US007049998B1

(12) **United States Patent**
Frady et al.

(10) **Patent No.: US 7,049,998 B1**
(45) **Date of Patent: May 23, 2006**

(54) **INTEGRATED RADAR, OPTICAL SURVEILLANCE, AND SIGHTING SYSTEM**

(75) Inventors: **Trent J. Frady**, Bloomfield, IN (US); **Dustin L. Wilson**, Odon, IN (US); **Kyle R. Werner**, Jasper, IN (US); **Eric S. Moody**, Bloomfield, IN (US); **Nancy J. Flynn**, Bloomington, IN (US); **Michael P. Konerman**, Bloomington, IN (US); **Paul L. Schmidt**, Bloomfield, IN (US); **Robert E. Mullen**, Bedford, IN (US); **Mark R. Koi**, Bloomington, IN (US); **Nigel G. Wasil**, Bedford, IN (US); **Michael G. Daugherty**, Mitchell, IN (US); **Bret R. Mehringer**, Jasper, IN (US)

(73) Assignee: **United States of America as represented by the Secretary of the Navy**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/094,541**

(22) Filed: **Mar. 30, 2005**

Related U.S. Application Data

(63) Continuation of application No. 10/943,648, filed on Sep. 10, 2004, now Pat. No. 6,903,676.

(51) **Int. Cl.**
G01S 13/86 (2006.01)

(52) **U.S. Cl.** **342/52**

(58) **Field of Classification Search** 342/52, 342/67; 367/96; 89/41.14, 41.07, 41.06
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,249,241	B1	6/2001	Jordan et al.	
6,690,296	B1	2/2004	Corwin et al.	
6,690,978	B1	2/2004	Kirsch	
6,700,528	B1	3/2004	Williams et al.	
6,704,619	B1	3/2004	Coleman et al.	
6,724,340	B1	4/2004	Carlos et al.	
6,903,676	B1 *	6/2005	Frady et al.	342/52

OTHER PUBLICATIONS

Dustin Wilson; "NSWC Crane and USS Ramage performs IROS3 Demonstration"; http://globalsecurity.org/military/library/news/2004/03/mil-040301-navsea.htm; 2pg.; Mar. 1, 2004.

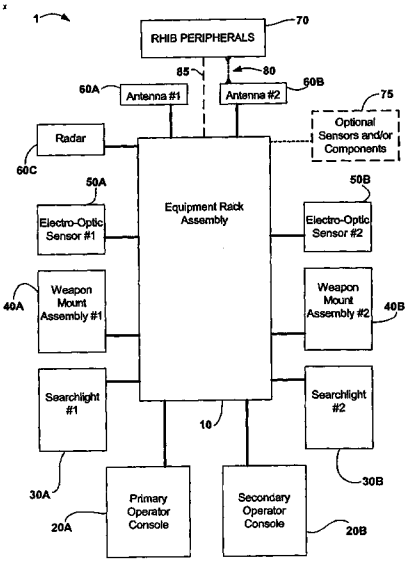
(Continued)

Primary Examiner—Daniel Pihulic
(74) *Attorney, Agent, or Firm*—Timothy J. Slabouz; John G. Mills, III; NAVAIR (Naval Air Systems Command)

(57) **ABSTRACT**

The present invention can be generally described as a protection system. This protection system is formed by the integration of commonly available subsystems, which may be controlled by non-proprietary, open architecture software, which, in turn, may accommodate the commonly known "plug and play" capability. This allows the present invention to easily incorporate a variety of lethal (or less-than-lethal) weapon payloads as well as a variety of sensors and detectors; thereby providing the user with the first real, integrated system (of systems) solution capable of providing an enhanced situational awareness capability.

20 Claims, 4 Drawing Sheets



OTHER PUBLICATIONS

"Integrated Radar Optical Surveillance and Sighting System [IROS3]"; http://www.globalsecurity.org/military/systems/ship/systems/iros3.htm; 2 pg.; Mar. 4, 2004.
Jerry Foltz; "IROS3 provides first line of defense"; www.navy.mil/navpalib/cno/n76; 2 pg.; Fall 2003.
Jerry Foltz; "Ramage Tests IROS3 Defense System"; http://www.globalsecurity.org/military/library/news/2003/09/mil-030922-nns02.htm; 1 pg.; Sep. 22, 2003.
David Nagle; "Navy to Demonstrate New Shipboard AT/FP System"; http://www.globalsecurity.org/military/library/news/2003/07/mil-030725-navsea02.htm; 1 pg.; Jul. 25, 2003.
"NSWC Crane Team Completes IROS3 Live Fire Test and Evaluation"; http://www.globalsecurity.org/military/library/news/2003/07/mil-030725-navsea01.htm; 1 pg.; Jul. 25, 2003.

* cited by examiner

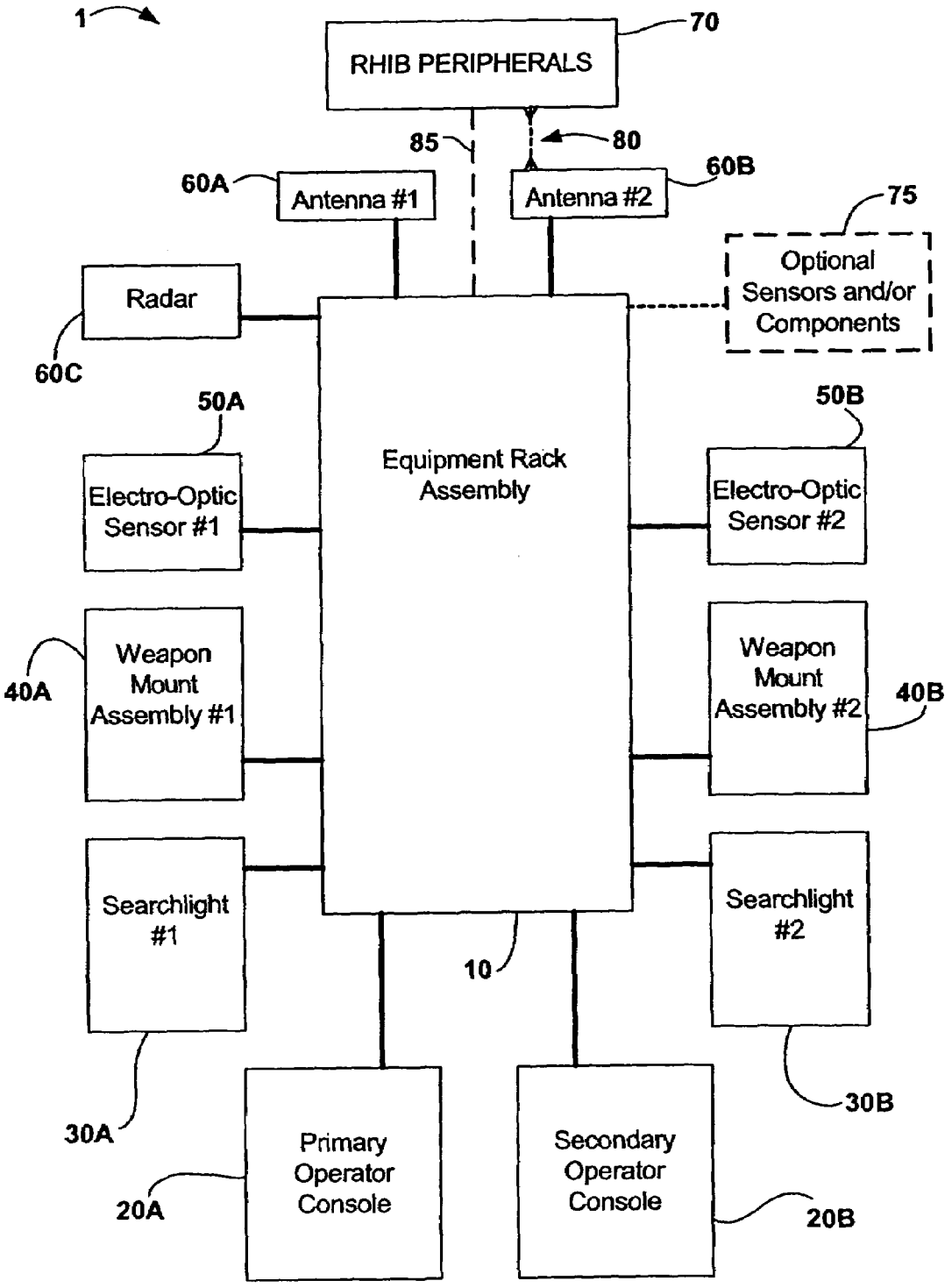

1
RHIB PERIPHERALS
70
85
80
60A
Antenna #1
Antenna #2
60B
75
Optional Sensors and/or Components
Radar
60C
50A
50B
Equipment Rack Assembly
Electro-Optic Sensor #1
Electro-Optic Sensor #2
40A
Weapon Mount Assembly #1
Weapon Mount Assembly #2
40B
Searchlight #1
Searchlight #2
10
30A
30B
Primary Operator Console
Secondary Operator Console
20A
20B

FIG. 1

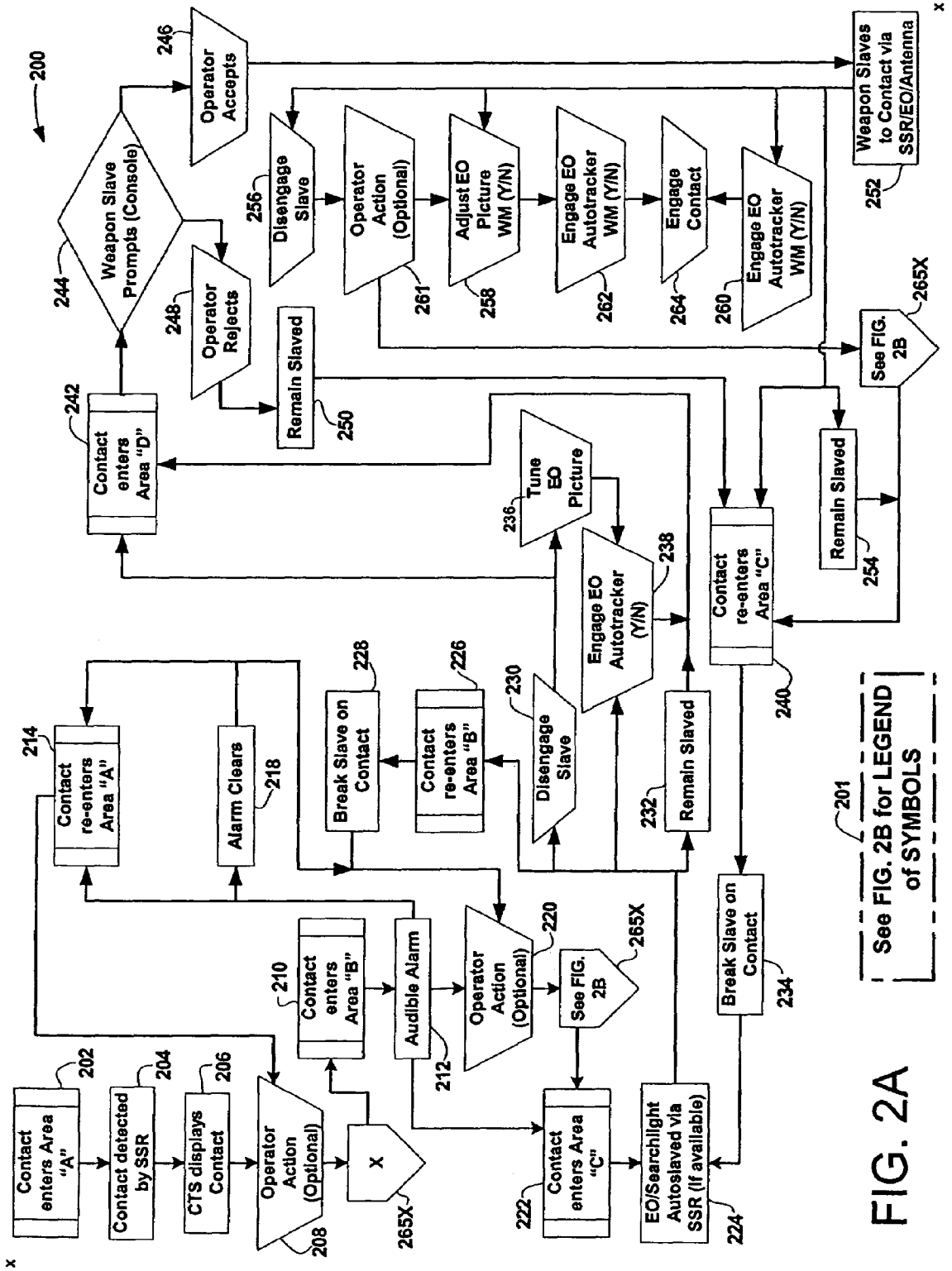

200
Contact enters Area "A"
202
Contact detected by SSR
204
CTS displays Contact
206
Operator Action (Optional)
208
X
265X
Contact enters Area "B"
210
Audible Alarm
212
Operator Action (Optional)
220
See FIG. 2B
265X
Contact enters Area "C"
222
EO/Searchlight Autoslaved via SSR (If available)
224
Break Slave on Contact
234
Contact re-enters Area "C"
240
Remain Slaved
254
Weapon Slaves to Contact via SSR/EO/Antenna
252
Operator Accepts
246
Weapon Slave Prompts (Console)
244
Operator Rejects
248
Remain Slaved
250
Contact enters Area "D"
242
Disengage Slave
256
Operator Action (Optional)
261
Adjust EO Picture WM (Y/N)
258
Engage EO Autotracker WM (Y/N)
262
Engage Contact
264
Engage EO Autotracker WM (Y/N)
260
See FIG. 2B
265X
Tune EO Picture
236
Engage EO Autotracker (Y/N)
238
Contact re-enters Area "A"
214
Alarm Clears
218
Break Slave on Contact
228
Contact re-enters Area "B"
226
Disengage Slave
230
Remain Slaved
232
See FIG. 2B for LEGEND of SYMBOLS
201

FIG. 2A

FIG. 2B

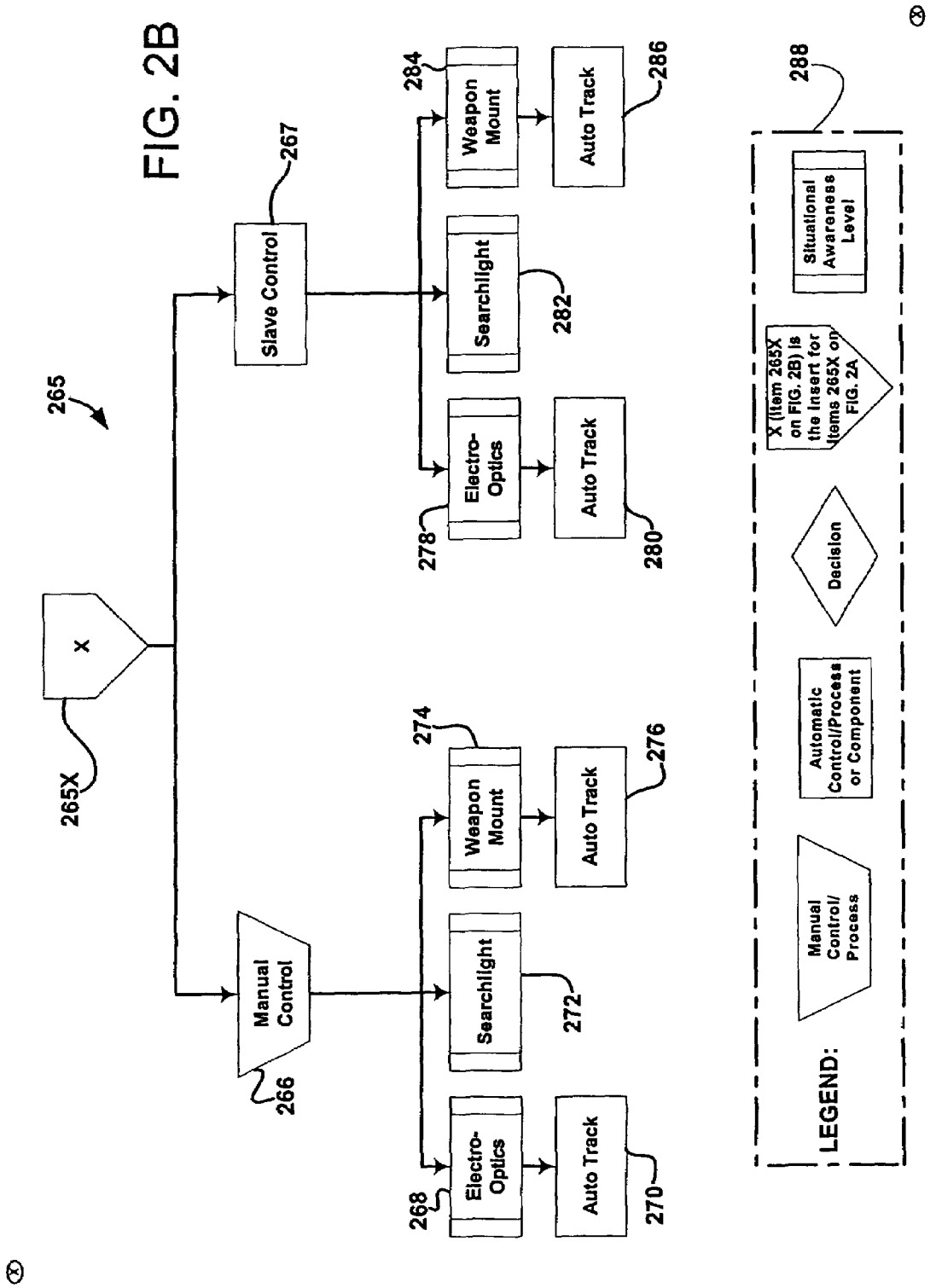
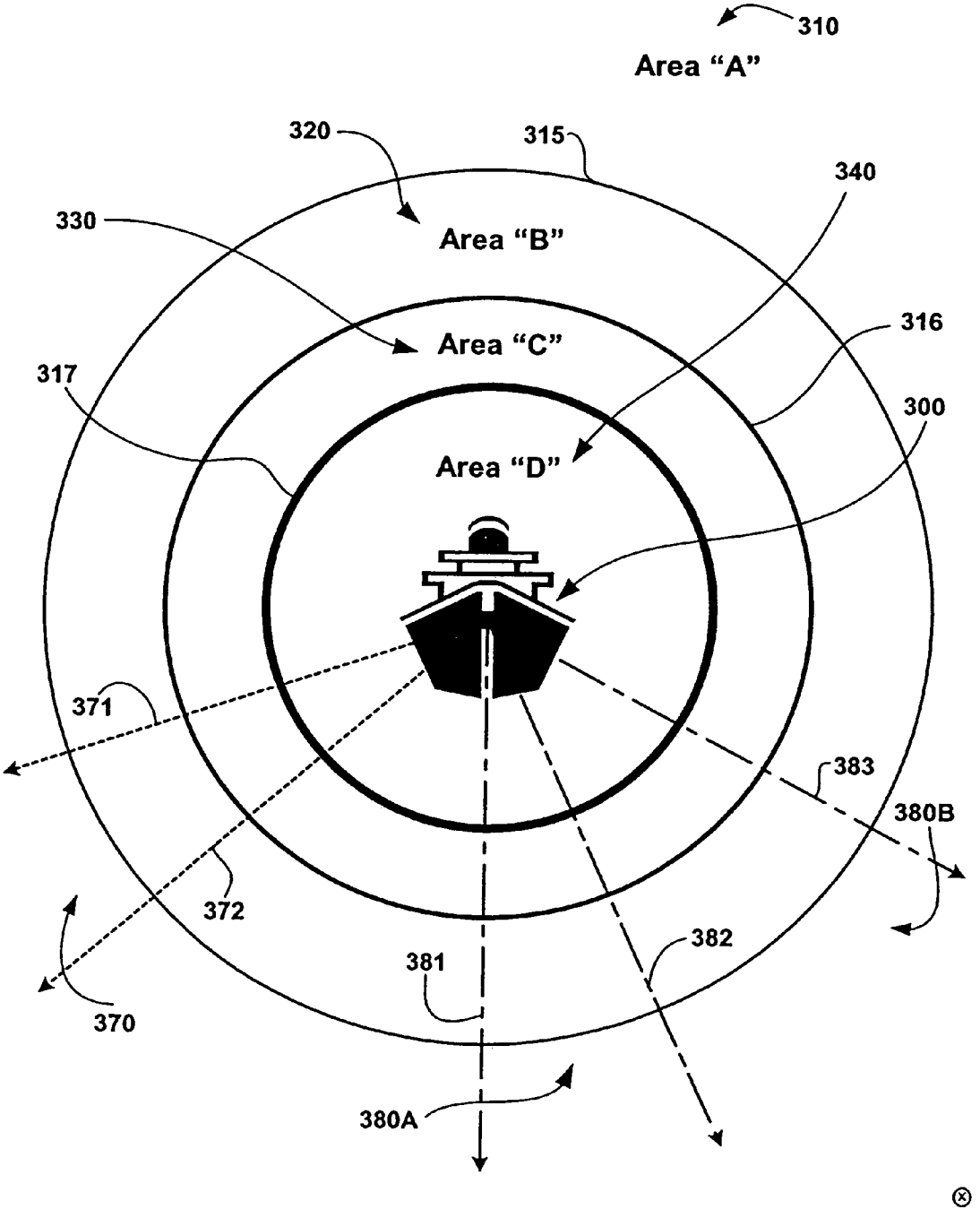

265
265X
X
Manual Control
266
Slave Control
267
Electro-Optics
268
Auto Track
270
Searchlight
272
Weapon Mount
274
Auto Track
276
Electro-Optics
278
Auto Track
280
Searchlight
282
Weapon Mount
284
Auto Track
286
288
Situational Awareness Level
X (Item 265X on FIG. 2B) is the Insert for Items 265X on FIG. 2A
Decision
Automatic Control/Process or Component
Manual Control/ Process
LEGEND:

FIG. 3


310
Area "A"
320
315
340
330
Area "B"
Area "C"
316
317
300
Area "D"
371
383
380B
372
382
381
370
380A

INTEGRATED RADAR, OPTICAL SURVEILLANCE, AND SIGHTING SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation, and claims the benefit, of U.S. Nonprovisional application Ser. No. 10/943,648, filed on Sep. 10, 2004, now U.S. Pat. No. 6,903,676, which is incorporated herein by reference. Applicant claims the priority date benefits of that application.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

REFERENCE TO A SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

Not Applicable.

BACKGROUND OF THE INVENTION

The present invention generally relates to a system capable of detecting, tracking, and, possibly, engaging one or more objects of potential concern, and more particularly, but without limitation, to a system of instruments (and/or components) capable of providing a protective boundary around a military platform or other entity of interest. (An "object (or "objects") of potential concern" will be either singly or collectively, referred to herein as either the singular or plural form of Target, Contact, and/or Threat; therefore, when any of these terms appear herein they should be considered as being synonymous.)

Today's global environment has led to the need for heightened security measures for both people and possessions including high price military platforms such as, but not limited to, U.S. Navy ships—the USS Cole (DDG-67) was bombed in Aden, Yemen, in October 2000. Because of this bombing and the terrorist attacks of Sep. 11, 2001, it was clear that improved Anti-Terrorism/Force Protection (AT/FP) capabilities were (and are) needed.

More specifically, with respect to U.S. Navy ships, ships need to be protected more than ever from a terrorist attack regardless if sitting in port, at anchorage, or while transiting restricted waterways, and this is the case whether the ship is located in, or is far from, the continental United States or its territorial waters. Moreover, it is often required that a ship's major combat systems (e.g., radar and/or sonar) must be secured (i.e., generally unavailable for use) due to a host nation's rules or regulations, or due to restrictions required by environmental rules and regulations. Currently, while these combat systems are secured, most shipboard protection on a U.S. Navy ship is provided by utilizing the following equipment and manpower: "crew-manned" weapons; personnel standing sentry duty; vision aids (i.e., binoculars); portable hand-held radios; and Rigid-Hulled Inflatable Boats ("RHIB"). [ASIDE: While the disclosure herein may be focused, in most part, on using the present invention on (or for) ships, and more specifically on U.S. Navy ships, it should be understood that the present invention can be used on, or with, other platforms/entities. Moreover, the acronym RHIB, when used hereinafter, should be considered to refer to not only Rigid-Hulled Inflatable Boats, but also to other remote platforms or other entities, whether mobile or fixed, that are possibly capable of providing at least some of the following: remote detecting; tracking; Contact engagement; and/or other sensor and/or other related functions. As non-limiting examples, these can include manned or unmanned vehicles (which may include, but are not limited to, aerial, above-surface, underwater, land-based and/or space-based vehicles) or may include, but are not limited to, aerial, above-surface, underwater, land-based, water-based and/or space-based platforms, entities and/or systems.]

There are disadvantages with the current methods of shipboard protection. For example, the ability to successfully engage a potential threat is constrained by the timeliness of the detection and warning, by the number of personnel available for sentry duties, by the equipment currently used, and by other human perception and skill limitations (including a reduced probability of hit when compared to an automated system). More specifically, the ship's personnel that are required to perform sentry duty may be required to stay alert for extended periods of time, and while walking the ship's deck(s)—many times in the middle of the night and, possibly, under conditions of extreme heat or cold. Clearly, these workplace conditions do not enhance the quality of life and may lead to human-based failures of the protection system. Furthermore, if the sentry personnel do not identify a threat in a timely manner, the response time required for a successful engagement of a potential threat may be lost. This may be exacerbated by requiring the sentry to relay the threat information to a remotely located supervisor prior to receiving authorization to engage the threat, which can cause further delays and, therefore, an increased likelihood of failure. Lastly, with respect to the use of sentries, if the ship's personnel must engage a threat with a crew-manned weapon, those personnel are at risk of injury or death including the risks associated with return fire.

Other sources of failures may be attributable to the equipment being used, or to the combination of equipment and its user's human capabilities. Typically, the best optical aid that ship's personnel have when standing sentry duty is a pair of binoculars. Some of the disadvantages of using binoculars are: limited range; limited field of view (especially when looking at one Contact while another Contact is approaching from another direction); a general dependency on fair weather; and the requirement to be hand-held, which can increase the time needed to man a weapon or which can impede the use of a hand-held radio. Likewise, communications using hand-held radios may be limited by the capability of the sentry to describe the on-going events. The sentry must paint a verbal picture of these events, which can lead to misinformation, incorrect information, or untimely information—all of which may lead to a tactical disadvantage.

Another potential disadvantage is attributable to a ship's RHIB. RHIBs are often sent out to engage (e.g., interrogate or otherwise obtain information on) potentially hostile Contacts that turn out not to be a threat to the main ship. (The term "main ship" when used herein should be taken to mean the military platform or other entity of interest on which the primary user interface (or operator console) of the present invention is installed or where "command and control" is located.) This wastes fuel, time, and/or other resources, and generally increases the need for additional maintenance and/or other services—all of which increase costs. Further-

more, engagement of a non-threat Contact may place the RHIB out of position to engage a real threat. Therefore, a need remains for a low-cost, yet robust, protection system that can provide an improved anti-terrorist and/or personnel protection capability for military platforms as well as for other entities of interest, and which is easy-to-use, and relatively simple to manufacture and install.

BRIEF SUMMARY OF THE INVENTION

According to its major aspects and briefly recited, the present invention relates generally, but without limitation, to a combination of devices that, through such combination, comprise an integrated sensor and communication system capable of providing an automated engagement capability.

More specifically, the present invention is an integrated radar and optical (and, possibly, other component and/or) sensor, surveillance and sighting system ("IROS^3") that is capable of providing a "protective umbrella" around a military platform (or other entity of interest). (The terms "platform" and "entity of interest" (in any form) may be considered synonymous, and will be referred to hereinafter as "Platform"). In other words, the IROS^3 integrates sensor information, communication data, and/or lethal and/or less-than-lethal/non-lethal engagement resources in order to provide an improved protection capability. Generally, the IROS^3 is a potentially autonomous system that may be comprised of well-known, commonly used devices, components, and/or one or more of the Platform's other systems or subsystems.

Preferably, the IROS^3 utilizes detection (and/or other relevant) information (and/or other data) from a variety of sources, which may include surface-search/scanning (and/or air-search/scanning) radar, digital navigation systems, and/or from underwater, land-based, space-based or other sensor systems, and/or from other information gathering and/or transmitting devices. Preferably, this information may be primarily used for directing (and/or controlling) the engagement and/or other functions of the IROS^3. As a non-limiting example, the IROS^3 may use detection information (on one or more potential threats) from its surface scanning radar to control one or more of any of the following: electro-optic (and/or any other detection and/or engagement) sensors; high-intensity searchlights (and/or other imaging and/or scanning devices); acoustic hailing device; sentry patrols; manned vehicles; unmanned vehicles (and/or other remotely controlled devices); and/or local and/or remote, weapons. As a result, the IROS^3 can increase the protection posture of the Platform (e.g., a surface ship), and may be able to provide this protection regardless of whether such Platform is stationary or in motion.

Operator control of the present invention may be provided by at least one operator console, and, preferably, besides using hard-wired data/communication lines, the IROS^3 may be able to utilize other means of communications in order to provide wireless transmission and/or reception of the information provided by (or to) the operator console. Regardless of the method of communications used, the IROS^3 is designed to provide such operator console information to all appropriately connected users, which will be referred to herein as the "common tactical scene" ("CTS"). This common tactical scene information may include, but is not limited to, sensor data (including, but not limited to, one or more video feeds), as well as data from other sensors, other inputs, an operator console, and/or from other sources. Preferably the transfer of information can be between (or among), but it is not limited to, the following: local and/or remotely located Platforms; sentries and/or other linked personnel; each RHIB; and any other appropriate facility including, but not limited to, piers and distant command centers. Furthermore, the RHIB, the sentries, and/or other linked users may be able to send video (and/or other information) back to the main ship (or to other linked users) through a variety of components and systems including, but not limited to, electro-optic binoculars, transponders, and/or other suitable information transmission devices.

A feature of the present invention is that it provides an integrated capability to detect, track, classify, and engage potential threats with less-than-lethal/non-lethal and/or lethal options, which provides the advantage of potentially creating a virtual protective envelope around the Platform against waterborne, airborne, and/or underwater threats.

Another feature of the present invention is that it is scalable and flexible, which provides the advantage of allowing the present invention to be tailored to meet a variety of situational awareness, anti-terrorist, force protection, and/or other needs.

Still another feature of the present invention is that it is based on an open-architecture approach with respect to sensor (and/or other) drivers and interfaces, which may provide the advantage of it being able to utilize well-known and readily available devices, components, and/or other systems or subsystems.

Still another feature of the present invention is an ability to provide either or both a lethal and a less-than-lethal/non-lethal engagement response which provides the advantage of handling a variety of engagement situations in a manner that is appropriate to the level of the threat.

It is a further feature of the present invention to be functionally and operationally simple to use and easily installed, yet be highly durable and reliable.

Another feature of the present invention is that it could be effectively used in a variety of environments including, but not limited to, those constrained by personnel considerations, and/or those subject to vibrations due to the nature of the Platform in which the present invention is being used, e.g., on ships and/or vehicles.

Other features and their advantages will be apparent to those skilled in the art from a careful reading of the Detailed Description of the Invention, accompanied by the drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a generic system configuration according to a preferred embodiment of the present invention.

FIGS. **2**A and **2**B is a flow chart illustrating a generic functional sequence comprising detecting, tracking, and/or engaging a single Contact using a preferred embodiment of the present invention.

FIG. **3** is an illustration of the concept of the present invention in a semi-automatic mode of operation according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

While the following discussion illustrates preferred embodiments of the present invention, it does not limit the present invention from being implemented (and/or configured) in a myriad of other manners within the spirit and scope of this Application. Moreover, while the devices, software, circuits, and/or other components used in the

present invention preferably come from the group of devices, software, circuits, and/or other components that are well-known, and/or are commonly (or readily made) available, other means of implementing the present invention may also be used as well. Furthermore, while the name being used herein for the present invention is "Integrated Radar, Optical Surveillance, and Sighting System," it should not be considered that the present invention is limited to using only the named systems, subsystems, and/or components (i.e., "Radar" and/or "Optical" related systems, subsystems, and/or components).

Referring now to FIG. **1**, a block diagram illustrating a generic system configuration of the Integrated Radar, Optical Surveillance, and Sighting System ("IROS^3") **1** is shown. As shown, the IROS^3 **1** can use an Equipment Rack Assembly **10** to at least provide equipment centralization for at least portions of the various integrated systems/components, the (location for or the) majority of the central processing and, possibly, a video distribution capability. In this capacity, the Equipment Rack Assembly **10** can be considered as a hardware and/or software "hub" for the components used in the IROS^3 **1**. Moreover, the Equipment Rack Assembly **10** may be configured to provide power to other IROS^3 **1** components (and/or elements). A preferred embodiment of the IROS^3 **1** may include, but is not limited to, the following components: an Equipment Rack Assembly **10**; a Primary Operator Console **20**A; a Secondary Operator Console **20**B; Electro-Optic Sensors **30**A and **30**B; Weapon Mounts **40**A and **40**B; Searchlights **50**A and **50**B; Antennae #**1 60**A; Antennae #**2 60**B; Radar **60**C; RHIB Peripherals **70**, and/or Optional Sensors and/or Other Components **75**, which, as the label implies, are preferably optional. The Primary Operator Console **20**A and/or the Secondary Operator Console **20**B are the main user interfaces with the IROS^3 **1**, and may provide the user with the ability to control the IROS^3 **1** either manually or through the use of a semi-automatic mode of operation; however, a fully-automatic mode may also be available. The Operator Consoles **20**A and/or **20**B are essentially user workstations housing the hardware and/or at least a portion of the software needed to operate the IROS^3 **1**, and may primarily control the IROS^3 **1** through use of a "hand controller" or a "graphical user interface" ("GUI") at an Operator Console **20**A and/or **20**B, and/or by some other control or interface system or "subsystem(s)." Preferably, at least some computer processing is located within an Operator Console **20**A and/or **20**B; however, this may be generally limited to local processing for the Operator Console **20**A and/or **20**B user interface(s)—with the majority of the processing preferably occurring through the use of components and/or systems at or in the Equipment Rack Assembly **10**. Preferably the Operator Console **20**A and/or **20**B logs into the primary controller (i.e., "Payload Interface Controller" or "PIC"), which is preferably located within the Equipment Rack Assembly **10**, in order to control sensors, and/or other components, systems (or subsystems), and/or to view, process, and/or manipulate system information. Consequently, by configuring the IROS^3 **1** in this way, the IROS^3 **1** may have greater flexibility in adding on users and/or other "operator consoles." Relatedly, the messaging and/or contact tracking functions are handled from a centralized control database, which may be resident at (or on) the Equipment Rack Assembly **10**, and/or in a remote (IROS^3 **1** linked) location, and which may be used to manage most (if not all) of the processing required for the IROS^3 **1**. Generally, the IROS^3 **1** software interfaces with at least some of the following: the Operator Consoles **20**A and/or **20**B, the operator console hand controllers, video switches, and/or digital input/output switches; the Electro-Optic Sensors **50**A and/or **50**B; the Searchlights **30**A and/or **30**B; the Weapon Mount Assemblies **40**A and/or **40**B; the (surface search or other) Radar **60**C; the Antennae **60**A and/or **60**B; the RHIB Peripherals **70**, and/or Optional Sensors and/or Other Components **75**. Moreover, the IROS^3 **1** preferably handles these items as individual payloads. Furthermore, the software may be written in any language, but it is preferably written in C, C++, and/or JAVA. Moreover, the software may provide (or assist in providing) a "common tactical display scene" ("CTS") to all of the IROS^3 **1** users by displaying some portion of the following: digital nautical charts (DNCs) and/or Global Positioning Satellite ("GPS") charts; Contact and/or Platform **300** information; threat rings **315**, **316**, and/or **317** (shown in FIG. **3**); and/or digital data/video from the RHIB and/or other linked users. Still further, each sensor/payload preferably has a direct interface unit, and a slewing capability using the DNCs and the contact list. More specifically, the IROS^3 **1** preferably uses a "Payload Interface Controller" ("PIC") to accept, process, and distribute input to and/or from any combination of sources used by (or the users on) the IROS^3 **1**. Furthermore, the PIC preferably controls most, if not all, camera and gimbal functions, and may be used to provide mechanisms (e.g., switches) to: "arm" the IROS^3 **1**; arm, aim, and/or fire each weapon; operate range (and/or location) detectors; and/or enable, engage, operate and/or provide any other control of the IROS^3 **1**.

Operator control of the present invention may be provided by at least one Operator Console **20**A and/or **20**B; however other means for controlling the IROS^3 **1** may be available including, but not limited to, a remote command-and-control location. The IROS^3 **1** may use hard-wired data/communication lines, and may be able to utilize other means of communications in order to provide remote control and/or use of the IROS^3 **1** including, but not limited to, wireless transmission and/or reception of the information provided by (or to) the operator console. Regardless of the method of communications used, the IROS^3 **1** is designed to provide such operator console information (referred to herein as the "common tactical scene" or "CTS") and/or control of the IROS^3 **1** to all appropriately connected users. As previously mentioned, the CTS information may include, but is not limited to sensor/detector information, and/or imaging information (including, but not limited to, one or more video feeds), as well as information from other inputs, the Operator Console(s) **20**A and/or **20**B, and/or other linked users. Preferably, the transfer of information can be between (or among), but it is not limited to, the following: local and/or remotely located Platforms; sentries and/or other linked personnel; each RHIB **70**; and any other appropriate facility including, but not limited to, distant command centers. Furthermore, the RHIB **70**, the sentries, and/or other linked users may be able to send video (and/or other information) back to the Platform (or to the other linked users) through a variety of components and systems including, but not limited to, electro-optic binoculars, transponders, and/or other suitable information transmission devices. More specifically, and depending on the type of RHIB **70**, the RHIB **70** may be able to communicate with the IROS^3 **1** through either a wireless **85** and/or a wired means **80** (as shown in FIG. **1**).

Preferably, the IROS^3 **1** is configured to use common and well-known communication (and/or electrical) standards including the RS-422, EIA-232 (formerly RS-232), RS-485, NTSC, ethernet, and/or VGA standards; however, other suitable standards could be used as well. Preferably, either or both Operator Consoles **20**A and **20**B are configured to have

at least one information display (and/or display system), and, in a preferred embodiment, each Operator Console **20**A and B may have at least one video display to provide video from video input sources such as video cameras. Any camera used to provide these video pictures may be either locally and/or remotely located, and may be capable of providing the transmission of their video signals via hardwired and/or wireless transmission means including, but not limited to, encrypted (and/or non-encrypted) shore-based, air-based, ship (or boat) based, and/or satellite feeds. Furthermore, these (and, possibly, other non-hardwired) signals are preferably fed into the IROS^3 **1** via Antenna #**1** **60**A and/or Antenna #**2** **60**B. To provide these video pictures to the user, the IROS^3 **1** may use any video display system that has the capability to process and display standard video signal formats such as, but not limited to, the VGA, NTSC, and/or other suitable formats, and may be able to provide well-known multiple "picture-in-picture," and/or other video capabilities as well. Other related features that may be used with the IROS^3 **1** include, but are not limited to, capturing some portion of the video (and/or other information) on at least one digital video recorder (or onto one or more hard-drives or other recording medium) so that the information may be capable of being played back upon demand. Preferably, the IROS^3 **1** is fully functional in all weather conditions and in any lighting condition—from full daylight to total blackout conditions—and may be configured to be usable with night vision goggles or other night vision aids as well. In a preferred embodiment, other information may also be provided to the user(s) by either or both Operator Consoles **20**A and **20**B (or from other IROS^3 **1** linked sources). This information may be associated with (or a part of) the previously mentioned CTS information and may include, but is not limited to, digital maps and/or navigation charts, informational overlays, Platform and/or Contact status information including, but not limited to: location; speed; and/or direction of motion. Information associated with the IROS^3 **1** and/or its components including, but not limited to, visual and/or audible alarms to alert the user of conditions requiring such notification, and/or any other information that may be needed to provide the functions and/or to meet the purposes of the IROS^3 **1** may also be provided. Moreover, the provision of information and/or operational control of the IROS^3 **1** may be facilitated by one (or more) GUI-based system, which may include at least one touch-sensitive display screen. While the use of at least one GUI-based system is preferable, non-GUI-based systems can be used as well. Preferably, these control systems are at least located on the Operator Consoles **20**A and **20**B. Moreover, the Operator Consoles **20**A and **20**B may house or incorporate other facilitation and/or control means and/or methods including, but not limited to, the hardware and/or software needed to incorporate at least one computer-like keyboard, hand-controller, track-ball (or other digital pointing device), and/or other devices. More specifically, the means and/or methods discussed above may be used to at least control the information flow between the users of the IROS^3 **1** and/or the functions of any of the following: local and/or remote cameras; the Weapon Mounts **40**A and **40**B; the Electro-Optic Sensors **50**A and **50**B; the Searchlights **30**A and **30**B; the Radar **60**C; communications (and/or other signal transmission, reception, and/or processing functions); and/or any other IROS^3 **1** linked peripheral equipment including, but not limited to, the Optional Sensors and/or Other Components **75**, or the RHIB Peripherals **70** (to be discussed below). The Operator Consoles **20**A and **20**B and the Equipment Rack Assembly **10** may be located within the interior of the Platform and, preferably, such location(s) will be within at least one well protected area. Many of the other components and/or systems, including, but not limited to, at least some portion of the following: the Electro-Optic Sensors **30**A and **30**B; the Weapon Mounts **40**A and **40**B; the Searchlights **50**A and SOB; Antennae #**1** **60**A; Antennae #**2** **60**B; and/or the Radar **60**C, may be located on or near the exterior of the Platform and, preferably, in locations that could possibly maximize the performance of the IROS^3 **1**—preferably by considering and by possibly maximizing at least some of the following characteristics: Field-of-View, Contact detection, tracking and/or engaging; and/or communications (including the transmission of operational and/or control data and/or signals). Relatedly, the RHIB Peripherals **70**, and/or possibly one of more of the Optional Sensors and/or Other Components **75** may be located away from the Platform, and, if any are so located, they may be able to communicate with the IROS^3 **1** using a wired and/or wireless means. It should be noted, however, that while these aforementioned methods and/or means of operating and/or controlling the IROS^3 **1** may be preferable, any other suitable means and/or methods could be used as well including, but not limited to, those methods and/or means that are equivalent to those discussed herein.

In general, the IROS^3 **1** may use, but is not limited to, one or more of the following: searchlights, weapons, sensors/detectors, antennae, and/or communications devices, as part of the IROS^3 **1** system. In a preferred embodiment shown in FIG. **1**, the IROS^3 **1** has two searchlights, two weapon assemblies, two electro-optic sensors, two antennae and/or communication devices, a radar, and peripheral "equipment," which may include, but is not limited to the RHIB. The Searchlights **30**A and **30**B are preferably high powered, long-range, and high-intensity (i.e., large candela rating) lights, and, as an example, may be of the type commonly used as security lighting at military installations and/or as surveillance lighting on military and/or law enforcement ships and/or aircraft. Preferably the Searchlights **30**A and **30**B are capable of being remotely operated by the IROS^3 **1**, and may include an automatic Contact-tracking capability. Preferably, the Electro-Optic Sensors **50**A and **50**B may be (or are similar to) the Wescam Model 14Q; however, other EO sensors and/or vision systems could also be used including, but not limited to, Argos Vision System's POP-200, Raytheon's AN/AAS-44, which includes a laser designator for targeting, and/or Raytheon's AN/AAS-52 Multispectral Targeting System (MTS), which, in general, is a sensor ball incorporating a laser designator and color EO and IR cameras. Likewise, the Radar **60**C may be (or is similar to) the Furuno Model 841 and/or the Model 8111-4 radar, which are of the surface scanning/search type radars. However, other radar (and/or detection) systems could also be employed as primary, secondary, and/or as additional detection components of the IROS^3 **1**. For example, the IROS^3 **1** may use one or more air-scanning/air-search radar, combination air and surface-scanning/search radar, IR and/or other electromagnetic energy detection device, sonar and/or other acoustic-based detection device. Moreover, the IROS^3 **1** may use one or more motion detection device including, but not limited to, those that are (or may be) based on ultrasonics, "magnetic anomaly detection" or "broadband electromagnetic detection and discrimination." Moreover, Antenna #**1** **60**A may at least be used as a "Time Synchronization Server," which may be used to obtain a time signal for the IROS^3 **1** from a GPS satellite or other suitable device, and either or both antennae **60**A and/or **60**B may be used for communications.

The ability of the IROS[3] **1** to engage a Contact may be provided by weapons that are attached or mounted onto the Weapon Mount Assemblies **40**A and/or **40**B. Preferably, each Weapon Mount Assembly **40**A or **40**B may be generally described as a motorized support or base that is configured to accept a variety of weapons through the use of mounting hardware and/or other components, and is preferably configured to provide up to a full panning and/or tilting capability for the aiming and/or firing of a weapon. However, full panning and/or tilting may be limited by safety interlocks, which may be implemented electronically and/or by using "hard-stops" on the Weapon Mount. Assembly **40**A and/or **40**B. The Weapon Mount Assemblies **40**A and **40**B preferably use high-speed motors and are provided with at least one motion compensation (and/or stabilization) system to compensate for Platform motion, e.g., the pitch and roll of a ship. In this regard, at least one-axis of stabilization may be provided, but preferably at least two-axes of stabilization are used with the IROS[3] **1**. Preferably, manual, or semi-automatic control of the Weapon Mount Assemblies **40**A and/or **40**B (and, therefore, the weapons) are provided at the operator console; however, a fully automatic mode may be available as well. In one embodiment of the IROS[3] **1**, the Weapon Mount Assemblies **40**A and **40**B are configured to handle loads weighing up to about 250 lbs. This allows the IROS[3] **1** to control a variety of weapons including, but not limited to, small arms products, missiles, and directed energy weapons. As a non-limiting example, the IROS[3] **1** may use weapons like (or similar to): the GAU-17A, 7.62 mm Gatling gun; single (or twin) M2 HG, .50 caliber machine guns; MK 19, 40 mm grenade launcher; the M60 or M240 machine gun; and/or a variety of less-than-lethal, or a combination lethal/less-than-lethal weapons. Less-than-lethal weapons may include, but are not limited to, flares, acoustic-based, chemical-based, and/or odorant-based instruments, as well as other appropriate offensive and/or defensive means of deterrence and/or suppression. Moreover, the Weapon Mount Assemblies **40**A and **40**B may be provided with at least one video or other imaging transmission device, which may include, but is not limited to, an infrared camera, and/or at least one electro-optic sensor. Moreover, it may be configured with an auto-Contact-tracking feature, which may include the use of the above-mentioned electro-optic sensor. Furthermore, the Weapon Mount Assemblies **40**A and **40**B may accept tracking, aiming and/or firing signals from one of more of the following: any (or all) of the Antennae **60**A and/or **60**B; through the Operator Consoles **20**A or **20**B; the Radar **60**C; any (or all) of the Electro-Optic Sensors **50**A and/or **50**B; and/or preferably through the Weapon Mount Assembly itself **40**A or **40**B—preferably by using an on-Mount **40**A and/or **40**B electro-optic camera with auto-tracking capability.

The IROS[3] **1** may be configured to have at least two modes of operation. Preferably, these modes are a "Semi-Automatic" and a "Manual" mode; however, other modes including, but not limited to, a "Fully Automatic" mode may also be available. While a Semi-Automatic mode is preferred, the Manual mode, if available, may be used to override semi-automatic and/or automatic responses from the IROS[3] **1**, and such mode may be configured so that automatic functions and/or alarms are unavailable. Moreover, the Semi-Automatic mode may include the below-described semi-automated responses, which are used to execute the IROS[3] **1** "Detect-To-Engage" sequence **200** (shown in FIG. **2**A, and showing detail of a FIG. **2**A sequence step **265**X on FIG. **2**B). [Also, FIG. **2**B shows a LEGEND **288** for the symbols shown in FIGS. **2**A and **2**B.]

In operation, at least the Detect-To-Engage sequence **200** may be based on providing virtual Platform-enclosing areas of protection. Referring now to FIG. **3**, an example of such areas is shown. In FIG. **3**, a ship is used as a representative example of a Platform **300**, and, as shown, is located in Area "D" **340** and is enclosed within Area "C" **330**, Area "B" **320**, and Area "A" **310**. (While concentric circles are described in the example herein (as shown in FIG. **3**), other suitable boundaries, of other varying shapes and/or sizes, can preferably be set by the user and/or automatically set or adjusted by the IROS[3] **1**.) In this regard, the IROS[3] **1** can be configured to have default settings for each boundary, and, as an example, a default setting of three concentric circles having radii of five thousand (5000) yards **317**, seventy-five hundred (7500) yards **316**, and ten-thousand (10000) yards **315** from the Platform **300** could be used. Relatedly, also shown in FIG. **3**, other boundary or sub-boundary areas could be separately or concurrently established and used. As a non-limiting example, the IROS[3] **1** may be capable of allowing the user to establish sectors of high and/or low importance (or concern), and/or may allow the user to characterize and/or define areas in a variety of other manners or for a variety of other purposes. As a non-limiting example, which is shown in FIG. **3**, an area not requiring a response, or a "No Response Sector" **370**, and/or a "Closest Point of Approach Sector" ("CPA Sector") **380**A and/or **380**B can be established. In addition, as shown in FIG. **3**, a "No Response Sector" **370** is the area bounded by the IROS[3] **1** generated No Response Boundary Lines **371** and **372**, and two "CPA Sectors" **380**A and **380**B are the areas bounded by the IROS[3] **1** generated CPA Boundary Lines **381** and **382**, and **382** and **383**, respectively. A purpose for a "No Response Sector" **370** may include, but is not limited to, the provision of the ability to allow a user to ignore a particular area of "non" interest while one purpose for a "CPA Sector" **380**A and/or **380**B may be, but is not limited to, allowing a user to establish areas that may be of special concern. Preferably, the number of boundaries and/or sectors, and/or their shape may be user-defined and then made a part of the CTS, either as a separate boundary or as an overlay to the threat rings or other CTS boundaries, and, while this may be preferable, the number of sectors and/or their shape may be predetermined and possibly hard-coded as well. One "tracking" (or surveillance) method that may be used with the "CPA Sectors" **380**A and/or **380**B, or possibly with any other IROS[3] **1** boundary, is known as the "Closest Point of Approach" ("CPA"). Generally, this method is based on the making of a, preferably, computerized determination of the closest possible distance between two dynamically moving objects, and is commonly used as an important calculation for collision avoidance systems. In many cases of interest, the objects (or Contacts), and/or the Platform **300**, are commonly referred to as "tracks." These "tracks" can be generally described as "points" moving in two fixed directions at fixed speeds, and are moving along two lines in space. However, their closest distance is not always the same as the closest distance between the lines since the distance between the points must be computed at the same moment in time. Therefore, even in two-dimensional space, moving points (or objects and/or Contacts) located on two intersecting lines (or tracks) may remain far apart. However, if one of the tracks is stationary, then the CPA of another moving track is at the base of the perpendicular from the first track to the second object's line of motion, which may be utilized in making the CPA determination. More specifically, CPA

criteria, which may be used in defining a "CPA Sector" **380**A and **380**B, also may include, but is not limited to, sector identifiers, locations, time and/or distance thresholds. Then, if one of the established thresholds is exceeded by a Contact (and/or object), the IROS^3 **1** can provide an audible alert to the user and/or perform other actions as appropriate. In this regard, therefore, it may be possible that the users of the IROS^3 **1** may not be using the CPA tracking method for the reason of collision avoidance in the classic sense, but may be concerned with collision avoidance in the sense that a Contact could be loaded with explosives and is making a direct line for the Platform at a high rate of speed.

As background of the operation of the IROS^3 **1** and in general, while the IROS^3 **1** is monitoring the environment, if there are no Contacts, the Platform **300** and/or the IROS^3 **1** could be considered to be in a base-line monitoring or tracking level, which can be described as a low "situational awareness" level. This situational awareness level changes, however, when a Contact enters one of the monitored areas **310**, **320**, **330** or **340** (as shown in FIG. **3**) and as represented by several of the Sequence **200** blocks **202**, **210**, **222**, and **242** (as shown in FIG. **2**A). Furthermore, as shown by the Sequence **200**, the level of the response that a change in situational awareness entails (which may be semi-automatic, manual, and/or automatic) is symbolized by the activity represented by the blocks that are linked to these blocks **202**, **210**, **222**, or **242**. Moreover, as is readily apparent from the Sequence **200**, as the distance between a Contact and the Platform **300** decreases, the level of response preferably increases, and vice versa. It should be noted, however, that a Contact identified as friendly may be removed from consideration by the IROS^3 **1** and/or the user/operator, and, as a non-limiting example, this may be accomplished by the software and/or hardware used for providing the display of the common tactical scene. Now referring to FIGS. **1**, **2**A, **2**B, and **3**, a non-limiting example of the Semi-Automatic mode, Detect-To-Engage **200** sequence (Sequence) follows.

First of all, one of the IROS^3 **1** sensors detects a Contact. In this example, a Contact enters Area "A" **310** (as shown in FIG. **3** and by the "Contact enters Area 'A'" block **202** on FIG. **2**A), and is detected by the Radar **60**C (as shown in FIG. **1**). The Radar **60**C, for this example, is a surface-search radar ("SSR"), and the detection is represented by the "Contact detected by SSR" block **204**. Additionally, the display of information associated with the common tactical scene and/or the detection of the Contact is represented by the "CTS displays Contact" block **206**. Optional user intervention is represented by the "Operator Action (Optional)" block **208** and the "X" block **265**X, which refers to the manual and/or slaved operations shown in FIG. **2**B. Next, if the Contact changes situational status by moving from Area "A" **310** into Area "B" **320**, the next portion of the Sequence **200** is entered. This portion may include one or more of the following blocks: "Contact enters Area "B" **210**; "Audible Alarm" **212**; "Alarm Clears" **218**; user intervention blocks represented by "Operator Action (Optional)" **220** and "X" **265**X; and/or Contact location status (or situational awareness level) change blocks as represented by "Contact re-enters Area 'A'" **214** or "Contact enters Area 'C'" **222**. More specifically, if the Contact enters Area "B" **320** by crossing the outer circle (or boundary interface) **315**, which has a default setting of ten-thousand yards in this example, at least one audible and/or visual alarm is activated at the Operator Consoles **20**A and **20**B, and, possibly, to any of the linked remote users of the IROS^3 **1**. Moreover, each operator and/or user may have the discretion to at least acknowledge alarms, view the data on the Contact (including, but not limited to, visual images of the Contact), and/or place the IROS^3 **1** in Manual, Semi-Automatic, or Automatic Mode at this time. If the Contact crosses the second boundary interface **316** and enters into Area "C" **330**, which occurs at seventy-five hundred yards in this example, and, "if available" (i.e., not currently being used for tracking of another Contact, or etc.), the appropriate (which may be the closest) Electro-Optic Sensor **50**A or **50**B and Searchlight **30**A or **30**B may be slaved to the Contact. This may allow for the auto-tracking of the Contact with the Electro-Optic Sensor **50**A or **50**B, with the Radar **60**C (as represented by blocks **222** and **224**), and/or with any other tracking components or devices. However, and alternatively, the IROS^3 **1** user/operator may manually control the Electro-Optic Sensor **50**A or **50**B and/or the Searchlights **30**A or **30**B to track the Contact. In other words, the operator (and/or user), the appropriate Electro-Optic Sensor **50**A or **50**B, and/or Searchlight **30**A or **30**B may follow or track the Contact by using the manual and/or automatic tracking features of the IROS^3 **1**. This portion of the Sequence **200** may also include one or more of the following blocks: "Remain Slaved" **232**; "Disengage Slave" **230**; "Engage EO Autotracker (Y/N)" **238**; "Tune EO Picture" **236**; and/or a Contact location status (or situational awareness level) change block represented by "Contact re-enters Area 'B'" **226**, which may be associated with the "Break Slave on Contact" block **228**.

Continuing with the example, the maximum situational awareness level may occur when a Contact crosses the inner boundary interface **317** and enters into Area "D," which occurs at five thousand yards in this example. Under these circumstances, at least one prompt may be displayed to each operator (and/or user) to slave the Weapon Mount Assembly **40**A and/or **40**B to the Contact (as represented by the "Weapon Slave Prompt" block **244**). Preferably, all other operator (and/or user) actions are locked out until the operator (and/or user) responds to the Weapon Slave Prompt **244**, e.g., YES or NO selections may be made via the Operator Consoles **20**A and **20**—as respectively represented by the "Operator Accepts" block **246** and the "Operator Rejects" block **248**. Then, if the operator (and/or user) chooses to slave either (or both of) the Weapon Mount Assembly **40**A and/or **40**B to the Contact, the Weapon Mount Assembly **40**A and/or **40**B may automatically "follow" the Contact's movements. As a non-limiting example, this may be implemented by using an Electro-Optic sensor **50**A and/or **50**B and/or radar **60**C, and/or by using an auto-tracker sending signals to either or both of the Weapon Mount Assembly's **40**A and/or **40**B controller(s), and, preferably, at least one electro-optic sensor and/or auto-tracker (not shown) may be mounted to the Weapon Mount Assembly **40**A and/or **40**B to provide this feature. At this point in the Sequence **200**, the Contact (target) may be lethally (or less-than-lethally) engaged-depending on the weapon and/or the discretion of the operator (and/or user). Moreover, this portion of the Sequence **200** may include one or more of the following blocks: "Contact enters Area "D" **242**; "Weapon Slave Prompt" **244**; and "Operator Rejects" **248**, "Remain Slaved" **250**, and "X" **265**X or, alternatively, "Operator Accepts" **246**, and "Weapon Slaves to Contact via SSR/EO Sensor/Antenna." Preferably, such slaving may be implemented with an on-Weapon Mount **40**A and/or **40**B electro-optic sensor having auto-tracking capability. Associated with this block **252**, are the additional user intervention blocks represented by "Disengage Slave" **256**, "Tune EO Picture (WM)" **258**, "Engage EO Autotracker WM" (Y/N) **260**, "Operator Action (Optional)" **261**, "Engage EO Autotracker WM (Y/N) **262**, and/or "Engage Contact" **264**.

["Tune EO Picture (WM)" **258**, represents the tuning of the images from the Weapon Mount Assembly **40**A and/or **40**B, and "Engage EO Autotracker WM (Y/N) **260** and **262**, represents the autotracker feature of the electro-optical device associated with the Weapon Mount Assembly **40**A and/or **40**B.] Also possibly associated with this portion of the Sequence **200** is the Contact location status (or situational awareness) change block represented by "Contact re-enters Area 'C'" **240**. Preferably, if a Contact of interest turns away from the Platform **300** and leaves Area "D" **340**, Area "C" **330**, and/or Area "B"**320**, the operator (and/or user) may release control of the "engaged" Weapon Mount Assembly **40**A and/or **40**B, and/or the IROS^3 **1** may be configured so that semi-automated (and/or fully-automated) responses are not automatically initiated for any retreating Contact.

Finally, it will be apparent to those skilled in the art of surveillance systems design (and/or other related fields) that many other modifications and/or substitutions can be made to the foregoing preferred embodiments without departing from the spirit and scope of the present invention. The preferred embodiments and the best mode of the present invention are described herein. However, it should be understood that the best mode for carrying out the invention herein described is by way of illustration and not by way of limitation. Therefore, it is intended that the scope of the present invention include all of the modifications that incorporate its principal design features, and that the scope and limitations of the present invention should be determined by the scope of the appended claims and their equivalents.

What is claimed is:

1. A protection system, said protection system comprising:

a. a plurality of sensors for detecting at least one target object and for generating at least one information signal corresponding to each said at least one target object, wherein said plurality of sensors includes at least one electro-optic device; and

b. means, in operational communications with said plurality of sensors, for generating a display, wherein said display generating means is capable of at least processing said at least one information signal and providing at least a visual representation of information associated with a common tactical scene, said common tactical scene comprising status information on at least one of said at least one target object, said status information comprising information on at least one of the location, speed, and direction of motion, of said at least one target object.

2. The protection system as recited in claim **1**, wherein said common tactical scene further comprises:

a. at least one digital map;

b. at least one navigation chart;

c. at least one video image; and

d. at least one virtual boundary area around said protection system.

3. The protection system as recited in claim **1**, wherein said common tactical scene further comprises information received from a Global Positioning Satellite.

4. The protection system as recited in claim **1**, wherein said plurality of sensors further comprises at least one surface search radar.

5. The protection system as recited in claim **2**, wherein said at least one virtual boundary area is used for establishing an operational criteria for causing said protection system to:

a. remain in its current level of protection;

b. change to a greater level of protection; or

c. change to a lesser level of protection.

6. The protection system as recited in claim **2**, wherein said protection system is capable of providing said common tactical scene to at least one remote user in wireless operational communications with said protection system.

7. A protection system, said protection system comprising:

a. a plurality of sensors for at least detecting at least one target object, and for at least generating target object information signals corresponding to said at least one target object, wherein said plurality of sensors comprises at least one surface search radar and at least one electro-optic device;

b. means, in operational communications with said plurality of sensors, for operationally controlling said protection system;

c. means, in operational communications with said operationally controlling means, for providing communications for said protection system, wherein said communications means is capable of transmitting and receiving at least said target object information signals; and

d. at least one protection system information displaying means, in operational communications with said operationally controlling means, for displaying protection system information to at least one user.

8. The protection system as recited in claim **7**, wherein said communication means further comprises a means for wireless communications.

9. The protection system as recited in claim **7**, further comprising:

a. at least one weapon; and

b. at least one means, in operational communications with said operationally controlling means, for remotely aiming and firing said at least one weapon at any of said at least one target object.

10. The protection system as recited in claim **8**, wherein said wireless communications is between said protection system and at least one remote user of said protection system.

11. The protection system as recited in claim **8**, wherein said wireless communication is between said protection system and at least one remotely connected sensor.

12. The protection system as recited in claim **9**, wherein said at least one weapon is capable of being manually aimed and fired at any of said at least one target object by said at least one user of said protection system, wherein said at least one user is remotely located from said at least one weapon.

13. The protection system as recited in claim **11**, wherein said at least one remotely connected sensor is carried on an aerial vehicle.

14. The protection system as recited in claim **11**, wherein said at least one remotely connected sensor is carried on a water vehicle.

15. The protection system as recited in claim **11**, wherein said at least one remotely connected sensor is land-based.

16. The protection system as recited in claim **11**, wherein said at least one remotely connected sensor is space-based.

17. A protection system, said protection system comprising:

a. a plurality of sensors for detecting at least one target object and for generating at least one information signal corresponding to said at least one target object;

b. means, in operational communications with said plurality of sensors, for processing said at least one information signal;

c. at least one operator console, in operational communications with said processing means, for providing at least one user with the ability to operationally control said protection system;

d. means, in operational communications with said processing means, for generating a display, wherein said display generating means is capable of incorporating said at least one information signal as part of said display and is further capable of providing at least a visual representation of information associated with a common tactical scene, said common tactical scene comprising:

(i) digital maps;

(ii) navigation charts;

(iii) status information on said at least one target object, said status information comprising information on at least one of the location, speed, and direction of motion, of said at least one target object;

(iv) video images; and

(v) at least one virtual boundary area around said protection system;

e. means, in operational communications with said processing means, for generating a tracking signal for each said at least one target object;

f. means, in operational communications with said at least one operator console, for providing wired and wireless communications for said protection system; and

g. means, in operational communications with said processing means, for engaging said at least one target object.

18. The protection system as recited in claim **17**, wherein said common tactical scene further comprises information received from a Global Positioning Satellite.

19. The protection system as recited in claim **17**, wherein said at least one boundary area is used for establishing an operational criteria for causing said protection system to:

a. remain in its current level of protection;

b. change to a greater level of protection; or

c. change to a lesser level of protection.

20. The protection system as recited in claim **17**, wherein said protection system is capable of providing said common tactical scene to at least one remote user in wireless operational communications with said protection system.

* * * * *