described. In particular, one an RFID is utilized, for the ID information and such an information is transferred unencrypted through the AIS. All this presupposes a network infrastructure (GSM o equivalent) currently present only near the coasts.

The patent US 2003233176 describes a maritime data collection and distribution system comprising a ship configured to transmit a signal (by satellite) corresponding to the current position of the ship, or to the foreseen position of the ship, a computer network including one or more databases, each one comprising one or more interest zones, wherein the interest data zone corresponds to a controller zone, and a services provider configured to receive the signal, recuperate one or more data of interest zones from the computer network on the basis of the signal and transmit to the ship one or more zone of interest data for the ship. The zone of interest data is constituted by maritime that are favourable to a secure and economical utilization of the ship. The interested zone is a three-dimensional area surrounding the ship or a time-limited zone surrounding the ship.

The patent document US 2008079608 describes a method for the optimization of the programming of the ships entering and editing into/out of the port, the method comprising the steps of:

a. combining the information from an automated identification system on each ship with the planning of information on each ship from a sending system to produce a combined programming/ID for each ship;
b. tracking the latitude and longitude of each ship by GPS for the production of latitude and longitude tracked for each ship;
c. comparing tracked latitude and longitude of each ship with the existing port maps;
d. continuously comparing the programming/ID for each ship with the tracked latitude and longitude of each ship.

The signalling are sent each time that the tracked latitude and longitude do not correspond to the expected latitude and longitude of each ship in a given instant. The method tracks and records each time a pilot embark or disembark from a ship.

Embodiments~~It is object~~ of the present invention seek to provide an advanced anti-piracy system that adapts perfectly to the functional VTMS architectures and constitutes a complementary function for the defence of extended areas that are

threatened by pirates or terrorists. The system ~~object of the invention~~ can also be utilized in all the control systems for boundary, national security/protection and Exclusive Economic Zone (EEZ).

According to a first aspect of the present invention, there is provided ~~It is subject-matter of the present invention~~ a maritime anti-piracy system, for the recognition of suspect watercrafts around one or more co-operating ships to be protected, comprising:

- a shore-based control system, comprising:
  - one or more centres, geographically distributed, comprising shore sensors for detecting watercrafts surveillance data;
  - a central station for collecting and elaborating watercrafts surveillance data;

  the shore-based control system comprising a bi-directional communication network between said one or more centres and said central station, in such a way that the central station be able to send commands to said shore-based sensors;
- a communication system between said one or more centres and said one or more co-operating ships to be protected,

The anti-piracy system being characterised in that it comprises:

- one or more devices, mounted on board of corresponding said one or more co-operating ships to be protected, for maritime surveillance data extraction from maritime surveillance sensors, which are mounted on board of corresponding said one or more co-operating ships to be protected and are suitable to watch over the space around said one or more co-operating ships, said one or more devices for data extraction being suitable to send said maritime surveillance data to at least one of said one or more centres through said communication system;
- an identification and authentication system of said one or more co-operating ships to be protected, which functions through said communication system and is shared among said one or more centres and each of said one or more co-operating ships to be protected,

Said central station for collecting and elaborating data elaborating the data coming from said one or more centres, and therefore also from said one or more co-operating ships to be protected, and launching the relevant alarms in the case of recognition of suspected watercrafts.

Here by "maritime surveillance" is meant the watching over the

watercrafts in a maritime zone.

The elaboration performer by the central station can comprise the crossing of all the data in order to individuate the suspected watercraft or recognize watercrafts silhouettes that are not among the forms of the co-operating ships, with particular reference to the processing of the kinematics of all the watercrafts to the end of assigning to each one of them a threat level that can be simplistically be friend, foe, neutral, based on heuristics and intelligent systems that learn and improve by experience the reliability of the proposed result.

Preferably according to embodiments of the invention, said maritime surveillance sensors comprise the radar mounted on board of said one or more co-operating ships to be protected.

In such a way, by enlarging, by means of the on-board radar and optionally also the camera(s), the coverage of the shore systems, one may drastically decrease the reaction times for the possible counter-measures (time factor is fundamental as above mentioned).

Preferably according to embodiments of the invention, said identification and authentication system comprises one or more AIS transmission devices mounted on corresponding said one or more co-operating ships, and at least a shore AIS receiving device, said one or more AIS transmission devices being suitable to transmit information of authentication of the identity of said corresponding said one or more co-operating ships to said at least a shore AIS receiving device.

Preferably according to embodiments of the invention, to each of said one or more AIS transmission devices and said at least a shore AIS receiving device an encryption unit is associated, which generates a key for the authentication of the AIS messages, without changing the structure of the exchanges messages, i.e. within the AIS systems standards.

Preferably according to embodiments of the invention, said identification and authentication system comprises or is constituted by a VHF communication with encrypted signature.

Preferably according to embodiments of the invention, said shore-based sensors comprise at least a shore camera and said maritime surveillance sensors comprise at least a camera, said central station elaborating the video data coming from said shore-based sensors and said maritime surveillance sensors to obtain watercrafts video tracks, including said suspected watercrafts and said one or more co-operating ships, which are elaborated

together with at least a track coming from said at least a shore AIS receiving device and said radar relevant to the same watercrafts, and may improveto the end of improving the recognition of the same watercrafts.

This may beis a novelty in the field, because till now the electro-optic information have not been integrated with the radar ones. One can integrate the data from shore cameras and/or on-board cameras. In particular, one integrates information coming from the optical analysis of the video fluxes of the (high-sensibility, daily and infrared) cameras with the information obtained from the processing of the electro-magnetic signals provided by radars and the AIS radar signals.

Preferably according to embodiments of the invention, said central station elaborates video data from camera to additionally obtain the watercrafts silhouettes and compares them with a series of pre-defined silhouettes relevant to known ships.

This may increase the confidence of the recognition and adds silhouette information of the watercraft under examination. This may beis a novelty as well, since as yet the recognition of the watercraft silhouette has been committed to analysis of satellite data of difficult (and expensive) realization and certainly not in quasi-real-time. Typically one collects satellite data for a long time period and then elaborates them off-line, obtaining the silhouettes of the watercrafts under examination.

One integrates thus information from the optical analysis of the video streams of the (high-sensibility, daily and infrared) cameras with the information obtained from the elaboration of the electro-magnetic signals provided by the radars and the AIS radar signals.

According to a second aspect of the present invention, there is provided a device for maritime surveillance data extraction from maritime surveillance sensors including radar sensors, disposed within a ship to be protected against suspect watercrafts in said space and configured to watch over the space around the ship, said ship including a data transmission device for sending data to a shore centre through an associated communication system, the device being characterised in that it comprises:

- a connection module for connecting to said maritime surveillance sensors, comprising:
  - a direct connection module, which extracts the data and calculates tracks; and

- a bus indirect connection module (ETH), which is a sniffer for tracks data extraction;

Which produce elaborated tracks by representing tracks in pre-defined formats;

- a gateway module connected to both said module for connecting to said maritime surveillance sensors and configured to be connected to said data transmission module;

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, in such a way that, in use, said elaborated tracks are transmitted to shore through said gateway module.

Preferably according to embodiments of the invention, each of said one or more devices for data extraction comprises:

- a module for connecting to said maritime surveillance sensors, by means of data bus or by direct connection;
- a gateway module for connecting to a data transmission module mounted on board of said one or more co-operating ships for the sending of the extracted data to shore through said communication system.

Without the direct connection module (tracker), one looses the great many cases wherein there are watercrafts that works with a format which is not standard and cannot therefore transmit to shore the data obtained from the on board sensors (the human operator in such a case

communicates the recognition, for example by phone).

Thanks to the device according to embodiments of the invention, one may enlarge the action range of the maritime localization (watching), since the on board sensors extend and detail the localization beyond the range of the shore sensors.

Preferably according to embodiments of the invention, each of said one or more devices for data extraction comprises an extracted data elaboration module, which is suitable to prepare elaborated data to be transmitted through said gateway module.

Preferably according to embodiments of the invention, extracted data elaboration module functions also as on board tracker, in particular in the case of data extracted from on board radar sensors.

Indeed many ships work with a non-standard format, failing said tracking module, and therefore they cannot transmit the data obtained from on board sensors (the human operator, in such a case, has to communicate the recognition, for example by phone).

Thanks to the device according to embodiments of the invention, one may enlarge the action range of the maritime localization (watching), since the on board sensors extend and detail the localization beyond the range of the shore sensors.

Preferably according to embodiments of the invention, said gateway module is suitable to operate towards a VHF radio data transmission module mounted on board of said one or more co-operating ships.

Preferably according to embodiments of the invention, said gateway module is suitable to operate towards a satellite and/or U/VHF radio transmission module, mounted on board of each of said one or more co-operating ships for sending of data to shore control system.

Preferably according to embodiments of the invention, said gateway module comprises a sub-module for the management of commands and parameters relevant to the radio communication, such as for example the hand-over in the selection of the frequencies and radio channels to be utilised in said communication system.

Preferably according to embodiments of the invention, each of said one or more devices comprises two modules of connection to said maritime surveillance sensors:

- a direct connection module, which extracts the data and represents them in a pre-defined format;

- a bus indirect connection module (ETH), which is a sniffer for data extraction and data representation in a standard protocol.

Preferably according to embodiments of the invention, said identification and authentication system utilises indifferently either message No. 8 or 6 of the AIS standard, being provided electronic elaboration means which append a secret information to the string of the 24 AIS messages and calculate a hash of the whole string so obtained, said a hash being inserted in the said either message 8 or 6, the string of 24 messages so obtained being finally sent through said communication systemPreferably according to embodiments of the invention, said secret information is a cryptographic key.

Preferably according to embodiments of the invention, each of said one or more devices utilises a GPS and a geographical localisation module, which is suitable to detect any deviation of the corresponding co-operating ship to be protected from the boundaries of a pre-determined secure area and/or the navigation plan in case of capture of the co-operating ship by pirates, and is also suitable to transmit such deviation to a shore-based control system.

There is also disclosed~~It is further subject-matter of the present invention~~ a device for maritime surveillance data extraction from maritime surveillance sensors mounted on a ship, characterised in that it comprises:

- a module for connecting to said maritime surveillance sensors, by means of data bus or by direct connection;
- a gateway module for connecting to a data transmission module mounted on board of the ship for the sending of the extracted data to a shore centre through said communication system.

Preferably according to embodiments of the invention, the device comprises a extracted data elaboration module, suitable to prepare elaborated data to be transmitted through said gateway module.

Preferably according to embodiments of the invention, said extracted data elaboration module functions also as an on board tracker, in particular in the case of data extracted from on board radar sensors.

Preferably according to embodiments of the invention, said gateway module is suitable to operate towards a VHF radio data transmission module mounted on board of said ship.

Preferably according to embodiments of the invention, said gateway module is suitable to operate towards a satellite and/or U/VHF radio transmission

module, mounted on board of said ships for sending of data to shore.

Preferably according to embodiments of the invention, said modulo gateway comprises a sub-module for the management of commands and parameters relevant to the radio communication, such as for example the hand-over in the selection of the frequencies and radio channels to be utilised in the communication to shore.

Preferably according to embodiments of the invention, the device comprises two modules for connection to said maritime surveillance sensors:

- a direct connection module, which extracts the data and represents them in a pre-defined format;
- a bus indirect connection module (ETH), which is a sniffer for data extraction and data representation in a standard protocol.

The invention will be now described, by way of illustration but not by way of limitation, making reference to the figures of the attached drawings, wherein:

- figure 1 shows the general architecture of the system according to the invention;
- figure 2 shows the information elaboration flow in the system according to the invention (shore part);
- figure 3 shows a video processing elaboration chain, in the pixel domain, i.e. optical domain, (segmentation of background/foreground, object tracking and classification/extraction of features to the semantic domain (data fusion and scene description) according to the invention;
- la figure 4 shows the features extraction technique for the classification of ships;
- la figure 5 shows the connection of a "safety box" device according to the invention;
- la figure 6 shows the modules of the safety box according to the invention.

The function performer by the system 100 according to the present invention (anti-naval-piracy function) is based on the analysis and tracking of targets based on various sources of information about scattered targets 30, 31, 50, to provide to the final user the possibility of obtaining a secure navigation channel in the economic exclusive zone EEZ, managed by the VTS centres or equivalent coastal centres.

CLAIMS

1. Maritime anti-piracy system (100), for the recognition of suspect watercrafts (50) around one or more co-operating ships (30) to be protected, comprising:

- a shore-based control system (10,20,40), comprising:
  - one or more centres (10), geographically distributed, comprising shore sensors (11,12) for detecting watercrafts surveillance data;
  - a central station (20) for collecting and elaborating watercrafts surveillance data;

  the shore-based control system (10,20,40) comprising a bi-directional communication network (40) between said one or more centres (10) and said central station (20), in such a way that the central station (20) be able to send commands to said shore-based sensors;
- a communication system between said one or more centres (10) and said one or more co-operating ships to be protected (30),

The anti-piracy system being characterised in that it comprises:

- one or more devices (90), mounted on board of corresponding said one or more co-operating ships to be protected (30), for maritime surveillance data extraction from maritime surveillance sensors (12',11'), which are mounted on board of corresponding said one or more co-operating ships to be protected (30) and are suitable to watch over the space around said one or more co-operating ships, said one or more devices (90) for data extraction being suitable to send said maritime surveillance data to at least one of said one or more centres (10) through said communication system;
- an identification and authentication system (13,70) of said one or more co-operating ships to be protected (30), which functions through said communication system and is shared among said one or more centres (10) and each of said one or more co-operating ships to be protected (30),

said central station (20) for collecting and elaborating data elaborating the data coming from said one or more centres (10), and therefore also from said one or more co-operating ships to be protected (30), and launching the relevant alarms in the case of recognition of suspected watercrafts (50).

2. System according to claim 1, characterised in that said maritime surveillance sensors comprise the radar mounted on board of said one or more co-operating ships to be protected ~~(30)~~.

3. System according to claim 1 or 2, characterised in that said identification and authentication system ~~(13,70)~~ comprises one or more AIS transmission devices ~~(70)~~ mounted on corresponding said one or more co-operating ships ~~(30)~~, and at least a shore AIS receiving device ~~(13)~~, said one or more AIS transmission devices ~~(70)~~ being suitable to transmit information of authentication of the identity of said corresponding said one or more co-operating ships ~~(30)~~ to said at least a shore AIS receiving device ~~(13)~~.

4. System according to claim 3, characterised in that to each of said one or more AIS transmission devices ~~(70)~~ and said at least a shore AIS receiving device ~~(13)~~ a encryption unit is associated, which generates a key for the authentication of the AIS messages, without changing the structure of the exchanges messages, i.e. within the AIS systems standards.

5. System according to claim 3, characterised in that said identification and authentication system comprises or is constituted by a VHF communication with encrypted signature.

6. System according to any claim 2 to 5, characterised in that said shore-based sensors ~~(11,12)~~ comprise at least a shore camera ~~(11)~~ and said maritime surveillance sensors comprise at least a camera ~~(11')~~, said central station ~~(20)~~ elaborating the video data coming from said shore-based sensors and said maritime surveillance sensors to obtain watercrafts video tracks, including said suspected watercrafts and said one or more co-operating ships, which are elaborated together with at least a track coming from said at least a shore AIS receiving device ~~(13)~~ and said radar ~~(12,12')~~ relevant to the same watercrafts, to the end of improving the recognition of the same watercrafts.

7. System according to claim 6, characterised in that said central station ~~(20)~~ elaborates video data from camera ~~(11,11')~~ to additionally obtain the watercrafts silhouettes and compares them with a series of pre-defined silhouettes relevant to known ships.

8. System according to any claim 2 to 7, characterised in that each of said one or more devices for data extraction comprises:

- a module ~~(91,93)~~ for connecting to said maritime surveillance

sensors ~~(12',11')~~, by means of data bus or by direct connection;

- a gateway module ~~(92)~~ for connecting to a data transmission module mounted on board of said one or more co-operating ships ~~(30)~~ for the sending of the extracted data to shore through said communication system.

9. *System according to claim 8, characterised in that each of said* one or more devices for data extraction comprises an extracted data elaboration module, which is suitable to prepare elaborated data to be transmitted through said gateway module ~~(92)~~.

10. System according to claim 9, characterised in that said extracted data elaboration module functions also as on board tracker, in particular in the case of data extracted from on board radar sensors.

11. System according to any claim 8 to 10, characterised in that said gateway module ~~(92)~~ is suitable to operate towards a VHF radio data transmission module mounted on board of said one or more co-operating ships ~~(30)~~.

12. System according to any claim 8 to 10, characterised in that said gateway module ~~(92)~~ is suitable to operates towards a satellite and/or U/VHF radio transmission module, mounted on board of each of said one or more co-operating ships ~~(30)~~ for sending of data to shore ~~(20)~~.

13. System according to any claim 8 to 12, characterised in that said gateway module ~~(92)~~ comprises a sub-module for the management of commands and parameters relevant to the radio communication, such as for example the hand-over in the selection of the frequencies and radio channels to be utilised in said communication system.

14. System according to claim 8 to 13, characterised in that each of said one or more devices ~~(90)~~ comprises two modules ~~(91,93)~~ of connection to said maritime surveillance sensors ~~(12',11')~~:

- a direct connection module ~~(91)~~, which extracts the data and represents them in a pre-defined format;
- a bus indirect connection module ~~(93)~~ (ETH), which is a sniffer for data extraction and data representation in a standard protocol.

15. System according to any claim 1 to 14, characterised in that said identification and authentication system ~~(13,70)~~ utilises indifferently either message No. 8 or 6 of the AIS standard, being provided electronic elaboration means which append a secret information to the string of the

24 AIS messages and calculate a hash of the whole string so obtained, said a hash being inserted in said either message 8 or 6, the string of 24 messages so obtained being finally sent through said communication system.

16. System according to claim 15, characterised in that said secret information is a cryptographic key.

17. System according to any claim 1 to 16, characterised in that each of said one or more devices ~~(90)~~ utilises a GPS and a geographical localisation module, which is suitable to detect any deviation of the corresponding co-operating ship to be protected ~~(30)~~ from the boundaries of a pre-determined secure area and/or the navigation plan in case of capture of the co-operating ship ~~(30)~~ by pirates, and is also suitable to transmit such deviation to a shore-based control system ~~(10,20,40)~~.

18. Device ~~(90)~~ for maritime surveillance data extraction from maritime surveillance sensors ~~(12',11')~~ including radar sensors, disposed within a ship ~~(30,31,)~~ to be protected against suspect watercrafts ~~(50)~~ in said space and configured to watch over the space around the ship, said ship ~~(30,31)~~ including a data transmission device for sending data to a shore centre through an associated communication system, the device being characterised in that it comprises:

- a connection module ~~(91,93)~~ for connecting to said maritime surveillance sensors ~~(12',11')~~, comprising:
  - a direct connection module ~~(91)~~, which extracts the data and calculates tracks; and
  - a bus indirect connection module ~~(93)~~ (ETH), which is a sniffer for tracks data extraction;

  Which produce elaborated tracks by representing tracks in pre-defined formats;
- a gateway module ~~(92)~~ connected to both said module ~~(91,93)~~ for connecting to said maritime surveillance sensors ~~(12',11')~~ and configured to be connected to said data transmission module;
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, in such a way that, in use, said elaborated tracks are transmitted to shore through said gateway module ~~(92)~~.

19. Device according to claim 18, characterised in that said direct connection module ~~(91)~~ calculates tracks for data from radar sensors and/or video sensors.

20. Device according to any claim 18 to 19, characterised in that it further comprises a geographical localisation module, which uses GPS information from the ship or from an integrated GPS, and comprises all the maps to detect any deviation from the boundaries of a secure area and/or a navigation plan, the deviation data being transmitted to shore through said gateway module.

21. Device according to any claim 18 to 20, characterised in that said gateway module ~~(92)~~ is suitable to operate towards a satellite and/or U/VHF radio transmission module, mounted on board of said ships ~~(30)~~ for sending of data to shore, in particular towards a VHF radio data transmission module inside an AIS device ~~(70)~~ mounted on board of said ship ~~(30)~~.

22. Device according to any claim 18 to 21, characterised in that said gateway module ~~(92)~~ comprises a sub-module for the management of commands and parameters relevant to the radio communication, such as for example the hand-over in the selection of the frequencies and radio channels to be utilised in the communication to shore.

23. Device according to any claim 18 to 22, characterised in that the device is used in the system according to any claim 1-17.