



Adoption of IoT technology in Maritime Sector

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ABSTRACT

By its very nature, the transport and logistics industry demands an extensive and effective data interchange for successful management and decision-making. A specific approach is needed for the marine industry because of the complex and diverse environment. The naval industry's quick adoption of IoT technology will make it easier to administer basic services like vessel monitoring, emissions control, preventative maintenance, safety, and welfare. The IoT solutions described in this article are tailored to the industry's current demands. The suggestions are in line with the projects, which intends to provide an interactive study course on maritime and surveyor IoT systems to fill the market need caused by the rapid growth of the Smart Maritime & Surveying business.

Keywords: IoT, Maritime, decision- making

1 Introduction

The term IoT refers to a network of interrelated computing devices that may be a physical device, mechanical or digital machines that are allowed to facilitate communication between one another and also connects over the internet (cloud). It includes sensors, electronics, actuators and communication protocols to collect, process and data exchange [1]. The rapid growth in technology contributes a lot in the evolution of smart cities. The application of technologies has uprooted the economic and vertical sectors like industrial, energy, transportation, healthcare and security. IoT favors as a leading gateway to transform technologies into digital. The abundance applicational usage of IoT in landscape can be catalogued in different blocks as follows.

- **Smart Home and Cities:** smart lighting, smart appliances, Intrusion Detection, smoke/Gas Detectors makes human intervention easier with home suppleness. Smart cities developed using smart parking, smart roads, structural health monitoring and emergency response.
- **Smart Environment:** improves the quality of environment with a constant monitoring like weather monitoring, air pollution and noise pollution monitoring and forest fire monitoring
- **Smart Energy:** focused on intelligent solution systems like smart grids, renewable energy systems, prognostics.



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- **Smart Retail and Industry:** gives a smart solution for inventory management, smart payments, smart vending machines. In industrial sectors, machine diagnosis and prognosis, Indoor air quality monitoring are few sectors of improvisations.
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Since 85% of the world's goods are transported by water, ships are essential to the global transportation system [4, 5]. The use of IoT technology in the marine sector allows shipping firms to link all of their boats to a single platform, enabling data exchange throughout the whole business ecosystem that stakeholders may take advantage of the digitization process has been straightforward for the transportation and logistics industries, which have long depended on exchanging decision-making data, putting them ahead in the shift. The marine business, which is deeply rooted in conventional methods, is confronted with a number of challenges. It operates in some of the world's most isolated locations, where M2M contact is challenging. Additionally, IoT technology and equipment created specifically for this sector have just recently been standardized.

The transition to digitization is being facilitated by a number of governmental and private sector entities. With a focus on eight domains—autonomous vehicles and robotics, artificial intelligence, big data, virtual reality, augmented reality, and mixed reality, the internet of things, the cloud and edge computing, digital security, and 3D printing and additive engineering—Sánchez-González et al. (2019) [8] compiled published work about the digitalization of the maritime industry. They get to the conclusion that the marine industry is digitalizing at varying speeds depending on the aforementioned sectors. Robotics and the Internet of Things are in progress as much as big data and artificial intelligence.

Large maritime companies are already investing in IoT technologies in the private sector to improve transparency, safety, and cost efficiency. IoT services are provided by several SMEs with an emphasis on safety, welfare, pollution control, ship tracking, and predictive maintenance. Here, we focus on six services that are directly connected related to this research.



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They analyze ship data to benefit ship owners, personnel, and organizations (such the coast guard and port authorities).

- IoCurrents [9] consists of a DataHub, a distant analytics cloud platform, and an on-board mini-computer that gathers and analyzes data locally.
- Green Sea Guard [10] provides tools for fuel analysis, engine diagnostics, and pollution monitoring of ships.
- For the purpose of monitoring equipment, Augury [11] installs sensors that measure vibration, sound, and temperature.
- Parsyl [12] inserts sensors that monitor a pallet or package's temperature, humidity, light, impact, and GPS position.
- A health monitoring system made exclusively for the marine environment has been created by ZS Wellness [13]. Individual crew members might have customized wellness programs made using the data provided.
- DanelecConnect [14] is a boat 2-shore information robotization arrangement which guarantees opportune, practical boat the board.

The Global Oceanic Association (IMO) is the Unified Countries organization answerable for the wellbeing and security of transportation and the avoidance of environmental and marine contamination [17]. The most significant treaties of the IMO include: i) SOLAS, the International Convention on the Safety of Life at Sea, which was signed in 1974 [18] ii) The 1973 Global Show for the Avoidance of Contamination from Boats (MARPOL) [19](iii) The 1972 Show on the Global Guidelines for Forestalling Impacts Adrift (COLREGs) [20].

To work ships efficiently and securely, access information from shipboard hardware and gear is required. Navigational instruments regularly utilize the IEC 61162 series of guidelines while moving information, however admittance to other shipboard apparatus and frameworks to gather information has not yet been normalized. Two generally new ISO norms has been produced for this reason. Unified guidelines for creating machine and human identifiers and data structures for shipboard machinery and equipment are established by ISO 19848:2018. what's more, the ISO 19847:2018 specifies necessities for execution, capability, administration and wellbeing for the shipboard information server that stores information from transport board hardware and gear, and sends it off the boat.

2 Usage of Edge Computing in Smart Maritime Platform

The digitalization interaction of the sea business permits Big Data to help coordinated factors the executives, direction, occurrence the board, alerts and cycle enhancement. A data acquisition platform based on edge computing is suggested in this section.

2.1 Architecture of Data Collection and Management

It consists of the following elements



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-Recovery node: the assortment and transmission of information from the IoT sensors of the basic gear and the ecological information are organized together, for the most part by a remote convention.

-Edge gateway: The data collector role is played by the edge gateway; supplying resources for the network, storage, computing, and other infrastructures. This assortment empowers pursuing framework choices in view of the consequences of the information examination.

-Cloud centre: utilized for huge information examination and information mining, it is the key where models are performed with Artificial Knowledge (man-made intelligence) procedures from the information transferred by the edge gear.

The IoT information assortment is acquired in light of the proposed edge processing plat-structure. The framework finishes the investigation and capacity elements of gathered information on the edge side. It can likewise be joined with the cloud community to help more perplexing necessities. Embracing edge and focal mists to consider both idealness and scale can be applied in different modern situations.

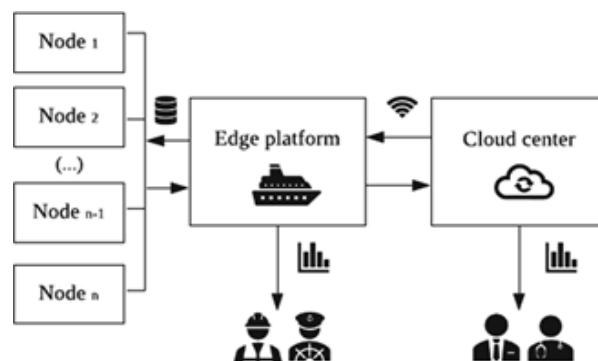


Figure 1: *Iot Data Processing using Edge Computing*

2.2 Platform for Edge Computing

In order to manage and monitor the data gathered by the sensors, the edge computing platform will be anchored in the ship. The development of a layered architecture will enable the control of the various components through the platform's modules (Figure. 2). Application and/or service management development can be developed incrementally with this architecture. Here, we proposed the accompanying:

- 1) Management on board (e-health, load monitoring)
- 2) Management off-board (eco-report, collision detection)
- 3) Protocols for centralized incident management
- 4) Augmented Reality installation and management



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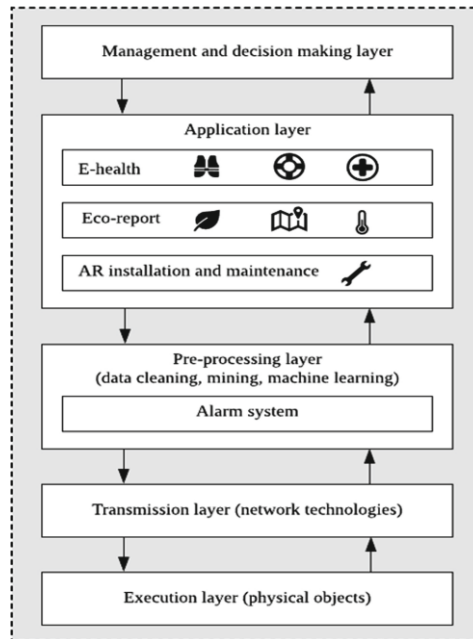


Figure 2: Application levels for the architecture proposed

3 Augmented Reality for Installation and Maintenance

The production industry is increasingly being influenced by technologies that enhance or recreate real-world environments in recent years. With Computer generated Reality (VR), Expanded Reality (AR) and the mix of both, Blended Reality (MR), it is feasible to reproduce practically any cycle did in the actual world [23]. The AR market is assessed to develop from USD 10.7 billion of every 2019 to USD 72.7 billion by 2024 [24]. These information support the positive assumptions regarding the eventual fate of these advances. For a variety of industries, it is essential to train technicians in new assembly and maintenance techniques. Since these errands can be extremely muddled, preparing professionals to efficiently perform new abilities is testing [25]. AR, a powerful industrial training technology that directly links instructions on how to perform service tasks to machine parts that need processing, can support this kind of formation. It is insufficient to instruct technicians in task execution due to the task's increasing complexity. Instead, technicians must receive training in the fundamental sensorimotor and cognitive abilities required for the effective acquisition and execution of new maintenance procedures. Complex gathering and support errands in modern conditions are extraordinary spaces for AR applications. The requirement for legitimate preparation and the admittance to a lot of docu-mentation are conditions utilizing AR strategies generally encouraging. The fundamental concept of augmented reality is to seamlessly integrate additional information into a user's view [16]. These realities outline the requirement for efficient preparing frameworks for upkeep and get together abilities that speed up the procurement of new support systems. Additionally, these systems ought to make it possible to



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reuse useful existing training material and enhance the process of adapting training to new scenarios.

In this specific situation, we proposed to foster an original idea and stage for multi-modular AR-based preparing of upkeep and gathering abilities, which incorporates sub-abilities preparing and the assessment of the framework. Since procedural abilities are considered the most basic abilities for upkeep and gathering tasks, we center around these abilities and the suitable techniques for further developing them. By giving spatially enrolled data on the assignment straightforwardly in the client's field of view, the framework can direct the client through new undertakings and envision data straightforwardly in the spatial setting where it is significant.

4 Conclusion

In the maritime sector, an increasing number of businesses are providing Internet of Things (IoT) services focused on ship tracking, emission control, predictive maintenance, safety, Edge computing architectures and related technologies must be included in order to connect IoT technologies to the maritime industry. IoT advances give a live association between the ocean and the coast that partners can take advantage of in decision-production while working on the efficiency of the area's exercises. Creating specific preparation in the combination of IoT advancements in the sea business emerges from the need to digitalize this area, quite possibly of the most secured in conventional strategy and welfare. In any case, there is certainly not a specific college degree that gets ready technologists in this field.

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