Title: A MONITORING SYSTEM FOR MARINE VESSELS

Abstract: A monitoring system for marine vessels including a data processor (10) arranged to be located on a marine vessel and having at least one data input for receiving data from at least one input device (11, 12, 13), the data relating to activities on board the vessel whereby a record of the activities can be obtained.
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A MONITORING SYSTEM FOR MARINE VESSELS

TECHNICAL FIELD

The present invention relates to monitoring of activities aboard marine vessels.

BACKGROUND OF THE INVENTION

Activities on board marine vessels may be monitored by putting in place a human observer. However, this approach has drawbacks. For example, many countries have a fishing management authority which is responsible for managing commercial fishing operations, to a large extent to prevent over-fishing and therefore maintain a sustainable fishing industry.

As part of the management process fishing authorities allow commercial fishing operations to use a specified number of fishing lines and fishing hooks. Fishing operations are also closely monitored to establish where fishing takes place.

To monitor fishing operations a human observer may be deployed on a fishing vessel and this person needs to record operations which occur on the vessel. This is expensive because it requires a person to be provided on each fishing vessel. Furthermore, effective recordal of fishing activities is dependent upon the abilities of the management personnel and the co-operation of personnel on board the fishing vessel.

It would be advantageous to monitor activities on board marine vessels without the need for human observers on board the vessel.

SUMMARY OF THE INVENTION

In one aspect the present invention provides a
monitoring system for marine vessels including: a data processor arranged to be located on a marine vessel and having at least one data input for receiving data from at least one input device, the data relating to activities on board the vessel whereby a record of the activities can be obtained.

The monitoring system may further include a transmitter arranged to be located on the vessel and to be operatively connected to the data processor, whereby the data relating to activities of the vessel may be transmitted to be received at a remote location.

The at least one input device may include a camera.
The camera may be a video camera.
The at least one input device may include a microphone.
The at least one input device may include a hydraulic pressure sensor.
The at least one input device may include a drum monitor.
The at least one input device may include a sensor to determine the rate of flow of water from a bilge pump.
The at least one input device may include a water oil content monitor.
The at least one input device may include a tackle monitoring means which is means is configured to sense an event signifying attachment of a fishing tackle item to a fishing line.

It is preferred that fishing tackle items include hooks, clips, floats or buoys.
The event may include an audible indication that items should be attached to a fishing line or alternatively or in addition a visual indication and/or electrical, analog or digital transmissions.
Preferably the tackle monitoring means includes an electrical sensor for sensing an electrical signal corresponding to the audible indication.

The audible indication may be an audible noise of a predetermined configuration or type such as a beep, barp, or beep barp etc.

Preferably the audible indicator emits different audible noises to signify that different items of fishing tackle need to be attached to a fishing line.

The audible noises may be emitted by a line controller device.

The tackle monitoring means may be connected to the line controller device.

Preferably the tackle monitoring means is configured to sense a current/voltage of a predetermined amplitude/frequency or period occurring in the line controller, which is utilised to generate the audible indication.

Preferably the tackle monitoring means is adapted to sense a predetermined current/voltage corresponding to different audible sounds representing the attachment of different items to the fishing line.

It is preferred that the system includes a line monitoring means for monitoring at least one characteristic of a fishing line.

The line monitoring means preferably includes at least one line monitor.

The system may include a plurality of line monitors each for monitoring a different fishing line.

Preferably each fishing line is wound onto a drum.

The line monitoring means may be connected to the data processor so as to transmit a line signal to the data processor which line signal represents a monitored/sensed
characteristic of a fishing line.

The line monitoring means preferably detects the number of revolutions of a fishing line drum.

Preferably the data processor is adapted to calculate the length of a line which has been deployed based on data received from the line monitoring means.

The data processor may be adapted to receive data from the line monitoring means relating to the rate of release of line and/or number of drums used and/or the/each drum direction.

Preferably the tackle monitoring means detects any one or more of:

number of clips counted on any drum;
number of hooks attached to a line;
number floats attached to a line;
number of buoys attached to a line; and
line spacing of any one or more of the above.

The camera may be positioned to capture images of any one or more of the or each fishing line, fishing drum, deployment of fishing line, fish caught.

The at least one input device may include a location monitoring means for monitoring the location of the vessel at a particular time.

The location monitoring means may be adapted to send data to the data processor relating to the location of any line deployed from the fishing vessel and/or the time of deployment and/or the location and/or time of deployment of any fishing tackle items.

The location monitoring means may include a GPS system or VMS.

The transmitter may be arranged to periodically transmit the data relating to activities.

The data processor is preferably adapted to calculate
hook counts, float counts, buoy counts, line spacing, time and date stamping when a drum is retrieving or releasing fishing line, when it is started, stopped and location of any one or more of the above events.

Preferably the data is transmitted to the base station at a predetermined time.

The predetermined time may be stored in the central processor or a central controller at the base station.

The data may be transmitted to the base station following a command signal transmitted to the central processor from the base station.

The data processor may have a storage means for storing data over a predetermined period of time.

The storage means may be located remote from the data processor.

It is preferred that the system includes an anti-tamper means for producing an alarm signal if there is unauthorised entry of an enclosure housing the central processor.

The anti-tamper means may produce an alarm signal if the storage means is tampered with.

Preferably the anti-tamper means is configured to transmit the alarm signal to the base station.

Preferably the anti-tamper means is adapted to identify the time and location of the tampering event, log this information and either store the information in the storage means or transmit the information.

The anti-tamper means preferably produces an alarm signal if data is corrupted.

The sensed data may be encrypted by the data processor.

The remote location may store a decryption code for decrypting sensed data encrypted and transmitted from the
data processor.

The encrypted data may be stored in the storage means.

It is preferred that the data processor tags data with an identifier associated with the vessel on which the central processor is located.

The system may further include a receiver for receiving command signals from a remote location.

Preferably the command signals may be used to control operation of any of the sensors by appropriate command signals.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a first embodiment of a system for monitoring activities on a marine vessel in the case of a fishing vessel and fishing activities are monitored; and

Figure 2 is a schematic diagram of a system for monitoring activities on a marine vessel according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

As shown in Figure 1 the monitoring system includes a data processor in the form of programmable logic controller 10 (PLC) which is located on a marine vessel and includes data inputs for receiving data from input devices 11, 12, 13. The input devices sense data relating to activities on board the vessel and this data is provided to PLC 10 whereby a record of the activities can be obtained.
Input devices are shown including a tackle monitoring means in the form of line controller sensors 11 and line monitoring means in the form of reed switches 12. Both of these devices are hardwired to PLC 10.

A video surveillance system 14 incorporating video cameras is linked to the PLC 10 through a wireless communication system.

PLC 10 is used to receive all data and processes it so that it may be recorded on the vessel or transmitted off the vessel to a remote location for storage or viewing.

PLC 10 is configured so that it can receive inputs from each of the above-identified components even though the components may transmit data in different formats or based on different signal types.

A line controller is a device that alerts a fisherman on board a vessel of the correct time during letting out a long line to attach various items of tackle to the line. These long lines can reach many kilometres in length. As a long line is let out from the vessel, clips, hooks, floats and buoys are attached at controlled intervals. The line controller signals to the fisherman to attach an item of tackle by making various audible sounds. Different sounds correspond to different items of tackle.

So, a “barp” sound might indicate the need to attach a float. A “beep barp” sound might indicate the need to attach a buoy.

Line controller sensors 11 monitor changes in voltage levels within the line controller at the output stage of the line controller. The sensors may pick up changes in voltage levels, the length of any output pulse by the line controller as well as the frequency of any output voltage or current.
The sensed voltage, and/or current is indicative of the signal output by the line controller to activate an audible alarm. Therefore, if the line controller produces a beep sound, this may be characterised by an output voltage of a predetermined level and period and so it can be monitored and converted at the PLC to signify a beep and therefore the time when a hook should be connected to a fishing line. Consequently every time a beep is detected by the PLC an accumulator in the PLC stores data relating to the number of beeps and therefore the number of hooks which should have been attached to the line each time the beep occurred.

A similar process occurs for other sensors in the line controller which monitor different sounds characterised by different voltage outputs of different periods. The PLC has separate accumulators for each type of sound which is detected (in the form of a voltage output) and an accumulated count of each type of sound can be stored in the PLC.

If a "barp" is sounded by the line controller the PLC will record a voltage signal received representing the occurrence of the "barp", which corresponds to the attachment of a float to the fishing line. Likewise, the recordal of voltage output corresponding to a "beep barp" signal would be recorded by the PLC to represent the attachment of a buoy to a fishing line. In addition to recording each time a sound is emitted from the line controller the corresponding location of the vessel at that time will also be recorded in an appropriate memory location by the PLC. Thus the PLC matches the location information received from the location monitoring unit 13 and stores this with the time the voltage output signal was sensed in the line controller.
From the above it can be seen that over a period of time a log can be provided of the occurrence of every voltage output signal from the line controller in addition to the associated time and location of the vessel.

In addition to the above the PLC is connected to reed switches 12 of the fishing line drums. The reed switches 12 are opened and closed at predetermined times corresponding to each revolution of the drum and/or each time the drum is operated (forward or in reverse). This data may be recorded as a simple on/off signal which again is stored in the PLC along with time and location data retrieved from the location monitoring unit 13. As an alternative to reed switches, other sensors could be used such as mercury switches, magnetic proximity sensors or optical sensors. The important thing is that the rotation of the drum is sensed.

In addition to the above, video cameras 14 are also mounted somewhere on the fishing vessel to monitor the line controller and fishing line drums. Data is continuously captured by the cameras and transmitted to the PLC 10. The transmission may be through wireless communication or through cabling. Data received from the cameras is also associated with timing and location information in a similar fashion to the other data received from the line controller sensors 11 and reed switches 12. In this way video images captured at a particular time and location can be compared to the data received from the other sensors. This provides a backup capability or checking facility in case other data received is corrupted in some fashion.

The PLC 10 is specially configured to be able to receive data inputs as well the electrical analog and digital inputs from the other sensors. The PLC 10 may
store all of the data in an appropriate memory location and medium such as a computer hard drive or the information may be continuously downloaded in information packets to a remote receiving station which could be onshore.

It is also possible that the PLC can be remotely controlled so that movement of the cameras 14 can also be controlled.

It is preferred that the cameras be black and white units that will send all data via a wireless LAN back to the PLC for storage. Transmissions may be at one frame per second to reduce storage requirements.

Provision may be made to monitor trawler type fishing by monitoring net deployment or hauling in of nets with a video camera. Activation of the hydraulic equipment that is used with trawler nets may be monitored to provide an indication of trawler fishing activity.

Another embodiment of the invention is shown in Figure 2. In this embodiment the monitoring system includes a data processor in the form of process controller 20 preferably with a back-up internal battery supply if external power supply is unavailable. Process controller 20 has a number of direct analog and digital inputs and outputs. Video inputs are connected to day-night cameras 21 and discreet cameras 22. Digital inputs are connected to drum counters 23 and line shooters 24.

Process controller 20 includes a microprocessor and operates under the control of a computer program.

Analog inputs are connected to temperature and turbidity sensors 25. Inputs are also connected to click counters 26 and to a GPS navigation device 27. Hydraulic pressure sensors 35 and other mechanical equipment such as water oil content meter 36 in the bilge or bilge pump flow
rate sensor 37 on board the vessel are connected to other inputs of the process controller 20. The process controller 20 is connected to an onboard data storage device 29. Both the process controller 20 and data storage device 20 are connected to a transceiver 34 preferably mounted on the vessel mast. Transceiver 34 is able to communicate via satellite 30 or wireless LAN or GPRS 31. All remote communications are directed to a base station 32 through integration software 33 associated with a land based transmitter/receiver.

In use the process controller 20 receives all data from the sensors 21 to 28, 35, 36 & 37. The time and place of the data is logged and stored on the onboard data storage device 29.

Before storage, or as soon as the data is received by the process controller 20, it is encrypted for security reasons.

Periodically, stored data may be transmitted to the base station or alternatively the base station may periodically or randomly retrieve the data from the process controller or data storage unit by appropriate command signals transmitted through the communication network to the process controller 20 or data storage unit 29.

The base station is equipped with decryption software which enables all the data to be decrypted and reviewed as required.

It is also possible for data to be stored by the data storage unit for retrieval when the fishing vessel returns to port. In this way data may be stored in a suitable memory device and can be removed and taken to the base station for processing.
According to variations of the embodiments a fleet of vessels may be provided with similar onboard monitoring devices. One of the vessels may be designated the main vessel and may be provided with satellite or wireless LAN communication abilities so that data can be gathered by that vessel from other vessels and can be transmitted to the base station on request if desired.

MARPOL regulations stipulate maximum petroleum levels in discharged bilge water and the monitoring system may be used to monitor compliance of a vessel with MARPOL regulations. Process controller may be arranged to monitor the data obtained from water oil content meter that is positioned at an outlet of the vessel through which bilge water is discharged. The monitoring system can thus determine if bilge water is discharged which contains a level of petroleum that breaches regulations. A breach of the regulations may cause data to be sent to the base station to alert of the breach and identify the vessel and location and time that the breach occurred.

Marine species are carried around the world in the ballast water of seagoing vessels. When discharged into new environments, they may become invasive and severely disrupt the native ecology, impact economic activities such as fisheries and cause disease and even death in humans. Regulations are in place to limit the impact of carriage of marine species in ballast. Particularly, a vessel on an international voyage is required to flush the contents of its ballast tanks three times in between international destinations. The flushing must be carried out at least 200 nautical miles off the coast.

To monitor compliance with ballast flushing regulations, process controller 20 may be arranged to monitor data from bilge pump flow rate sensor 37 and GPS
receiver. Process controller 20 can thereby detect whether bilge flushing is carried out at least 200 nautical miles off shore, and whether a sufficient bilge flushing is carried out before the destination is reached.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or in any other country.
CLAIMS

1. A monitoring system for marine vessels including: a data processor arranged to be located on a marine vessel and having at least one data input for receiving data from at least one input device, the data relating to activities on board the vessel whereby a record of the activities can be obtained.

2. A monitoring system according to claim 1 further including a transmitter arranged to be located on the vessel and to be operatively connected to the data processor, whereby the data relating to activities of the vessel may be transmitted to be received at a remote location.

3. A monitoring system according to either claim 1 or claim 2 wherein the at least one input device includes a camera.

4. A monitoring system according to claim 3 wherein the camera is a video camera.

5. A monitoring system according to any preceding claim wherein the at least one input device includes a microphone.

6. A monitoring system according to any preceding claim wherein the at least one input device includes a hydraulic pressure sensor.

7. A monitoring system according to any preceding claim wherein the at least one input device includes a sensor to determine the rate of flow of water from a bilge pump.

8. A monitoring system according to any preceding claim wherein the at least one input device includes a water oil content monitor.

9. A monitoring system according to any preceding claim wherein the at least one input device includes a
tackle monitoring means which is configured to sense an event signifying attachment of a fishing tackle item to a fishing line.

10. A monitoring system according to claim 9 wherein the event includes an audible indication that items should be attached to a fishing line or alternatively or in addition a visual indication and/or electrical, analog or digital transmission.

11. A monitoring system according to claim 10 wherein the tackle monitoring means includes an electrical sensor for sensing an electrical signal corresponding to the audible indication.

12. A monitoring system according to claim 11 wherein the audible indication includes an audible noise of a predetermined configuration or type.

13. A monitoring system according to claim 12 wherein the audible indicator emits different audible noises to signify that different items of fishing tackle need to be attached to a fishing line.

14. A monitoring system according to any one of claims 11 to 13 wherein the audible indication is emitted by a line controller device.

15. A monitoring system according to claim 14 wherein the tackle monitoring means is connected to the line controller device.

16. A monitoring system according to claim 15 wherein the tackle monitoring means is configured to sense a current/voltage of a predetermined amplitude/frequency or period occurring in the line controller, which is utilised to generate the audible indication.

17. A monitoring system according to claim 16 wherein the monitoring means is adapted to sense a predetermined
current/voltage corresponding to different audible
sounds representing the attachment of different items
to the fishing line.

18. A monitoring system according to any preceding claim
wherein the at least one input device includes a line
monitoring means for monitoring at least one
characteristic of a fishing line.

19. A monitoring system according to claim 18 wherein the
line monitoring means includes at least one line
monitor.

20. A monitoring system according to claim 19 including a
plurality of line monitors each for monitoring a
different fishing line.

21. A monitoring system according to claim 20 wherein
each fishing line is wound onto a drum.

22. A monitoring system according to claim 21 wherein the
line monitoring means detects the number of
revolutions of the fishing line drum and the
direction of rotation of the drum and the data
processor is adapted to calculate the length of a
line which has been deployed based on data received
from the line monitoring means.

23. A monitoring system according to claim 3 wherein the
camera is positioned to capture images of any one or
more of the or each fishing line, fishing drum,
deployment of fishing line, fish caught.

24. A monitoring system according to any preceding claim
wherein the at least one input device includes a
location monitoring means for monitoring the location
of the vessel at a particular time.

25. A monitoring system according to claim 24 wherein the
location monitoring means includes a GPS system or
VMS.
26. A monitoring system according to claim 2 wherein the transmitter is arranged to periodically transmit the data relating to activities.

27. A monitoring system according to claim 2 wherein the data is transmitted to the base station at a predetermined time.

28. A monitoring system according to claim 27 wherein the predetermined time is stored in the central processor or a central controller at the remote location.

29. A monitoring system according to claim 2 wherein the data is transmitted to the remote location following a command signal transmitted to the data processor.

30. A monitoring system according to any preceding claim wherein the data processor includes a storage means for storing data over a predetermined period of time.

31. A monitoring system according to claim 30 wherein the storage means is located remote from the data processor.

32. A monitoring system according to claim 30 wherein the system includes an anti-tamper means for producing an alarm signal if the storage means is tampered with.

33. A monitoring system according to claim 32 wherein the alarm signal is produced if there is unauthorised entry of an enclosure housing the data processor.

34. A monitoring system according to claim 32 wherein the anti-tamper means is configured to transmit the alarm signal to a base station.

35. A monitoring system according to claim 32 wherein the anti-tamper means produces an alarm signal if data is corrupted.

36. A monitoring system according to any preceding claim wherein the data relating to activities is encrypted by the data processor.
37. A monitoring system according to claim 36 wherein the remote location stores a decryption code for decrypting the data.

38. A monitoring system according to any preceding claim wherein the data processor tags the data with an identifier associated with the vessel on which the data processor is located.

39. A monitoring system according to any preceding claim wherein further including a receiver for receiving command signals from a remote location.

40. A monitoring system according to any preceding claim wherein the command signals are used to control operation of any of the sensors by appropriate command signals.
FIGURE 1
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: G01S 13/06, 5/14; B63B 35/14; G06F 17/60; G08B 25/10; H04B 7/26

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)

WPAT, USPTO, Esp@cenet: marine, fishing, boat, vessel, monitor, surveillance, record, indicate, processor, controller, sensor, camera, audio, signal, data and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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[ ] Further documents are listed in the continuation of Box C  [ ] 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
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  "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

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# INTERNATIONAL SEARCH REPORT

**International application No.**
PCT/AU2004/000399

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Note for "Y" indications: These documents do not disclose the claimed invention individually, but can be combined with any one of "X" documents to disclose all the essential features of the Claims.
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.

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

END OF ANNEX