

Final report

1. Project details

Project title	Autonomous monitoring of marine growth on vessels, the way to a more energy efficient shipping industry
File no.	DBd-00023
Name of the funding scheme	Grøn omstilling af Det Blå Danmark
Project managing company / institution	Blue Atlas Robotics
CVR number (central business register)	39944618
Project partners	
Submission date	23 April 2024

2. Summary

The purpose of this project was to develop a commercial mature robotic underwater visual inspection solution, called Blue Atlas Sentinus, that can inspect large underwater structures, including ships and harbor quay walls, through implementation of a computer vision-based autopilot feature.

Use of Blue Atlas Robotics solution will give access to a complete, consistent, and repeatable picture and data regarding the quality of paint, coating, corrosion, damage, fouling on the hull as well as any other assets being exposed to the marine environment.

This will allow for visual and data-based monitoring of the individual vessel's condition over time, as well as comparison of collected data across an entire vessel fleet.

Through processing the collected image material, the associated software package will enable the generation of 3-D models of the inspected vessel, representing a significant improvement to manual and labor-intensive review of hours of video and annotation of individual image frames used today as part of generating inspection reports.

As part of different work packages in the project Blue Atlas Sentinus has been developed from an initial concept, in-house mechanical design, manufacturing, assembling to being used in an operational environment performing inspection of a wide range of marine assets including several types of vessels.

At the conclusion of the project a complete product and solution have been launched as Blue Atlas Sentinus.

Formålet med dette projekt var at udvikle en kommerciel moden robotbaseret undervandsvisuel inspektionsløsning, under navnet Blue Atlas Sentinus, der kan inspicere større undervandsstrukturer, herunder skibe og havnekajer, gennem implementering af en computervision-baseret autopilotfunktion.

Brug af Blue Atlas Robotics-løsning vil give adgang til et komplet, ensartet og gentageligt billede og data vedrørende kvaliteten af maling, begroning, korrosion samt beskadigelse af skroget på et skib såvel som alle andre marine aktiver.

Dette vil give mulighed for visuel og databaseret overvågning af det enkelte fartøjs tilstand over tid, samt sammenligning af indsamlede data på tværs af en hel fartøjsflåde.

Gennem behandling af det indsamlede billedmateriale vil den tilhørende softwarepakke muliggøre generering af 3-D-modeller af det inspicerede fartøj, hvilket repræsenterer en væsentlig forbedring af manuel og arbejdskrævende gennemgang af timers video og annotering af individuelle billedrammer, der bruges i dag som en del af generering af inspektionsrapporter.

Som en del af forskellige arbejdsplaner i projektet er Blue Atlas Sentinus blevet udviklet fra et indledende koncept, internt mekanisk design, fremstilling, montering til at blive brugt i et rigtigt driftsmiljø og der er udført inspektion af en bred vifte af marine aktiver, herunder diverse typer af fartøjer.

Ved afslutningen af projektet er der udviklet et komplet produkt og en løsning, som er blevet lanceret som Blue Atlas Sentinus.

3. Project objectives

Fouling on ships leads to extra costs of fuel. Therefore, ship hulls are protected by specialized coatings and are periodically cleaned, which result in significant cost savings and reduced emissions through lower fuel consumption.

An efficient cleaning and maintenance schedule require knowledge of the hull's condition, which today are done using divers or remotely operated vehicles (ROV). The problem that vessel owners face is that traditional inspections methods are limited by speed and by low visibility in harbor waters, which results in poor quality video that only covers a small area of the hull.

Today's ships are large and value operating assets for their owners up to 400m in length, far too large for divers or manually piloted ROV to effectively inspect. The lack of hull data has become a limiting factor for further optimizing the operation of a modern ship, at a time when new standards are demanding cleaner hulls and management of invasive species.

Blue Atlas' solution is the first underwater robot that can produce a 3D image of a ship hull below the water. This 3D images are built from the high-quality video collected by the robot, and it is an archivable data format which simplifies comparisons between inspections. The format serves as an index for the raw underwater video, since every point on the 3D images are linked to the original images that were seen by the robot's cameras.

The purpose of this project is to develop a sellable version of Blue Atlas' underwater imaging robot which can autonomously image an entire ship hull and meets the demanding requirements of vessel owners.

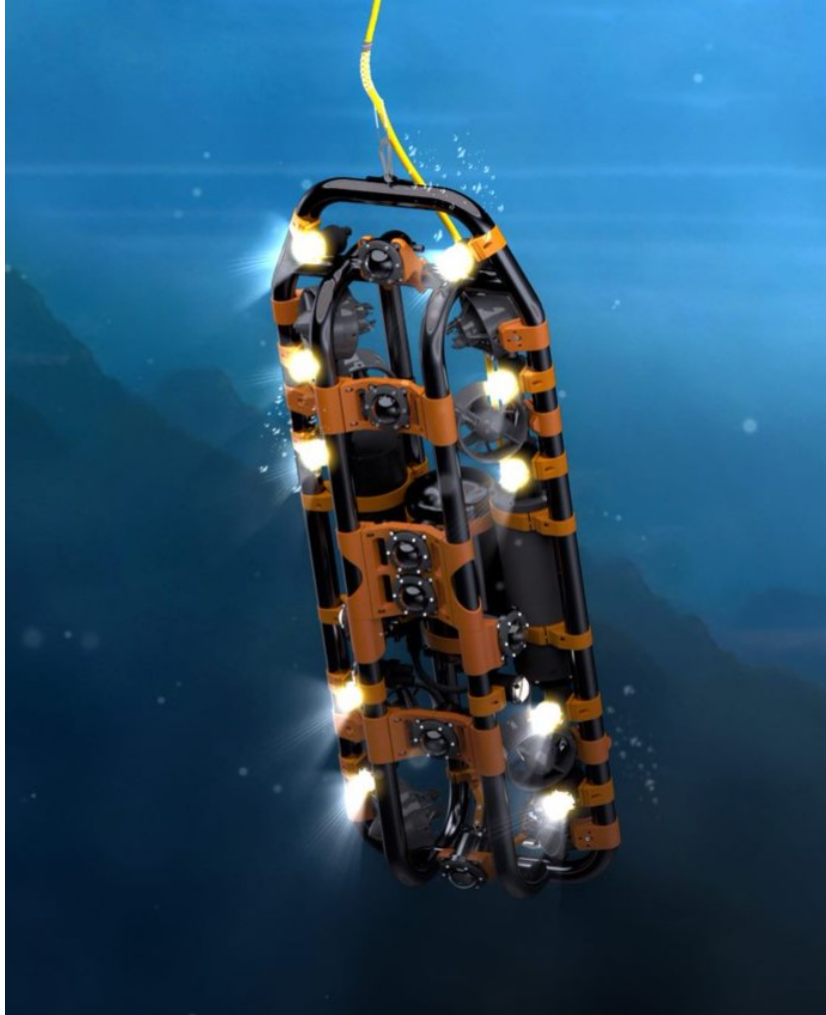


Figure 1 Blue Atlas Sentinus

As part of the project Blue Atlas Sentinus has been developed from an initial concept, in-house mechanical design, manufacturing, assembling to being used in a operational environment performing inspection of a wide range of marine assets including various types of vessels.



Figure 2 Example of 3D-model generated of side of a vessel, allowing for overview as well as detailed inspection of selected areas.

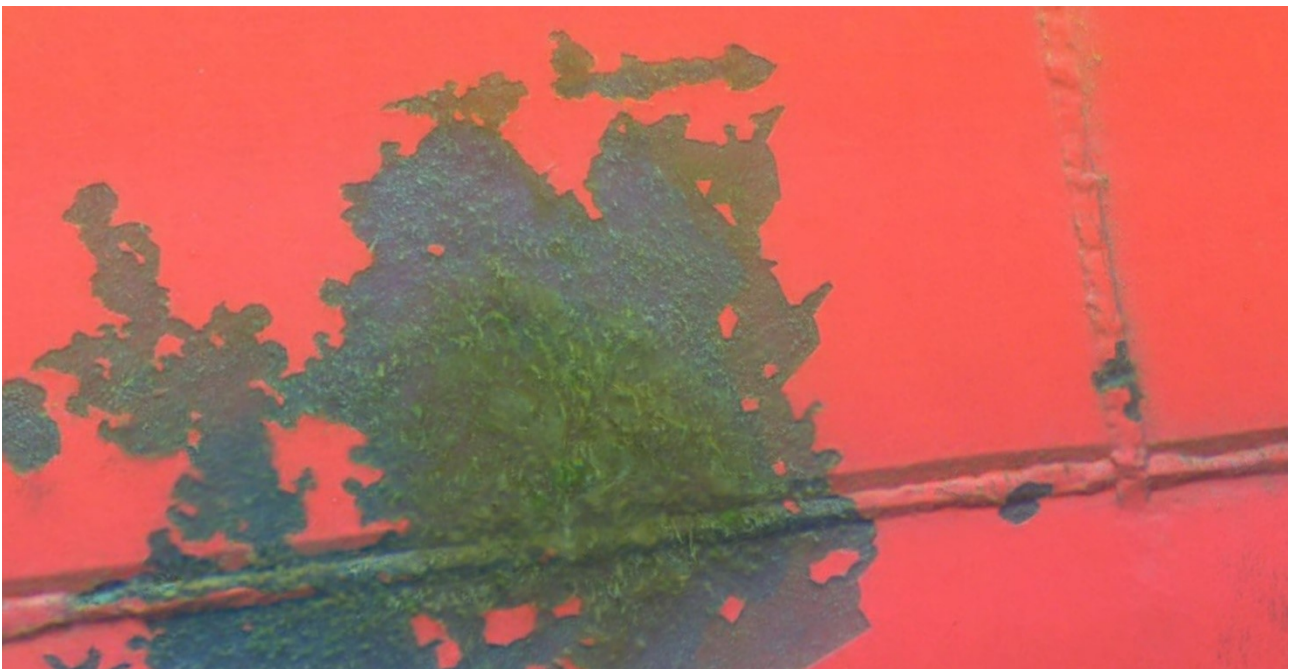


Figure 3 Example of levels of details and visual quality that the Blue Atlas Sentinus can deliver.



Figure 4 Blue Atlas Sentinel in flight mode, look at the topside monitor as the autopilot allows for a handsfree operations.

4. Project implementation

The project progressed as per the 4 work packages and timeline for same as set out before the project was initiated.

First part of the project was to design, manufacture and assemble a robot with the appropriate profile, that would allow for energy efficiency movement in all directions, allowing for optimal placement of the selected camera rig while remaining compact and light enough to be human portable and suitable to use the field for future users.

As part of deploying the newly designed robot, certain sub-components, and configuration of for examples cables has been redesigned and adjusted based on learning in the field.

Once achieved, the computer vision-based autopilot features together with robot's ability to orient itself in any direction was used to demonstrate its ability to inspect complex structures, also the full part of a vessel including niche areas, such as propellers, and extended horizontal surfaces such as a flat bottom barge.

The project was completed through demonstrating the ability to generate large scale 3D-models of complex structures, including the hull of a vessels, and also implementing a cloud hosted service for same, that can support the future commercialization of the Blue Atlas Sentinus.

5. Project results

All the technical and commercial milestones for the project have been achieved, as well having a technical and commercially mature product, that have been launched officially from May 1st 2022 under the name Blue Atlas Sentinus.

The developed solutions have already been demonstrated in commercial settings and wide range of customer segments are being targeted for sale of the develop solution all the different maritime related industries.

Dissemination of the results from the project has been presented through various channels, such as own social media platforms and for example in presentation at event arranged by IDA Maritime on the 7th of March 2022 under the title "*Next level underwater inspections - A presentation of new technical solutions including 3D – twin*", article adapted by the publication Ingeniøren on the 22nd of June titled "*Robot scanner skibsskrog med autonomi som en Tesla*" and through publication of collaboration by LE34 through their social media platforms, <https://www.le34.dk/da/projekter/ertholmene> .

6. Utilisation of project results

The technical achievements and milestones completed during the project, will be embedded into key parts of the product Blue Atlas Sentinus, that will be used to scale the commercial go-to-market strategic plan that Blue Atlas Robotics will implement in the coming years.

7. Project conclusion and perspective

The project has enabled us to develop our first commercial and technical market ready product, that will generate revenue streams for the company already in 2022 and kick off to the first part of our scalability plan from 2023 and beyond.

The develop solutions and the technology behind is also scalable and can be adapted to a multitude of different environments and allow for adding additional sensor technology onto our multifunctional platform.

8. Appendices

The Blue Atlas Robotics website <https://blueatlasrobotics.com/> contains information about our product, use case and will be continuously updated when new products and features will be released going forward.