Hello everyone, the topic of my pre today is Bionic Mechanical Goose Based on Water Surface SLAM Mapping. We named this project as GOOBOT. Because the solution we finally chose is a bionic goose-shaped robot, so we created GOOBOT for this robot. Also it means good robot.

Firstly I want to introduce some initial ideas and goals of the project. One day, Professor Zhu was walking by the Weiming Lake and thought: Can we make a type of water robot to help garbage salvage and water quality monitor. So our project was born. We want to complete a water robot that can precisely control its actions and have some intelligence to accomplish some tasks.

First of all, because it is a water robot, it must have a physical structure that can float on the water and have robustness in some scenes. In terms of sports, it should be able to precisely control its own posture, speed, and position to achieve autonomous cruises according to the planned route. Before autonomously planning a path, it is also necessary to have a ability of getting surrounding environmental information, such as: modeling ability on the water surface and shore through vision or laser, and then autonomously plan a definite cruise route to complete the expectation Task.

We also want to realize a robot that is Harmoniously blend into the natural surroundings. This requires our robots to be smaller, emit less noise when running, and have an appearance similar to some animals. At the same time, in order to be enjoyable, it can also interact with people and complete some funny actions.

Refer to Professor Zhu’s requirements for amphibious, and bionic fins or other mechanical structures may be added in the future.

Currently we divide the project into six phases, First of all, we have conducted a detailed investigation,. There are few successful examples of small surface robots. Most of them are for large surface robots or underwater robots.

We independently design the shape and physical structure of the goose, roughly placing the center of buoyancy directly above the center of gravity, ensuring that its slight sideways will not cause instability of the overall system, which will lead to overturning.

The belly of the goose is hollowed out, There are battery storage unit and development boards. Two propeller motors are symmetrically equipped under the abdomen of the goose as the power source for the movement. The gooseneck is equipped with a steering gear, which can complete the rotation of the gooseneck. Goose head is equipped with a camera, responsible for collecting visual information of the environment.

Of course, the current bionic mechanical goose still has large space to install more sensors and other equipment

This picture shows the electrical system design of goobot. At present, three types of sensors transmit external information into the system. The remote control can control the goose as a mandatory control measure. The JY61 gyroscope is responsible for detecting the posture, which is passed to the Raspberry as the input of the PID. The camera is responsible for taking real-time images for Slam.

We design to use robomaster as a motion control board to convert motion information into PWM wave output, so as to control the speed of the motor and complete the control of behavior.

The Raspberry serves as the upper board, receiving gyroscope information, doing PID control, and outputting it to the robomaster board for execution. The real-time picture is transmitted to the server through the socket, and the server builds the picture in real time. When the map is gradually mature, the server can send instructions to guide the goose's direction or cruise route.

The next stage is to realize the communication problems between the various modules so that they can be linked as a whole. We can also look at this picture. Except that the communication between the Raspberry and the server is still being debugged, the other communication functions have been developed. The figure also marks the next stage of work focusing on PID debugging and SLAM development.

Finally, let’s summarize the work done on the hardware.

Chen Yang will talk about the detailed situation here

The big difficulty lies in being unfamiliar with the IDE and configuring the environment

Here I will talk about the problems encountered in detail. We tried to calculate the quaternion through the angular velocity and angular acceleration returned by the six-position sensor, and then integrate it into Euler angles. Eliminate drift errors through the acceleration of the center of the earth. But after Lele's theoretical analysis, we found that the acceleration of the center of the earth cannot eliminate the drift of the yaw angle anyway, it eliminates the pitch angle and roll angle. In the end we decided to replace the nine-position sensor to solve the problem.

The next topic is the slam part. Its full name is Simultaneous Localization and Mapping

Based on our original design, Can I use the camera to complete the slam?

The difficulty is that the pure camera mapping can only infer the size of the object by judging the difference in the size of the object between the two frames, and it does not have a cognitive information about its own state. And there are very few feature points recognized by the camera on the water surface.

Based on the small unknown waters that we want to map, such as Weiming Lake, we can synthesize the information on the shore to outline the movable range of the goobot, and deal with the garbage on the water surface (pixel mutation ) Perform modeling and calibration.

I conducted some experiments with the two existing algorithms. ORB corner detection algorithm and canny edge detection algorithm.

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In our next stage, we first want to conduct a launch test first, and collect some data as a basis for subsequent debugging.