YRKESHÖGSKOLAN NOVIA

Spatial Recognition

Spatial Recognition with Robotics using Autonomous Database for Spatial Studio based on A.I and Machine Learning

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Abstract

This is a project-based research document based on using modern tools of technology to bring better safety, navigation, and overall ship orientation by recognition of space around to help the future autonomous shipping industry. A system will be designed with help of underwater robots as well as aerial vehicle to be used as input devices of data. Once data collected from around the space will be sent to an autonomous database center.

The autonomous database center which will be based on A.I and machine learning capabilities will prepare, sort, and configure it for right useful purposes.

The data can further be delivered to either remote operating center to run analyses with spatial studio software to draw predictions based on Artificial intelligence and machine learning to make safety warnings.

Robots will be run in simulation environments with required sensor fusion to collect big data information that will be sent to autonomous database warehouse by oracle. The data collected, will be sort prepared and configured by autonomous data warehouse tool by oracle with an open-source dataset. An open-source model dataset will be used to do the final post processing in spatial studio to draw and map spatial predicted results.

Language: English

Keywords & Abbreviations
A.I: Artificial Intelligence
WEBOTS: A robot operating system tool for simulations
Spatial: Comprising Space round around an object

UAV: Unmanned Aerial Vehicle
ROV: Remotely Operated Vehicle
Spatial Topology: Space based on Geometric Geographical Area
GPS: Global Positioning System
Spatial: Relating to occupying space round around
API: Application Programming Interface
JSON: JavaScript programming Object Notation
Geo: Based Geological Geography space
Lidar: Light Detection and Ranging
Radar: Radio Detection and Ranging
Python: Programing Language for Data Science to program computers
IMO: International Maritime Organization
AIS: Automatic Identification System
VTS: Vessel Transport System
OLAP: Online Analytical Processing
XML: Extensible Markup Language

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1 Introduction

This thesis is a project-based research paper which aims to define key aspects for the future of digitization and innovation in maritime sector. Focus is aimed towards industrial revolution for the growth of new industry in shape of autonomous shipping and automation in marine sector. Therefore, these papers find solutions to some of the key rising challenges for efficiency and safety of autonomous ships with the aid of tools such as Artificial intelligence with machine learning in coo-relation with robotics.

As part of the fourth industrial revolution happening currently in maritime sector there is a massive change occurring at a very rapid scale. This does not only will require new skilled work force with new tools but also a combination and manipulation of new technological industries incorporated to achieve that smooth transition towards digital sector.

The document will point some core basis about reliance of future of marine sector towards automation. The research will also find some crucial challenges as well achievements towards big data science with help of robotics. The project work will prove the feasibility of tools such as an autonomous database aided by a powerful compute resource using artificial intelligence for purposes of spatial analysis for spatial recognition for an autonomous vessel.

Main objective achieved will allow autonomous vessels of future to have a better communication in between available resources at a minimalistic cost. With better spatial understanding and recognition of multidirectional space around such as predictions of any sort of unusual mis happenings in surroundings.

Agile process and methodologies have been used throughout the phases of research and development with rigors rapid prototyping. When an objective is defined it is always based on a thorough research. During the core studies of course Automation in Autonomous vessel a new way of autonomous was presented by the course lecturers. The students were involved in a Simulink project using MATLAB to design a process control for an autonomous car to create a gain and delay about when to overtake a lane. This led to the core need of similar solution to be applied in autonomous vessels. During the degree program studies as second course was organized with the help of a senior lecturer from Åbo Akademi University with focus on designing and understanding neural networks using Machine Learning model of

Gradient Descent. The students were encouraged to perform project assignments using Tensorflow Kerras Library of neural networks powered by google to analyze different datasets while training the machine learning models. This further enhanced the confidence to apply modern techniques such as artificial intelligence based on machine learning models with power of computing shared resources via cloud.

Thus, a need of a system to be designed was planned using data flow and process flow mockups and diagrams which can be seen in the thesis planning chapters. The system consists of two parts input and then a desired output. To collect the input, simulation technique of testing the software has been applied using Webots robot simulation operating system. This gives, enough validation to apply an actual topology dataset obtained from open-source dataset source provider. Then the data is processed, refined and prepared using autonomous data warehouse cloud computing instances service by Oracle. In the last stage the dataset is split in two parts train data and test data. This allows the software such as oracle spatial studio to draw prediction of possible points of elevation such as invisible islands over the sea surface in Oracle Spatial studio software.

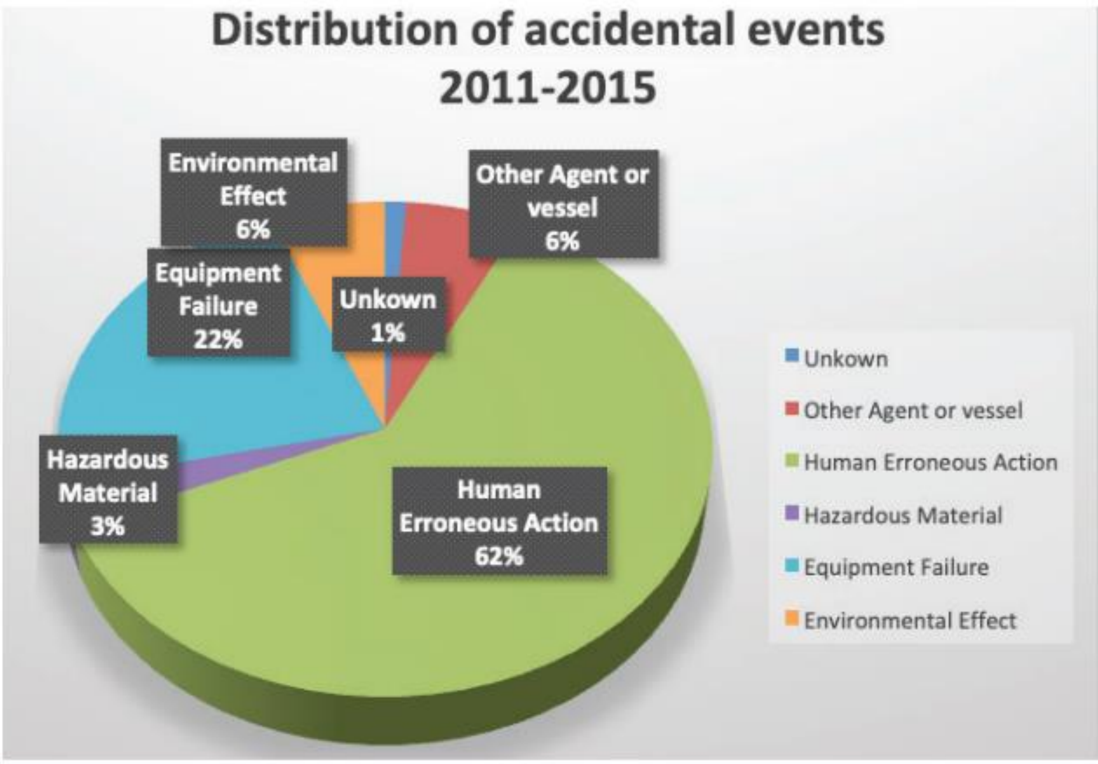


Figure 1.Distribution of accidental events from 2011-2015 in maritime sector.

The figure 1 above shows around 92% of accidental events being caused to be controlled via the solutions purposed in this research. (Bratic, Pavic, Vuksa, Stazic, 2019, p. 254). This cannot be achieved without keeping key aspects in mind such as safety, speed and efficiency. The figure above depicts us to keep in account safety as the paramount issue for autonomous vessels of future. Thus, this project-based research will define and address some of those issues with use of three dimensional printed robotic devices. The main reason they are called with the word three dimensional robotic devices here is because of the use of modern digital modeling of printing objects with a nano scale of accuracy.

Those electronic robot devices will be capable of sensor fusion to achieve functionality such as autonomous driven exploration, obstacle avoidance, collision avoidance and self-destined drive. This is all made possible today because of the use of small-scale printing intelligence achieved in electronic sector with aid of computer aid design of complex circuits. The word complex circuits describe here small scale of nano printed electronic memory and computer chips.

This will allow not only safety exploration but gathering of large amount of data in this project research. The data can be then processed as well with A.I based tools of an autonomous database that can self-heal and self-repair to achieve validity of dataset from input UAV (Unmanned aerial vehicle quadcopter drone) and underwater ROV (remotely operated salamander robot vehicle).

Once this is achieved, data can be sent or received anywhere on sea or offshore centers to be processed as well as analyzed with machine learning capable tools of spatial topology. One of the most crucial spatial topologies used particularly in this project is Spatial Studio by oracle. Spatial has emerged as the new box of pandora not just for the sake of marine technology and industrialization but also for the future space exploration missions.

The use of spatial to recognize the spatial topology around a ship with highest accuracy will come true at the end of this research. The least connection of geographical space topology around future autonomous vessels such as to discover the best possible route of navigation will be an out after this project.

Another use case scenario of possible points of elevation in an archipelago for an autonomous ferry on voyage with human passengers on board as a payload could be given most secure path of navigation with least possible points of elevation to hit a rock bottom during its voyage.

The use of spatial comes with unlimited possibilities in conjunction with robotics aid as well as utilizing artificial intelligence machine learning and deep learning to provide a supportive backend computing engine. Most space exploration depends upon the movement around an orbit of a planet towards its spatial altitude. This enables scientist to draw visual graphs for possible landing missions such as Mars Exploration program. This will develop a pattern for best possible safe sites of another planet based on its geographical points of interest drawn by a spatial topology.

Landing on Titan Moon of Saturn has been done via the control intelligence of design of a control system to control the speed of the probe towards gravitational force variation. Thus, once a desired input is achieved a desired output to be predicted is possible with given input datasets as described by Samuel Kounev, Jeffrey O.Kephart, Aleksandar Milenkoski, Xiaoyun Zhu (2017) in *Self-Aware Computing Systems*.

Spatial studio with algorithms to predict delay times or estimated times of arrival, chances of collision, optimal speed with proved industrial record history in aviation will become effective for marine sector.

2 Overview

The research has been conducted after a thorough year of studies done at AboMare Maritime campus for the program of Autonomous Engineering in Maritime sector. Autonomous shipping is a new domain so does the automation in maritime sector. Autonomous shipping just not involves the navigation of ships with automation or no humans on board but also port operations, ship berthing processes as well as cargo or payload mooring. A baseline template pattern or an infrastructure must come in need to be defined on all major required and crucial terms.

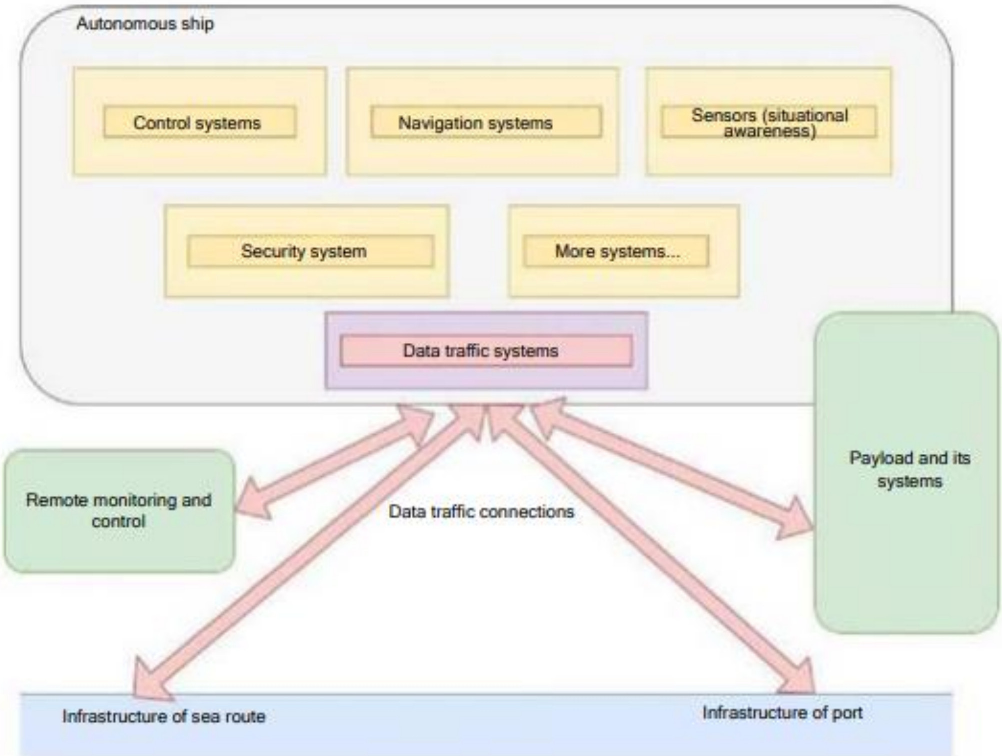


Figure 2 Base ICT from security perspective of a modern ship.

The figure 2 above shows a baseline infrastructure of complexity involved towards a functional autonomous vessel. (Leppänen, Rauti, Rindell & Holvitie, 2018). An autonomous vessel movement is based on the number of commands given to its brain called control systems usually composed of computational electronic circuits and its components. The control system commands work based on a routing path guided by navigational systems composed of Global positioning units, automatic vessel identification systems, offline tools such as gyro movements, compass and pre-installed satellite based offline routing paths also known as offline maps.

During the study of the program an extraordinary excursion visit has been arranged for the remote pilot center for the world's first autonomous ferry operation center. The students had the chance with an opportunity to discover on premise operational equipment such as a radio TCP/IP link connection of the center to the autonomous vessel at Finnferries remote pilot center. Thus, after the excursion to one of the project's pioneer vendor's headquarters at the remote center, this lead to the understanding about a navigation system does not work alone but with conjunction of communications via different protocols and networks with a sensor fusion mechanism. The job of a sensor fusion comprising different sorts of identification RADARS, LIDARS, and cameras is to provide visualization around the ship.

The communication must have to be secured so that a sensor data can be trusted for the purpose of reliability in case of a malfunction GPS or a hacked camera feed image. This is achieved via end-to-end encryption between the signal propagating device and signal receiving device. This is called security system for an autonomous vessel. There are also many more systems involved including network system, backup system, update system that do the job of keeping the clutter cleaned in case of unnecessary raw data obtained from an accessory sensor. One system is dependent upon the other system and simply cannot work without the other.

This makes it possible for connection from vessel inside systems to external systems as well including other autonomous vessels over the ocean. The other vessels communicate to infrastructure installed over the ocean such as communication antennas, control towers as remote connecting units. Since, there are multiple vessels thus, multiple communication channels of a different frequency radio links exist which all need to be centralized to a one bigger vessel transport system hub.

The vessel transport system monitors and optimizes the communications from vessels to other vessels as well as to destination points. The destination ports then transfer the information to payload owners such as good suppliers and buyers. This makes possible for the good owners to track the shipping delivery times with an up-to-date Realtime data. The mechanism of operating an autonomous vessel becomes complex itself with involvement of numerous parties having the same goal of a successful voyage without any hassle. But the breakdown of this complexity makes it easier to understand the overall procedure of putting an autonomous vessel in to functionality.

Figure 3 shows the world's first Autonomous ferry from route to Turku operated by Finnferies.

In the figure 3 above one of the very first successful voyage of an autonomous ferry project SWAN has been taken as inspiration for this project. Mäkinen, M. (2016). The connection to ferry from remote center has also been made via a radio TCP/IP link. Thus, in this project it has been established to follow the same connection with one first initial plan of achieving safety with external sources of reliability. Mäkinen, M. (2016).

In this case, robotics as a branch of science comes in place to play the role of external source. External robots could be installed in this case mere simulations. With the robotics comes also the aerial view drone capability of an autonomous drive and an obstacle avoidance. Both the underwater robot and unmanned aerial drone will have capability of autonomous drive to return to its launch point with ability to navigate with object detection as well as obstacle avoidance.

Both the devices will have sensor fusion in action with nodes of range sensor with light rays as lidar cloud points. This will also help to scan and verify the map topologies.

```
from controller import Robot

class Robot:
    def getAccelerometer(self, name):
    def getBrake(self, name):
    def getCamera(self, name):
    def getCompass(self, name):
    def getConnector(self, name):
    def getDisplay(self, name):
    def getDistanceSensor(self, name):
    def getEmitter(self, name):
    def getGPS(self, name):
    def getGyro(self, name):
    def getInertialUnit(self, name):
    def getJoystick(self):
    def getKeyboard(self):
    def getLED(self, name):
    def getLidar(self, name):
    def getLightSensor(self, name):
    def getMotor(self, name):
    def getMouse(self):
    def getPen(self, name):
    def getPositionSensor(self, name):
    def getRadar(self, name):
    def getRangeFinder(self, name):
    def getReceiver(self, name):
```

Figure 4

Figure 4 shows the python script code screenshot of *WEBOTS* Robot operating system sensor fusion attachment for a generic robot. (Webots reference manual nodes and API functions, Robot, ´wb_reobot_get_device´).

There will be sensors attached to both underwater robot as well as to aerial drone as part of its hardware such as gyro, compass, salinity, temperature, speed and GPS to measure, wind pressure, and water current to aid remote vessel transport centers.

In the figure 4 above a generic class from robot operating system WEBOTS is visualized using python built-in script which shows the number of sensors fusion possibilities. Below the object-oriented class of an object such as any robot in this case scenario a UAV or an ROV. The object inherits a defined set of number of functionalities of its attached generic sensors.

The term generic represents a set of binary and Boolean values for the amount of data captures by a particular sensor. In case of a light sensor, the black values or dark could represent zero number digit and bright or light could represent one’s. The more the zero’s equals a darker area and vice versa. The number of attached sensors is dependent on the control board communication slots attached. The sensors can range from GPS, LIDAR, Compass or to even a Joystick controller to control an equipment or the robot itself.

Once, the data is collected via sensors on robots it can be used for multi-aiding purposes. Collected data will then be selected via autonomous data warehouse algorithms by oracle capable of self-performing functions such as sorting, self-healing, self-segregation and self-repair. Once this done, data is ready to be used for performing SQL queries within spatial studio software by Oracle Spatial family of software.

Where, the studio will do topology graph orientations to draw further predictions for voyage, to predict better estimated time of arrival, speed achievements targets and weather forecasts. The number of possibilities in use-cases such as thickness of ice to affect ship, ship speed, amount of visibility, speed of wind, water current pressure, all the variations based on spatial geology can be compared simultaneously with better predictions by use of Artificial intelligent and machine learning algorithms of spatial studio by oracle. Murray, C. (2019).

2.1.1 Scope of Autonomous Shipping in Finland

Previously Rolls-Royce and currently Kongsberg had a successful operational test demonstration claimed to be the world's first autonomous ferry on a short route near Turku archipelago pictured in figure 3 above. The state-owned ferry operator Finn-ferries have been actively participating in many trials with ship intelligence firms including ferry falco between Parainen to Nauvo a roughly distance of 1.5 miles. Mäkinen, M. (2016).

During the trials in 2018 a combination of ship intelligence by Rolls-Royce and homemade autonomous navigation technology has been used. This not only elaborates the active participation but also a step closer towards next generation of shipping in Finland. Mäkinen, M. (2016).

"Combining a strong, established maritime ecosystem with world-leading capabilities in digitalization, sensor fusion and wireless technology, Finland is a global forerunner in the development of autonomous and remotely operated vessels. Bringing together both Finland-based and international companies with public sector organizations and innovation networks, the country's marine ecosystem benefits from effective cooperation, state-of-the art technology and strong government support. In June of 2018 the Finnish Parliament approved a legislative amendment that permits exemptions to minimum vessel manning requirements and watchkeeping for a fixed term in order to promote technological innovations.” (Lainio, 2018).

“The One Sea autonomous shipping technology alliance has announced that it has secured new funding from the Finnish government to support its role as business ecosystem and has also welcomed Ship-brokers Finland as a new partner.”

One Sea is led by DIMECC Ltd (Digital, Internet, Materials & Engineering Co-Creation), and includes a variety of high-profile companies working on autonomous systems and technologies, with members including ABB, Cargotec, Ericsson, Finnpilot Pilotage, Rolls-Royce Marine, Tieto and Wärtsilä.

The Finnish government has been very proactive in its support for the development of autonomous shipping through both domestic legislation and international advocacy, and the country’s new investment in the One Sea project, via Business Finland, will help to sustain the ecosystem’s work for the next three years.

The funding will support the project’s technology partners in pursuing further sea trials of their new technologies, as well as their further efforts to drive the international agenda when it comes to adoption of autonomous shipping standards. The One Sea ecosystem says that it aims to enable autonomous maritime transport by 2025.” (O’Dwyer, 2019).

Finland has been pioneering when it comes to new innovations. With the current funding and interests of state towards autonomous shipping and digitization of maritime sector there is no doubt that the future of marine sector in Finland will be truly revolutionized. The automation sector is also playing hands in hands with ability to contribute renewable energy sources for future autonomous ships and vessels powered for safe and clean environments.

2.1.2 Future of Autonomous Shipping Worldwide

Autonomous ship market is experiencing strong growth. Over the next ten years, lives of humans will be totally shaped and changed to accept global digitalization in connection to autonomous ships as floating drones on sea surface. The resulting impact will be a self-sustained digitized and automated supply chain. Not just these drones will be capable of performing mature intelligence functions such as maneuvering harsh weather conditions to self-navigate but at the same time capable of sensor fusion to even predict next natural disaster. The seismic sensor capable ships could not predict the high tidal wave to trigger a Tsunami alert warning but might also prevent a major damage towards human loss.

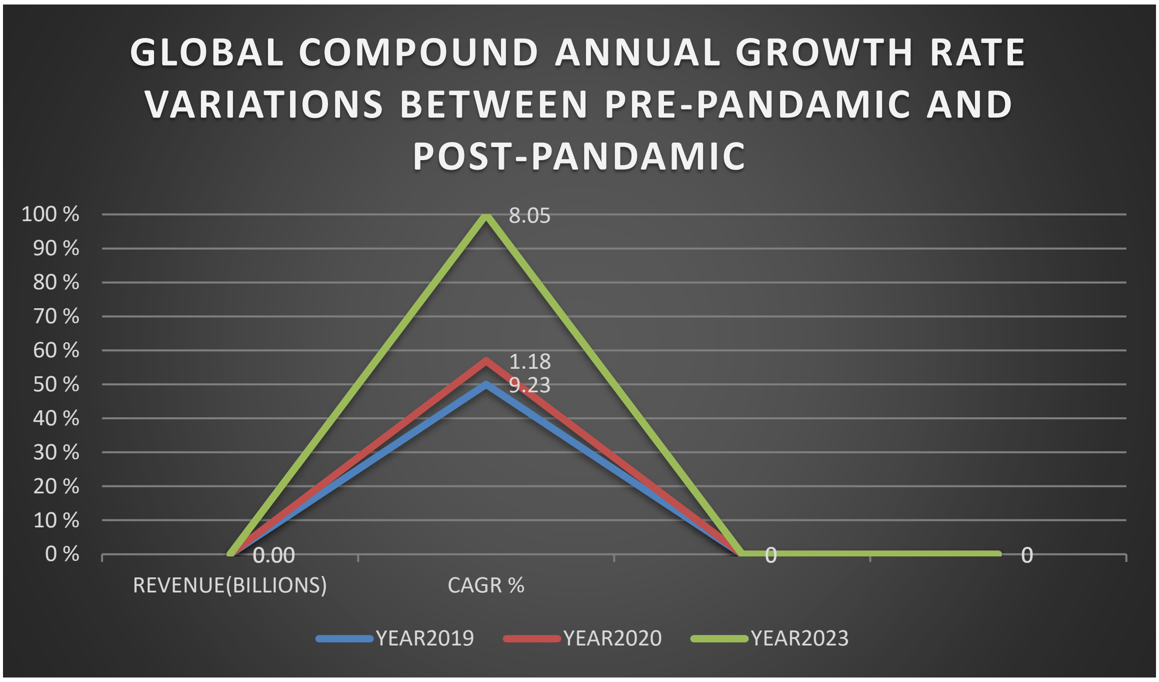


Figure 5

Figure 5 shows statistical data forecast for projected growth rate affected due to Global Pandemic for the future of Autonomous shipping worldwide. (The Business Research Company, 2020).

Major demand for autonomous shipping had previously emerged through the scientific advancements in smart technology with IOT devices such as three-dimensional printing and artificial intelligence on the rise. This led to an era of digitalization in every sector whether financial or health. Marine ecosystem was left with no choice but to replace paper system with digital forms of logging.

The digitalization just not brings digital formats of logging but also computation towards self-automation for ship sway to ship engine fuel checks. This brings the greater needs for validation and reliability of those digital checks in forms of data. Thus demands, more funding, more innovations for research and development of nano scale accuracy sensor measurements. Big companies such as General Electric, DNV GL, Rolls-Royce Holding PLC, Kongsberg Gruppen AS, NYK Line, Mitsui E&S Holdings Co Ltd, Wärtsilä Corporation, DSME Co., Ltd., Vigor Industrial LLC., and Praxis Automation Technology B.V already make up the scene of global autonomous shipping more feasible for required technological advancements. (The Business Research Company, 2020).

The above-mentioned big players tend to make the future of autonomous shipping look bright but the decline in growth comes as a challenge after global Covid-19 crises hit resulting in growth decline.

“Autonomy is now a necessity for the maritime industry to “remain relevant”

While people have been talking about what autonomy might mean in the maritime industry for a few years, it has now become a necessity for the sector to progress. As James Fanshawe, chair of the UK’s maritime autonomous systems regulatory group puts it: “90% of trade by volume comes into the UK through the sea and making sure that trade can move around the world safely is something we must focus on. Autonomy will be critical in the future and in developing the maritime industry so that it remains relevant for the next 50 years.” (Saraogi, 2019-2020).

“Autonomous shipping will be the future of maritime industry, as disruptive as the smartphone the smart ship will revolutionize the landscape of ship design and its operations.” (Mäkinen, 2016).

Kongsberg is developing world’s first autonomous, self-driving, fully electric, zero emissions container ship with project named **YARA-BIRKELAND**. Kongsberg has already been developing self-driving ship control systems for Maritime Autonomous Surface Ships also knows as MASS/Unmanned Ships. Kongsberg had produced the first radar-based collision avoidance detection system back in 1969. This leads them to one of the pioneers to bring the autonomous shipping in to reality at world stage. (Kongsberg, 2020).

2.1.3 Purpose of Research project based on Research Questions

- What kind of tools are possible with current technology combined together to enable a ship to operate autonomously miles from its operating center or shoreland?
- How it can be made safe to save lives with autonomy achieved meanwhile no safety at risk comparable to existing ships with mitigating maneuverability?
- What will make sure to invest as the owners of ships to cut costs at the same time achieve efficiency with more speed from autonomous vessel or ship?

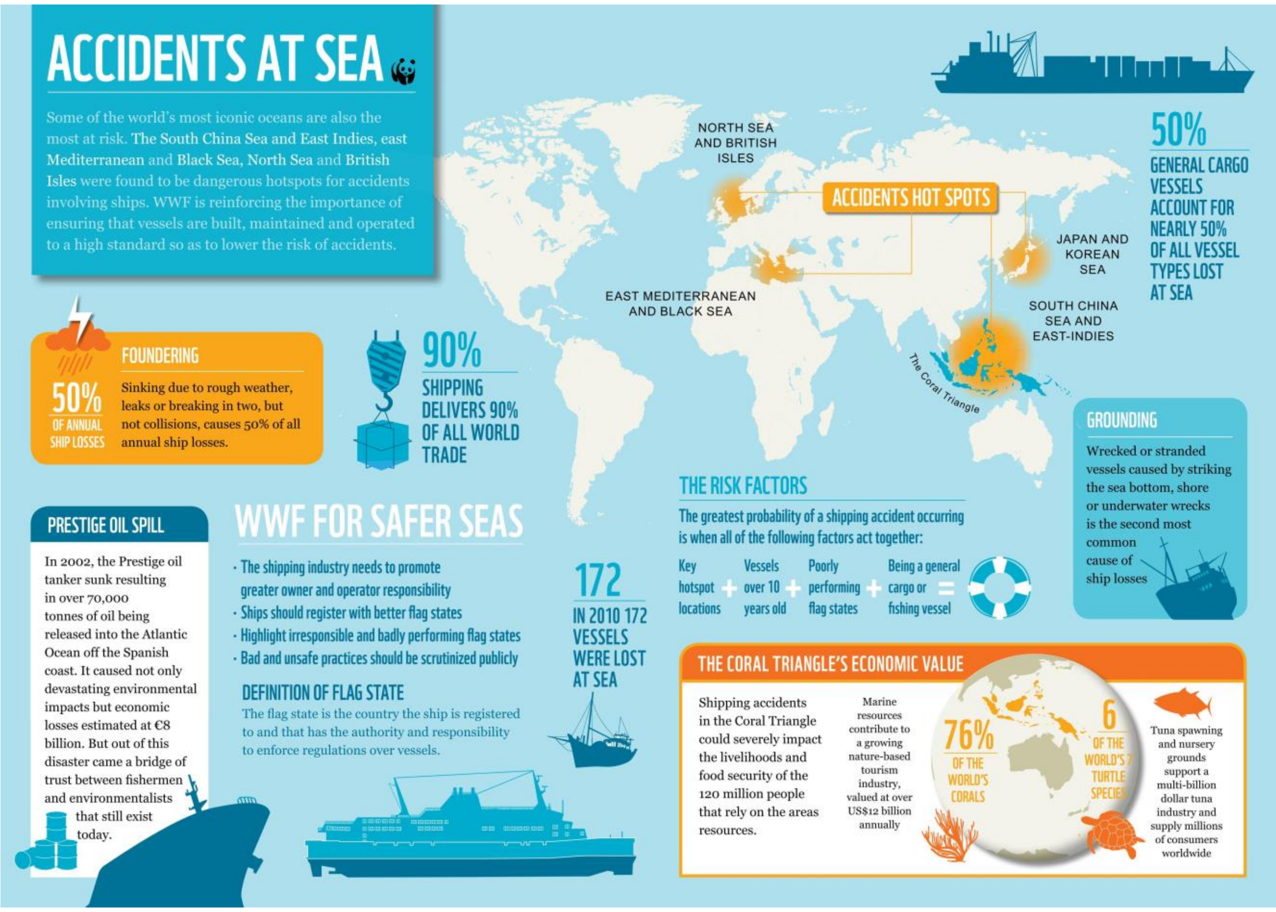


Figure 6

1. Figure 6 shows some of the key stats related to marine and shipping industry. (Butt, Johnson, Pike, Pryce-Roberts, Vigar, 2013).

The figure above shows the number of maritime statistical data for accidents. The amount of information and big data collected and obtained has come to a point to be used for modern sciences of artificial intelligence with machine learning to allow machines with massive computing powers to compromise and then improvise. This will put test data separated from train data for an accurate prediction graph. Lives will be saved with amount of automation achieved. This has been the main purpose of this research that whereas the scientist minds a new system is developed.

2.1.4 Research Technique

In this research the technique used have been to first collect data via robotics. The main is to automate the process as much as possibly do able. The best method is in that regard to have as less human involvement as much possible. Thus, this can only be achieved with the help of robotic arms of automation and locomotion. Sensors attached to those robots do help in the collection of all required necessary data based on real-time motion. Data such as from pressure sensor, salinity sensor, compass sensor, RGB camera sensor will help determine multiple factors including depth, viscosity, speed, visibility, and wind speed. This is a very modern way of source of information to be real time dependent on hardware equipment. This does not only have several advantages such as reliability when there is an equipment failure but also more better understanding for mathematical models to adopt to most recent up to date changes in sensor values such as a recent change in coordinate will predict the change in position.

This leads to rapid prototyping for the mathematical model to predict changes such as in this case an adaptive data model has been used to draw and visualize trends to rapidly produce prototypes in simulation based on sensor data values to predict which areas in archipelago surfaces will have possibility of losing depth for sea water levels to block navigation for future autonomous ships.

The technique has been widely used even being the most recent and up to date leading to technologies such as re-use able rockets for space travel by a well renown but a recent company called “Space X”. A similar fashion has been used in development of modern energy consuming transits systems including modern electric vehicles starting from very low range to improvement towards high range daily vehicles. A recent phenomenon had also emerged as a biggest contributor for the sake of health industry to cope with vaccine development during an era of post covid-19 viruses.

Thus, rapid prototyping technique was applied during this paper as well for the intended project to develop simulations leading to applications with proven required results to be applied on an actual topology dataset. The only difference made has been replacement of simulated robot sensor values with articulated data from an open-source dataset repository from Finland National Land and Survey datasets.

2.1.5 Robotics Technology

Robotics is a branch of science which has been on humans’ minds since we could build things. Artisans have tried to make machine that could mimic human motions and behaviors. Examples include Venice’s San Marcos Clock that could hit the clock on the hour and figurines that could tell a story date back to Fifteenth century. An astronomical clock from old town hall in Prague is another example. Multiple small toys to self-repeating sophisticated machines all were built with aim to either reduce human interaction or to self-repeat a task based on automatic interaction. (Niku, 2010).

Figure 7

Figure 7 shows centuries old figurines and statues that mimic human motion in some sense. (Niku, 2010).

A robot is a machine that does not need much human interactions but runs on program controlled by a computer. If a convention crane or a towing vehicle machine compared with a robot cannot perform any task on its own. Thus, a simple machine manipulator cannot be called a robot. A robot is a device that is controlled by a computer program to perform not a single but multiple action simultaneously using installed computing based on a program with certain algorithms on its own. (Niku, 2010).

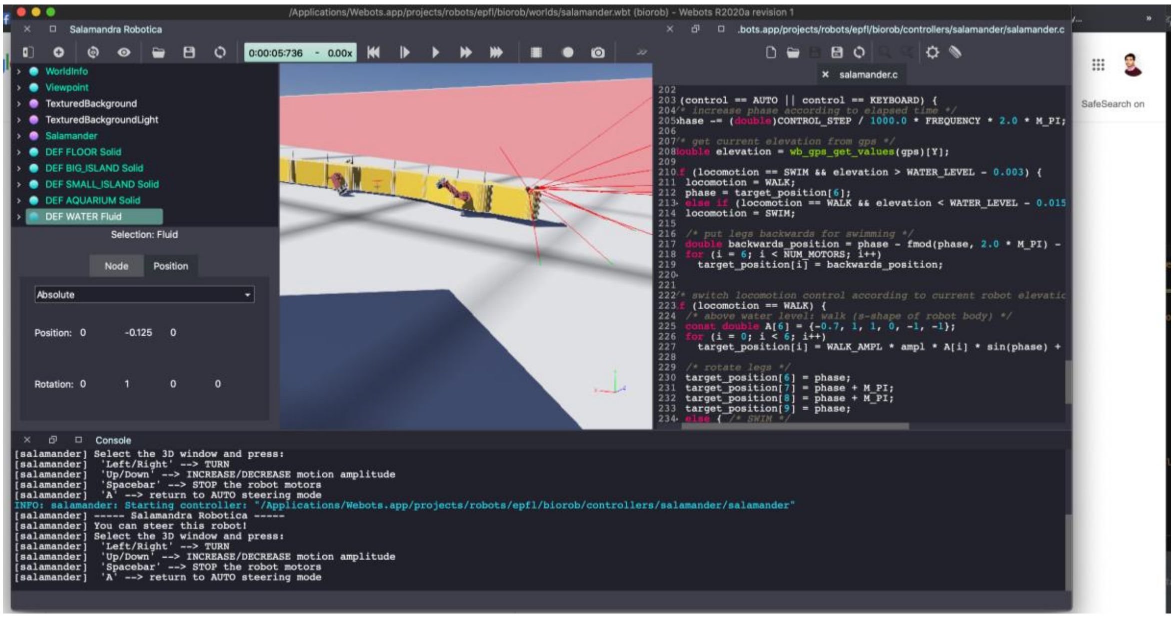


Figure 8

Figure 8 The figure above shows a capture of screen from WEBOTS Robot operating system of one of the robot simulations created for the project.

The robot above can be seen in figure with ability to collect multiple types of data including a c programming language code to fetch GPS coordinates from GPS chip. The robot has capability of self-steering locomotion as well as human control manipulation. This way, data collected is more reliable since no human involvement brings zero to none, human error chances of mistake. The data collected will be later parsed to the ship or vessel of the robot as well straight to a remote operating center via radio signal antenna modem installed over the robot.

2.1.6 Research Methodology

Main method of research in this project has been based on a modern technique called rapid prototyping. In the method of rapid prototyping project evolves based on multiple prototype models created with set milestones.

There could be involved multiple phases and cycles of development with each phase evolving into a next cycle of improvement than its predecessor. In this way not only the work ethic procedure proceeds without any halt but also keeps improvising on standards of quality as every cycle with a new challenge.

Since, in this research, also technology of automation has been taken into account from automation course of designing control systems to tracking autonomous cars technology.

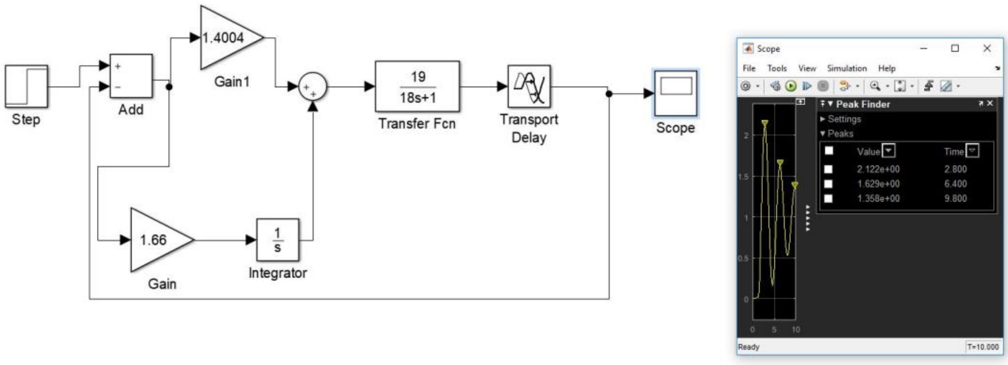


Figure 9

Figure 9 shows a control system design using MATLAB Simulink to find peak gain for an autonomous car transport delay time in decision making to take over other cars in same lane.

The project for the simulation using MATLAB Simulink for automation demonstrated the validity checksum for the results in an ideal environment. This experiment during the lab exercises lead to the basis of project foundation over a robot operating system using simulation at its core.

MATLAB is a math-based programing toolset used by professionals to achieve theoretical results based on mathematical calculation perform with aid of computer designed nodes. The tool has also an accessory based toolset such as SIMULINK to perform physics science operations in conjunction with math calculations such as for measuring control designed circuit outputs.

The idea elaborated the achievement of ideal transport delay times for a control system design for an automation system unit to control the speed of an autonomous car taking over different speed lanes as shown in figure 9 with peak value achieved in wavelength with variation in transfer function node. This set a trend for feasibility of automation to be combined with machine learning capabilities using modern mathematical models of artificial intelligence where systems to be designed with controlled desired output.

Thus, robotics science has been used to get the required desired input data as a dataset of values. The dataset to be controlled with required machine learning neural networks for usability towards required output. Once the dataset is ready and prepared, it is further stored and optimized in autonomous Datawarehouse. The Datawarehouse enables dataset to be applied on an application based on artificial intelligence for prediction analysis in spatial studio tool.

Chua, Leong & Lim, (2003) states the basis for rapid prototyping by dividing prototypes in to three different categories. Since, the methodology of rapid prototyping has been applied as the fundamental procedure in this project.

2.1.7 Types of Prototypes

- Implementation of prototype into sub-assemblies and components from entire product and or a system itself.
- Formation of a prototype from a virtual to a physical prototype where such as a virtual system has been integrated and programmed into a hardware.
- The approximation of rough representation in conceptual product to an exact copy and replica of an actual product

  The technique of using concept cars for demonstration has been in place where the multiple beta phases taken after alpha phases. In this particular project the rapid prototyping of virtual system to be formatted into an actual system of data from a physical location has been taken into account.

  This is the point where the data of robots in simulation has been reproduced by an actual topology dataset from national land of survey. Source: Chua, Leong & Lim, (2003) defines the reason of applying rapid prototyping to be based on different roles a prototype can play during the development phenomenon.

2.1.8 Roles of prototypes during rapid prototyping

- Learning with experimentation
- Proofing after Testing
- Interaction with communication between different layers of development
- Integration with synthesis of different components

- Scheduling and marking of achieved progress

Taken in above points of development accumulation this project proceeds in all phases of rapid prototyping towards a system that has been tested on a new era of artificial intelligence and machine learning platform. The platform itself is yet in a development stage of maturity by Oracle as the oracle spatial studio while the robotics has been in use with production machines.

2.1.9 Site Map of the document

The document has been divided in to three initial parts. The first part as including a brief short description and summary for the document including giving its intended reader an initial brief idea. This is with its sole purpose to aware the reader about the technical complexity of this research project. Reader will understand the included tools, technologies behind the research and its intended project. The project then will proceed to the next phase.

The second phase for the document focuses solely on getting the right input to start. In this phase an initial outline base has been set up. Organized solution has been projected. The candidate proceeds to the required tools of gathering information to be used as a provided source of input. In this case scenario has been robotic input instruments of UAV and an ROV.

Two proposed devices for used to segregate two different types and forms of data. Aerial data and underwater data. The nature of information is different from each other. The chances of malfunction of a sensor exist in both scenarios pertaining to any mishaps such as harsh weather conditions. Though a robot operating system with simulated environments has been used in this case thus, no variables but constants of fixed values. The tidal pressure, light visibility, temperature has been varied among fixed set values of a simulated threshold.

The next phase moves towards implementation of obtained data to be used for the intended purpose. The purpose of the solution has not just been to gather big amounts of data obtained from on spot physical location sensors but rather to analyze it. The amount of information received cannot be classified in to one object class of documentation thus, a huge power source with multiple computing modules in required.

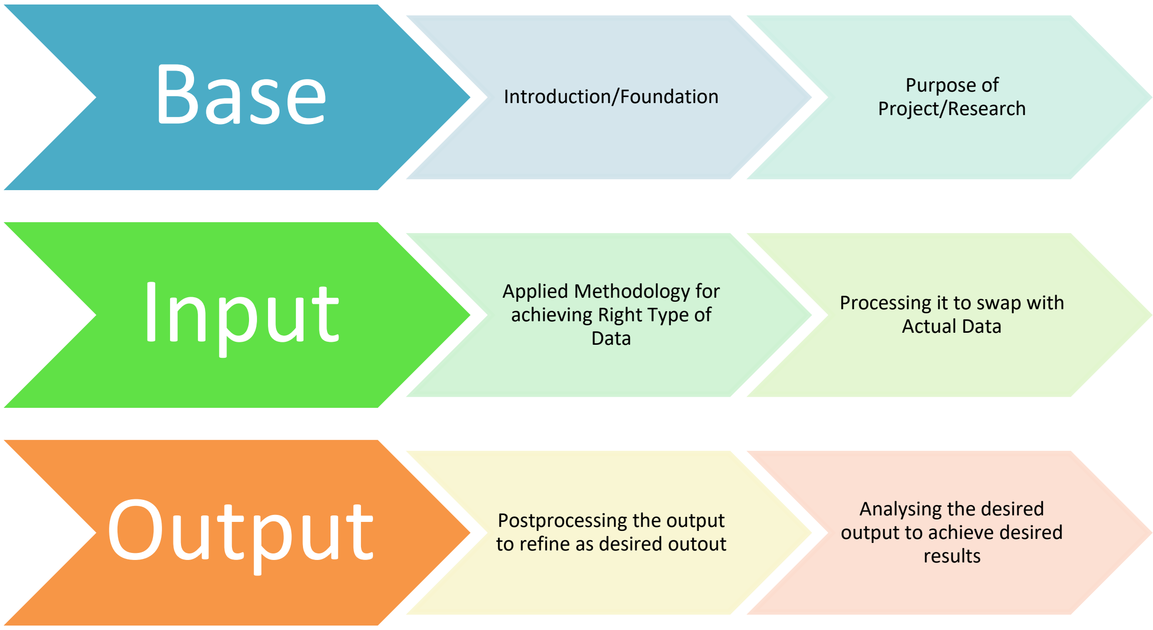


Figure 10

Figure 10 shows the basic principle of hierarchy used in the process of creation of the project research.

This led to the manipulation of an Autonomous data warehouse cloud center such as Oracle Autonomous database. The database is fully powered with numerous automated functions and features for self-performance. Some of the functions include built in queries for refining data with identification of data types from integers to strings. This easily indexes data by itself as well as runs segregation to segregate a character data type from a numbered integer data. This becomes extremely helpful while segregating location data points of coordinates from geometric data of x-axis versus y-axis on a vertical between horizontal field of view data.

3 Development Technology

Any project solely depends upon the selection of right set of tools and information combined to form a mechanism of events that can be translated into a viable result. The technique used in this research project has been no different than a preview of evolving nature of technology. Technologies such as artificial intelligence and machine learning are still at a very early age nowhere close to be declared as mature science.

Thus, a sequence of events has been followed such as introduction of levels of autonomy achieved at automobile sector. The level one of autonomous cars with emergency braking system to be revoked in proximity of an obstacle led to the acceptance of human mind towards greater safety. Once a life saved via automation or introduction of science of autonomous self-performing machines completes the purpose to enhance and proceed further forward.

The era of nano printing brought us the endeavors of smart technologies such as smartphones capable of AI fusion chips to detect scene background in terms of photography as well as detection of hand gesture. Project soli by google is a miniature radar which can detect as well understand human hand and finger motion which could lead to next generation of touchless devices. Source: Annette S. (2017) *HYPERMATICS detects the behavior of automated profiles of social bots on twitter*

The technology today is at the level of eye autofocus cameras to understand the movement of human eye retina. This will enable where just a presence of an object is the interface we need. Any movement of action performed will be monitored and translated in to a detection of data for machine. This where the machine will not only be able perform certain tasks but respond by teaching humans. Thus, a next level of intelligence HYPERMATICS where data provided is now at a reached level where machine will convert it to self-learning. (Schmid, 2017).

Thus, use of A.I becomes more and more evident where to be combined with self-learning machines such as an underwater robot with obstacle avoidance autonomous drive to perform a survey of tasks. This resulting in an enormous amount of data capture to be used for another system with a capability of machine readable to machine organization of raw unstructured information for prediction algorithms. The final product an enhanced analysis system with development capabilities of new information from given input to be used as a both test and train for the machine computation.

3.1.1 Planning

Every project involves a phase of planning. This is not only crucial but necessary to develop a roadmap of tasks to be accomplished based on one's selected series of milestone. A similar approach has been made during the planning of this research-based project. The planning involved a core concept of how a tradition system such as one's own personnel computer operates. Thus, a very basic architecture of an intelligent machine has been laid such as a source of energy to make the electrons flow in circuits. The flow of electrons transforming into computations inside complex circuit boards with the help of external devices such in a daily computer a hardware based connected keyboard dictates with the pressure applied to show case an output of a letter in a picture tube striking electrons on a glass screen called display.

Meanwhile that series of actions becomes a data which needs a space to be stored in traditional cases a storage disk also leading to databases on a larger scale. The stored date can be stored inside internally in random access memories for temporary purposes such as multi task execution or could be sent to another location of an external modulated disk drive or an attached external solid-state drive. In today's world with frequencies of larger bandwidth such as a 5 giga bytes of a radio signal, stored data can also be shared or transferred to another remote or far away location such as a remote center off shore. The diagram below gives a further visual glimpse of this planned architecture phase in below.

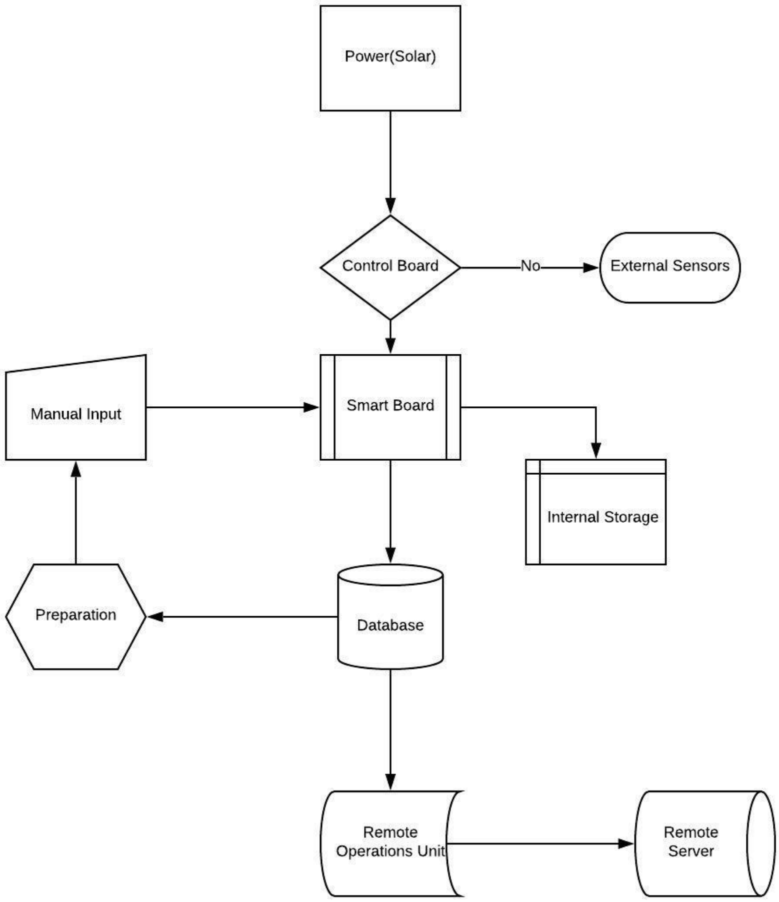


Figure 11

Figure 11 shows a Data flow diagram for different phases of flow of data for the project to achieve desired success output as part of the planning for the project.

Based on the initial planning it has been planned in the beginning of engineering studies for autonomous engineering in maritime at Aboa Mare Maritime Academy to first collect data using external sources. Purpose of external sources is to bring more reliability. External sources identify to the external sensors outside of the bounding vessel. In this case, it has been chosen to have some sort of sensor fusion outside of our autonomous vessel. Thus, comes in use the branch of robotics. Where, the robots have the ability of self-locomotion with intelligence of a sensor fusion to gather extreme amounts of big data either for a remote operating center or a ship control unit.

As can be seen in diagram above a process flow of data flow is explained where for any electronic unit an energy unit is compulsory. In this case only for the purpose of reference a solar is an option to power the robots. The robots comprise of sensor fusion technology with external sensors such as lidar, radar, GPS, gyro, proximity, temperature, pressure, salinity attached to it sending data to robot control board. The board transmits data via an external

radio link now 5G to be processed onboard ship processing unit with cloud data connection. This stores data functions in Autonomous data warehouse. The autonomous data warehouse performs self-initiating functions such as backing up to the autonomous database.
The data is divided in to functioning datasets that can be used by the offshore operating centers at a remote location as well. The data is also stored on a temporary storage. The data is then divided in to test and train units with manual inputs for further analysis on AI based machine learning tools such as spatial studio.

Figure 12

Figure 12 shows a first drone UAV that can achieve high speeds while recharging itself to cover long distance for first responders. (Young, 2020).

This could bring more freedom to attached robotic intelligence in terms of power and energy consumption. Once the power give, robot’s control board starts collecting data. This is just a raw data without any segmentation and sorting.
Data is coming straightforward to the control board of the robotic devices. The robotic devices do have the possibility to manually fetch the data with queries by a remote connection to the robot with a pre-installed modem to convey a radio signal. Else while the data can be prepared over the inbound ship processing unit to first sort or segment with autonomous database functions.
Thus, once prepared the data can be sent to the remote operating centers as well as vessel transport systems to make decision for automatic identification systems.

3.2 Selection of my Technique of choice

With background in robotics and automation of data API from Finnish weather institute using tenser flow to train a neural network with AIS data from Finnish traffic, it became evident to have further predictions since Artificial intelligence is in use with big data applications over cloud. Source: TensorFlow (2020) *An end-to-end opensource Machine Learning Platform*

This gave me the idea to create a process of reliable information with an alternative to vessel intelligence from external sources. Installation of external intelligence and sensor fusion cannot be done anyway better than using smart and energy efficient robots. With help of 3D printed electronics, having powerful actuator motorized drones is not anymore one's dream. This led to the combination of data from all the angle views, above ground as well as below seal levels.

Once data collected it can be then automated. Thus, modern tools of Artificial intelligence such as autonomous data warehouse from oracle comes in hand. With implementation of collected data towards comparison with autonomous database gives a possibility to refine all the collected information.

The collected data is refined and transmitted via cloud to be compared inside spatial studio.

One of the core main purpose of achieving automation I always to reduce human interaction. Since human error has been the major cause of majority of shipping accidents. This brings to a level of trust for machine, but the machine can only trust if it is self-monitored.

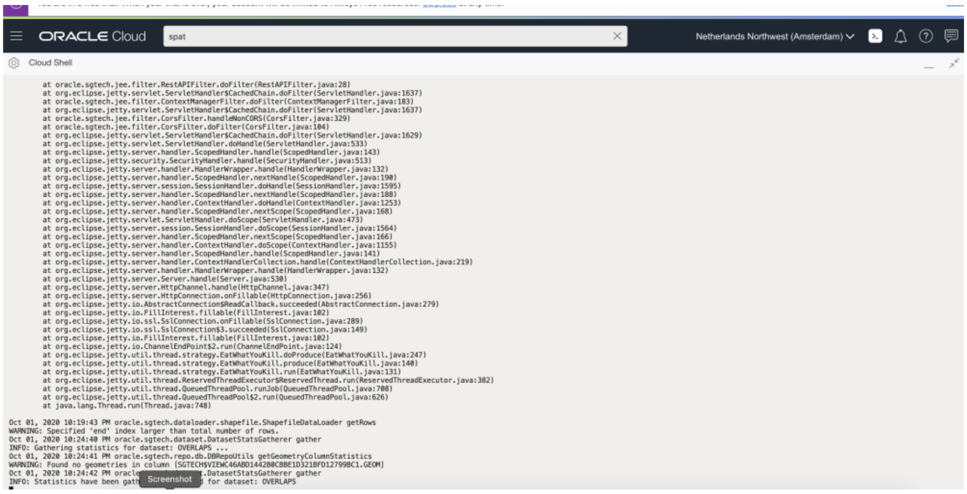


Figure 13

Figure 13 shows a screen capture of output of automated processes transcript of records performed without any human intervention at Oracle cloud compute engine instance for Autonomous Database tier.

The figure above shows a script of cloud performed actions via automation without human intervention. The oracle cloud in this instance makes the Datawarehouse storage compartments ready to store data files based on their type and format.

This is done via an artificial intelligence-based segregation filter applied to filter files for usable data frame based on the viability of data and remove any unusable data frames such as empty rows of missing values of coordinates in spreadsheet containing coordinates of a particular geography. The server also dumps the empty lines to not read again by reducing task actions to save memory for other multitasking operations to be performed over the required datasets. This saves over heating memory usage issues as well as reduction in computing to repeat doing the same tasks of killing or removing operations not needed for an end user.

The automated process keeps running encryptions with cross origin attack prevention to not allows any external links to access data outside of this particular autonomous data warehouse. This makes an autonomous database secure as well as dedicated towards a particular encryption for its owners. Safe, secure, less power consuming, more fast, accurate, reliable autonomous database has been the core reason of choice for this project to be dependent upon.

3.2.1 Data collection technique

Data must be in a state where it can be utilized with proper validity. A data is only trustable when it is up to date. Thus, on location devices such as robotics have been put in place to not only verify but also validate data with on spot physical sensor fusion coordination.

A device such as a smartphone is equipped of many sensors such as proximity, gyro, compass, infrared, web camera, light, and many more. The power of computing has reached to scale of nano scale printing where verification of any data set is possible with on point sensors drawing LIDAR points of coordination to scan any geometry.

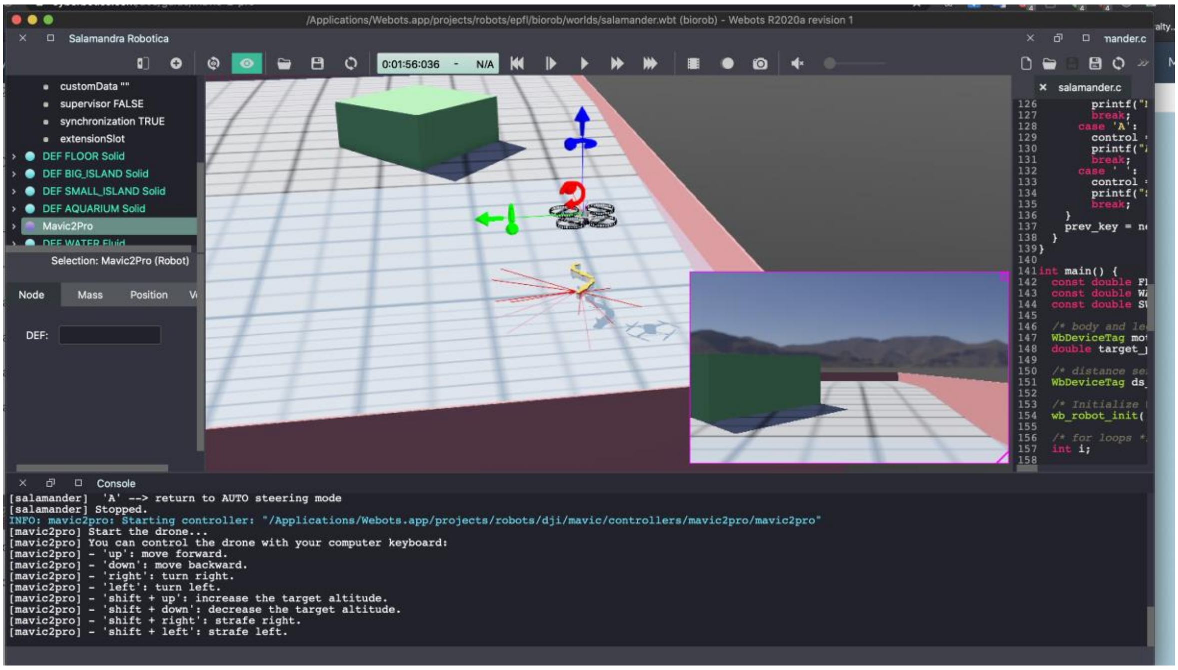


Figure 14

Figure 14 shows a simulation of Lidar point rays scanning to form a Geometry topology in 3D.

Three dimensional (3D) printed robots are more than capable of scanning any environment with laser light coordination points to see if there is a new emerging obstacle instead just relying on an offline or satellite imagery data. This makes any dataset more reliable, verified and validated. The figure above shows the salamander robot as an underwater bio robot with laser beams to scan up to 200 meters underwater for topology imagery manufacturing. This will be used for the underwater seabed data.

The data obtained from LIDAR is not only used to measure depth of a shape object for obstacle avoidance but also for detection of viscosity in terms of fluid pressure is a significant factor. In the figure above the light rays emitted show case a scenario when actual view window is portrayed with help of web camera sensor attached to salamander robot.

The controller releases commands of movement based on detection of hurdles in the environment to actuators of robots. In case of an obstacle avoidance, if the obstacle is depth on the left the controller of the robot will release forward commands to right actuators to avoid obstacles on the left. This obstacle avoids command-based navigation will give the robots a fully functional autonomous drive to follow a path from launch point to destination point and backwards.

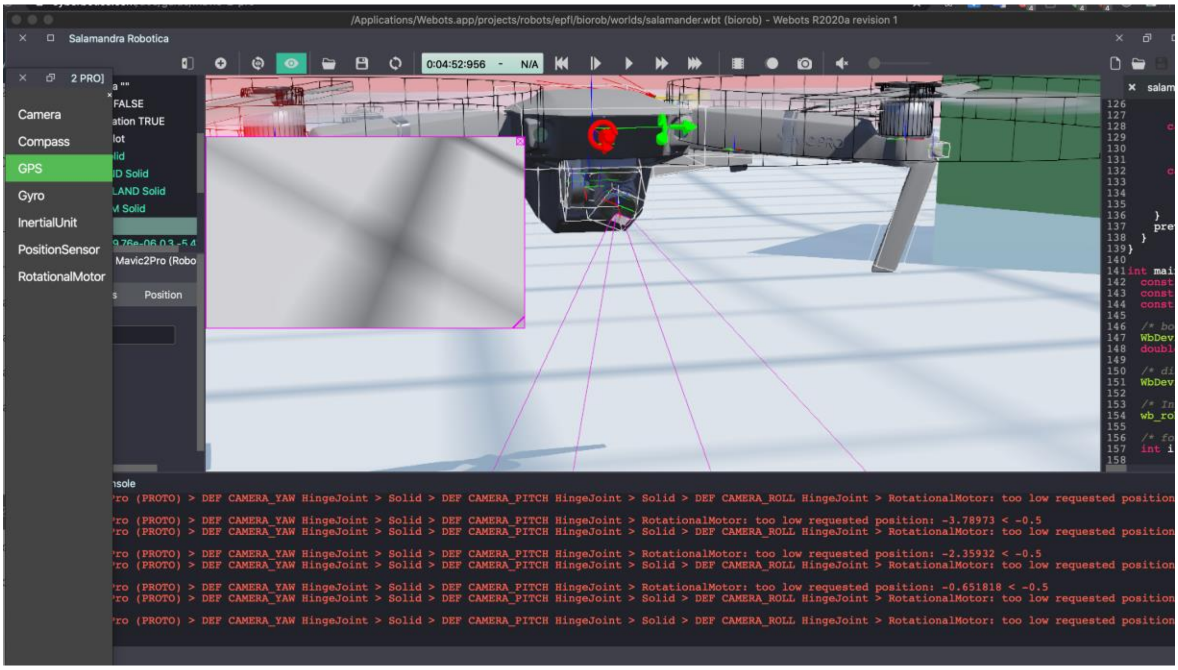


Figure 15

Figure 15 shows a simulation screen capture of aerial dataset for emerging obstacle imagery using drone lidar beam points coordination view.

The aerial UAV will be collecting and verifying dataset with aerial inspection of sensor fusion using LIDAR in this case scenario. There is also equipped an RGB camera sensor, that will help to identify Red, Green, and blue values for an object. There is also an infrared sensor that will collect binary data for mapping a topology geometric shape. The UAV will also be reading compass values to be combined with GPS sensor chip to identify coordinates within a proximity scope.

This will also use proximity and gyroscope sensor to determine altitude, and some rotation motors to verify wind pressure.

The collected dataset will then be sent to autonomous cloud Datawarehouse. Autonomous Datawarehouse will be revising the obtained data to eliminate any empty or missing values to an autonomous database. The autonomous database then will repatch the amount of big data into a useable dataset.

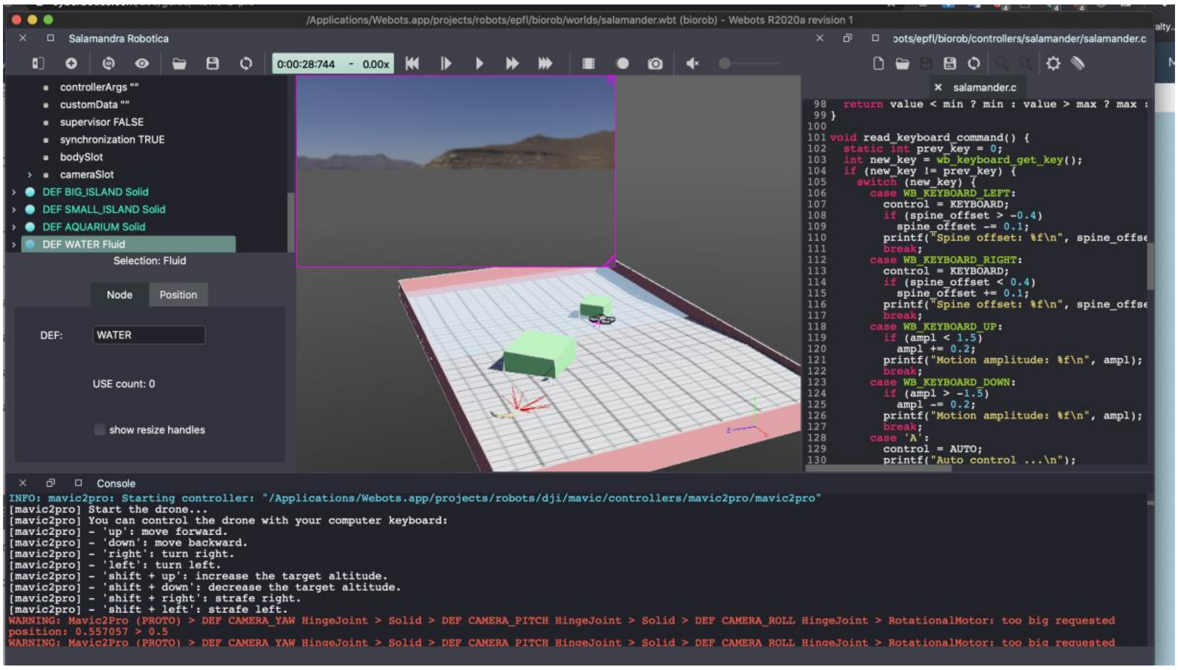


Figure 16

Figure 16 shows a combined dataset view of both aerial UAV and underwater robots laser scanned lidar points topology environment structured imagery.

The figure above shows a combined view of simulation environment for both aerial robot as well as underwater robot. The data obtained from both input devices make it possible to draw a clear geometric topology for the view to help any ship orient itself in a more reliable and safe way. The dataset is more accurate than any other source since it has been verified by robot attached sensors on the location which helps the larger vessels to see a better clear image.

3.2.2 Input Methodology

The datasets obtained are compiled for use. The data captured as lidar points or any other geometric draw points are combined to form shape files, or a spreadsheet containing all the marked points.

The data input depends upon the fairness in terms of data reliability and its validity. Though plenty of data is available via simulations with inertial sensor, compass but the validity stays in question due to slight to little variation for fixed simulated environment. Thus, a real time data of elevation points of a geographical location of interest is not just required but necessary.

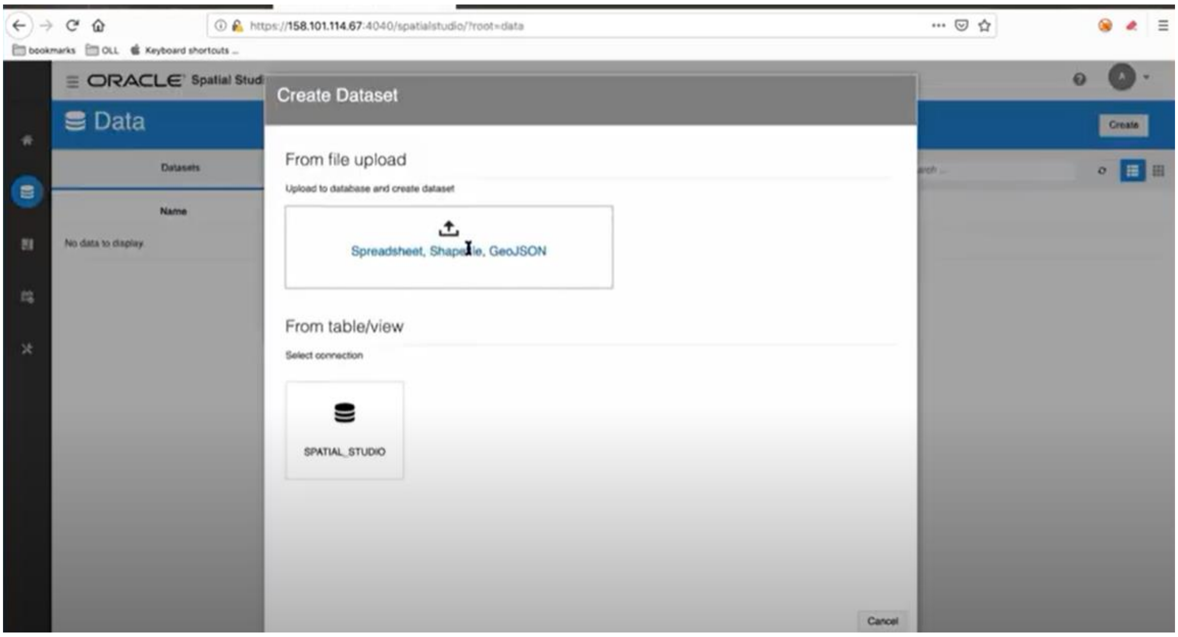


Figure 17

Figure 17 shows a screenshot capture from the project window of the format for spatial studio data input options for autonomous database to interlink with autonomous data warehouse compute server.

The figure above shows the utilization of obtained dataset to its point of need at ease. The data is transformed as in to Geo-JSON files or shape files of containing marked light points of a shape formed to help a ship sway away once analyzed be prediction algorithm tools such as spatial studio. Multiple dataset models can be supported simultaneously such as JSON, XML, Text, OLAP, Relational, in-memory and Sharded.

Once, a type and format are selected, the studio starts spatial indexing afterwards as a self-performed action. The studio will obtain the raw dataset shape files or spreadsheets to validate and verify them at the autonomous data warehouse to be used by autonomous database.

3.2.3 Data Selection Technology

Oracle's free cloud tier autonomous database for autonomous Datawarehouse has been the selection of choice to handle large and huge amounts of shape datasets. The number of geographical datasets obtained from any geological point if interest can be so large for a normal computing source to handle that it might run out of resources to process. Thus, a service with elasticity, built in functionality of traditional web such as java, python, and server query language (SQL) queries can be efficient with backing of a powerful computing source. A powerful computer resource such as a server in traditional web becomes crucial for the handling of large influx of input data.

Main reasons of selection of oracle as a technology platform for data handling

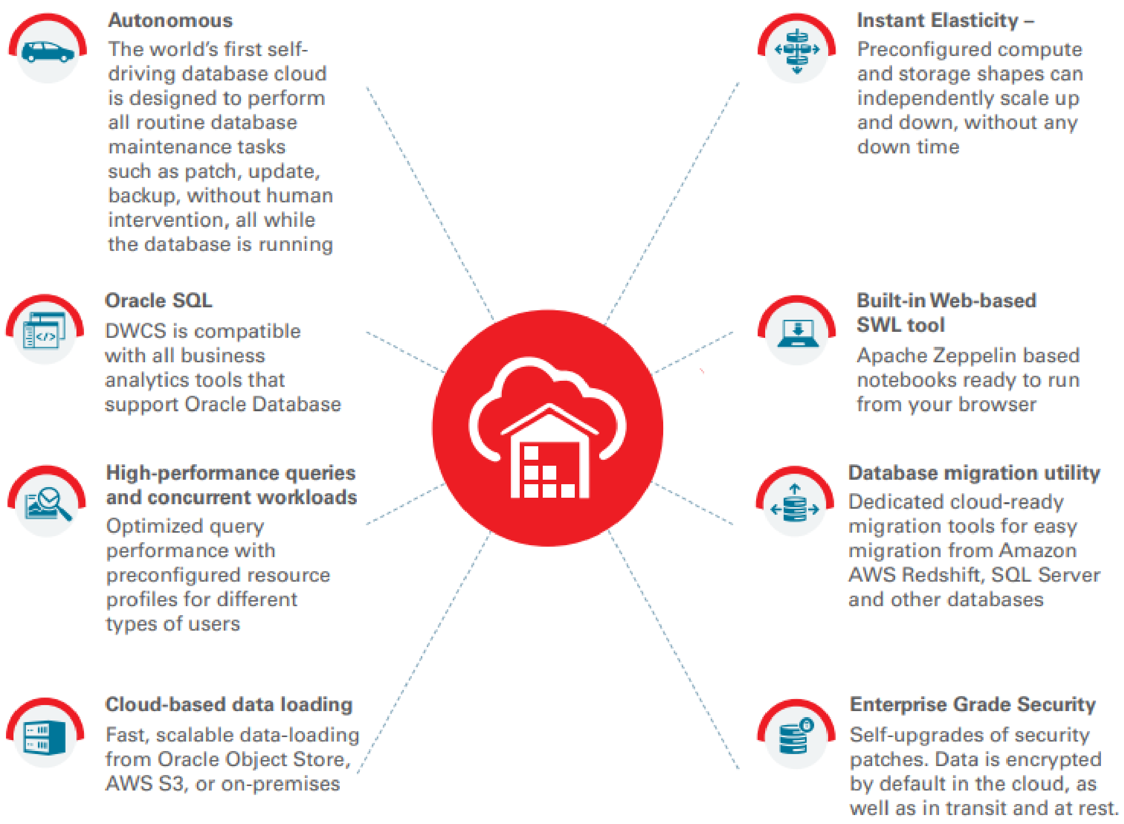


Figure 18

Figure 18 Shows the selection of technology for the handling of data input collected by robotics for its core features. (Oracle Cloud, 2017-2018).

Oracle's autonomous database service has been the world's first autonomous database cloud computing powerhouse. The self-automation does the magic of removing any chances of human error with its self-maintenance tasks such as override to repair corrupted cells of data. Data is continuously self-updated based on an automated process. Data is supplied while healing, repairing, and updating.

Not only the data is empowered with all these features, but it also ships with Oracle's version of server query language to perform any manual actions on the web logic server supplied by oracle computing house. Oracle has built a history of refined set of queries to perform specific functions over a dataset that makes, it faster and safer than traditional set of programming tools to optimize a dataset.

Oracle, cloud also comes with integrated support of Amazon Web services computing servers to fast scale database for larger sets of data such as discovery of new navigating routes over the arctic.

This interlinks between other computing storage spaces make it much faster to easily scale without any down time for running services of an autonomous ship or its remote operating center.

The data is always ready to be migrated or interchanged since with multiple locations of storage makes it almost ready to migrate at any time. With integrated third-party embedding such as amazon web services servers the data is always backed up and up to date.

There is an available integrated web server logic development tool that allows to run web scripting language commands right from the browser linked URL. This makes it easier for an autonomous database to integrate basic web tasks such as graphic user integration for a button component to listen to an event or an alert dialog to notify for an abnormality in data values.

The tools used include software listening components to run a set of computer commands to be not visible to end user but executed over a remote server. This allows safe and secure query execution such as to magnify or sort data values.

Data is always stored with end-to-end encryption thus running it in a cyber secure environment with powerful computing algorithms on an enterprise level makes it impossible to be compromised.

Thus, having oracle autonomous Data warehouse as the main source of selection of data being the main technology makes it the best towards any enterprise scale project.

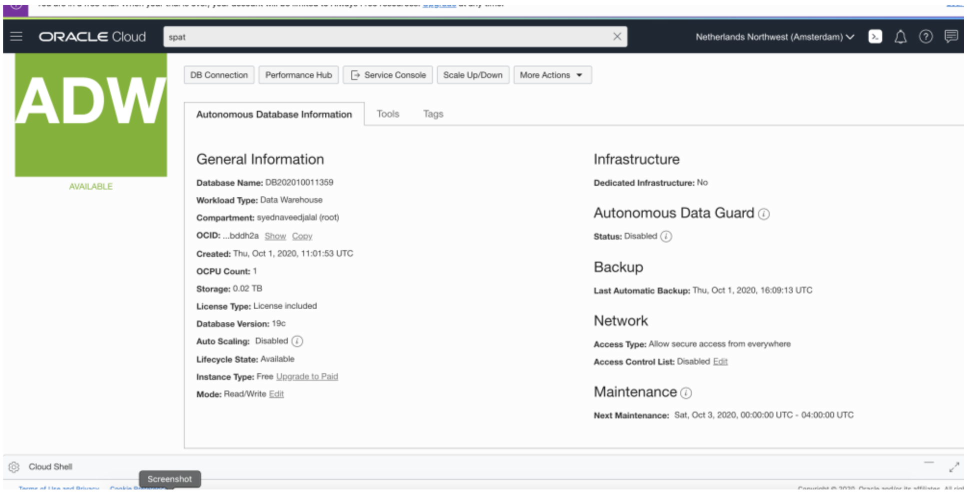


Figure 19

Figure 19 shows a screen snapshot of the backend information about an Autonomous Data Warehouse cloud instance over an oracle cloud computing infrastructure for an autonomous database.

Autonomous data warehouses come pre equipped with autonomous encryption data guards to protect and monitor datasets for any kinds on intrusion on a twenty-four-hour monitoring bases as can be seen in the figure 16 above. The figure above is an actual snapshot from the instance created for this research practical project part.
The figure shows some of the key stats about maintained up time as well as network security layer which will hold the URL link to connect with spatial graphs for oracle spatial studio. The data is transmitted via secure links with encryption enabled hash codes of a URL link. This makes the delivery of information also secure with any human intervention.

3.2.4 Data Processing Technology

When dealing with large chunks of complex data it is always a matter of trust whether to automate the process or manually configure. The word configure refers here to sorting, preparing, verifying and validation of data from raw data as to useful parts. The raw data can compose empty values or zero to null values of a position sensor in a vertical axis when the position changes only in horizontal axis, thus makes it impossible to use those values with no digit number on effect.

The traditional way of sorting could involve using a sort query with any server compute power behind for the server query language. In a more complex scenario, a sort algorithm can also be applied after the sort query gets executed. But this could lead to huge lags and delay times. Resulting in a result that could not only harm the process execution time but also the accuracy could be affected due to the efficiency and effectiveness of certain variables such as the type of data and type of query processing unit.

There comes, the tool of new era with built-in query engine as well as processing power. This can be shown in the figure below with a combination of an autonomous data tier with spatial studio.

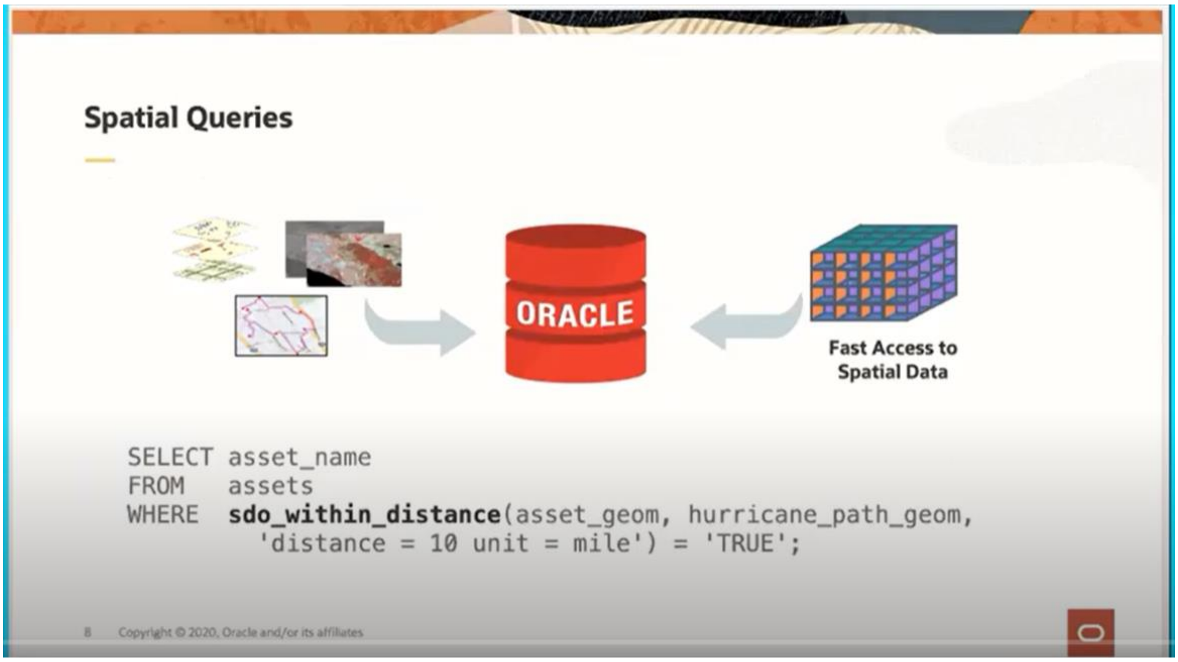


Figure 20

Figure 20 shows the Server query language commands for a general data selection after segregation from train to test to identify the right asset. (Lapp, Viehmann, 2020).

The figure above shows the basic set of server-side query language command that's performed on a server each time a data set is imported as an asset file. The file can be a shape file, a spreadsheet containing coordinates or a geometric set of objects representing a particular geometry. Once the asset is ready, then spatial graph technology will separate the objects from the variable containing distance for collision with secondary variable such as a hurricane.

This can help to an analyst to decide from a certain set of data which objects or autonomous ships will run in the range path of a hurricane. This could help traffic handles at vessel transport centers to issue pre alert warnings for any vessels which might encounter visibility challenges or windspeed pressure challenges due to an upcoming hurricane during the hurricane season.

This is just one query commands example to demonstrate how the obtained data is transmitted into useful information once ready to be analyzed by data analysts. So, the transmission of data from machine readable to human readable and then human readable to machine reading commands will set a new way of communication between remote autopilots as well as next generation autonomous vessels.

This processing of data technology is just the tip of the iceberg where the actual server of an autonomous Data warehouse running an autonomous database inside performs an infinite number of queries for oracle spatial studio to do the magic of spatial analysis as a complete machine to machine communication.

3.2.5 Data Transmission Technique

Once the data is collected and refined for maximum usability, it becomes vital to define the type. The types of data in spatial range from linear horizontal surfaces to multidimensional and multi shape data. This could comprise a total space round around an autonomous ferry or a vessel operating either on an autonomy level of given instructional commands to self-operation. The transmission of data has to be an organized process with bare minimum latency to avoid any loss of data integrity and its genuinely. The figure below shows a mechanism of different types of data that could be retrieved via input resources such as a robot equipped with multi sensor fusion technology.

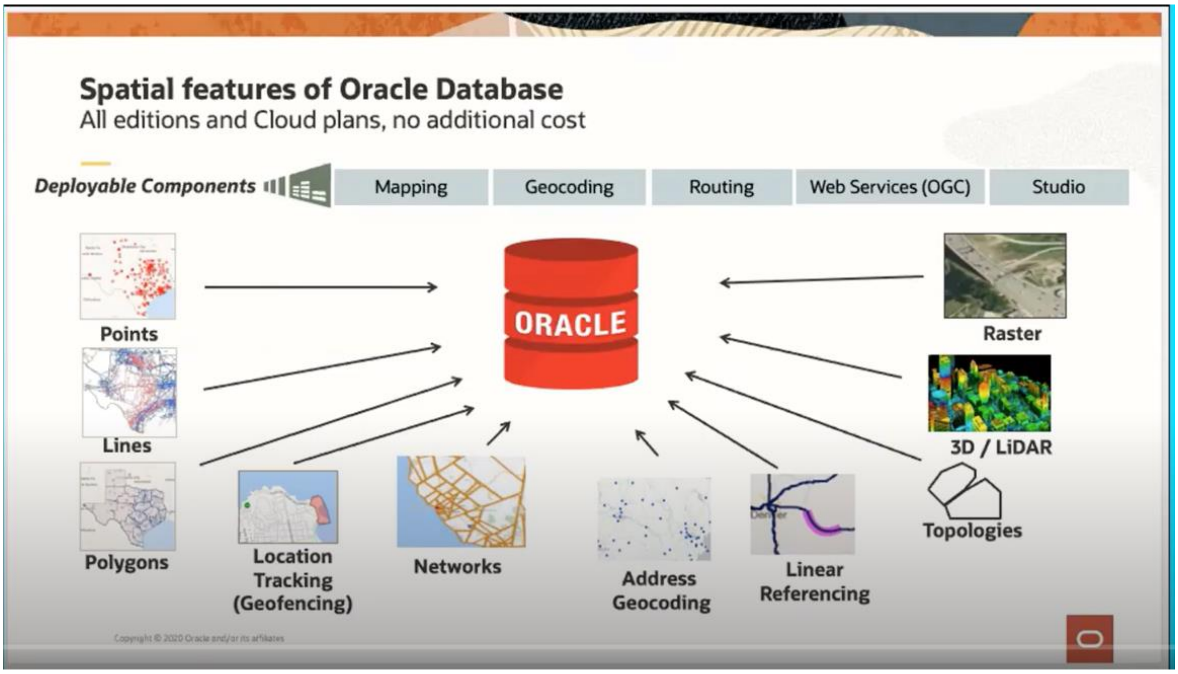


Figure 21

Figure 21 shows the types of datasets accepted by Oracle Server Query Language Interpreter Engine based on AI and machine learning identification algorithms. (Lapp, Viehmann, 2020).

Desired datasets are collected, gathered, combined and refined through a core communication engine of ORACLE spatial data warehouse. The data is mapped and remapped from shapes, lines, polygons, location tracked geo fenced coordinates or topologies as well LIDAR points.

Even any raster data set is then again geocoded, routed to web server logic programming events where in traditional computing a human used to perform set actions such as data interpolation using python or java languages. This all done via automation of machine learning makes the dataset ready to be implied with an aid of artificial sense of intelligence to interpret from machine written code commands for another machine written software.

The software itself is visualized both for humans as well as machines to make final decision commands based on the achieved outputs unlike algorithms written such as linear regression or logistic regression in tradition compute programming's of python and java.

3.2.6 Data Analysis Technology

Data analysis is the core of this project to evaluate the purpose of navigational patterns in spatial recognition towards a clear path. In this regard, data has been received via robotic arms maneuvering in deep waters as well as over space to collect and to tasks of transmission of coordinate values or windspeed and wind pressure values, that could lay an effect over speed of a vessel.

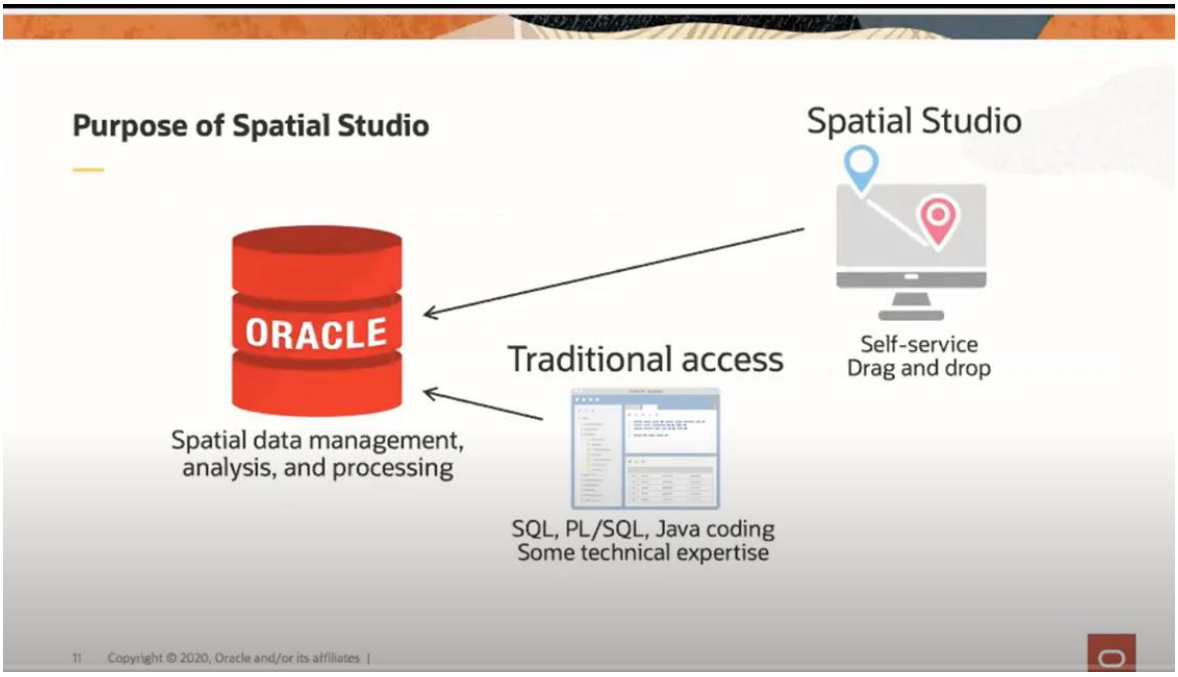


Figure 22

Figure 22 shows the key element of edge for traditional programing vs oracle autonomous data warehouse for spatial graph and spatial query datasets to be interlinked with spatial studio for spatial analysis.Source: David Lapp, Hans Viehmann from Oracle Developers, (2020) *Getting started with Oracle Spatial Studio on Oracle free cloud tier*.

The oracle analytics cloud powering spatial studio enables the data to be visualized in many ways via many different options. The studio allows business analyst or backend intelligence dashboards even excel files to be added with map views without writing any code of programming language for computer understanding. Thus, any analytics developer can access and perform spatial functions to visualize data on a map.

Spatial Studio is a self-service web application for spatial analytics and mapping. It can be used to visualize your raw tables from spatial in the database, but it is even more useful for visualizing your spatial analyses results. It’s designed for users with no spatial or GIS knowledge and provides access to a wide range of spatial operations which are typically hidden behind complex SQL syntax. Everything is done through mouse clicks and menu options.

Many tasks and daily operations faced by users are simplified with Spatial Studio. It provides an advanced web interface for loading your geospatial data into Oracle Database. Your source can be shapefiles, Excel spreadsheets, or GEO JSON files. Spatial Studio prepares the data for spatial analysis. You can then easily share the results of your spatial analyses and visualizations with others.

Spatial Studio has a developer API. When you build a spatial analytics application using the menu options, you can also see the underlying SQL to understand what is happening behind the scenes. This allows you to take the underlying SQL and write more complex SQL if you want to build more complex applications. (Murray, 2019).

3.3 Ethical Standards

The demand for fairness in any technology experiments comes from the fact of bad reputation of technology standard where no software can ever be declared hundred percent bugs or error free. The relation of technology with its feature works in a way of reliance on electrical equipment's made of chemical components of matter such as graphite, silicon, and copper iron or other metal ingredients. The cost it bears is the degradation of this metal elements as part of chemistry where a charge will self-drop when once released into the environment. There, comes the degradation of electric batteries and other components such as memory chips made from silicon resulting in physical loss of memory dumps by the time it age.

These are some of the elements that weight so heavily in the factor of reliance on any technology impossible unless it is working in condition where keeping an ideal physical environment is not only difficult to achieve but also not very cost effective.

This makes it even harder to just rely on any test data obtained just from some mere simulations. Any simulated environment will represent values of a fixed constant when put in place for comparison with a fluctuating variable such as horizontal visibility in relation to amount of fox could be high wind and frozen temperature as the hidden variable.

The fairness depends upon weather the solution meets ideal condition in its relation to actual variables of an actual environment.

Therefore, an actual dataset has been put in place where to support the theory simulated environments have been used in this research-based experimentation of robotic input devices.

The dataset applied for predictions has been based on actual datasets of prerecorded point sets as being currently in used by organizations such as coastal border guards, maritime safety organizations, Maritime Transport services.

3.4 Development Challenges

One of the biggest challenges when it comes to technology-oriented projects is the lack of actual equipment such as computing servers, survey drones, laboratory software rights. Thus, has been the case scenario in relation to this research where the candidates have access to open source. The open-source robot operating software WEBOTS provides enough simulated rendering for testing but no actual data of geometric shapes or objects at open sea. The simulated renderings are just fixed values of points of elevation or speed of wind, water, and available visibility at both horizontal and vertical axis.

The values cannot be changed or neither replicated to keep the simulation rendering smooth. This brings a challenger for the actual testing of software solution at a point to rely only on an actual dataset. Either way the dataset cannot be manufactured but only obtained to verify the validity of proposed solution through this project.

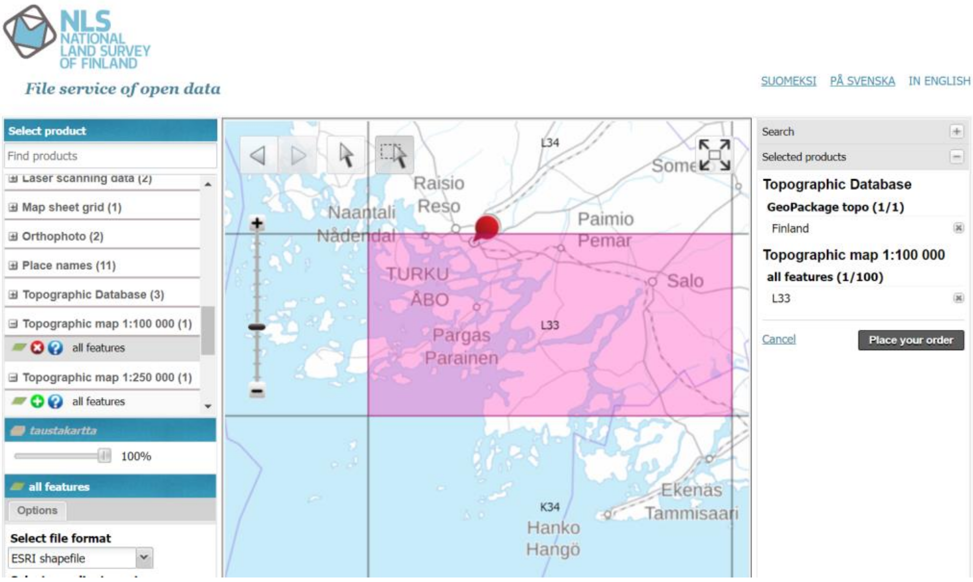


Figure 23

Figure 23 shows the shape file format for the open dataset ordered from National Land Survey service of the Turku Archipelago for the fairness of proposed software solution applied over it. (National Land Survey of Finland Open Dataset file service)

This has been done fortunately relying on free open-source Finnish map dataset services to order any existential map topology recorded and saved. (National Land Survey of Finland Open Dataset file service). Hence forth an open raw dataset has been ordered for Finnish city of Turku Archipelago points of islands with visible elevation. Unfortunately, the data has been pre-recorded thus not up to date compared to a robotic device doing survey verification with its sensor fusion intelligence for us just like in a Webots simulation.

Hence, the biggest challenge emerged during the project has the transformation of simulated data towards real time location data. Because if the project has been made run with simulated values such as of inertial unit or lighting conditions to draw map points for possible elevation points, there is no possible way to validate either verify it. Thus, a real topographic map has been a must requirement. This is where the possibility meets opportunity provided by Finland Institute of Map and Land survey.

3.5 Concluding End results

The project has been run through several iterations were collection of data, its foundation. All in all, conjugating to a point where first the data is planned, implemented, and then collected. The prepared data is the configured for testing and training purposes for an autonomous data warehouse running an autonomous database. All the data elements are put in place with sequenced geometric patterns.

First machine needs an amount of dataset to be split. This split will provide enough values for the computation to run iterations on different mathematical models for the machine to test. This testing will make it possible for the computing power to make sure in such kind of neural network if it is feasible to have a result.

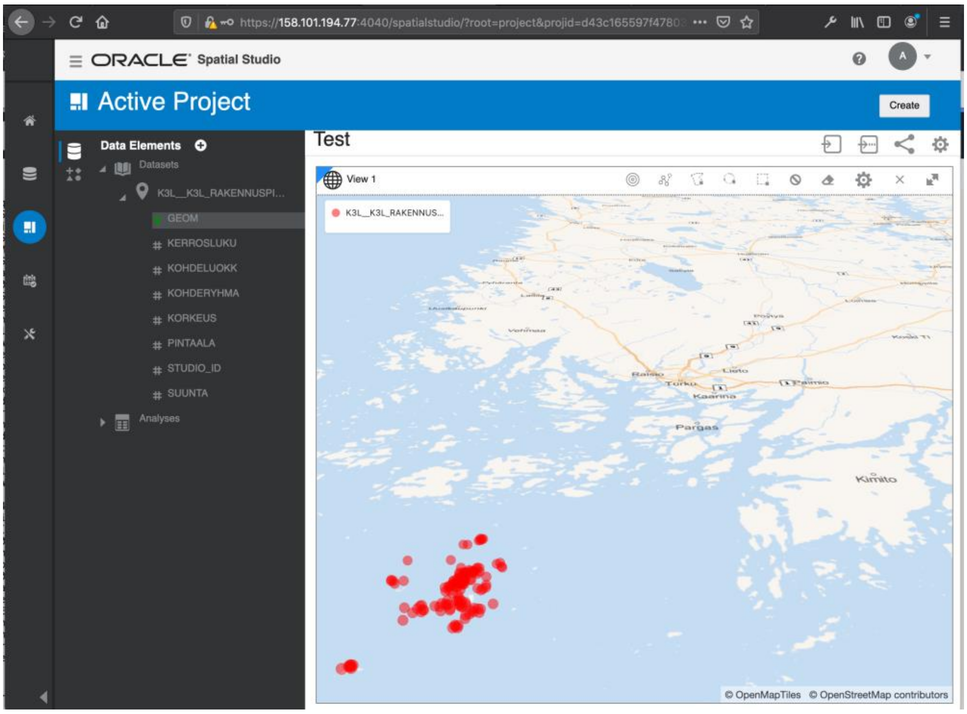


Figure 24

Figure 24 shows a screen capture shot for a sample of test data for points of possible elevation from Dataset obtained thru national land and survey dataset service.

The figure above shows the possible locations of elevation values of possible islands. These values are a result of given dataset being split into a data frame of testing values. The red dots above represent given values out of a data frame of a test. This test will then run iterations on different built inside algorithms of a spatial studio analysis.

The test data has same values which will be then given to the next phase of iteration of running training the machine on its neural network.

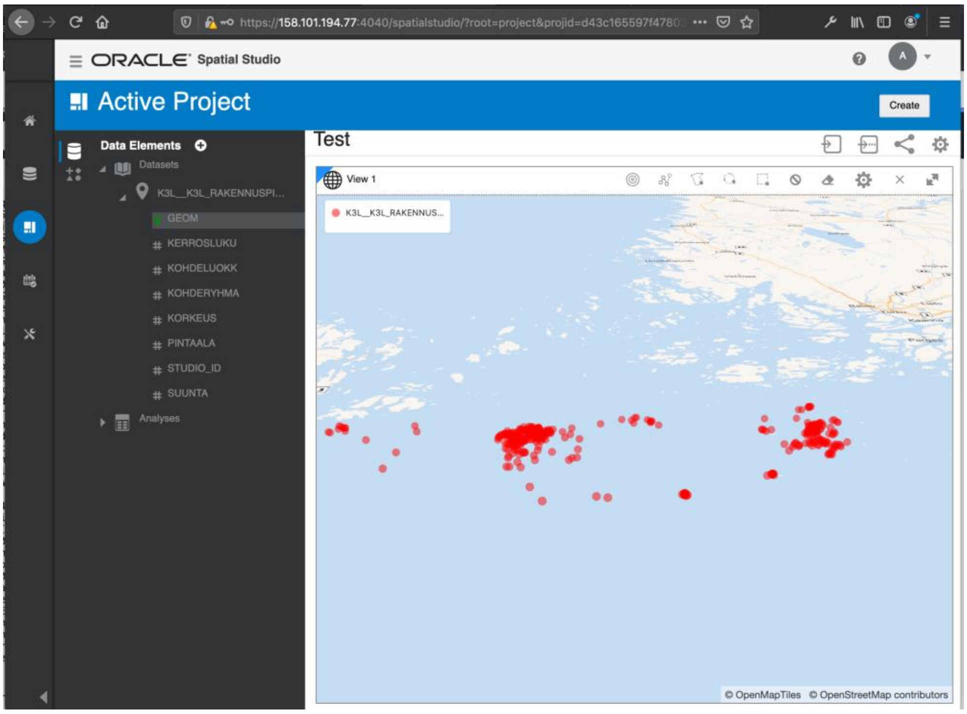


Figure 25

Figure 25 shows a sample of points of coordination drawn for a training dataset for possible points of elevation as new islands in spatial studio.

In the figure above red dots represent a training dataset. The training dataset has been created from the test dataset. After the split of dataset from a certain value set of testing to training dataset is created. This can be well seen that the training dataset is larger since the machine requires a bigger value set for running the computations again and again against the test values feed. The feeder test values created makes it easier for a machine to be trained based on the given test.

After this a final model will be applied which could be an adaptive machine learning or an analytical learning model to build final prediction dataset with highest probability. The amount of probability will be viable based on its accuracy of given input model. Thus, a better and more accurate dataset collected in its raw format the better the prediction of possible elevation points as new islands for new vessel traffic systems in case of low sea water levels.

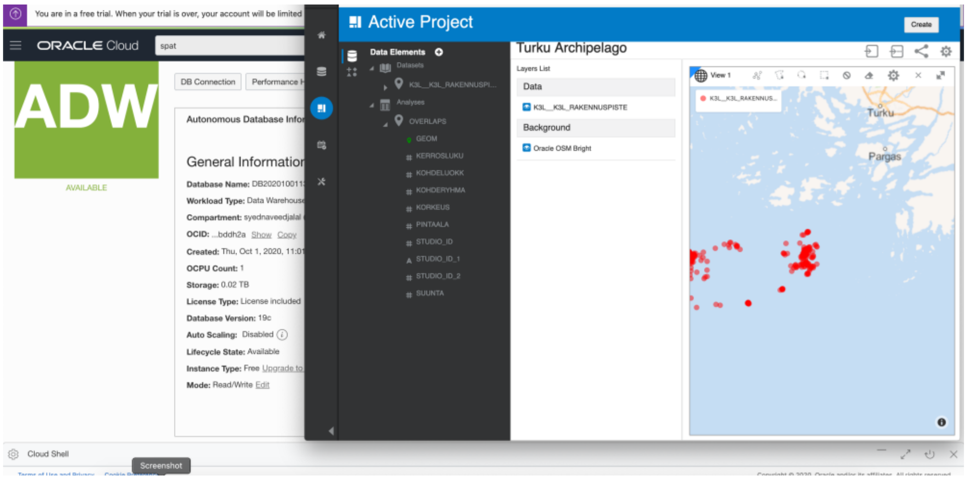


Figure 26

Figure 26 shows an analysis result from train and test data divided in spatial studio with prediction of sites with possible points of elevations to emerge as new islands in case of decreased seawater levels to hinder marine traffic via spatial studio with Autonomous database thru autonomous Datawarehouse cloud empowered computing source.

As can be seen in the figure above a final iteration of analysis. Once the query actions have been performed after the split of data by autonomous data tier. The results are an end product of test data versus train data. The spatial studio by oracle intelligently performs a prediction based on the results obtain while test data possible islands have been marked as red dots. This has been done after performing another sequence of events over training data of possible points of elevation to train the machine.

The combination of both then gest refined with further iterations of computations to have a clear analysis. The spatial studio shows a visual spatial graph where in the above picture all final accurate possible points of elevation as islands might appear to halt or cause obstacles to marine traffic. The new points of shallow depth could make ships cause longer navigation times or delay in movement across marked red dot zones.

Thus, must need to be taken in to account to either avoid or change route paths while navigating through region of Turku archipelago.

4 Shipping and Maritime Evolutionary History

Oceans and rivers cover around 70 percent of our planet earth. Since the very early age of mankind, oceans and reivers have presented great opportunities with tremendous amount of formidable navigational challenges. Over four thousand years ago the early man had built boats and ships which were used to do all the tasks and jobs that a modern ship does today. (IMO, 2017).

Though knowledge of early vessel development is merely sketchy with very little to hard archeological evidence.

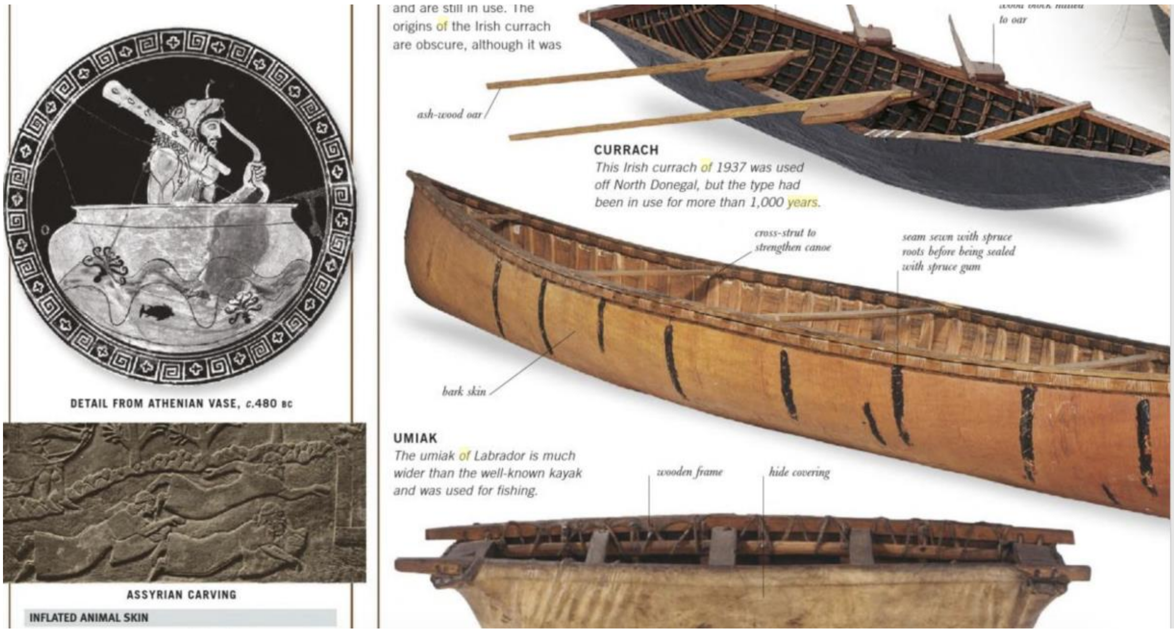


Figure 27

Figure 27 shows the early man kind used pots to floating devices made from animal skin for delivering good, humans and food as early vessel development. (Lavery, 2004).

Today the opportunities range from 80 percent of the population living today only a day travel away from a coastline while more than 90 percent of the world trade being carried out by the sea. ocean, and rivers. Marine transportation is not only the most cost effective but also the most reliable source of mass goods and raw materials transportation around the globe since the ancient times.

Maritime industry plays a key factor role in the global economy for the alleviation of poverty, removal of hunger, empowering of individual employment via providing jobs in logistics, ship building, ship repairing as well as port services among many other sectors of interconnected and related industries. (IMO, 2017).

The evolution in maritime sector followed a long sequence of developments ranging from pots as floating devices to animal skins used for swimming and later Egyptian ships for their rowing speeds. (Lavery, 2004).

The quest for speed, space and efficiency led us to the discovery of steam engines used to maneuver toughest weather conditions such as sailing around Nordic icy waters by English empires.

The Vikings after romans with their spread and influence for 1100 years were much more skillful shipbuilders as the key factor of their rule around Scandinavia to Atlantic for strong grip over territorial waters. This proves one thing throughout the history of maritime sector how seafaring has been connected to both wealth and power as together.

The same trend continues today, with modern day warships capable of stealth technologies to navigate without being detected by enemy or hostile forces to conquer shores. The warship today is not just the first time used as a weapon of war for power but as a symbol of strength to go beyond land to another land with show of strength and agility.

4.1 Background for Project

Foundation for this research begins at an academic course of Artificial Intelligence and Machine learning at AboMare campus for Novia University of Applied sciences. The students participated has been assigned to test the feasibility of artificial intelligence applications in case of a data analysis applications. The main tasks included using open datasets from Finnish Metrological Institute about weather data for different weather points of interest such as wind pressure and horizontal visibility.

The location selected has been port of Turku with Turku archipelago as key factor. The second variable to be tested has been JSON data from Finnish Digital Traffic for Vessel Transport Systems using Automatic Identification systems to establish the estimated time of arrival of ships. The result to be using a model weather it is feasible to utilize a neural network machine learning technique to have a correlation between weather data over estimated time of arrival of ships.

This resulted in having a trend towards ship arrival times with weather data making an effect and establishing a core foundation of artificial intelligence with machine learning using python as programming language for a network library of neural network called Tensor flow available by google computing engine.

Thus, as participating student candidate, a direct connection of real time events has been made possible in connection to data science with actual data from weather agency to machine learning of neural network-based computations using linear regression to plot graphs as shown in figure below.

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y,
                                                    test_size=0.4, random_state=101)
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from pandas import DataFrame
%matplotlib inline

plt.scatter(df7["eta"], df7["Horizontal visibility (m)"], color='red')
plt.title('Horizontal Visbility in Meters Vs ETA of a Vessel', fontsize=14)
plt.xlabel('eta', fontsize=14)
plt.ylabel('Horizontal visibility (m)', fontsize=14)
plt.grid(True)
plt.show()
```

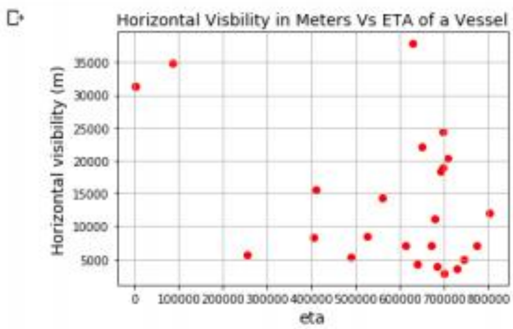


Figure 28

Figure 28 shows a data frame from the course project with projected ship arrival times based on the amount of visibility having an effect using Linear Regression done on TensorFlow Lite neural network by google. (Jalal’s project for AI and Machine Learning course, *A project to analyze Data from Finnish Coastal Service with Open Weather Datasets for ETA of ships using AIS for Finnish VTS)*

The figure above shows the power full pandas' library of python programming language for machine learning graphs plotting. The code above shows some of the most powerful tools available today in terms of python programing language to run different mathematical algorithmic models with powerful neural network-based computing engines for modern predictions.

In the figure above tow variables has been considered one as the scaler variable and the other as the dependent variable. In this case the Estimated time of arrival for ships as the depending variable being dependent over the scaler variable of Horizontal visibility. Where the scale of variation in horizontal visibility as having a direct effect over the other.

4.2 Academic Overview

In any project a testing mechanism and a platform for running experiments plays a key role to its success. The platform cannot be oriented by itself for one as a candidate of research unless guided by a repute academic institute. The research in this project started after introduction of a neural network platform introduced by the lecturer during artificial intelligence course.

Thus, TensorFlow was used for the project foundation to find the feasibility of research conducted using multiple tools and technologies along the way including machine learning, robotics, and artificial intelligence itself. Researcher has been using rapid prototyping for a sub project connected indirectly for the feasibility of a data analysis to be taken to the next level of automation. The difference became further obvious where, the data is machine provided and automated to be prepared instead of isolation in data frames using python.

The task is done using autonomous data cloud free tier by Oracle Autonomous data warehouse payload for an autonomous database. "TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML powered applications." (TensorFlow, 2020).

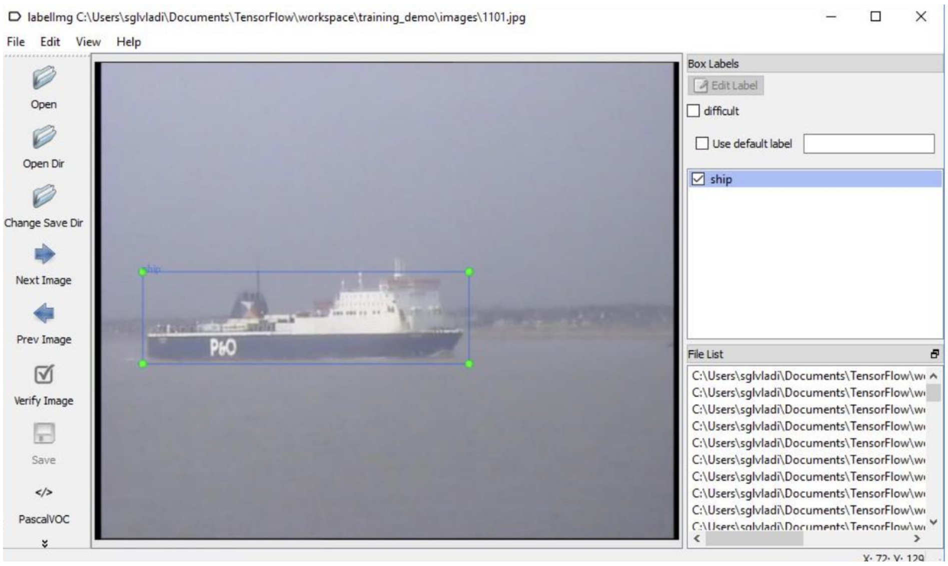


Figure 29

Figure 29 shows an object detector for covering a shape then, using labeling dataset to be labeled as a ship object once labeling installed in the application based on older object detection model of TensorFlow 2Object Detection API Tutorial. (Vladimirov, 2020).

The figure above shows one of the many key features of tensor flow including the machine learning capabilities of any given input video to perform an amount of computation processes to start identifying objects of interest such as cars from a live video camera feed. An open-source video decoder database is used with preset object detection models.

The use of neural networks and external computing sources is in very early stages, but the fact of shared computing sources is a great initiative. This will help and enable use of super computers by big tech firms to be available for training machines on different mathematical models and algorithms. Thus, more maturity and issues of such as bias in terms of color recognition with A.I can be reached to a level of fixed maturity. The term fixed maturity represents the technique of as little doubt as possible in software science. This means, even though the small bugs or issues remain but the validity could be verified at a highest level of accuracy.

The course of Artificial Intelligence and machine learning at AboMare campus of Novia University of Applied Sciences under supervision of Professor Johan Lilius from AboAcadamey University, students were asked to participate in a similar practice of exercises. The students were asked to run Google’s collab neural network compute sources for its TensorFlow library to train an object detection with 80% above accuracy to recognize different objects in an image such as a cow from a dog differentiation. The project comes as a preinstalled with TensorFlow lite network to run multiple iterations to train the model using "tf.train.GradientDescentOptimizer". (Bengio, 2012).

The project found many new discoveries including the basis of lack of dataset. In terms of not enough dataset values the model discovered abnormalities which proven to use Adaptive Machine learning more suitable for smaller scale than large scale datasets. The model "tf. train. AdamOptimizer" proven to be more precise when run 1200 iterations per second over linear regression.

The reason proved to be just because the variation between values of given dataset as weather data in this case was too little to draw gradient thus adaptability for the machine becomes necessary based over the dataset. (Bengio, 2012).

4.3 Legal Overview

The international Maritime Organization (IMO) is the global regulatory authority for International Shipping and Marine Industry. The organization composes a senior technical body called Maritime Safety committee (MSC). The Maritime Safety Committee endorsed a framework for regulatory scoping of exercising of the fourth revolution in Maritime sector as a work in progress.

This included the definition of Maritime Autonomous Surface Ships (MASS) with degrees of autonomy and methodologies to determine different ways to look in to how safe, secure and environmentally stable the future ships look. To aim the Autonomous shipping industry the regulatory authority defined "Maritime Autonomous Surface Ship (MASS) a ship that can operate to a varying degree independently without any human intervention".

"To facilitate the progress of the regulatory scoping exercise, the degrees of autonomy are organized (non-hierarchically) as follows (it was noted that MASS could be operating at one or more degrees of autonomy for the duration of a single voyage):

Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.

Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location, but seafarers are on board.

Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.

Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself.

As a first step, the scoping exercise will identify current provisions in an agreed list of IMO instruments and assess how they may or may not be applicable to ships with varying degrees of autonomy and/or whether they may preclude MASS operations.

As a second step, an analysis will be conducted to determine the most appropriate way of addressing MASS operations, taking into account, inter alia*, the human element, technology and operational factors."* (IMO, 2018).

Thus, the purpose of this research has been mainly to target and address the second step. This is where a bridge of connection has been drawn between the human interaction and operations to operate a MASS ship. Thus, an analysis tool has been used with a purposed theory of collection of data to be supplied using robotic instruments and devices.

The data though could not be collected over budgeting and international water treaty issues these simulated environments have been used for the demonstration. Henceforth, actual data becomes more crucial since the sensitivity of information to be tested.

"The MSC, which was meeting for its 99th session (16-25 May), established a correspondence group on MASS to test the framework of the regulatory scoping exercise agreed at the session and, in particular, the methodology, and report back to its next session, MSC 100 (3-7 December 2018).

The Correspondence Group will test the methodology by conducting an initial assessment of SOLAS regulation III/17-1 (Recovery of persons from the water), which requires all ships to have ship-specific plans and procedures for recovery of persons from the water; SOLAS regulation V/19.2 (Carriage requirements for carriage of shipborne navigational equipment and systems); and Load Lines regulation 10 (Information to be supplied to the master).

If time allows, it will also consider SOLAS regulations II-1/3-4 (Emergency towing arrangements and procedures) and V/22 (Navigation bridge visibility).

The Committee further invited interested Member States and international organizations to submit proposals related to the development of interim guidelines for MASS trials to its next session, MSC 100.”

Treaties under consideration

The list of instruments to be covered in the MSC’s scoping exercise for MASS includes those covering safety (SOLAS); collision regulations (COLREG); loading and stability (Load Lines); training of seafarers and fishers (STCW, STCW-F); search and rescue (SAR); tonnage measurement (Tonnage Convention); and special trade passenger ship instruments (SPACE STP, STP).

IMO in 2017 adopted Strategic Directions for the Organization, including one on the integration of new and advancing technologies in the regulatory framework - balancing the benefits derived from new and advancing technologies against safety and security concerns, the impact on the environment and on international trade facilitation, the potential costs to the industry, and their impact on personnel, both on board and ashore.

Speaking at the opening of the MSC meeting, IMO Secretary-General Kitack Lim highlighted the importance of remaining flexible to accommodate new technologies, and so improve the efficiency of shipping, “while at the same time keeping in mind the role of the human element and the need to maintain safe navigation, further reducing the number of marine casualties and incidents”. (IMO, 2018).

A real time data set has been obtained for educational purposes to meet all the legal standards of international maritime organization to access geographical coordinates of an actual land of survey where a ship might operate. The future MASS ship could be on a voyage at the route in between Turku archipelago at the possible points of elevation used in this research test of data analysis using spatial studio with oracle autonomous database from an autonomous Datawarehouse.

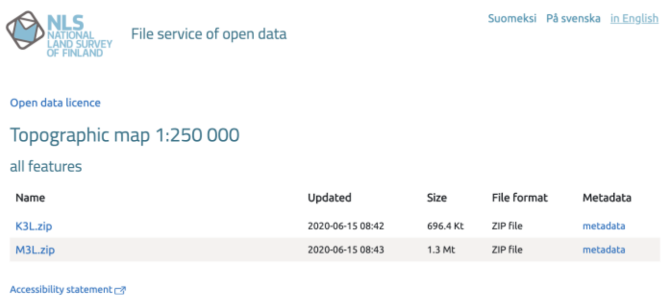


Figure 30

Figure 30 shows a transcript of open data license package received from Finnish National Land of Survey open data service for research and development purposes with a topographic map dataset packages of raw metadata

The figure above shows the map file service to obtain open datasets for educational and research purposes. The Finnish National Land Survey data is covered by open data attribute of Creative Commons version 4.0. The creative commons License 4.0 allow to humans for sharing and adapting.

- **Share**

Copy and redistribute human read able material in any format

- **Adapt**

Remix, transform and build or rebuild for any purpose even commercial usage

The creative commons consortium for open-source data platforms and datasets sharing states to must credit the work. Given appropriate credits, accessible link to the data for any changes made should be reported. The data should not be misused, abused in any criminal or wrongful purposes with endorsement without credit as well. (A nonprofit content consortium that survives on donations for free content).

The dataset license requires the candidate to mention the Licensor in this case creative commons 4.0, the name of the dataset as show in the figure above and the time when the National Land Survey delivered the datasets. (A nonprofit content consortium that survives on donations for free content).

4.4 Human awareness and acceptance

The human mind only perceives things which it has seen before in its action of imagination. Being aware of an upcoming future is predictable but being ready for it is always the question of perception of acceptance. One can be ready but if they are not willing to accept it will always require special skills to adopt to it.

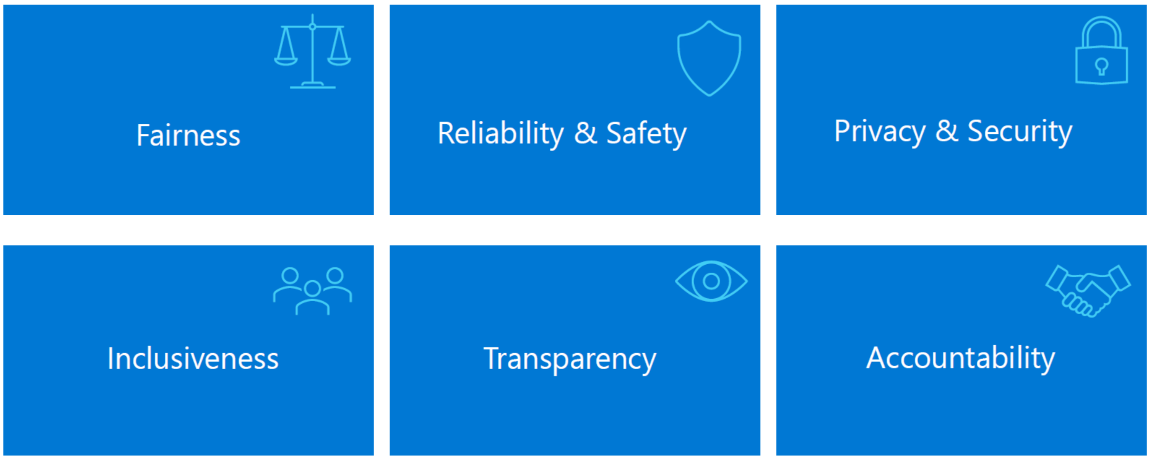
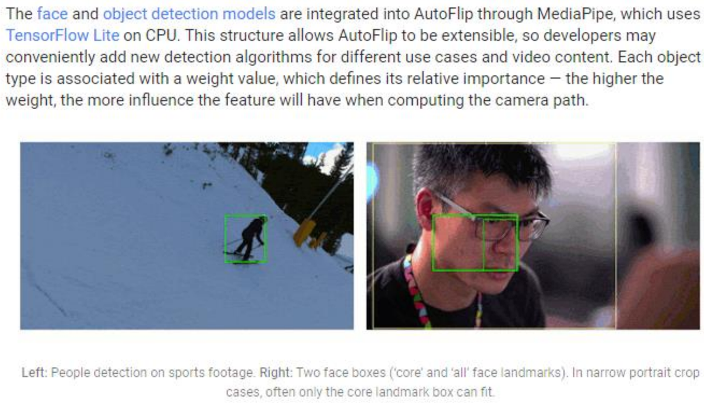


Figure 31

Figure 31 shows the building stones as a foundation for Human Acceptance of modern technologies such as AI itself by Understand Responsible AI (Microsoft 2021)

Today a machine can assist a human with the gestures such as leading to display parameters on one's phone screen, but this begs the question are we ready as humans to accept machines. This leads to further deep understanding of machine behaviors to be dictated by humans as in the end it is called artificial intelligence not natural or realistic intelligence. The future machines will be able to predict future based on data of pas events but to avoid bias the data must be genuine with integrity of trust.

Human mind will only perceive based on what the society believes in, this issues of such as gender inequality, racism, and other political phenomena could affect the output one could expect from a mathematical model leading to denial rather than acceptance.



The face and object detection models are integrated into AutoFlip through MediaPipe, which uses TensorFlow Lite on CPU. This structure allows AutoFlip to be extensible, so developers may conveniently add new detection algorithms for different use cases and video content. Each object type is associated with a weight value, which defines its relative importance — the higher the weight, the more influence the feature will have when computing the camera path.

Left: People detection on sports footage. Right: Two face boxes ('core' and 'all' face landmarks). In narrow portrait crop cases, often only the core landmark box can fit.

Figure 32

Figure 31 shows object detection model using auto Filip library by google based on TensorFlow Lite neural network computer unit. (Zheng, 2020).

The level of detection of an object can be optimized today based on a feed of sequential imaging to even construct an object to be detected before even it will become visible. Thus, it will lead to a world of not only prediction but generation of a future that might not exist because of the feed of events fed based on a bias of culture or political impact.

4.5 Personnel concluding statement discussion

The artificial intelligence and machine learning have just started to invade human provision of understanding and improvising of perfection. Though level of maturity with issues such as bias within A.I are still a question to ponder but use case are itself impressive already. Having large amount of data with no use is arguable.

When multidimensional electronics of nano scale bring actuators at a stage to create million-pixel imagery from chemical process of thoughts in one mind, it is without any doubt the exploration of exoplanets towards greater universe is just a beginning. When an image taken from moon can identify the hidden minerals thus, trust in man-made intelligence could increase over the intelligence of mankind itself.

The ability of neural networks to run computations of complex mathematical algorithmic models at such a large scale for a given data that, humans feed to a machine that the machine becomes capable to feed itself and improve will lead us to discovery of hidden layers for next generation of network to carry data.

The next generation of 5G or 6G network could be an advance radio signal to not only carry information but perhaps a piece of matter not identified yet. This could bring us closer to the transfer of energy as a matter with Einstein theory of relativity where energy equals mass as a matter.

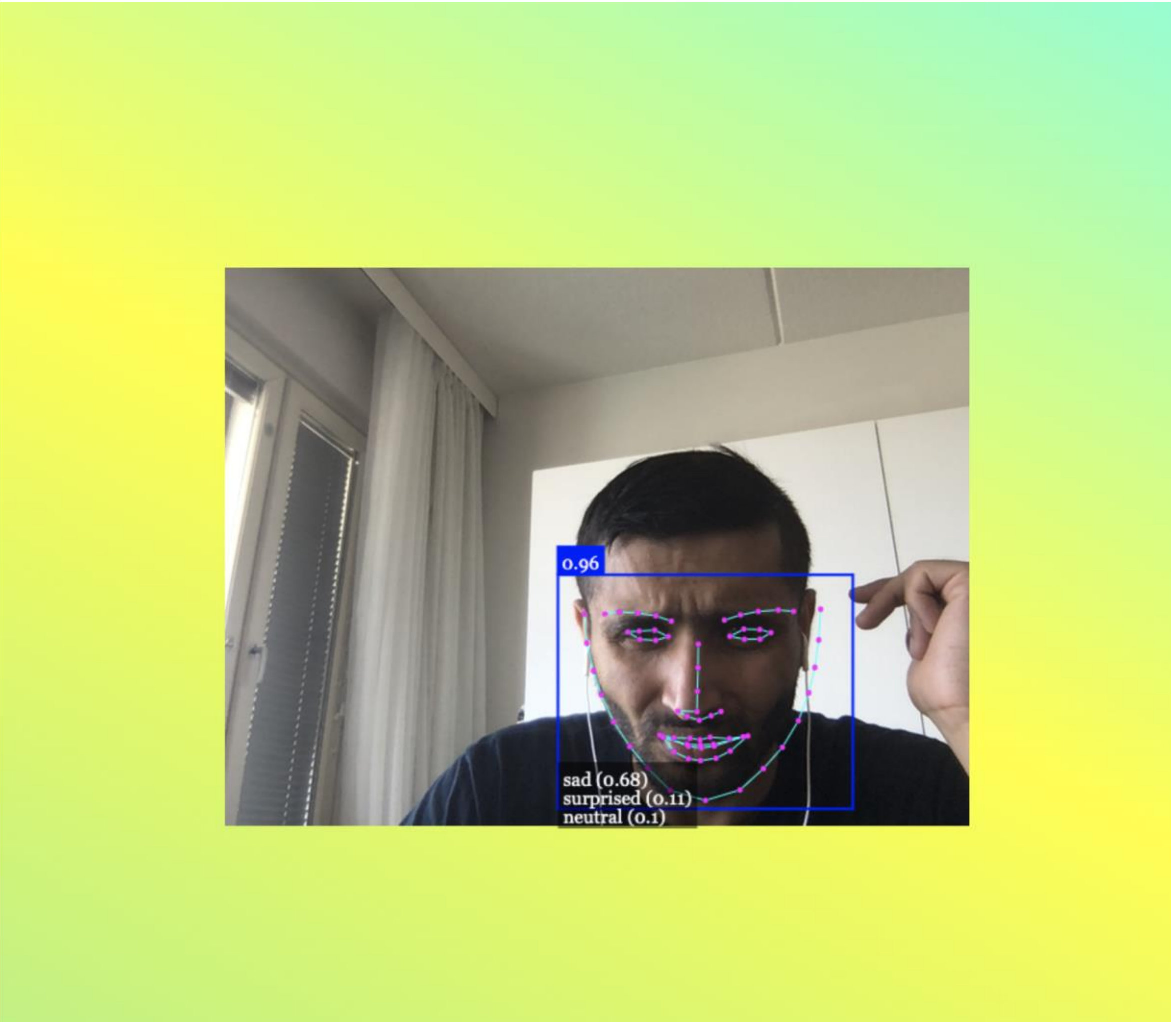


Figure 33

Figure 32 shows an advance application of A.I and machine learning using JavaScript API for Tensor flow to identify human facial gestures based on expressions. (justadude whohacks, 2020).

The figure above is a clear example of one of the use cases of modern-day applications of artificial intelligence based on machine learning over a neural network where a human gesture can be recognized.

The camera sensor of a device acts as a machine providing a continues feed of data of facial gestures to a TensorFlow neural network to run multiple mathematical models of different algorithms to train the computer. The computer learns and gets trained to identify raised eyebrows as a notion of surprise every time triggered. This is already in testing in autonomous vehicles to identify drunk drivers in case of a collision between an automobile with human on board.

Nothing is never mature if it does not reach its maximum potential and thus the conclusion cannot be drawn earlier than that. With the sole purpose of this research to predict future to an extent to avoid ships of future to run into issues of collision or loss of power with the help of modern technology-based tools and resources. One might be able to predict and build a voyage in an autonomous vessel with a predicted speed in future using the power of computing resources from cloud with aid of robotic devices scanning paths with sending feed of data to mother board style computing resources installed on board of the vessel to make paths of safer navigation with in autonomous data ware house empowered autonomous database hosting spatial studio.

The A.I has been given a lot of negative press feedback within its relation to especially branch of robotics as killer machines towards mankind. This cannot be fair until, it has reached a level of maturity where more of the mankind and its problems are solved by it. This is just the tip of the iceberg where the maritime industry starts to evolve at a level where next space exploration missions at planets with oceans of plasma have the autonomous ferries doing explorations for inhabitants of planet earth.

5 Conclusion

This research had three major achievements in journey towards fourth revolution happening in the era of digitalization in maritime sector. One how the data can be obtained at a large scale for the upcoming missions.

This will include cargo vessels or any passenger ferries to be equipped with robotic arms and vehicles to assist in case of an emergency need. This will also replace future emergency aid equipment such as boats inside ships and ferries with drones and robots. The modern vessels will have tons of options to verify an outer surface space by conducting a spatial analysis for data capture via these pre-installed pre-built inside devices of autonomous drive, obstacle avoidance drive, collision detection drive capable.

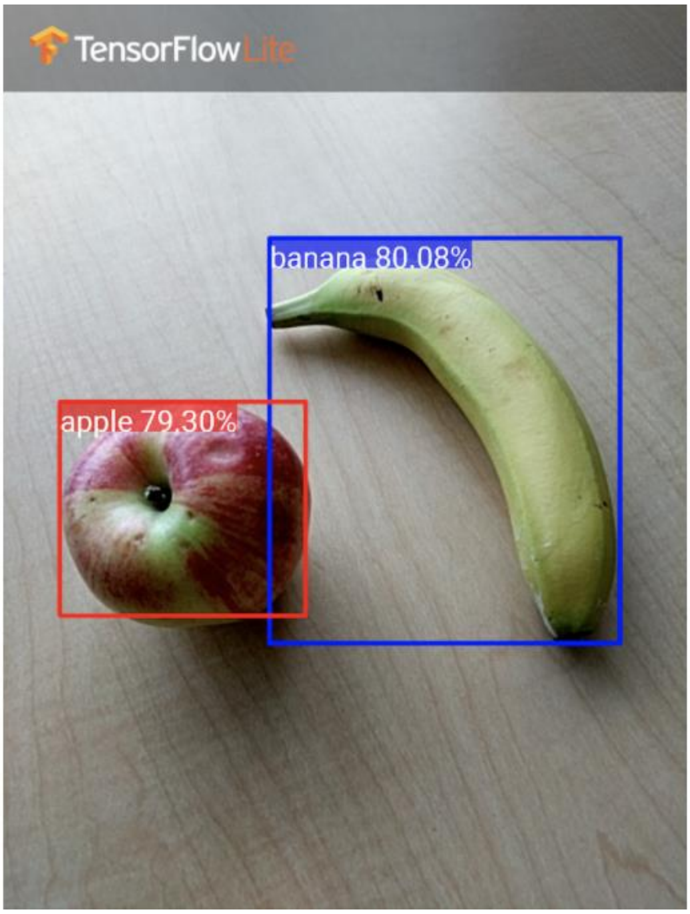


Figure 34

Figure 33 shows a use case scenario for a mobile solution of TensorFlow lite's powerful image and its position recognition capabilities. (TensorFlow, 2020).

5.1 Further development

The era of deep learning with artificially intelligent machines fighting to interchange and interexchange human perception has just started. Today a human understanding and its capability to perceive certain information in identifying whether it's a machine bot trolled piece of knowledge or a man-made transcript. As a human a new race towards understanding machines has started where in the past a made a machine and give it certain commands to perform a certain functionality. But today's machine has been commanded by a human from years and years, so thus it has developed the capability to do what a human might expect.

Challenges and Risks with AI

Challenge or Risk	Example
Bias can affect results	A loan-approval model discriminates by gender due to bias in the data with which it was trained
Errors may cause harm	An autonomous vehicle experiences a system failure and causes a collision
Data could be exposed	A medical diagnostic bot is trained using sensitive patient data, which is stored insecurely
Solutions may not work for everyone	A predictive app provides no audio output for visually impaired users
Users must trust a complex system	An AI-based financial tool makes investment recommendations - what are they based on?
Who's liable for AI-driven decisions?	An innocent person is convicted of a crime based on evidence from facial recognition – who's responsible?

Figure 35

Figure 35 shows the challenges for further development of modern technologies such as AI (Microsoft 2021)

There will always be risks and challenges involved but until they do not hurt the man-kind with the outcome of results in our daily lives, they cannot be ignored. This does not end here but a machine today is also capable to commands human back. This simply means the ear of human being controlled by a machine simply because machines can act to do so. The invention of brain link neural link chips is just a clear sign of what the machines have achieved in terms of intelligence and understanding by humans. (Neuralink, 2020).

Once upon a time it was mankind during the early 1970's of science revolutions with certain inventions such as light bulbs and Television etc. The machine was made to do tasks to help humans. Today machines such as robots are making machine such as cars for humans. The digital scale is a bit further ahead though where the intelligent chat bots and information content management systems are creating blog posts to run political campaigns for political gains of humans.

This ends to a point where a machine is creating a machine to take over human sense of intelligence to perceive information with prior bias towards right and wrong. This has been proved when the artificially intelligent bots were fed with information to create twitter posts and then those posts making humans to lead towards a certain goal of interest as desired required output beating human sense of understanding. (Schmid, 2017).

This is just a tip of the iceberg towards a new creature of perhaps less superior or might be more superior in terms of intelligence. The man-made creature as such robotics and machine with artificial intelligence installed to use a sensor such as depth sensor to learn new obstacles on the way and avoid might enable deep learning architectures to improve the code of upcoming cars as autonomous vehicles.

5.2 Future development

The autonomous cars of future might not improve on aiming down sights of collision to avoid but rather predict future accidents that could happen. Thus, leading us to a level of future prediction via sensor fusion collected data, resulting in feeding the information to machine learning algorithms with deep learning capable chips, having an artificial intelligence so mature that could take over human senses. (Hawkins, 2020).

Figure 36

Figure 34 shows the reframe use case scenario of auto flip library based on subject of interest detection by Google's neural network based TensorFlow supercomputer processing unit. (Zheng, 2020).

The technology of deep fakes using Artificially intelligent made video frames has already put in place the question of trust towards digital information. This has led to an end where only a machine can verify another machine. The amount of data and information received and available in a digitally manipulated or a totally created from scratch fake video with digital deep fake technology could be broken down with a powerful computing engine to decrypt any hiding encoding encryptions how, the video was made.

So, the machine fights with machine in terms of power and available computing resources to decrypt a data. This leaves a future of quantum scale of computing where the machines could only communicate with each other in terms of information verification.

The future of video making will be using A.I in a sense where a missing piece of information in a frame could be regenerated by the giving amount of data available in a frame. This will not only enable the future space exploration missions to discover hidden planets but also perceive more data how a surface could have structured itself after a dust storm.

The use of technologies such as deep fusion for sensor information is not just been limited to marine sector but the space sector could benefit at large as well. The future space missions comparing no humans on board for the transportation of luxury minerals such as gold, copper and uranium could be using the tools. The use of spatial is not just limited to our planet earth but the discovery of minerals to be brought to earth.

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1. Appendixes

An autonomous drive capable Remote Operated Vehicle as a Remote-Controlled Boat with solar powered battery cells and a Remote-Controlled Autonomous drive as well obstacle avoidance drive quadcopter drone was used during the project. The values such as proximity, position data, camera values with position coordinates from a GPS chip has been observed.

Figure 1 shows two equipment devices used during the project for the feasibility of data information verification. (A Remote-controlled boat with solar cell and a quadcopter drone)