Thanks to artificial intelligence (AI) ships now sail with the aid of assistance systems, either semi-autonomously or controlled remotely from the mainland by means of sophisticated automation technology.

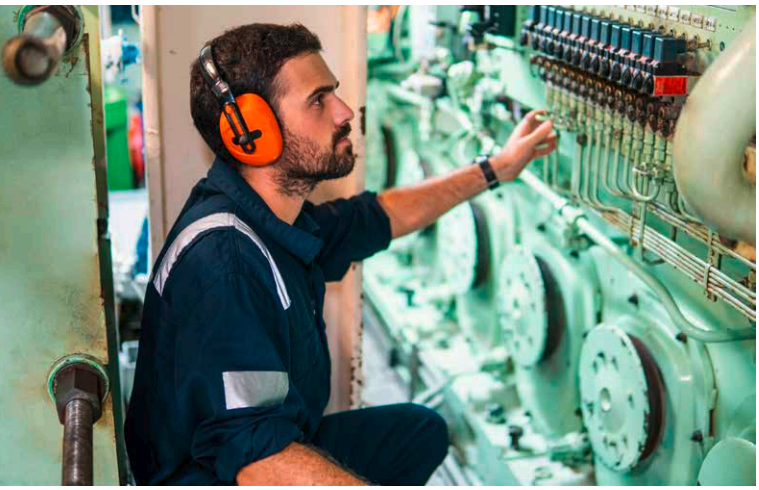
Human being and machine – optimal teamwork thanks to AI

Smart-Ship uses the Bachmann M200 controller to develop haptic feedback technologies

Automation concepts based on machine learning (ML) and artificial intelligence (AI) are already part of the day-to-day work routine in the maritime industry. For example, ships now sail with the aid of assistance systems, either semi-autonomously or controlled remotely from the mainland by means of sophisticated automation technology. The Dutch company, Smart-Ship, uses the Bachmann M200 controller to implement „force-feedback technologies“ in the maritime industry.

Thanks to artificial intelligence (AI), personnel on board ships with modern equipment are relieved of many tedious routine tasks. Today, humans only perform partial tasks or are only responsible for monitoring the system in a supervisory capacity, depending on the degree of automation.

The benefits of such concepts for the maritime industry are quite clear. Software-based ship intelligence can reduce human error and prevent collisions or other accidents at sea. The crew and skipper can handle other tasks. Optimal navigation routes reduce fuel consumption. This, in turn, reduces costs and is good for the environment. Moreover, AI-based predictive maintenance enables repairs to be initiated in good time and keeps downtime to a minimum.



AI-based predictive maintenance enables repairs to be initiated in good time and keeps downtime to a minimum.

Sophisticated technology

However, a number of components must interact to make semi-autonomous, remote-controlled or fully autonomous ships a viable reality. For example, sensor technology that monitors the ship's condition and the environment, or GPS navigation that determines the ship's precise location at any time. In addition, highly complex controller algorithms that make decisions based on available data, as well as visualization that provides all the important information to both personnel on board as well as personnel on the mainland virtual bridge. A fail-safe connection between the systems on land and on board, as well as real-time data exchange between systems from a number of different manufacturers and a wide variety of platforms are also indispensable. The robust and safe Bachmann controller combined with the Connext® software provided by the leading California manufacturer for autonomous systems, Real-Time Innovations (RTI), establish the prerequisite for a flexible and fail-safe automation platform for networking distributed systems.

With Data Distribution Service (DDS), the RTI software supports an open standard for exchanging messages with high data connectivity and scalable architecture for real-time applications. Thanks to DDS, all controllers communicate directly with each other in real time. Constant availability of current data is the foundation for reliable, autonomously controlled procedures.

Human-machine communication

Note that in addition to all this technology, humans are also still working in autonomous navigation. However, many automation concepts are not oriented towards actively involving human beings in the process. For example, some of these automation concepts can only be switched on or switched off, or they run in the background as assistance systems, without the skipper being aware of them. Therefore, it is vital that personnel understand what the machine is doing at the specific moment and why. This is the only way to ensure that the crew on deck or on land can monitor the procedures on the ship and respond appropriately if necessary. Moreover, in spite of automation there are certain procedures that still require ongoing training so that they are not forgotten. For instance, an assistance system can indeed perform specific maneuvers autonomously, however the skipper must be able to intervene or take over control at any time. This means that regular training of the crew must by no means be dispensed with, even for autonomous ships.

Feeling the ship

Haptic feedback is a trend in the maritime industry and a possibility of bringing human and machine closer together. This technology enables systems and devices to communicate with the user by means of touch impulses. Similar to the advances in modern automobiles, assistance systems on ships provide haptic feedback, for example, when intervening in the control or regulating speed. Haptic feedback is also a way of ensuring that users maintain control over automated procedures – and even more importantly, that they can also override them. Also training courses can be conducted more efficiently with the aid of simulators that provide haptic feedback. Due to the intuitive learning method, training time can be significantly reduced.

The processors of the Bachmann M200 series enable ship control in real time. Configuration example for this controller: The MC220 has a 1.6 GHz QuadCore CPU, three Eth100/1000 modules, an RS232 interface, and a three-in-one RS232/422/485 interface.

More than just vibration

The Dutch start-up, Smart-Ship, uses the Bachmann M200 controller for "force-feedback technologies", i.e., haptic feedback in the maritime industry. Components that are specially manufactured for ship control, such as gas lever, tiller, azimuth compass, and joystick are connected with an algorithm that provides haptic feedback to skippers through resistance and vibration during complex control procedures.

We are all familiar with the most basic form of haptic feedback, namely a vibrating mobile phone. However, the Smart-Ship technology is capable of much more. "Thanks to a control lever equipped with haptic feedback we can transmit many different forces," explains founder Roy Kok. "In addition to vibration, resistance is also an important force. A variable resistance signals that you are either approaching a destination or moving away from it. Thus, we can also create virtual walls or no-go areas."

Deliberate control

In particular, for remote operation of ships and decision-making support in critical situations, it is important to quickly establish an awareness of the current situation. For instance, if the ship's AI changes the speed, the skipper feels vibration on the gas lever and can immediately verify why this action has been executed, and whether it was correct. If it was not correct, the skipper can intervene at any time and override the system. Conversely, the system could apply resistance on the gas lever and thus signal that given the current sea state or the present visibility conditions, a speed increase is not recommended.

"Haptic feedback provides an awareness of what a machine is doing, even if visibility is poor or there is no visibility at all. And this is precisely the function that will help us take the step to fully autonomous navigation," states Roel Kuiper, Research & Development Engineer at Huisman Equipment and consultant at Smart-Ship.

Smart-Ship also equips training simulators with the same technology. According to Kok, humans respond instinctively to haptic stimuli and this is the source of its great potential. "From infancy on, humans have learned to interact with their environment by experiencing forces. Consequently, use of haptic operating elements in training enables faster and more intuitive learning.

Security: protection from hackers

Cybersecurity is one of the most important prerequisites in the development of autonomous navigation. The consequences of

Smart-Ship uses the Bachmann M200 controller to implement "force-feedback technologies" for gas lever, azimuth compass, tiller (left to right) and other ship control components. Image: Smart-Ship

Roy Kok
Smart-Ship founder

„Variable resistance signals that you are either approaching a destination or moving away from it.“

a targeted destructive attack on a ship control system could be fatal. A thoroughly thought-out, multi-layer, IT security concept, use of hardware-based cryptographic procedures, and a robust operating system are key factors for adequately protecting against threats in the area of networked automation. Moreover, end-to-end encryption of communication via SSL renders eavesdropping measures ineffective. “All of these functionalities are supported by the Bachmann hardware,” explains Kok. “In addition, the controller from Bachmann offers enough capacity that the entire dynamic model can run in real time. This capacity accelerates development as well as testing of new systems and enables us to provide a high quality,” states Kok.

Exciting future

Highly-automated and semi-autonomous navigation is a reality today and the technological developments in the maritime industry are promising.

Currently, Smart-Ship is taking another step. The innovative Dutch company is extending its force feedback control systems such that the users can sail at maximum efficiency with any propulsion method. Whether fuel cell, wind support, full-electric propulsion or hybrid – in the future, in terms of energy efficiency, any type of propulsion can be optimally supported. In the future, at the optimal operating point, the control elements will reduce the counter-pressure and through this “dip” the user will feel that he is sailing the ship optimally.

FIND OUT MORE:

Maritime Automation Solutions

CONTACT

Joeri ten Napel
Key Account Manager

T: +31 852 1005-54
info@bachmann.info