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Automation in Current Shipbuilding Process

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ABSTRACT

The maritime industry since the beginning of recorded time has been the focal point for transportation of goods around the world. It is the most economical and environmentally friendly way to transport large goods throughout the world.

Today, around 90% of world trade is carried by the maritime industry. Around 50,000 merchant ships, registered in over 150 nations and manned by over a million seafarers of nearly every nationality, transport every kind of cargo internationally. As the shipbuilding industry is multi-dimensional many concepts of welding and cutting find its applications in various sectors.

Our aim is to introduce the concept of machine-to-machine communication in this sector and that will significantly improve the current cutting and welding processes. The aim is to make the process smarter and faster and build it in a way in which it can save industry tons of money and help the people to operate and make this process more efficient.

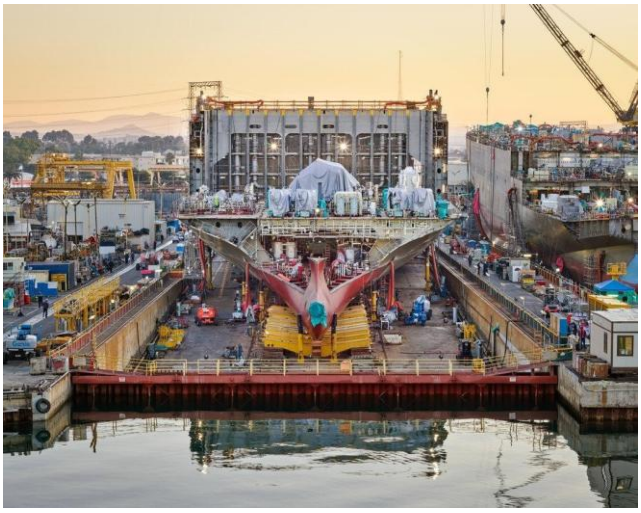
LITERATURE REVIEW

. Literature review Recently, much government funded research has been conducted for the purpose of turning the originally labour intensive and experience-centred
shipbuilding industry into a knowledge-based and technology intensive industry with advancements in information technology based on computer technology. The United States Navy's Defense Advanced Research Projects Agency (DARPA) runs a SBD programme in order to develop a design system/environment that can reduce the cost of system design and developments, reduce development time, and verify and reduce
risks. Starting in 1996, phase I of the SBD programme established an environment for the implementation of SBD, and in phase II, SBD architecture that supports
verification of phase I concepts are being developed (Cardner 1993, Fast 1996). DARPA has tried to develop a few prototypes to apply the SBD concept in feasibility studies and follow-up research. Good examples are the operation simulation of LPD-
17, a next generation carrier, NSSN submarine development of General Dynamics
Electric Boat Division, and Mobile Offshore Base of the Gulf Coast Region Marine
Technology Center (GCRMTC). The technology used in these development processes is being commercialised. In addition, Bath Iron Works (BIW) performed a simulation
of crane usage, floating dry-dock usage, dock and pier usage, installation and removal
of production equipment, emergency vehicle movement and routes through yards, and personnel emergency evacuation routes from ships (Hugan 2000). The Virtual Reality Laboratory (VRL) in the University of Michigan is doing research on the application of virtual reality, such as immersive virtual reality and augmented reality, to industry (Beier 2000). This research includes structural walk-through modelling, accident simulation and training simulation.
Projects related to virtual prototyping and virtual reality are ship motion simulation, and virtual simulation of the shipbuilding process. Traditionally, Europe has led
shipbuilding system technology and naval/marine related organisations conducting
inter or international projects by the European Community under the Competitive and
Sustainable Growth (GROWTH) Programme. Representative of such programs is
VRSHIPS-ROPAX 2000 led by the University of Strathclyde with many European naval-related organisations and run as a part of the Thematic Network (TN) SAFER
EURORO II on 'Design for Safety'. VRSHIPSROPAX 2000 aims at producing an integrated virtual environment for a life-cycle ship design. It addresses the need for the test of various design elements by producing a virtual model of a passenger ferry (Safer EURORO II 2001).
Also, the Ship Stability Research Centre (SSRC) at the University of Strathclyde is conducting research on computer technology applications and interfaces between human factors as a means of achieving the objective of shipyards such as user
requirements, competitiveness of ships, cost efficiency, and safety, under the rapidly changing environment of the shipbuilding industry (Vassalos et al. 2001). The main project includes Sub-sea Navigation of Remotely Operated Vehicles (ROV) and Evacuation Simulation of Ro-Ro Ferry Ships.

Japan is trying at governmental level to maintain its current level of technology and competitiveness while turning the shipbuilding industry into a futuristic industry.
Under the direction of the Ship and Ocean Foundation (SOF), the Computer
Integrated Manufacturing for Shipbuilding (CIMS) project was begun in the mid-
1980s and was succeeded by the General Product Model Environment (GPME) project in 1996 to acquire technology for putting ship CIM models to practical use (Nagase et al. 1997).
Recently, the GPME-based advanced CIM, which is related to knowledge sharing technology, and the LINKS project for implementing a virtual shipyard under the CALS concept were completed.
The shipbuilding industry in Korea is number one in the world in the amount of building, but in terms of quality of technology, it still lags behind other countries. In Korea the Computerised Ship Design and Production System (CSDP) project led by the Korea Research Institute of Ships and Ocean Engineering (KRISO) was initiated
to acquire ship CIM-based technology and the ship manufacturing system integration technology development project for acquiring application technology was completed
and, recently, preparations have been made for ship CALS/EC development (Lee
1999)

INNOVATION

- As we know that ship building is a very capital- and labour-intensive work. Thousands of people are involved in the process and stakes are too high because this is a high-ticket project.
- There is always a scope of making mistakes when there are more people involved in something. As we say, too many chefs spoil the dish. And building a ship is one of the most difficult and long processes in the world. The building of a ship and a spacecraft takes the same time (12 - 16 months).
- When a giant ship is built every component is made separately and most companies in the world outsource the work to different companies. Each component is made with utter precision and safety but still errors happen and it costs millions of dollars to the shipping company and the economy as a whole.
- We worked on the current automation process and tried to make it better with the use of M2M, with the application of this the machines can communicate with each other through data and work more efficiently. They will be transferring data and we will store that data in our SQL database.



The above image is a snippet of how the *ship looks* when you start building it.

Building the First Ship

- The building of the first ship has no solid proof till date but it is assumed that the Egyptians were the ones to build the first ship which can float in water. They got their idea from the floating log of wood.

- Ships in the 15th Century - In the 15th century a larger trading ship was developed called the carrack. This was carvel built (the planks did not overlap) and had three or four masts. There were square sails on two masts and a triangular sail on the mast at the back. Carracks that were used as warships were armed with great guns.

- In the 16th century, holes called gunports were cut in the sides of the ship for the cannon to fire through. By the time that carracks were being used, sailors had compasses and other instruments to measure the height of the Sun or the North Star. By using these, sailors could work out their latitude, or north-south position, so finding their way became much easier.

- In the 1880s steel began to be used instead of iron. Ships also began to be fitted with steam engines. Steam engines were first used in paddle steamers. The engine turned two paddle wheels.

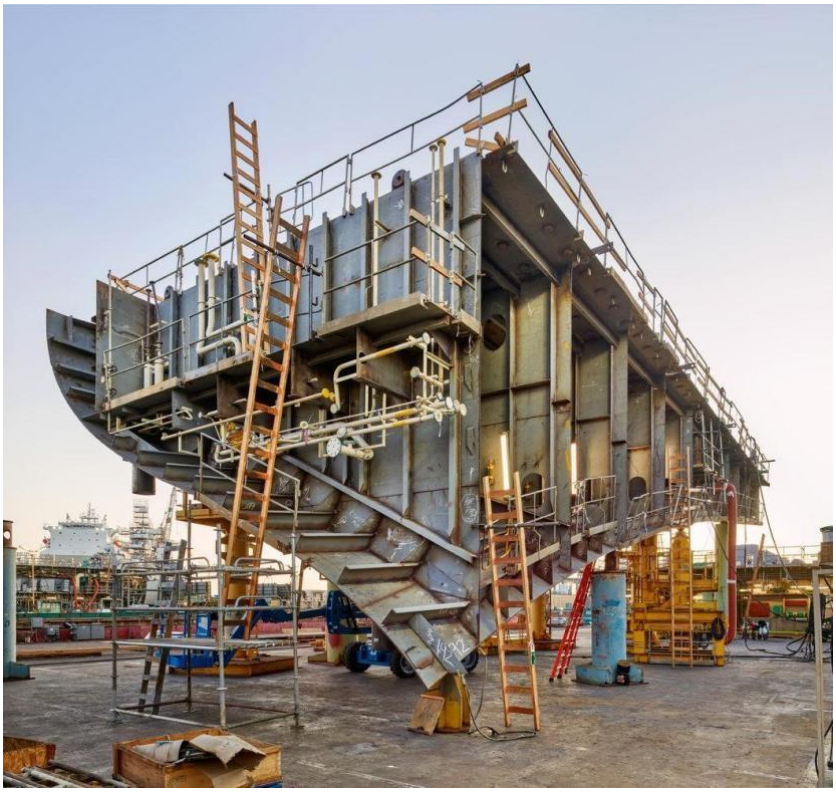
- Paddle steamers were not suited to the open sea because in heavy seas the waves lifted one wheel right out of the water while the other one went right under, and this strained the engines.

- The first steam-powered vessel to be introduced was the Charlotte Dundas, engineered in 1801 by William Symington, the British pioneer of marine steam propulsion. She was used on the Forth-Clyde canal to tow vessels.

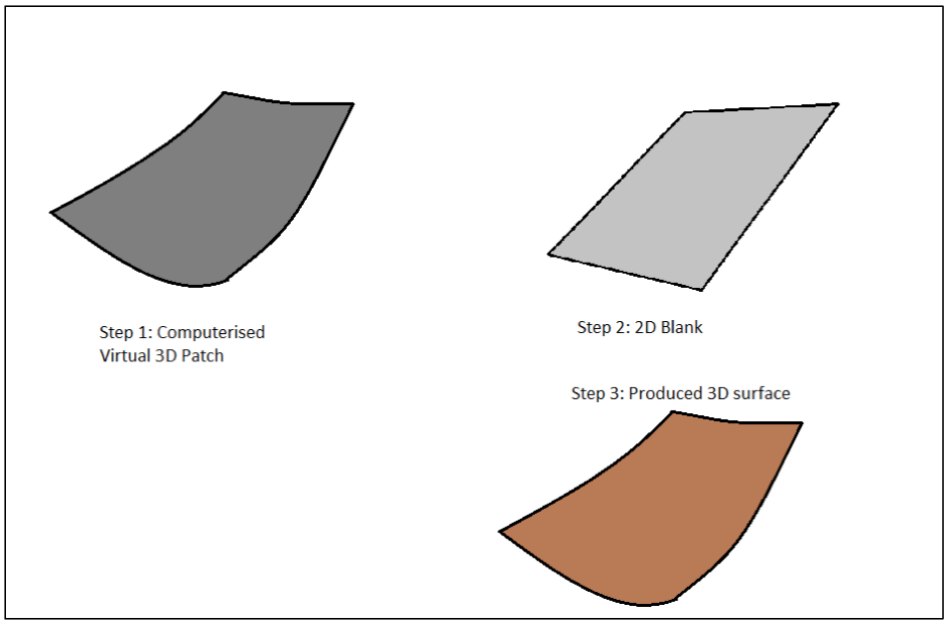
The first ship which was used was building woods, logs and twigs.

Automation used in current Ship Building process

- The process starts with the cutting of thin steel plates into panels. This process is done by automation and is done by big machines which can cut big metal sheets into panels. The panels, in turn, are twisted and shaped into the skeleton of the ship.



- The panels are then converted into blocks. Blocks are the shape which is achieved by curving the panels and then making them to hold tons of load for a long period of time.

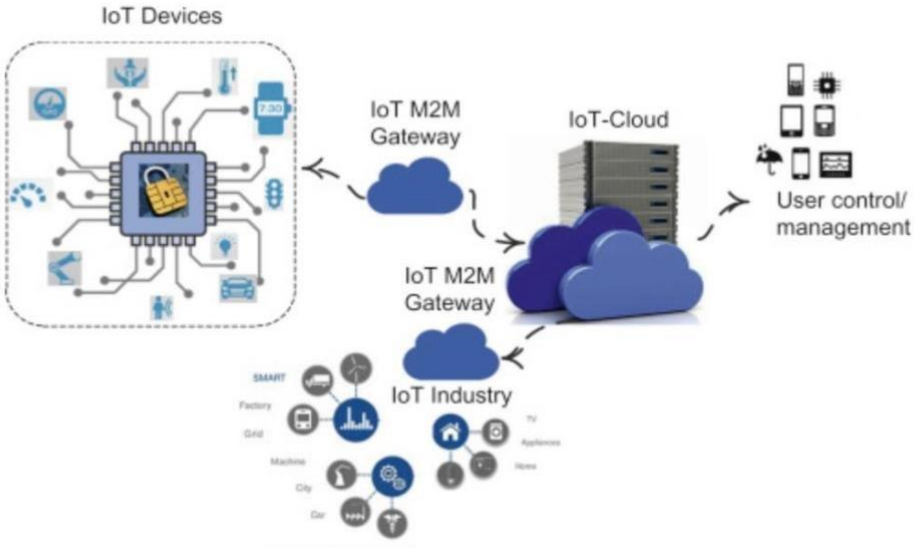


- The blocks are then blasted and painted before entering the final stages of outfitting, where they are filled in with equipment, cables and piping. Sometimes, the blocks are turned upside down because the work is easier to perform facing the ground.

- The pieces are then assembled into bigger “grand blocks” and, ultimately, into the bigger ships that can carry dozens of loads.

Project Innovation

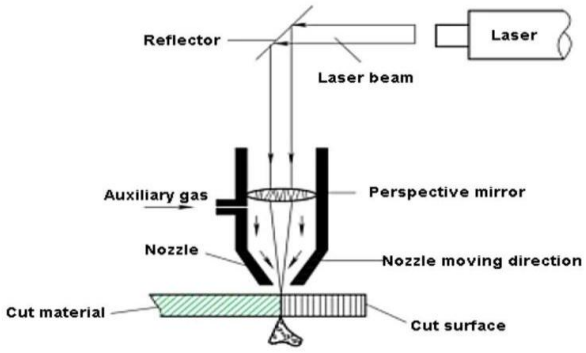
- In this project we have worked on two types of automation which will transfer the working data to our SQL database and then the database will analyse it to give accurate results that can help in saving money for the company and make the process more efficient.
- We will attach a data transmitter in our machines then we will fetch data from there and save it in our database. We have not extensively used the data points because we were not very efficient with the use of AI and Machine learning in this.
- We have used M2M technology that will help us achieve our desired results and take all the data from all the machines simultaneously.



- This is how the M2M technology works, it takes the data from the working devices then stores them in the cloud and then continuously uses the data to improve user experience.
- Apple watch is a great example of using the M2M technology and saving lives, the watch continuously monitors the humans heart rate and Oxygen consumption and then stores it within their cloud and then send updates to the hospital if your levels fall below the normal and then the hospital sends help without the patient telling them to do so. This is how great and lifesaving technology can this be if implemented in every field.
- We will use the same technology in this, we will be using this in the cutting and the welding machines that are used in the industry and use their data points in our application.

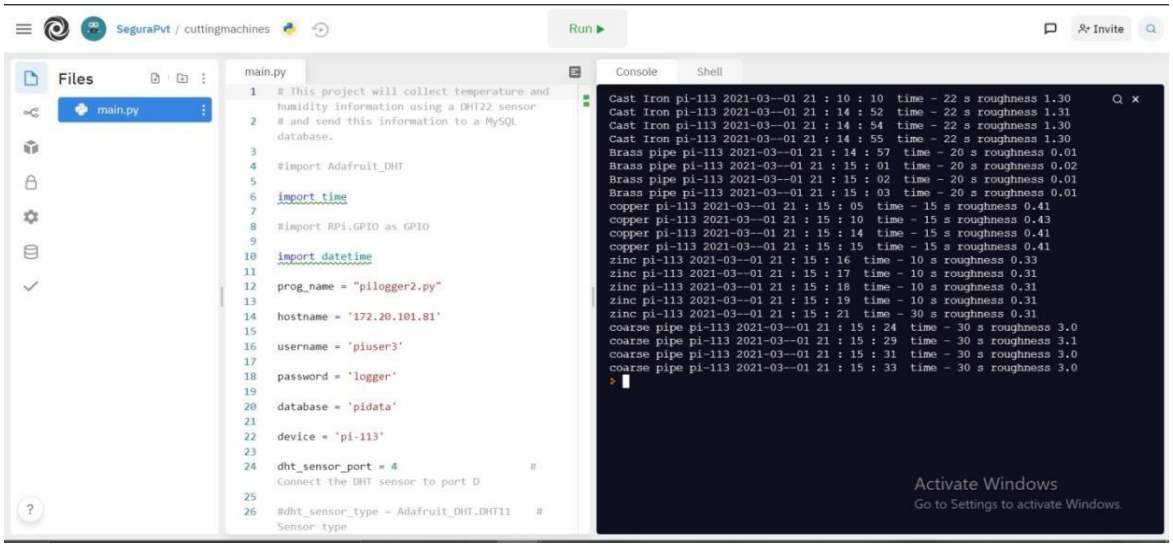
Cutting Machine

- The existing cutting machine worked like this. This is a purely automated process but still requires human interventions.
- What we did was attach a sensor to the machine and collect its data in the SQL database and then use the data for the better working of the machines in one way or the other.
- For the cutting process we have written our code in python that extracts the input data and sends it to our application.



Laser cutting principle

- The following is the code that we wrote for the cutting machines that store data points such as roughness, time to cut the metal, etc.



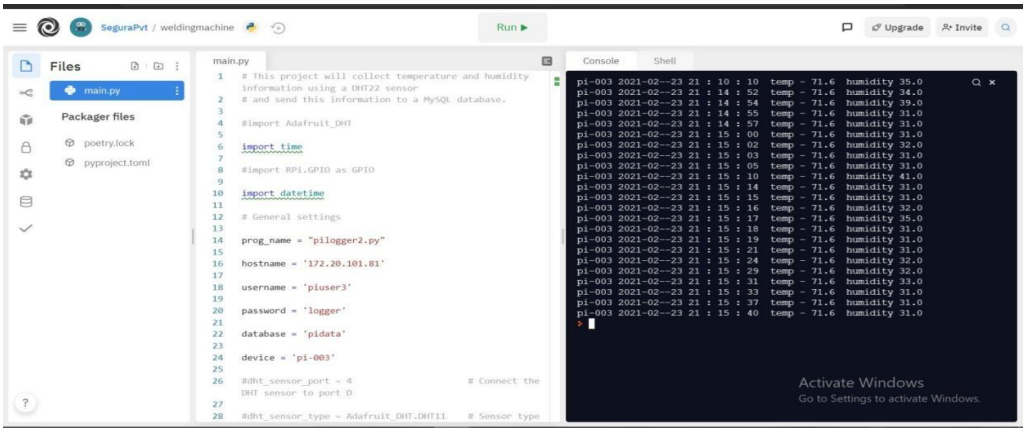
- We have also made our app that will help us in the manual monitoring of the machines. The users can use it remotely to know the data and shut down the machine when needed.

People can use the app remotely to work with the machines. We have just built an MVP but if we could make the full-fledged version of the app then people could fully operate the machine from their homes.

- Users can use the data stored to monitor the data of the cutting and find a more efficient way in which cutting could be done in less time with less roughness and it could potentially save millions of dollars to the industry.

Welding Machine

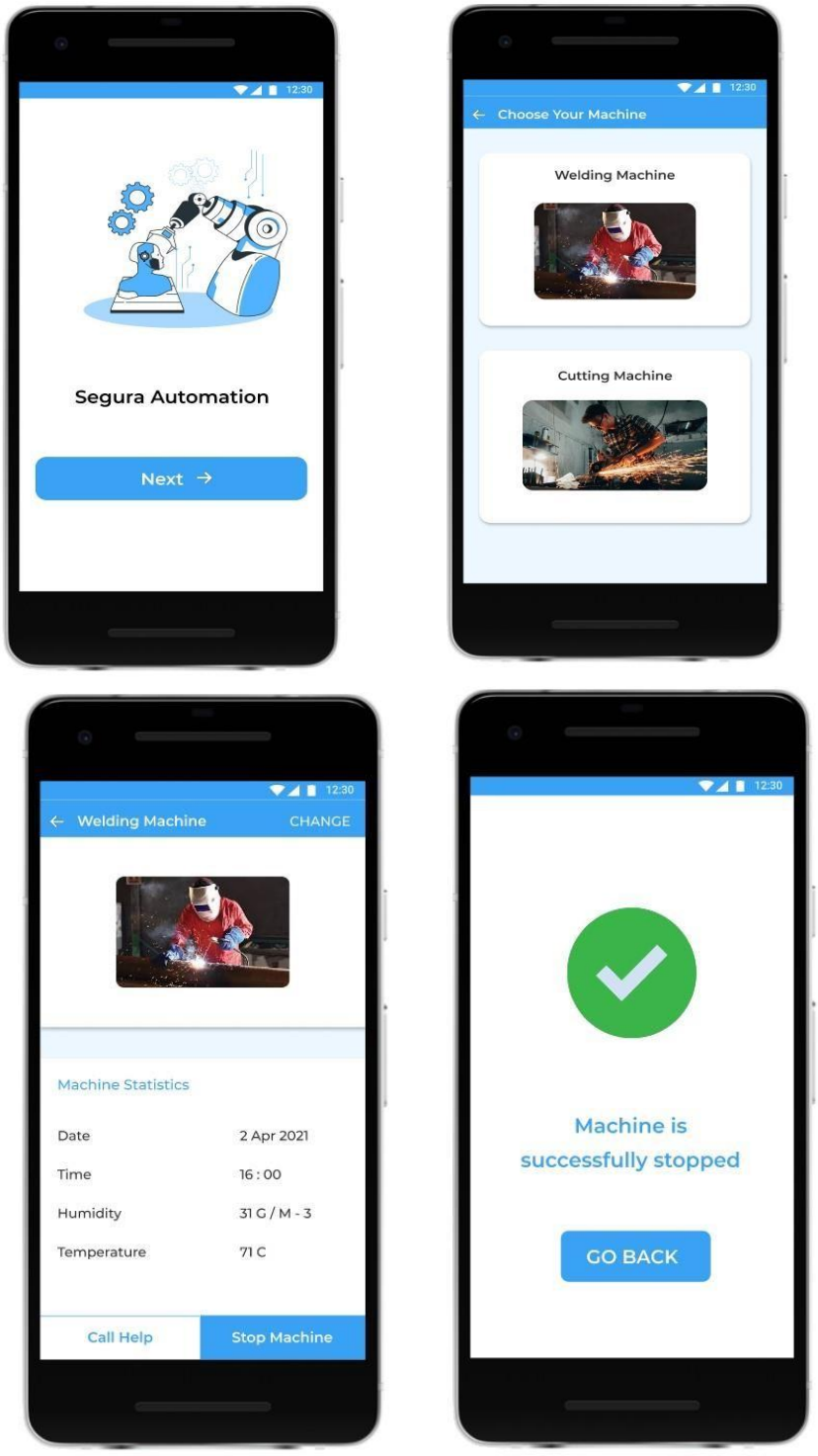
- The existing welding machine works on partial automation with the touch of humans in it. The metal is welded under a specific temperature that is required for the metal so that we could get a perfect weld.
- What we did was attach a sensor to the machine and collect its data in the SQL database and then use the data for the better working of the machines in one way or the other.
- For the welding process we have written our code in python that extracts the input data and sends it to our application.
- You can anytime stop the welding process remotely if you think that our weld is not doing it correctly.



- We have also made our app that will help us in the manual monitoring of the machines. The users can use it remotely to know the data and shut down the machine when needed.
- Welding is a process that can require close supervision for the exact quality we need from the weld.
- People can use the app remotely to work with the machines. We have just built an MVP but if we could make the full-fledged version of the app then people could fully operate the machine from their homes.
- Users can use the data stored to monitor the data of the cutting and find a more efficient way in which welding could be done in less time with less roughness and it could potentially save millions of dollars to the industry.

Android Application

- We have also developed a user interface for the application, the users can use the app and know more about the current status of the machine.



- If you want to see the whole application, see the link here. You can experience the whole experience and use the app to use

https://www.figma.com/proto/q4FAxLRip4tGdMyYQSuLo2/EAZYPGWORK?node-id=17%3A164&scaling=scale-down&page-id=0%3A1

CONCLUSION

- While working on the project we realised that ship building is a very huge industry and even a very small change in the process can save a lot of time and money.
- We used the data points from the welding and cutting machines and showed them on our app so that people can monitor the machine remotely and Optimizely use the data.
- We however were not successful in implementing AI and machine learning concepts because they were beyond our reach.

ACKNOWLEDGEMENT

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