the mobile mine operators at the mine sites, and capabilities to provide the mobile mine operators with data that can be visually displayed to the mobile mine operators and other information aurally to facilitate technical assistance at the mine sites.

2. The system defined in claim 1 being configured so that a support centre operator is the driver of the entire system and as such has access to all the software functionality of the system.

3. The system may defined in claim 1 or claim 2 comprises bidirectional voice communication, video communication, and data collaboration between an operator at the support centre and a mobile mine operator.

4. The system defined in claim 3 wherein information collaboration is achieved by setting up a "remote desktop" type connection.

5. The system defined in any one of the preceding claims comprises unidirectional information transfer from a support centre operator to a mobile mine operator.

6. The system defined in claim 5 wherein the unidirectional information transfer comprises a support centre operator selecting a window of a data and image

display screen at the support centre and transferring this window to a display screen carried by a mobile mine operator.

7. The system defined in any one of the preceding claims wherein the support centre is configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information.

8. The system defined in any one of the preceding claims wherein the support centre is configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information to thereby facilitate selective retrieval and display at the support centre at least the data and/or image signals during subsequent transmission of signals to and receipt of signals from the mobile site apparatus.

9. A support centre configured for communicating with a mobile site apparatus worn by an operator located remotely from the support centre, the support centre being configured for transmitting over a communications network at least voice and data signals to and for receiving over the communications network at least voice, data and image signals from the mobile site apparatus, the support centre being configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information.

10. The support centre defined in claim 9 being configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information to thereby facilitate selective retrieval and display at the support centre at least the data and/or image signals during

subsequent transmission of signals to and receipt of signals from the mobile site apparatus.

11. The support centre defined in claim 9 or claim 10 being configured so that the support centre operator is the driver for transmitting and receiving at least the data and/or image signals.

12. A mobile site apparatus worn by an operator located remotely from a support centre, the mobile site apparatus being configured for communicating with the support centre, the mobile site apparatus being configured for transmitting over a communications network voice, data and image signals to the support centre, and the mobile site apparatus being configured for receiving over the communications network voice, data and image signals to the support centre.

13. A remote assistance system for providing technical assistance comprising a support centre, a plurality of sites requiring technical assistance from time to time, a communications network link between operators in the support centre and mobile site operators at sites at which technical assistance is required, and capabilities to provide the support centre operators with audio and visual information from the mines via the mobile site operators at the sites, and capabilities to provide the mobile site operators with data that can be visually displayed to the mobile site operators and other information aurally to facilitate technical assistance at the sites.

14. The system defined in claim 13 being configured so that a support centre operator is the driver of the entire system and as such has access to all the software functionality of the system.

15. The system may defined in claim 13 or claim 14 comprises bidirectional voice communication, video communication, and data collaboration between an operator at the support centre and a mobile site operator.

16. The system defined in claim 13 wherein information collaboration is achieved by setting up a "remote desktop" type connection.

17. The system defined in any one of claims 13 to 16 comprises unidirectional information transfer from a support centre operator to a mobile site operator.

18. The system defined in claim 17 wherein the unidirectional information transfer comprises a support centre operator selecting a window of a data and image display screen at the support centre and transferring this window to a display screen carried by a mobile site operator.

19. The system defined in any one of claims 13 to 18 wherein the support centre is configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information.

20. The system defined in any one of claims 13-19 wherein the support centre is configured to store voice, data and image signals received from or transmitted to the mobile site apparatus against time, date, location and/or session information to thereby facilitate selective retrieval and display at the support centre at least the data and/or image signals during subsequent transmission of signals to and receipt of signals from the mobile site apparatus.

21. A mobile site apparatus for a mobile site operator comprising the following components:

(a) a headset;

(b) a processing unit, for example in the form of a wearable computer;

(c) a hand-held camera unit;

(d) a display unit; and

(e) a battery pack.

22. The apparatus defined in claim 21 comprises a backpack that supports at least the processing unit.

23. The apparatus defined in claim 22 wherein the display unit is connected to the backpack, for example chest straps of the backpack, via a telescopic arm that is hinged at both the backpack and the camera unit to enable translational and rotational movement of the display unit.

24. The apparatus defined in any one of claims 21 to 23 comprises an additional fixed camera which forms part of the headset.

25. The apparatus defined in any one of claims 21 to 24 comprises a laser pointer associated with each camera.

26. The apparatus defined in any one of claims 21 to 25 comprises a GPS attached to or incorporated in the processing unit

27. A method of operating a mine that comprises using the remote assistance system defined in any one of claims 1 to 8 at the mine.

28. A method of operating a mine that comprises using the mobile site apparatus defined in any one of claims 12 and 21 to 26 at the mine.

29. A system for providing technical assistance from an operator of a support station to an operator or a mobile support apparatus located remotely of the support station; the system comprising:

the support station and the mobile support apparatus;

the support station and the mobile support apparatus being in communication via a communication network;

the mobile support apparatus comprising wireless communications apparatus for wireless communication of at least voice and image data between the mobile support apparatus and the communications network;

the mobile support apparatus further comprising at least one processor for processing at least voice and image data received from the support station and for displaying at least the image data on a display of the of the mobile support apparatus and for playing at least the voice data through speakers operatively associated with the mobile support apparatus;

the mobile support apparatus being further adapted to capture voice data from a microphone operatively associated with said mobile support apparatus and to capture still and/or video image data from at least one camera operatively associated with the mobile support apparatus and to transmit said voice, still and/or video image data to said support station; and

the support station being adapted to receive and play the voice data and to receive and display the still and/or image data and to selectively store in response to operator input at least the still and/or video images against any one or more of time, date, location and

session data for subsequent retrieval and display on a display operatively associated with the support station.

30. The system defined in claim 29 wherein the at least one camera is operatively associated with a light source to indicate to the operator of the mobile support apparatus an area of a surface in a field of view of the camera.

31. The system defined in claim 30 wherein the light source is a laser or a focused light beam.

32. The system defined in any one of claims 29 to 31 wherein the camera is mounted to a head set of the mobile apparatus whereby an operator of the support station views an image consisting of at least part of a current field of view of an the operator of the mobile support apparatus.

33. The system defined in any one of claims 29 to 32 wherein the camera is mounted in or onto a head set of the mobile support apparatus which plays voice data transmitted from the support station.

34. The system defined in any one of claims 29 to 33 further comprising a hand held camera incorporating a light source, whereby in use an operator of the mobile support apparatus directs the light source to illuminate a location on a surface for which still and/or video data is to be captured by the camera for transmission to the technical assistance station.

35. The system defined in claim 34 wherein the light source is a laser or a focused light source.

35. The system defined in any one of claims 29 to 34 wherein the support station is adapted to simultaneously

display and store still and/or video transmitted by the mobile support apparatus.

36. The system defined in any one of claims 29 to 35 wherein a display associated with the mobile support apparatus is a passive display adapted to only receive data from the support station.

37. The system defined in any one of claims 29 to 36 wherein the support station further comprises an image selection window for selecting an area of a computer desktop on which the support station is operating and transmitting the image displayed at the selected area to a display of the mobile assistance apparatus.

38. The system defined in claim 37 wherein the selection and transmission of image data from the desktop on which the support station is operating enables the mobile support apparatus to operate substantially independently of process intensive software applications, such as Computer Aided Drawing (CAD) software packages.

39. The system defined in claim 38 wherein the display of the mobile support apparatus is adapted for the operator of the mobile support apparatus to zoom in and out of the image data received and to pan and scroll the image data received.

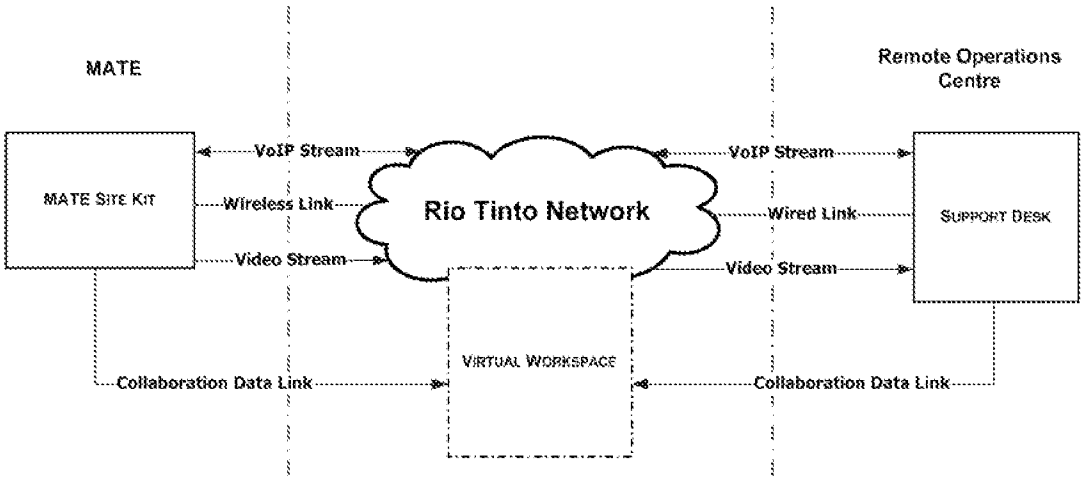


FIG.1

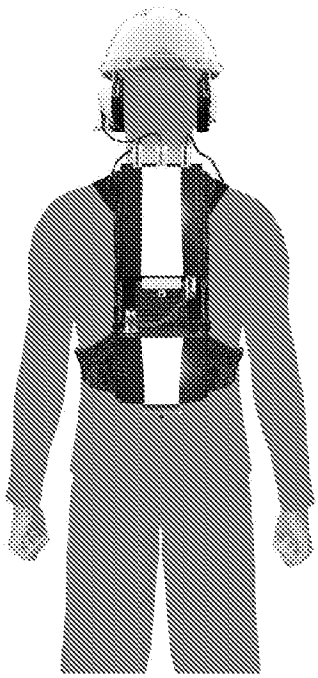


FIG 2

Rear view of mobile mine operator showing backpack-mounted apparatus

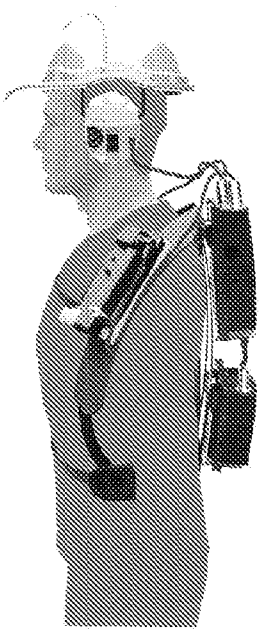


FIG.3

Side view of operator and apparatus shown in FIG. 2

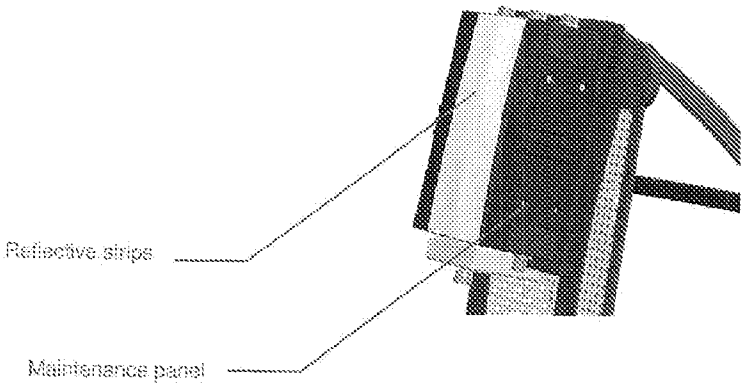


FIG. 4

Perspective view of processing unit of the apparatus shown in FIG.2 and FIG.3

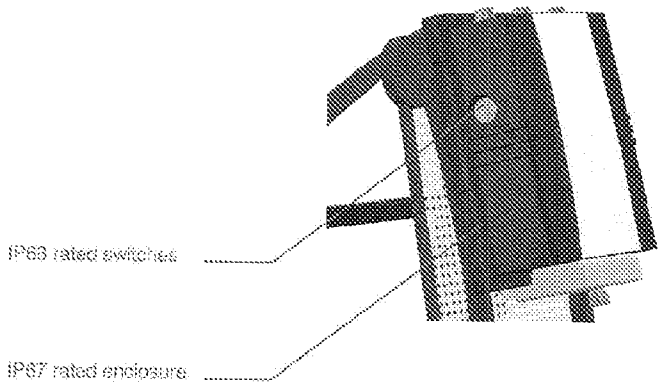


FIG. 5

Further perspective view of the processing unit

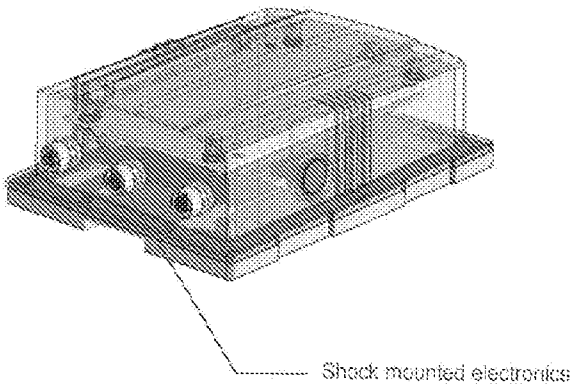


FIG. 6

Further perspective view of the processing unit



FIG. 7

Perspective view of the headset of the apparatus shown in FIG.2 and FIG.3

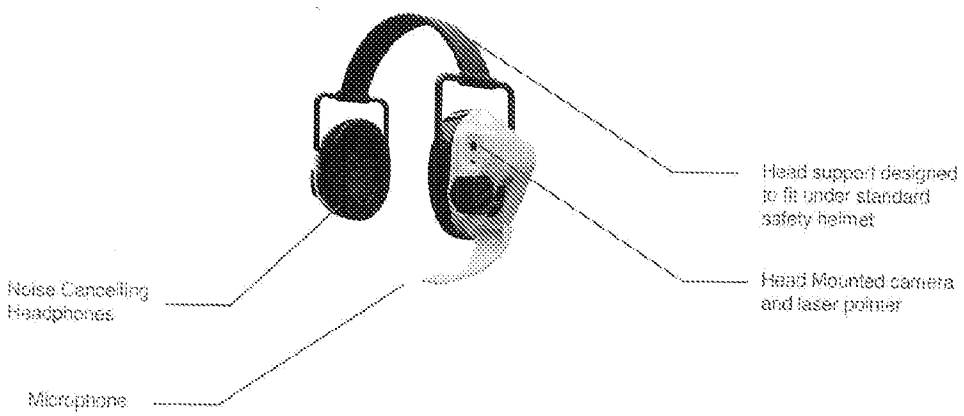


FIG. 8

Further perspective view of the headset

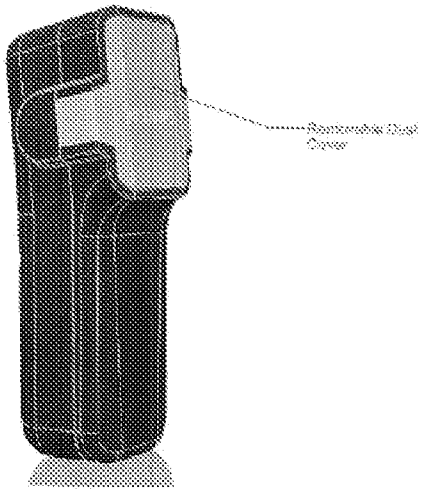


FIG. 9

Perspective view of the handheld camera of the apparatus shown in FIG.2 and FIG. 3

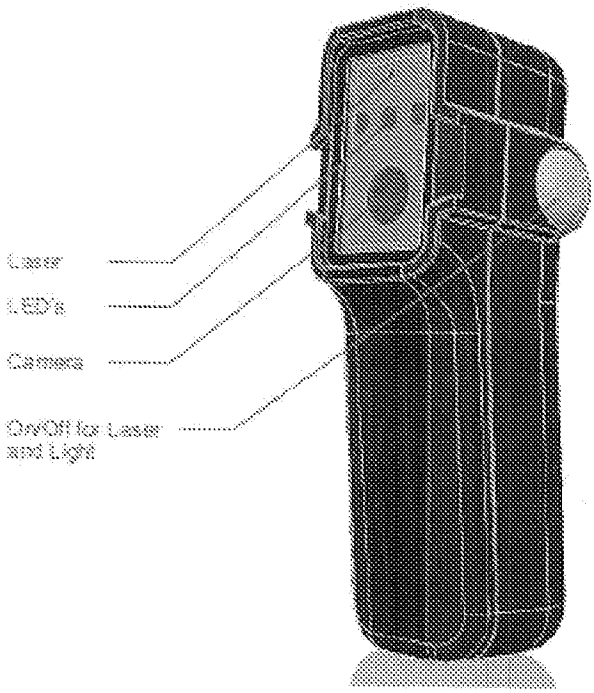


FIG. 10

Further perspective view of the handheld camera

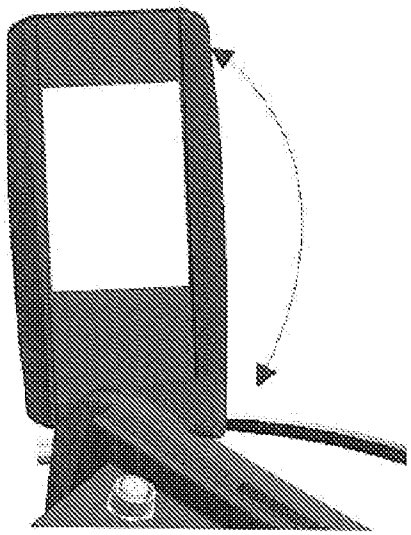


FIG. 11

Perspective view of the display unit

shown in FIG. 2 and FIG.3 in one position of the display unit

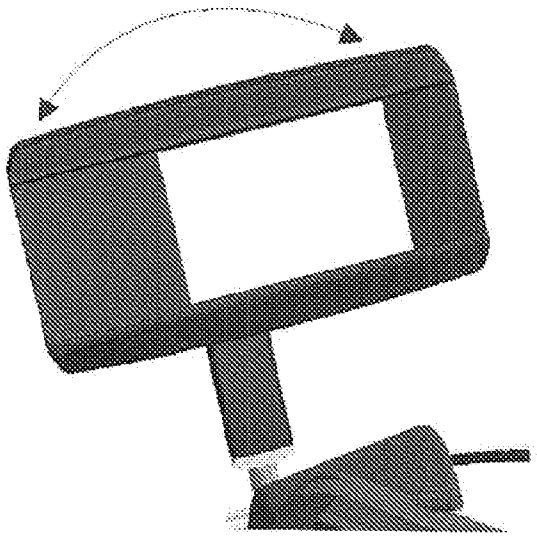


FIG. 12

Perspective view of the display unit

shown in FIG. 2 and FIG.3 in another position of the display unit

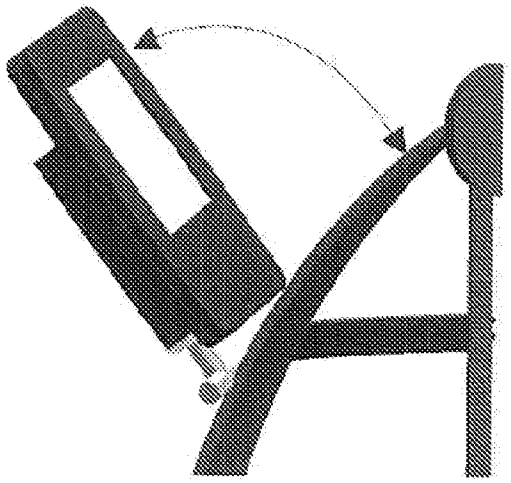


FIG. 13

Perspective view of the display unit
shown in FIG. 2 and FIG.3
illustrating coupling of the display unit to the backpack

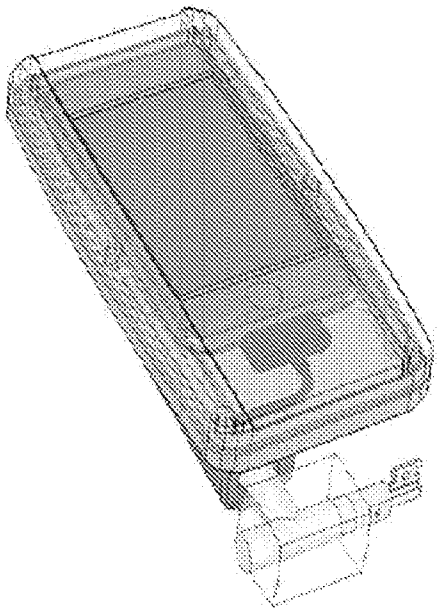


FIG. 14

Further perspective view of the display unit

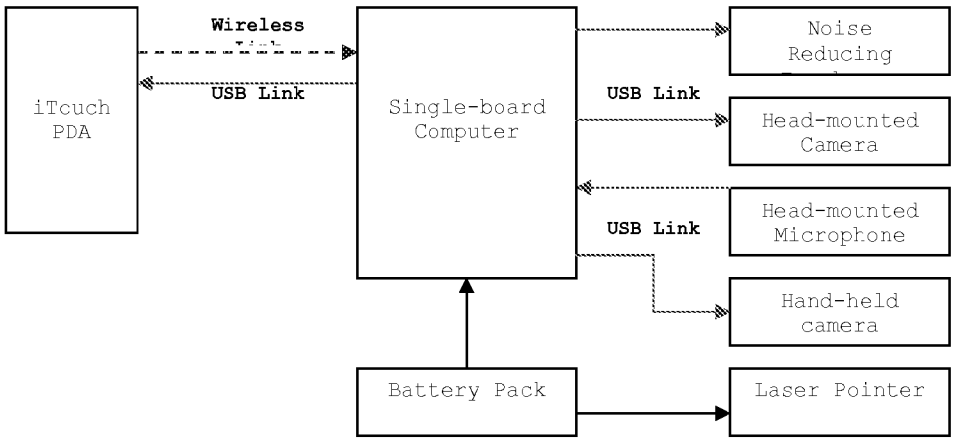

iTouch PDA
Wireless
USB Link
Single-board Computer
Noise Reducing
USB Link
Head-mounted Camera
USB Link
Head-mounted Microphone
Hand-held camera
Battery Pack
Laser Pointer

FIG. 15

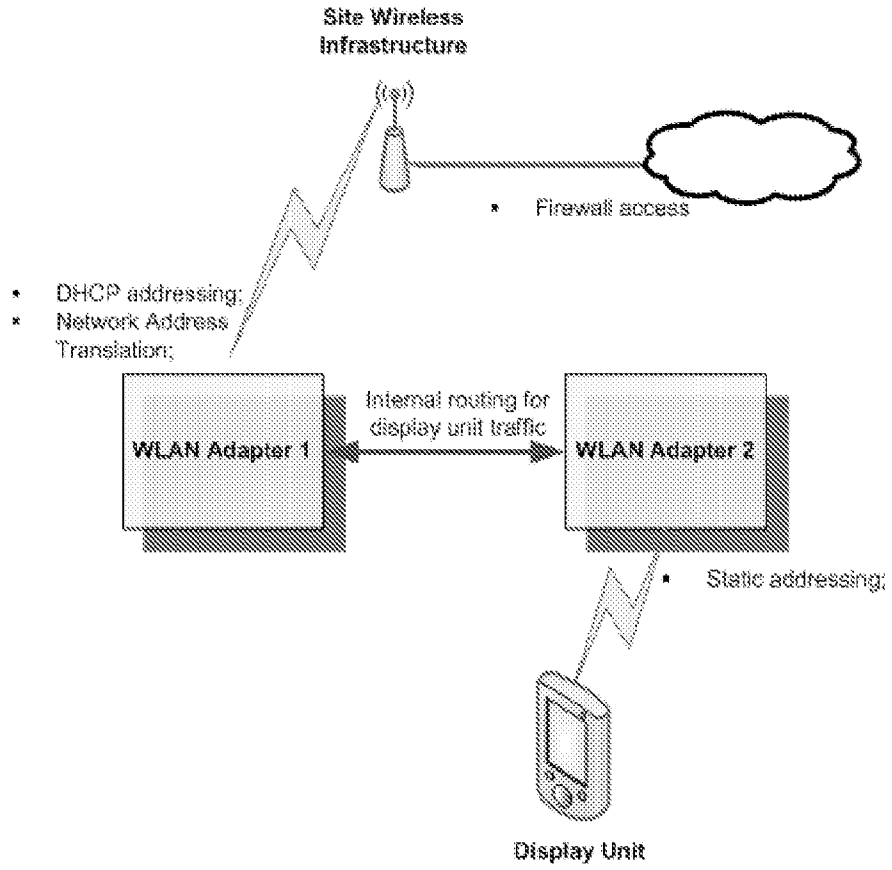

Site Wireless Infrastructure
Firewall access
DHCP addressing;
Network Address Translation;
WLAN Adapter 1
Internal routing for display unit traffic
WLAN Adapter 2
Static addressing;
Display Unit

FIG. 16

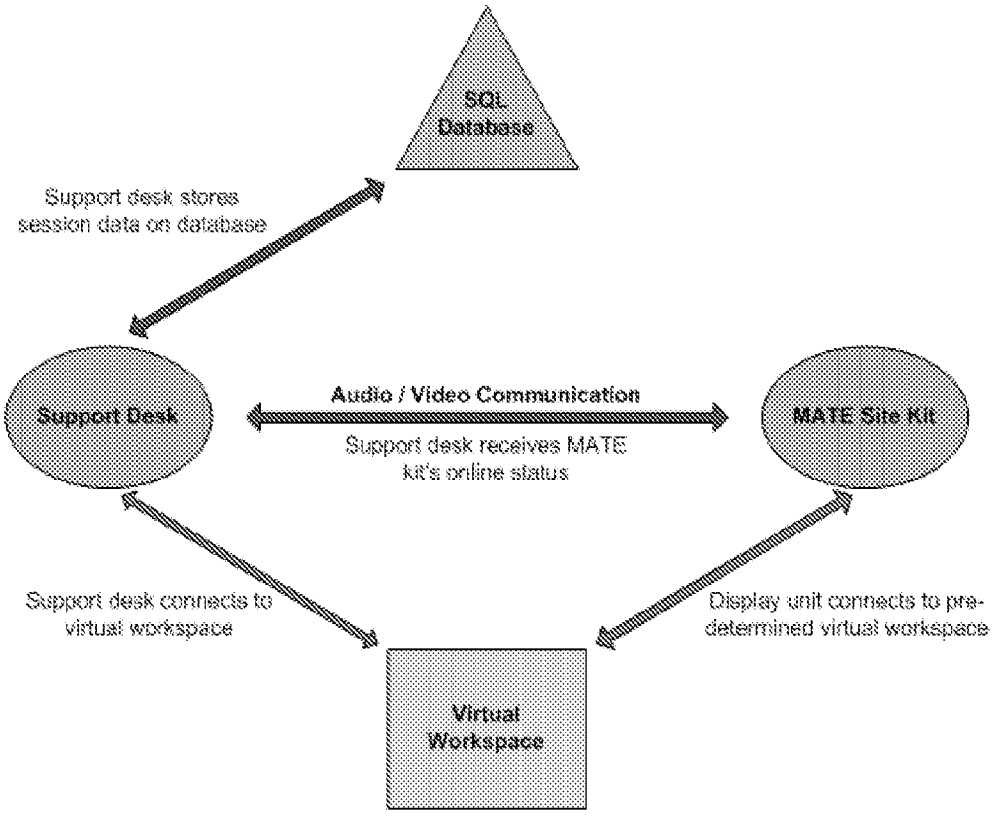

SQL Database
Support desk stores session data on database
Support Desk
Audio / Video Communication
Support desk receives MATE kit's online status
MATE Site Kit
Support desk connects to virtual workspace
Display unit connects to pre-determined virtual workspace
Virtual Workspace

FIG. 17

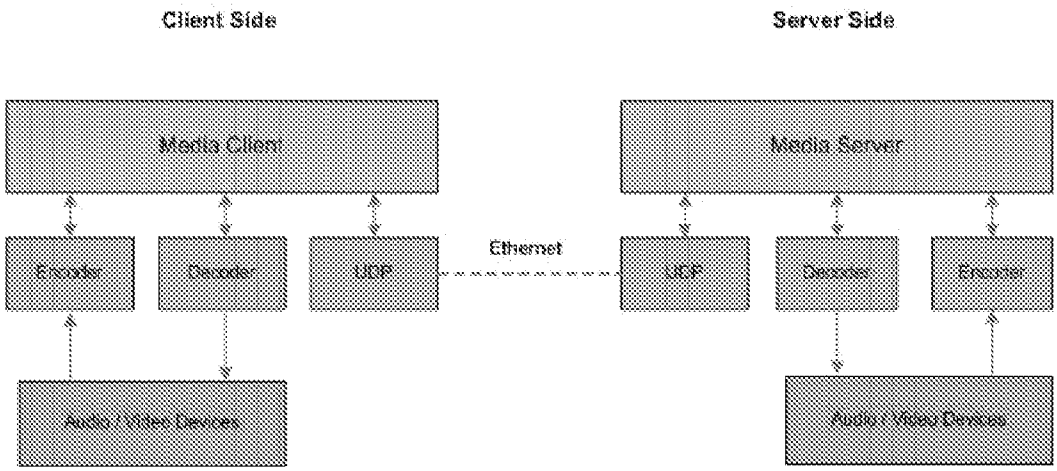

Client Side
Server Side
Media Client
Media Server
Encoder
Decoder
UDP
Ethernet
UDP
Decoder
Encoder
Audio / Video Devices
Audio / Video Devices

FIG. 18

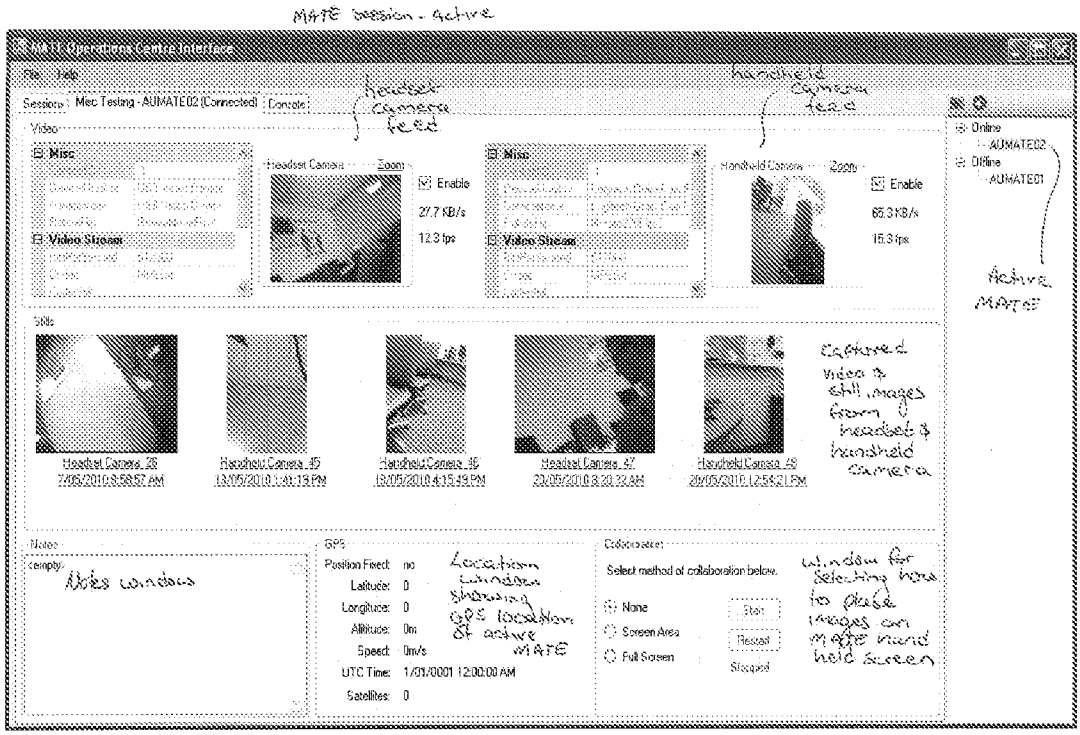

MATE session - active
Headset camera feed
Handheld camera feed
Active MATE
Captured video & still images from headset & handheld camera
Notes window
Location window showing GPS location of active MATE
Window for selecting how to place images on MATE mini hold screen
Misc
Video Stream
Enable
27.7 KB/s
12.3 fps
65.3 KB/s
15.3 fps
Online
AUMATE02
Offline
AUMATE01
Stills
Headset Camera: 38
7/05/2010 3:58:57 AM
Handheld Camera: 45
13/05/2010 1:41:13 PM
Handheld Camera: 46
18/05/2010 4:15:48 PM
Headset Camera: 47
20/05/2010 8:20:32 AM
Handheld Camera: 48
23/05/2010 12:54:21 PM
Notes
<empty>
GPS
Position Fixed: no
Latitude: 0
Longitude: 0
Altitude: 0m
Speed: 0m/s
UTC Time: 1/01/0001 12:00:00 AM
Satellites: 0
Collaboration
Select method of collaboration below.
None
Screen Area
Full Screen
Start
Restart
Stopped

FIG. 19

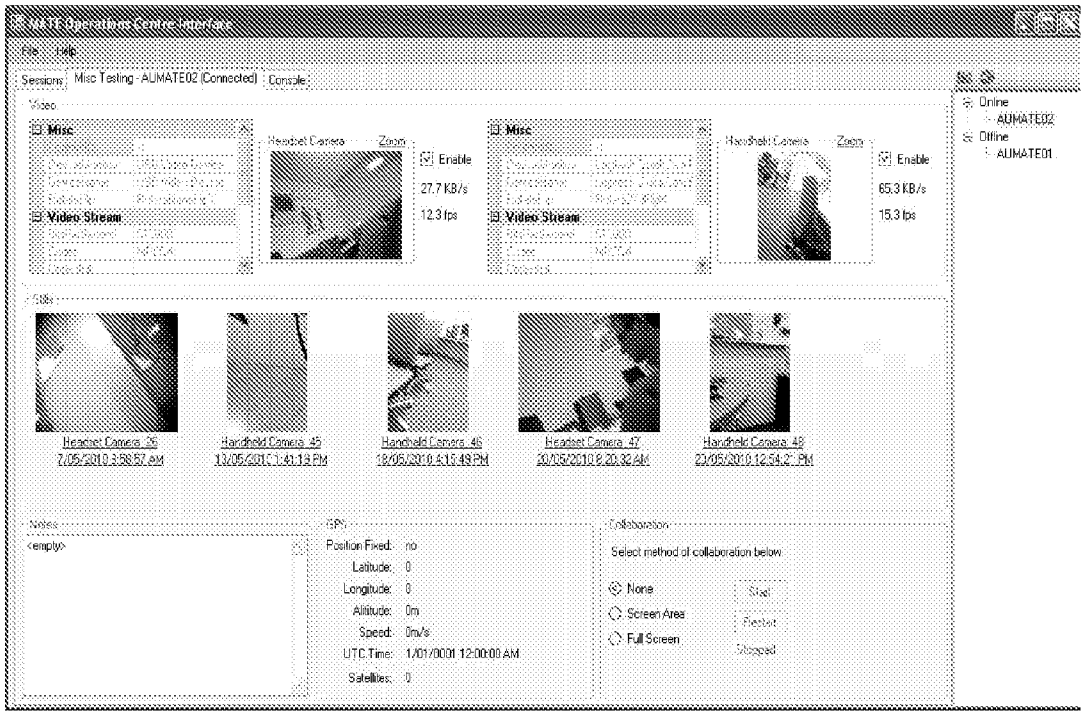

Misc
Video Stream
Enable
27.7 KB/s
12.3 fps
65.3 KB/s
15.3 fps
Online
AUMATE02
Offline
AUMATE01
Stills
Headset Camera: 38
7/05/2010 3:58:57 AM
Handheld Camera: 45
13/05/2010 1:41:13 PM
Handheld Camera: 46
18/05/2010 4:15:48 PM
Headset Camera: 47
20/05/2010 8:20:32 AM
Handheld Camera: 48
23/05/2010 12:54:21 PM
Notes
<empty>
GPS
Position Fixed: no
Latitude: 0
Longitude: 0
Altitude: 0m
Speed: 0m/s
UTC Time: 1/01/0001 12:00:00 AM
Satellites: 0
Collaboration
Select method of collaboration below
None
Screen Area
Full Screen
Stopped

FIG. 20

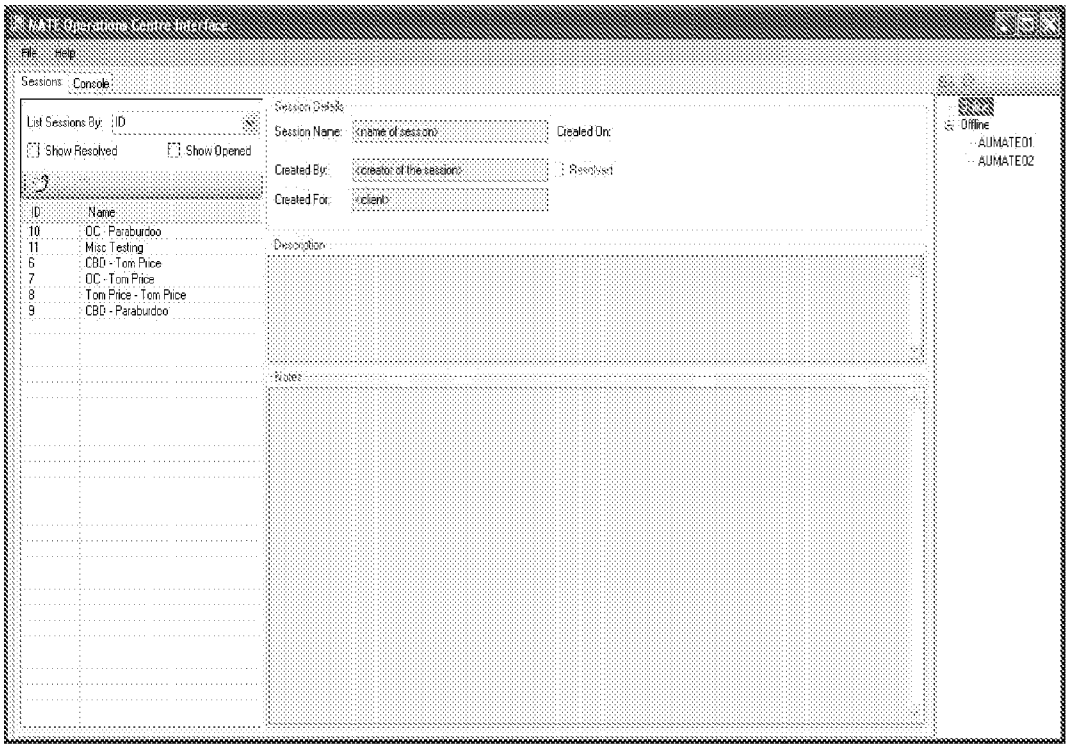

File Help
Sessions Console
List Sessions By: ID
Show Resolved
Show Opened
ID Name
10 OC - Paraburdoo
11 Misc Testing
6 CBD - Tom Price
7 OC - Tom Price
8 Tom Price - Tom Price
9 CBD - Paraburdoo
Session Details
Session Name: <name of session>
Created On:
Created By: <creator of the session>
Resolved
Created For: <client>
Description
Notes
Offline
AUMATE01
AUMATE02

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/000682

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H04B 7/26 (2006.01) ***E21F 17/00*** (2006.01) ***H04W 4/04*** (2009.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI, EPODOC, INSPEC, Google Patents, Google Scholar with keywords including remote/centralised assistance/support, mobile, portable, wireless, mine/mining, audio/video, etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/0186668 A1 (THOMASON) 12 December 2002 - Figure 1, paragraphs [0009]-[0010], [0012], [0022], [0030]-[0032], [0036], [0043], [0046], [0067]	1-20, 27-29, 35(b), 36
Y		30-35(a)
X	EP 1550895 A2 (C.R.F. SOCIETÀ CONSORTILE PER AZIONI) 6 July 2005 - Paragraphs [0001]-[0002], [0007]-[0010],[0012]-[0013], [0024], figure 1	1-20, 27-29, 35(b)-39
Y		30-35(a)

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 August 2010	11 AUG 2010
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **MLADEN MITIC** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 3193

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/000682

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
L, X	Ralston, J. "Numbat Mine Reconnaissance Vehicle" [online] CSIRO Mining Automation, 20 July 2008. [retrieved on 4 August 2010]. Retrieved from the Internet: <URL:http://web.archive.org/web/20080720004512/http://www.dem.csiro.au/mining_automation/research/projects/numbat/index.html> - Whole document	1, 27
Y	CN 201216206 Y (BEIJING UNICOM ELECTRONIC TECH) 8 April 2009. English abstract retrieved from EPODOC database - Abstract, figures 1 & 2	30-35(a)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/000682

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See supplemental box

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-20 and 27-39

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box
(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: III – Lack of Unity of Invention

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-20 and 27-39 are directed at a system for providing technical assistance to remotely located mobile operators, including a support centre, a plurality of mobile operators, a communications link facilitating communication of audio-visual and other data between the support centre and the mobile operators. It is considered that the arrangement for communication audio-visual and other data between the support centre and the mobile operators comprises a first distinguishing feature.

- Claims 21-26 and 28 are directed at a mobile site apparatus for a mobile site operator, comprising a headset, a processing unit, a hand-held camera, a display unit and a battery pack. It is considered that the arrangement of components of the apparatus carried by the mobile operator comprises a second distinguishing feature.

Note: Claim 28 appears in both inventions because of its appendence to any of claims 12 and 21-26.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2010/000682

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	2002186668	US	6317039	US	6690273
EP	1550895	US	2005156816	US	7333073
CN	201216206	NONE			

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX