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Research on Obstacle Avoidance Strategy of Mobile Robot

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Abstract: Robots are involved in many disciplines and fields such as machinery, electronics, control, computer, artificial intelligence, sensor, communication and network. It is a comprehensive integration of the development results of a variety of high and new technology. As an important part of the technology, robot obstacle avoidance technology begins to study from the appearance of mobile robot, but at the beginning, he does not study as a single column technology. People usually implement it in path planning. Path planning is used to guide the behavior of robot to reach its long-term goal. Based on the principle of ultrasonic ranging, this paper explores the robot obstacle avoidance technology to achieve the robot's obstacle avoidance function.

Keywords: Mobile robot; ultrasonic obstacle avoidance; path planning.

1. INTRODUCTION

Obstacle avoidance and target tracking based on ultrasound are based on acquiring distance and location parameters of related objects, and then carrying out specific action strategies. Based on the principle of ultrasonic ranging, the obstacle avoidance control scheme is established in this paper, which lays the theoretical foundation for the robot's obstacle avoidance function.

2. CONTROL STRATEGY OF OBSTACLE AVOIDANCE

The obstacle avoidance control strategy based on the information depth of obstacles is to establish a simple robot obstacle avoidance control system. It is important to understand the functions that the robot should have at least in order to keep the robot stable and avoid the obstacle continuously. The stability of the work is reliable, and the identification of the obstacles is accurate. The motion of the robot must be consistent without pause, which requires that the depth of information provided to the decision system needs a certain amount of advance, and the formulation of the obstacle avoidance strategy should be based on the speed and reaction time of the robot's walking system.

The system uses multi-channel ultrasonic sensors to work together to complete the obstacle avoidance and path planning of the whole robot system. In the first half and 180 degree direction of the mobile robot, 1 groups of ultrasonic sensors are installed at 45 degree intervals by arc. There are 5 sets of ultrasonic sensors.Suppose that the robot is reaching the safe area of the destination. (at this time, the robot is far away from the obstacle. The location of obstacles was measured n times at different times of n. If there is no obstacle in the forward direction when measuring, then the robot starts to power the DC motor, and the robot starts to move forward.On the next n measurement, the robot is at A point, and the obstacle is at O point. Next time point, when there is no obstacle, the robot should arrive at the B point. If B is in a circle with O as a center and a radius of an obstacle step (the distance moving in a unit time), the robot should move in a certain angle in the actual process (Fig. 1, the intersection of AB and the tangent AC of the circular O over A points).

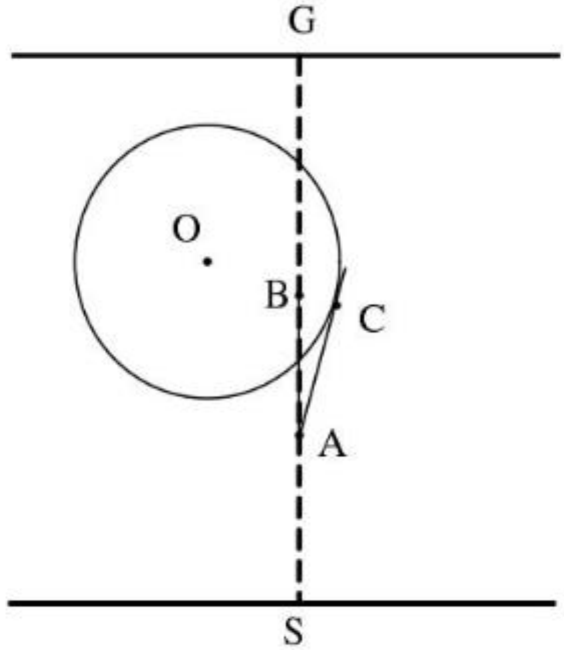

Fig.1 The moving distance within a unit time

If B is not in a circle with O as a center and the distance of the obstacle step (the distance moving in a unit time) is within a radius of the radius, the robot moves along the SG direction as shown in the original plan, as shown in Fig. 2. At this point, the robot reaches C (B). In this process, the obstacle is measured again, which is equivalent to the n+1 measurement of the obstacle at different times. Repeat the above steps until the robot safely bypasses obstacles and then move along the straight line to the destination G.

Of course, since the robot is likely to be next to the obstacle before it is running, it is possible to find an obstacle in front of the robot's supersonic wave sensor when it is just starting to work. In this case, the robot is in a stop state first. After the sensor is measured, the left turn command is executed if there is no obstacle on the left. In the left turn process, a right angle turn of 90 degree can be rotated, or a certain angle can be rotated according to different conditions of obstacles. Theoretically, this angle is from 0-180 degrees. However, due to the influence of various factors (such as the friction coefficient of the two wheels, the braking performance of the motor and the hardware structure of the robot, etc.), the angle of rotation should be between 15-180 degrees.

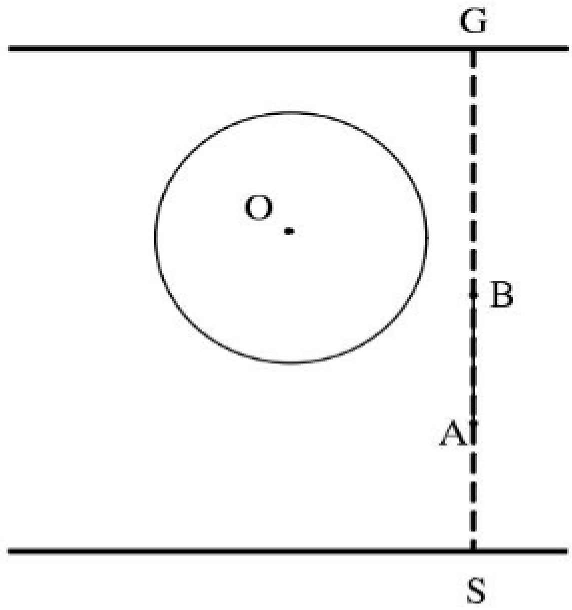

Fig.2 The situation is not within the unit time moving distance

3. TARGET TRACKING CONTROL STRATEGY

Target tracking and obstacle avoidance strategies are usually used on different automatic robots, such as the task robot usually uses the obstacle avoidance strategy. The interference robot usually uses the tracking strategy, and of course there are exceptions. For example, the automatic block robot can start the interference program and disturb the machine in the time of using the available "Pearl". People do not find goals and obstacles in their progress. They also need to use obstacle avoidance strategies. Compared with obstacle avoidance, tracking strategy is relatively simple. It only needs to find the target and move towards the target, but it can judge more in the process of finding the target. Reliable and continuous is still a function that needs to be satisfied. It still requires that the deep information that the perception system provide to the decision system needs a certain amount of advance.

Several important points in the process are path planning, target recognition and target judgement. No target path planning: This is a pre-set, which requires interference robot to find the route without finding the target. This is a cycle line. When the target is not found during the competition, the robot will always run along the route. This is a set of changes based on information, in the case of the information of the opponent, with the initial setting; when the opponent information is known, according to the operation route of the robot which has the greatest effect, the planning route is changed as the key target of the interference robot, and the goal is found more quickly and more promptly. The purpose of interference.

Target obstacle identification: the object recognition method based on ultrasound has been introduced in the previous article. The following rules are introduced to improve the recognition accuracy and speed specifically for the rules of the competition. There are 20 islands in the competition area. Each island has a diameter of 360mm, and the location of each island is known. Considering the actual size of the robot, the existence of the "Pearl" block and the maximum error of the measurement, I set the center point of each "island" as the center, and

the area of the radius 0.4m is an obstacle area. That is to say, objects in this area are directly judged as non targets, and then target recognition is carried out outside the region.
Target judgement: This is the choice of targets for the detection of multiple targets. The selection principle is based on a variety of factors such as the distance and direction angle measured by the sensor, so as to simulate the motion of the robot to calculate the time needed to disturb the robot to the target position and to have a higher priority.

4. OBSTACLE AVOIDANCE BEHAVIOR

In the selected scheme, the automatic robot is driven by some other processes, such as trajectory planning and path tracking. Obstacle avoidance behavior monitors the running space of autonomous mobile robot, and adopts appropriate obstacle avoidance strategy when obstacles are encountered.
The state set Q of the discrete event system of the autonomous mobile robot and the event set sigma are: Q={static, motion, obstacle avoidance, path tracking}, $\sum$= : {detection of obstacles, no obstacle path, stop, motion change, detection to motion, no motion, regular walking path, walk (predetermined) path}. The set of uncontrollable events in event set $\sum u$ is as follows: $\sum u$ ={detects obstacles, detects motion, no movement, barrier free, goes through (predetermined) path, plans walking path, stops}.

The starting state is q_0 ={static}.
State 0 still: the autonomous mobile robot is still.
State 1 motion: autonomous mobile robot moves forward, and sensors continuously monitor their front running space.
State 2 obstacle avoidance: the autonomous mobile robot turns around at a certain speed to avoid obstacles.
State 3 path tracking: tracking path with feedforward control strategy.
Events detect obstacles: if there are obstacles on the path of autonomous mobile robots, that is, in the field of autonomous mobile robots, it will show that this event occurs.
Event free path: if the obstacle field of autonomous mobile robot is in the field of view, it means that this event happens.
Event motion changes: once an autonomous mobile robot changes the direction and / or speed of motion, it means that this event happens.
The path is completed: once the autonomous mobile robot has finished the given path, it will show that this event has happened.
Event stops: the autonomous mobile robot stops moving.
Events detect motion: when we detect the motion of an autonomous mobile robot, we can assert that this event has happened.
Event free motion: when an autonomous mobile robot is at a stationary state, it indicates that this event has happened.

When the motion of the robot involves navigation, it always activates the obstacle avoidance behavior. The behavior of autonomous mobile robot is mainly in path tracking or in a detection way driven by a detection strategy. The obstacle avoidance process begins at state 0, transitioning to state 1 or state 3, depending on whether to track a particular path or to detect the motion caused by the detection process (or other process). In the state 1 and state 3, we continuously monitor the running space before the autonomous mobile robot. When an unexpected obstacle appears (that is, when an event detects an obstacle), the state of the autonomous mobile robot is switched to state 2. In state 2, after the qualitative analysis of the running space map, the appropriate turning speed is calculated, and the obstacle avoidance strategy is subsequently implemented. Once the autonomous mobile robot's field of vision is free, it will go to state 3 and track the original path. In the case of no path tracking, the state of the autonomous mobile robot is changed to state 0. When the free space is small enough to avoid the obstacle, the autonomous mobile robot stops moving (that is, the occurrence of the stop event). From the point of view of discrete event control, obstacle avoidance behavior is controllable.

5. TRACKING BEHAVIOR

The state set of the tracking behavior and the most of the event sets are the same as the obstacle avoidance behavior, but the path tracking becomes the path tracking / target tracking, the target tracking and the path tracking selection execution. Many targets are detected in the event set, and the target path is completed to complete the tracking task.

State 3 path tracking / target tracking: tracking path or target with feedforward control strategy, tracking path without target, tracking target when there is a target.

The event detects the target: if the target of autonomous mobile robot is in the range of detection, that is, in the field of autonomous mobile robot, there is a target indicating the occurrence of this event.

Event completion tracking target: if the autonomous mobile robot tracks the target, that is, tracking the target until the target enters the blind area and is close to the switch, it means that this event occurs. Because the main purpose of the jamming target robot is to interfere with the work of the target, there are two main interference methods: the collision is used to destroy the path planning of the opponent's navigation, and the opponent is interfering with the opponent with the electromagnetic signal. The two way is to disturb the robot to approach the target, so the tracking target is also set to contact with the target. When the target is moved away from the blind area of the ultrasonic sensor, the target event is detected again, and the target tracking is again started until the target is hit again. This continuous collision is proved to be more disturbing.

6. CONCLUSION

This paper focuses on the obstacle avoidance scheme based on ultrasonic sensor, analyzes the principle of obstacle avoidance according to the actual demand, discusses the method of ultrasonic obstacle avoidance, studies the feature extraction and obstacle analysis, and finally makes out the strategy of obstacle avoidance.

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