User-centric solutions for a flexible and modular manufacturing in small and medium-sized shipyard

MARI4YARD

3D Projection with a Pan/Tilt Unit

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AIMEN

4th Workshop - AIMEN Technology Center, Spain

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006798

3D Projection with a Pan/Tilt Unit

The technology

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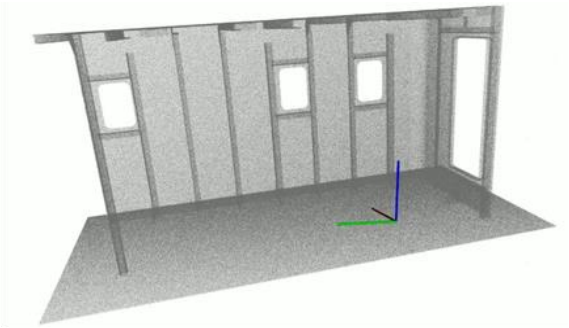
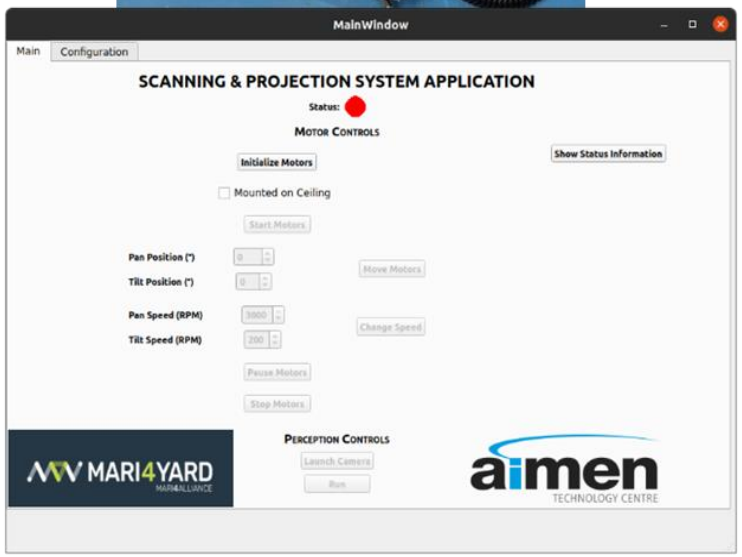
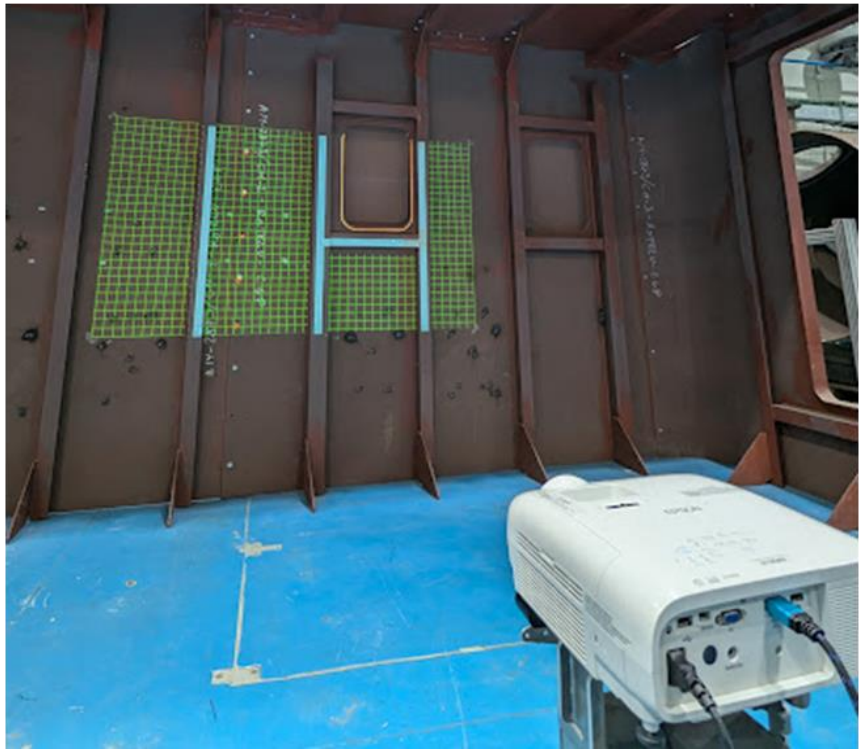
Components:
- Pan-Tilt Unit
- Epson 5400TW Projector
- Zed2i Camera
- PC with GPU

Process:
- Initial calibrations
- Scan
- Localize
- Project

Specifications:
- 10 Kg of weight
- 1º of accuracy
- COMMS: USB, HDMI, CAN







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The demonstration in the shipyard

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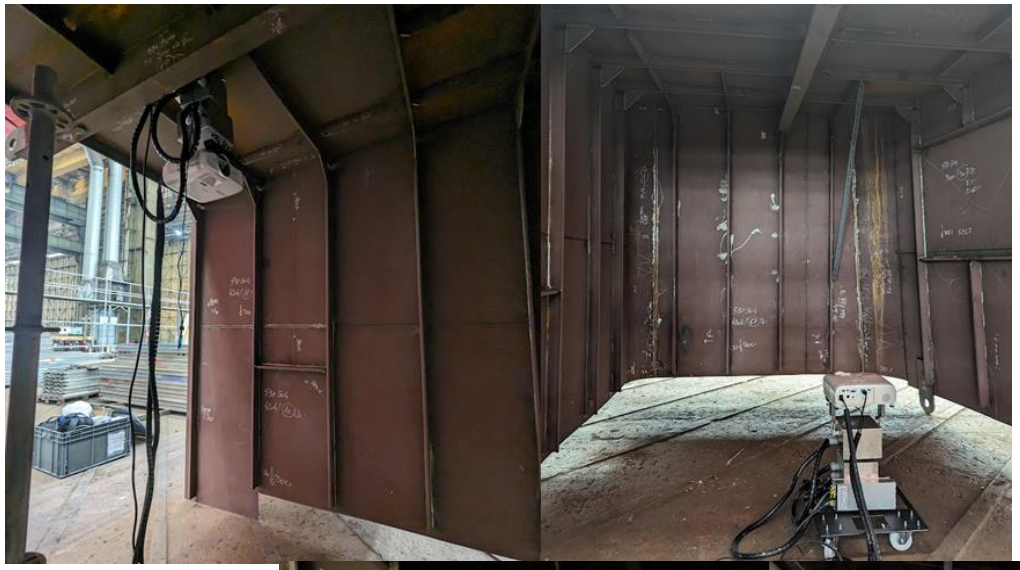
The demonstration in the shipyard

KPIs achieved:

- 2 configurations (floor and ceiling)
- Less than 5 mins to install and remove it
- Eliminate classical paper drawings
- Zero modifications: less than 60%

Tests:

- 3 different distances
- 3 types of scans



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Results during demonstration in BIS

Accuracy and Precision *Distance: 2.0m*								
6 Scans	Upper Left		Upper Right		Bottom Right		Bottom Left	
Test No.	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*
1	-6	3	-6	3.5	-6	3	-6	2.5
2	-6	1	-6	1	-6	0	-6	0
3	7.5	-2	7	-2	8	-3	7	-3.5

	Total (cm)	X (cm)	Y (cm)
Average	-0.625	-1.542	0.292
Standard Deviation	4.955	6.590	2.463
Mean Absolute Error	4.250	6.458	2.042
	6.773	Average Total Displacement	

Accuracy and Precision *Distance: 2.0m*								
12 Scans	Upper Left		Upper Right		Bottom Right		Bottom Left	
Test No.	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*
1	-10	3.5	-10.5	3.5	-10.5	3.5	-10.5	3
2	-5.5	8	-6	8.5	-6	8.5	-6	8
3	-4	1	-4.5	1.5	-5	0.5	-4.5	0.5

	Total (cm)	X (cm)	Y (cm)
Average	-1.375	-6.917	4.167
Standard Deviation	6.349	2.636	3.215
Mean Absolute Error	5.542	6.917	4.167
	8.075	Average Total Displacement	

Accuracy and Precision *Distance: 2.0m*								
18 Scans	Upper Left		Upper Right		Bottom Right		Bottom Left	
Test No.	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*	*X (cm)*	*Y (cm)*
1	-8	5	-8	5	-8	5	-8	5
2	-22	9	-22	9	-22	9	-22	9
3	-23	15	-23	15	-23	15	-23.5	15

	Total (cm)	X (cm)	Y (cm)
Average	-4.021	-17.708	9.667
Standard Deviation	15.133	7.187	4.292
Mean Absolute Error	13.688	17.708	9.667
	20.17	Average Total Displacement	

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Results after demonstration

Accuracy and Precision
Distance: 2.0m
pan:-5;5 tilt:0;12

4 Scans	1 (1.058; 1,147)		2 (1,058; 1,396)		3 (1,365; 1,396)		4 (1,365; 1,147)	
Test No.	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)
1	-0,3	0,4	-0,3	-0,8	-0,5	-0,3	-1,1	0,6
2	0,2	0,6	0,3	-0,7	-0,2	-0,5	-0,7	0,9
3	0,1	0	0,2	-1,5	-0,2	-1,1	-0,7	0,3

	Total (cm)	X (cm)	Y (cm)
Average	-0,221	-0,267	-0,175
Standard Deviation	0,605	0,429	0,759
Mean Absolute Error	0,521	0,400	0,642
	0,756	Average Total Displacement	

Accuracy and Precision
Distance: 2.5m
pan: -8;-2 tilt: 0;4

4 Scans	1 (1.058; 1,147)		2 (1,058; 1,396)		3 (1,365; 1,396)		4 (1,365; 1,147)	
Test No.	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)
1	-2	-1,6	-2,2	-1,8	-1	-2,1	-1,4	-1,4
2	-1	-2,8	-1,6	-3	-0,2	-3,4	-0,4	-2,8
3	-2,4	-1,3	-2,8	-1,4	-1,6	-2,1	-1,8	-1,3

	Total (cm)	X (cm)	Y (cm)
Average	-1,808	-1,533	-2,083
Standard Deviation	0,798	0,783	0,743
Mean Absolute Error	1,808	1,533	2,083
	2,587	Average Total Displacement	

Accuracy and Precision
Distance: 3.0m
pan: -6;-3 tilt: -20;0

4 Scans	1 (1.058; 1,147)		2 (1,058; 1,396)		3 (1,365; 1,396)		4 (1,365; 1,147)	
Test No.	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)	X(cm)	Y(cm)
1	-2,5	2,9	-2,6	2,5	-1,2	1,7	-1,6	3
2	-2,3	3,6	-2,3	2,7	-1,4	2,1	-1,8	3,3
3	-2,8	3,2	-3	2,8	-1,8	2,2	-2	3

	Total (cm)	X (cm)	Y (cm)
Average	0,321	-2,108	2,750
Standard Deviation	2,540	0,566	0,545
Mean Absolute Error	2,429	2,108	2,750
	3,47	Average Total Displacement	

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The impact for the shipbuilding industry

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The impact for the shipbuilding industry

- No need to use physical drawings for new operations in the structure.
- Unique positioning for multiple operations in different perpendicular planes.

No.	Technologies	Use-Case	Safety	Time consuming	Process control	Quality	Ergonomy	Cost	Impact (12, 20 use-case)	Impact (14, 12 techs)	RANKING (12)
T11	Cost effective projection	Position elements by means of projection based in the vessel 3D Model	0	2	3	1	0	1	7	7	9

Needs

WP5 PI's Section	Usability	Localisation performance	Manipulators and process execution	Robots Safety	Ergonomics, flexibility and response capabilities	KPI Impact local score
KPI-11.1: No. of reduced paper drawings. Eliminate the classical usage of the paper drawing for the given use-case	1	0	1	0	1	3
KPI-11.2: No. of instalment configurations. Ability to be mounted on ceiling, wall and floor	1	0	1	0	1	3
KPI-11.3: No. of operations effected. Zero modifications to onsite operates at the shipyard	1	0	1	0	1	3
KPI-11.4: Time to install and remove the projector	1	0	1	0	1	3

Demos

Performance

KPI Impact global (27)	Ranking (12)	Total Technology Impact (39)	Overall Impact RANKING (12)	GAP (use-case technology)
12	8	19	10	1

Gap of 1: Shows better KPI performance of demo in terms of addressing the needs

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Thank you!

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