Intelligent Internet of Things in Shipping Industry

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Abstract: Industries now adapting data driven and intelligence based solutions for business. Shipping Industries are more flexible in the resources and network as they are spread across the globe. Making shipping Internet of Things (IoT) and Artificial Intelligence (AI) enabled will help reduce costs, provide accurate navigation, better analysis of shipping trip, enhanced security measures.

Initial Port-

At the first port all the digital documents related to ship, which will include type of ship, carrying capacity, max speed of ship, material, colour, ship registration number, extra load barring capacity, security equipment installed, safety measures, etc. will be provided to port officer and inspectors.

Once done with the verification of digital documents, weight of the ship at the initial stage will be measured and recorded in the system.

Server situated at company headquarters will be Artificial Intelligence (AI) enabled server, which will learn and process the statistical and past data records on weather at particular month, and calculates best possible routes automatically. On successful exchange of signatures and security keys,

server at shipping company will send navigation and routes update to system employed on the ship. Software on ship will generate 3D maps with live information about the wind speed, sea water temperature, route marked with dots and line connecting them.

Connected architecture using Internet of Things (IoT) and added intelligence will help calculate loading capacity based on the maximum weight ship can bear and accordingly communicated to shipping company as well as server at port office. Loading capacity will not just take the maximum weight ship can bear but Machine Learning (ML) algorithm will also consider the safety factors related to ship and containers, safe bound limits for extra weight carrying, distance of the shipping trip and speed ship has to maintain to cover distance.

On Loading-

While the containers are being loaded on the ship cameras will track every container. For tracking video frames from camera will be processed through Computer Vision algorithm. Using Computer Vision every container can be tracked and can also be marked with unique ID and virtual markers. Virtual markers can be used to detect the position of the particular container on the ship, at any emergency cases. Every time container loaded on the ship, connected systems will communicate and share data regarding it. Based on products that are being shipped, location of the shipment, type of products, Machine Learning (ML) algorithm can predict which container to be placed first on the ship and which to be placed last. As the system at ship and server at port and shipping company are connected over Internet of Things (IoT), with the help of video frames from camera and weight of the ship after every container loaded, Machine Learning (ML) algorithm will calculate available space and allowed weight. This available space on the ship doc and weight capacity can be notified to crane master using Internet of Things (IoT) architecture.

Cameras can also be used to mark the movements of the crane carrying the containers to ensure the safety of ship and employees as well as workers at shipping port. Any unusual movements of the crane may lead to catastrophic events.

Upon reaching the limit alert will be sent to company as well as officer on the ship. Alert system will provide the reasons and actions to be taken in case of overload. Crane operator can also be notified of ship weight limits.

After loading is complete, container count will be provided to company, dock and ship officer. Machine Learning based algorithm will help to calculate time expected to load the decided count of containers, elapsed time, time actually taken to carry out the loading operations, delays if any, reasons for the delay, etc.

Before Leaving Port-

Security systems such as alarms, washing down, leakage proof, etc. will be tested and detailed report will be provided by sensors to system at company and inspection authority. Sensors involved in testing will result in decreased human errors. If any maintenance is required alert will be sent to company's maintenance department. Reports on any changes or maintenance carried out will be pushed to system on the ship via update.

Attendance can be marked using facial recognition system as well as iris scanner, whenever employee

boards ship. To implement such attendance system a list of employees with every detail including photograph will be posted to the system on the ship. Such attendance system will reduce time taken to mark attendance of every employee and also helps in intrusion detection.

On Leaving-

Considering the distance to the next port Artificial Intelligence (AI) algorithm will calculate the time required to travel that distance as well as the speed to be maintained in the journey to reach destination on time.

System will draw a map based on longitude and latitude and will add markers after some distance to keep track of the route. Update of the current location and speed will be communicated to company after every 30 minutes. In case of extreme weather shipping company will communicate the updated route of navigation to the ship officer and same will be acknowledged with system. On receiving new route again distance and time will be calculated and speed variations will be done accordingly.

Sensors connected over intra-net on the ship using Internet of Things, will keep record of temperature,

humidity, wind direction and wind force. Based on the Internet of Things (IoT) enabled sensor data, intelligent systems on the ship can maintain the temperature inside the ship. Alerts will be delivered to ship officer and shipping company in case of icing, fire, or leakage.

Engine conditions will be regularly monitored through Artificial Intelligence (AI) program and that data will be stored for further analysis. In case of overheating, fuel deficiency, icing, fire, leakage, etc. maintenance manager will get alert with reason(s) of problem and actions to be taken. In case of emergency alarm will ring to get attention of officials, managers, etc.

On Reaching Destination-

When ship is about to enter port all the e-documents related to ship including number of people on the ship, engine, hygiene conditions, distance travelled, route, company name, ship type, ship unique id, etc. will be communicated to port authorities over smart Radio Frequency IDentification (RFID).

As ship reaches to port cameras at the entry and exit points will track the movements of employees whether leaving ship or not. Such data will be useful to track the employees and provide a number of employees on the board.

Cameras on the board will help offloading the containers by providing the exact position of the container on the board. Such cameras will also keep track of container movements to maintain the count of containers on board. Update about container count, engine conditions during previous trip, fitness of ship will be provided by system to company and port officials after completion of loading operations.

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