

#### Abstract

Similar to most cities in China, the water system of Beijing's Public Park has been developed and the water is basically kept clean and tidy. But is there any more pollution in the water system of the park? What causes the pollution? Are aquatic plants and animals living well? The quantifiable data is demanded for the citizens.

Yuan Capital Earthen Wall Relics Park is a well-known relic park, which contains the ruins of the Yuan Dynasty city wall. It is also the park with water system closest to our school. Therefore, we decided to explore whether there was underwater pollution.

Our robot had only been tested in the swimming pool, so it was an open question at the beginning whether the ROV would be able to complete the task and obtain underwater videos of the actual environment



# **Background & Motivation**

We are expecting to know whether every city park has been well managed, and whether our DIY ROV has the capability to do so.

We are wondering whether our Seaperch ROV adapts to the real water system and has the ability to perform real tasks. What will we make an effort to develop in terms of mobility and image acquisition capabilities?

The Yuan Capital Earthen Wall Relics Park we are about to explore has a long history and is surrounded by many residents. The river inside is the moat of the Yuan Dynasty, with the length of several kilometers from east to west. We are going to investigate whether every section is clean enough and whether there is a pollution.



# The Exploration of the Underwater Garbage in Yuan Capital Earthen Wall Relics Park

# Beihang University Experimental School (Primary School) Team Beihang University Experimental School (Primary School)

# **Research Methods**

The method is to install an image acquisition system on the ROV. Two solutions have been adopted. One is a Waterproof Industrial Endoscope on the left picture, and the other is a GoPro Hero which can work underwater on the right picture. We have conducted an investigation on Taobao. The advantages and disadvantages of the two solutions are predicted as follows.





• Two ROVs were prepared and a simple method was used to fix the two image acquisition systems. Then we completed the software installation and debugging. We tested the image acquisition of two ROVs in the classroom at the same time.

	<b>GOPRO SESSION</b>	INDUSTRIAL ENDOSCOPE
IMAGE QUALITY	Clear 1080p	General 480p
PRICE	Expensive RMB700	Cheap RMB70
ILLUMINATION	NA.	LED
CABLE	NA. (Good mobility)	Yes (Poor Mobility)
LIVE IMAGE VISIBILITY	Invisible Underwater	Visible Underwater

	<b>GOPRO SESSION</b>	INDUSTRIAL ENDOSCOPE
IMAGE ACQUISITION SOFTWARE	Goproquick8.0	AMCap9.21
IMAGE FORMAT	JPG, 16:9	JPG 4:3
NUMBER OF PLANTS	5	4
NUMBER OF FISH	1	0
NUMBER OF UNDERWATER RUBBISH	2	1
NUMBER OF SURFACE RUBBISH	0	0





Photo 2-3: The image obtained by the industrial endoscope, presents the close-up images of construction waste and water plants. The construction waste wrapped in non-degradable plastic woven bags is involved.



# **Results & Discussion**

On the afternoon of April 30, 2021, under the leadership of Ms. Lu Ying, all the members of our team carried out a 2-hour investigation of the actual environment. Two modified Seaperch ROVs have been used as the following.

The first ROV with the industrial endoscope has a blurry observation of distant objects due to its thick cable and poor maneuverability, but its observation preforms that near images is relatively clear and the viewing angle is relatively small.

The second ROV with the GoPro is more flexible and can observe close and distant objects more clearly with a larger field of view.

The problem: the propeller is easily entangled by water plants, and it is necessary to carefully look for a route without water plants.

Photo1: The image obtained by GoPro shows a clear, complete image of construction waste, with a wild fish swimming around inside the red circle.





We also hope that in addition to the camera, we can install more water quality sensors.



Thanks to Dr. Liang for industrial cameras and Gopro. Thanks to the management of the park for their help.

**References:** https://gopro.com/en/us/shop/quik-app-video-photo-editor https://map.baidu.com/search https://baike.baidu.com/item/%E5%85%83%E5%A4%A7%E9%83% BD%E5%9C%9F%E5%9F%8E%E9%81%97%E5%9D%80%E5%85 <u>%AC%E5%9B%AD/2676436?fr=aladdin</u>

### Conclusion

• The experiment proves that the two image acquisition devices we have installed are both successful. They both obtained clear images of suspicious objects at a depth of about 1 meter from the shore about 5 meters away.

• The one with GoPro has a better field of view and clearer images, but it cannot be seen on the ground in real time.

• The one with the industrial endoscope has a small field of view, but the close-up image is clear, and the image can be seen in real time on the ground.

• We see a complete absence of human waste on the surface, and we see construction waste underwater in white woven plastic bags which are not biodegradable. In general, the plants under the water are growing well, and we have seen lively fishes.

## **Future Plan**

We hope to use ROV to investigate more water systems in parks or cities, villages or industrial areas.

We hope to know whether only economically developed cities like Beijing are well managed.



# Acknowledgements