A pipe climbing robot project for 2021 Basics Of Mechatronics class in Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie

1. INTRODUCTION

[1]http://robotics.umng.edu.co/concept.html visited 06.2021
[2]http://www.k.hosei.ac.jp/~ito/ visited 06.2021
[3]https://youtu.be/p46e7phn8Uo visited 06.2021
[4]http://biorobotics.ri.cmu.edu/projects/modsnake/gaits/gaits.html visited 06.2021

university: Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie
subject: Basics Of Mechatronics

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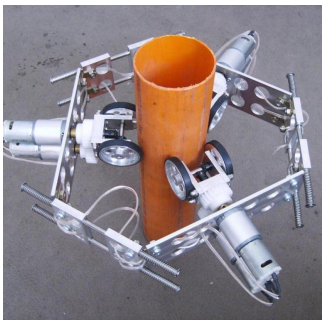
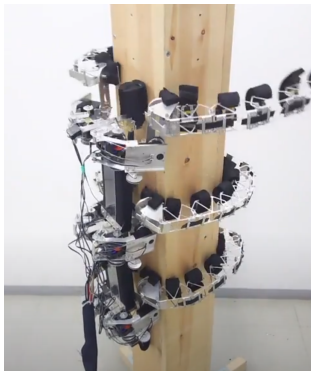
2. OVERVIEW OF EXISTING SOLUTIONS

On the market there are three popular solutions to robots moving on pipes.
Most popular is [1] the robot in ring formation. It's stable but has a major flaw in that it can't be easily removed from the pipe. The second most popular system is [2] the robot with 2 or more hands which alternate between moving and holding the robot. It can be constructed using soft-body materials and hydraulics, but isn't as stable as other solutions. [3] Robots using scissor-like mechanisms to clamp down aren't as popular but can be found. In development there are also animal like robots working like [4] snakes or caterpillars.

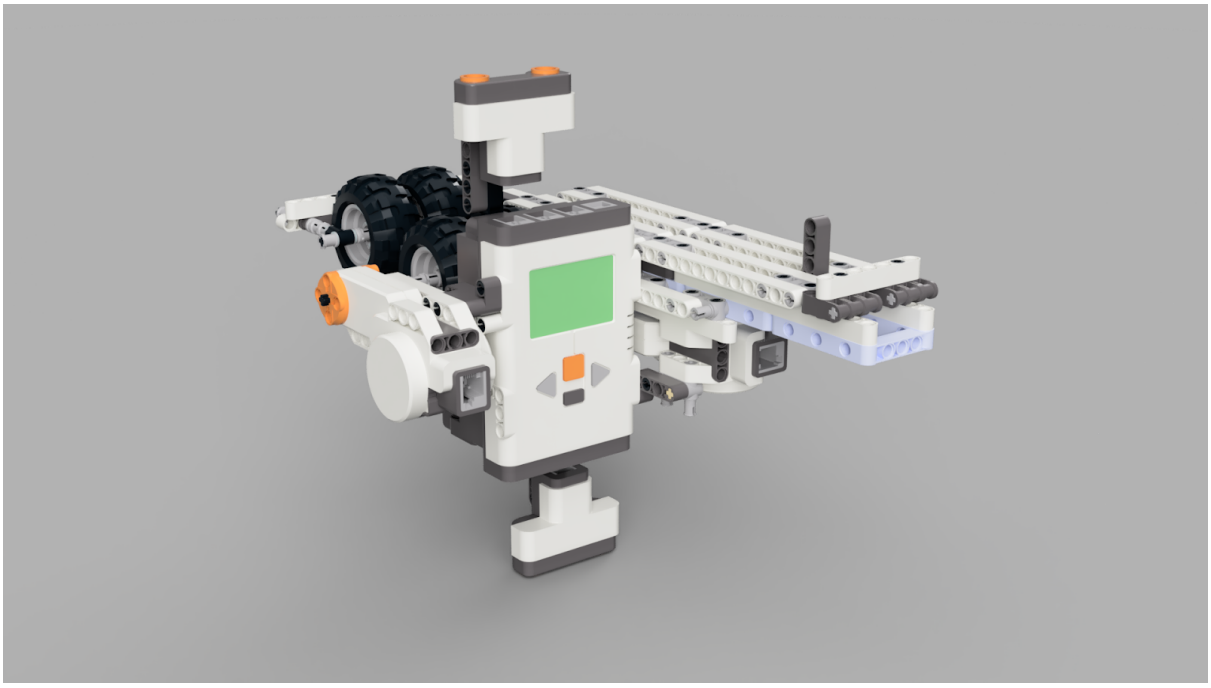
Our robot differs from them by using a new system of tightening on the pipe.

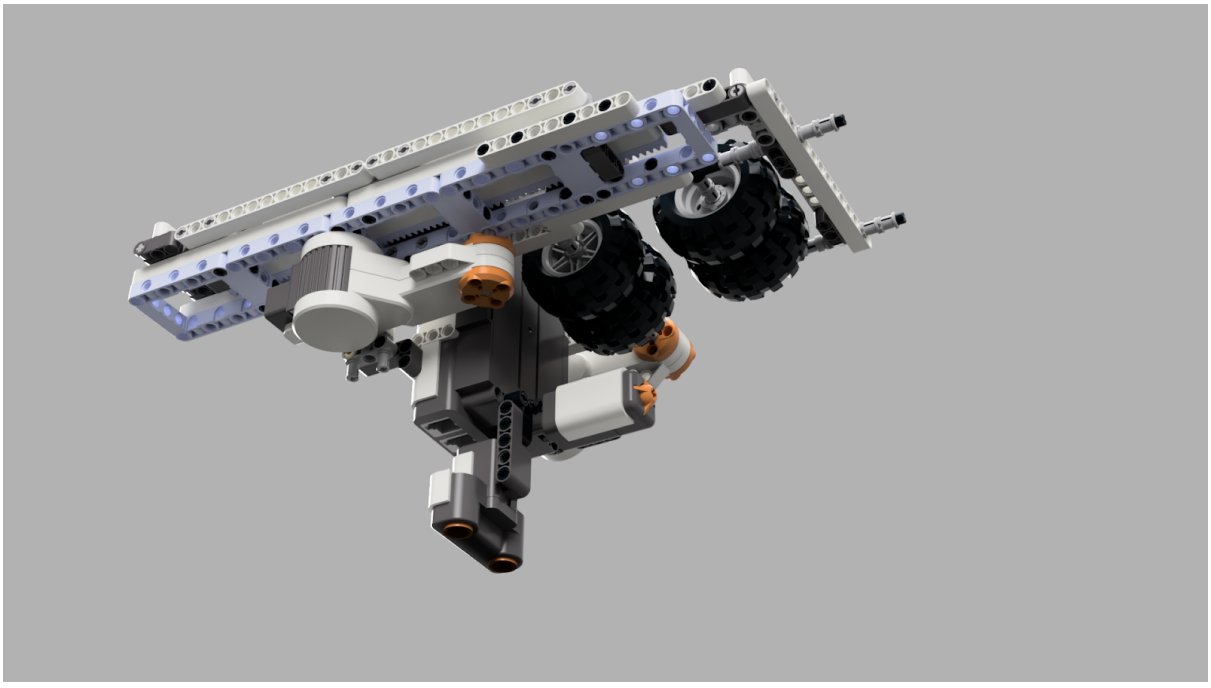
3. MORPHOLOGICAL CHART (3pages MC + 2-5 pages explanation)

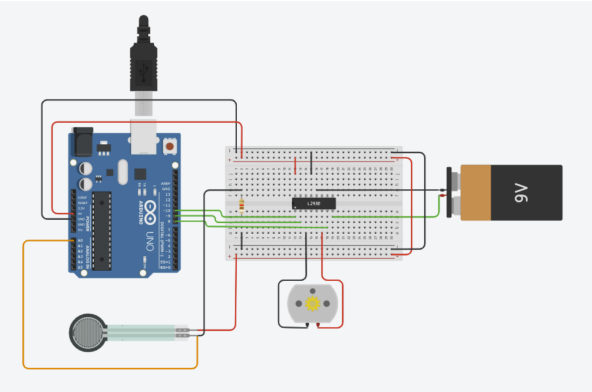
Morphological chart for pipe climbing robot project AGH2021							
index	problem	solution 1	solution 2	solution 3	solution 4	solution 5	legend
mechanics							
	tightening method	caterpillar	scissor	guided rail	ring	2 hands	solution
		high	low	average	high	average	price
		average	simple	average	complex	complex	complexity
1		average	low	high	average	low	quality
	number of segments	1	2	3	4	>4	solution
		low	low	average	high	high	price
		simple	simple	average	complex	complex	complexity
2		low	average	high	average	inadequate	quality
	constructio n	LEGO	3D printed	CNC machined	Softbody	plywood	solution
		average	low	high	low	low	price
		average	average	average	high	low	complexity
3		average	average	high	low	low	quality
electronics							

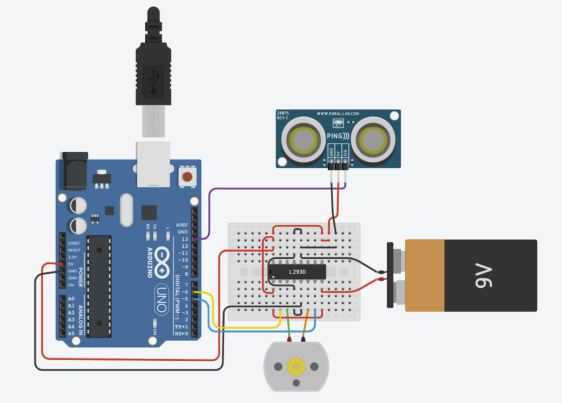
	processor	PC	Raspberry PI	LEGO MINDSTORMS	Phone	hydraulic	solution
		free* (user provided)	low	high	free* (user provided)	high	price
		high		average	high	high	complexity
1		average	high	high	average	low	quality
	connection	cable	bluetooth	wifi	cellular	IR	solution
		low	average	average	high	average	price
		low	average	average	high	low	complexity
2		low	high	high	low	low	quality
	space awareness	none	ultrasonic	set boundaries	bumpers	lidar	solution
		free	average	free	low	high	price
		low	average	high	average	high	complexity
3		low	high	low	average	high	quality
software							
	OS	Windows	Raspberry OS	RTOS	Debian	MacOS	solution
		average	free	free	free	high	price
		easy	average	hard	easy	easy	ease of use
1		high	high	average	high	high	quality
	code language	Python	C++	C	ASSEMBLER	Swift	solution
		easy	average	easy	hard	average	ease of use
		complex	complex	average	simple	complex	complexity
2		high	high	high	low	average	accessibility
	movement mode	user controlled	looped tasks	space aware	edge to edge	hydraulic	solution
		easy	average	high	average	high	price
		simple	simple	complex	average	complex	complexity
3		average	low	high	average	inadequate	quality

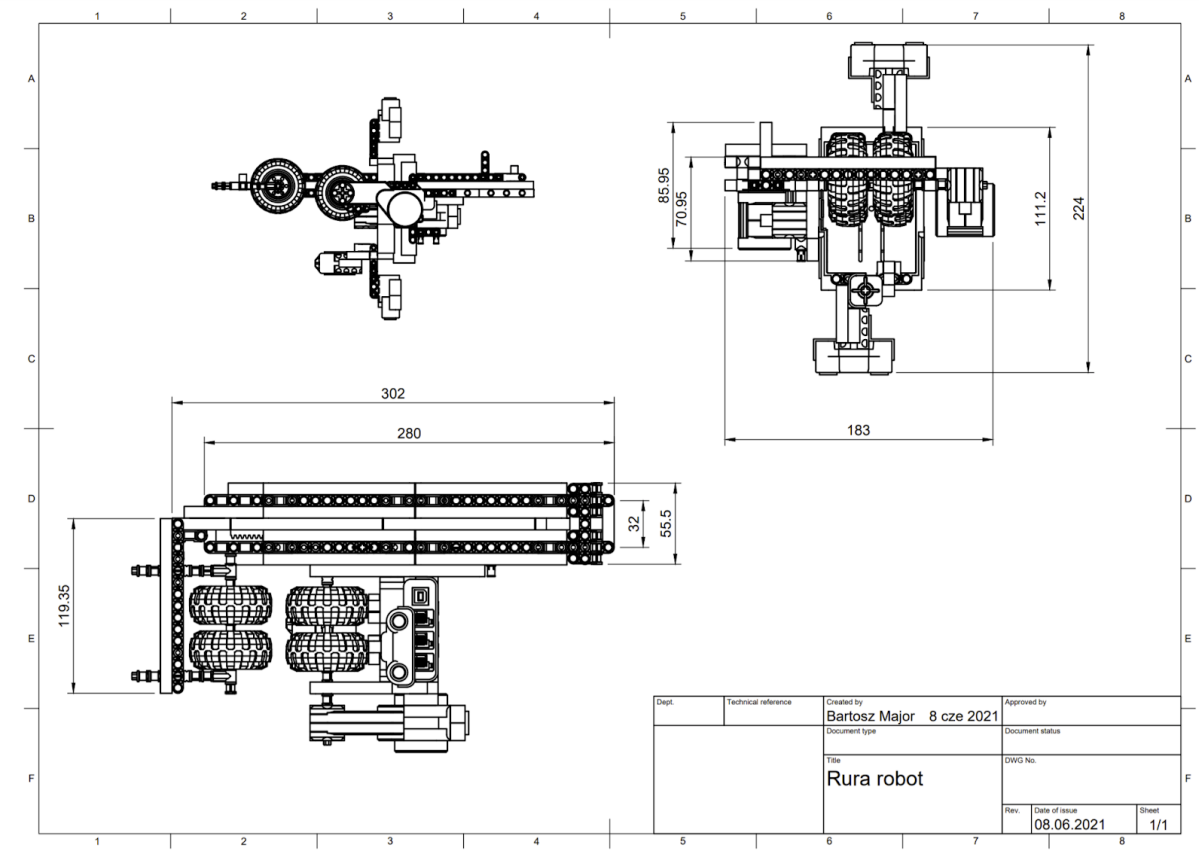
4. MODEL AND SIMULATIONS











5. PROTOTYPE AND EXPERIMENTAL TESTS

Prototype is designed using the LEGO system of blocks for convenience. Testing was not possible due to restrictions

6. SUMMARY AND CONCLUSIONS

As of now we have completed the design part of the project. We have a detailed CAD model and working software. The code has proven to be the most challenging part of the project. Without real life results it's not possible to tune the motors and sensors. Given resources and time it would be relatively simple to create a working model. In the future our team is planning to create a model first from lego, and eventually from cnc machined parts for quality. In plans are also additional operation modes to increase the usefulness of the robot.

7. BIBLIOGRAPHY

Similar solutions photos
[1]http://robotics.umng.edu.co/concept.html visited 06.2021
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