Obstacle Avoiding Robot Based on Arduino

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ABSTRACT: Trajectory preparation is a prime method in the mobile robot navigation research. Sampling-based algorithms are capable of creating trajectories that help the robot meet the target avoiding obstacles. Through this proposed study, an Enhanced Artificial Potential Field (E-APF) produces the trajectories for mobile robots and ensures the reliability and stability of the trajectory at the same time. E-APF approach is proposed for Wheeled Mobile Robot (WMR) route planning, aiming at the problem that the classical APF cannot adjust to the dynamic trajectory planning and collapse as a prey to the optimal local solution. Combining the current development status of smart robots, obstacle avoidance and automated tracking is the subject of robot travel issues. Based on the development status of smart domestic control systems, existing technology, etc, this paper uses Arduino as the core control device, combined with an infrared tracking module. Four modules, such as ultrasonic obstacle avoidance module, motor drive module and power module, have developed a strong control system to perform the wheeled robot's intelligent tracking function and obstacle avoidance.

KEYWORDS: Wheel robot, Arduino, Tracking, Obstacle avoidance, Reliability, Stability.

INTRODUCTION

Wheeled mobile robots (WMR) are increasingly present in existing manufacturing and service robotics systems, particularly when autonomous movement capabilities are needed on relatively smooth grounds and surfaces. Several mobility conjurations (number and type of wheel, position and actuation, single or multi-body vehicle structure) can be found in the applications. Local navigation is a fundamental issue for mobile robots working in real-world environments: a robot must move towards a target position while avoiding unexpected obstacles. Motion-planning problems is classified in static or dynamic for mobile robots. With the former, prior to planning, the challenge knowledge is expected to be identified to the planner in its entirety. For the latter, environmental knowledge is only known to the planner during runtime and also during the execution of a partially planned program.

Some of the most common methods of collision avoidance are based on artificial potential, where the direction of steering of the robots is determined assuming that obstacles on the robot assert repulsive forces, and the target asserts attractive forces. All of these methods measure the desired direction of motion and steering commands in two different steps, which in a complex perspective is not appropriate. With non-holonomic systems such as mobile robots, their cinematic constraints make time derivatives of certain configuration variables non-integrable and a collision-free path in the configuration space is therefore not necessarily feasible.

Many of the current studies deal with non-holonomic structures and avoidance of artifacts using two primary methods. The other one is to concentrate solely on motion preparation under non-holonomic constraints, without consideration of obstacles. The second approach is to adjust the outcome of a holonomic planner, so that the resulting direction is possible. For example, the online sub-optimal obstacle avoidance algorithm in Sundar and Shiller is based on the admission of stationary obstacles and the planned path is holonomic and the feasibility of a non-holonomic mobile robot has to be varied. Control of WMRs was also studied from many perspectives, including stabilization of the set point, trajectory-tracking, path-following, etc. Trajectory tracking control for WMRs and other robotic mechanisms is a method that fits the research orts. The path has a related velocity properly, with each trajectory point embedding space-temporal information that the WMR along the path is to satisfy. Therefore, the question of trajectory-tracking is stated after a virtual target for WMR. The WMR with specified velocity profile is assumed to travel exactly along the road.

Variable structure control (VSC) has proven to be a versatile approach for different applications and has been successfully applied to control issues as diverse as automatic sight control, electrical motor control, chemicals management, space systems and robotics. The sliding mode control (SMC) methodology is a specific type of VCS system. The SMC theory has been extended to different control systems as it has been shown that this nonlinear form of control has some excellent properties, such as robustness against large parameters.

LITERATURE REVIEW

A real-time approach to collision avoidance is proposed in this paper for peaceful coexistence between the human-robot. The key contribution is a quick method for determining distances between the robot and potentially moving objects (including humans), based on the depth space principle. The distances are used in the generation of repulsive vectors used to monitor the robot when performing a generic motion function. The repulsive vectors can also benefit from an estimation of the velocity of obstacles. A simple collision avoidance algorithm was implemented in order to maintain the execution of a Cartesian task with a redundant manipulator where various reaction behaviors are set up for the end-effector and other control points along the robot structure [1]. The goal is to create an obstacle by using supersonic sensors to push away the robotic vehicle for its movement. To accomplish the required operation a microcontroller ATMEGA328 is employed.

A robot may be a computer with a steering or mechanical function. Artificial intelligence is also a combination of artificial intelligence and physical (motor) devices. The programmed directions include machine intelligence. The project proposes a robotic vehicle that has an intelligence built in that it has specified that it directs itself if an obstacle comes before it. Built this robotic vehicle, using an ATMEGA328 microcontroller. This paper introduces a novel approach to real-time obstacle avoidance based on Dynamic Systems (DS) that ensures multiple convex formed objects are impenetrable. The proposed method can be applied to avoid obstacles in Cartesian and Joint spaces, using autonomous as well as non-autonomous DS-based controllers. Obstacle avoidance occurs by modulating the controller's initial dynamics.

The modulation is parameterizable and allows to evaluate a safety margin and to increase the reactivity of the robot in the face of uncertainty in the obstacle's localization [2]. The paper focuses on a mobile robot's navigation subsystem that works in human settings to perform different activities, such as hauling waste in hospitals or escorting people to exhibits. The paper describes a hybrid approach (Roaming Trails), which combines a priori environmental information with local expectations in order to perform the assigned tasks efficiently and safely: that is, by ensuring that the robot can never be stuck in deadlocks even while working in a complex environment that is largely unknown. The article contains a review on the properties of the method, as well as experimental results reported during the experiments in the real world [3]. This paper proposes a method to learn from human experiments about this coupling term beginning with simple features and making it more stable to escape a wider range of obstacles. They test our coupling term's ability to model different forms of human obstacle avoidance behaviors and use this trained coupling term to reactively avoid obstacles. This line of work seeks to move the boundaries of reactive management approaches to more complicated scenarios, so that as far as possible complicated and typically computationally more expensive planning methods can be avoided [4]. Collision avoidance is a must for mobile robots.

It is more difficult to avoid moving obstacles (also called dynamic obstacles) with unexpected shifts in direction, such as humans, than to avoid moving obstacles whose movement can be predicted. Precise information about humans' potential moving directions for use in navigation algorithms is unobtainable. In fact, human beings should be able to carry out their tasks unimpeded and without thinking about the robots around them. Both active and vital regions are used in this paper to tackle human motion uncertainty. A method is implemented for estimating the sizes of the area based on conditions of worst-case avoidance [5]. A real-time collision-avoidance algorithm has been developed for human-symbiotic robot, which is required to avoid multiple pedestrians. An algorithm for predicting the probability of an obstacle collision was based on the relative velocities between a robot in motion and multiple obstacles. An algorithm was also developed which can produce the optimum sequence of paths to a target in real time. Repeating an operation to select two tangent paths that connect a via-point on a path to a collision circle of each obstacle that exists in the relative space produces the collision-avoidance direction [6]. This paper proposes a method to learn from human experiments about this coupling term beginning with simple features and making it more stable to escape a wider range of obstacles. They test our coupling term's ability to model different forms of human obstacle avoidance behaviors and use this trained coupling term to reactively avoid obstacles.

This line of work seeks to move the boundaries of reactive management approaches to more complicated scenarios, so that as far as possible complicated and typically computationally more expensive planning methods can be avoided [7]. This paper introduces a hybrid approach for the avoidance of obstacles in an unstructured environment for autonomous navigation of a mobile robot. The decision is made on the basis of the classical procedure, depending on the environmental scenario in which the gap between several obstacles is assessed and the feasibility of moving the robot through any pair of immediate obstacles examined. For other instances the Fuzzy Logic controller makes the decision. The algorithm developed is tested and checked experimentally with a mobile robot platform equipped with forward-looking sonar for the detection of obstacles [8]. This paper addresses three methods which are all active sensor-based methods used in obstacle avoidance and route planning, i.e. the Bug algorithms, the Potential Field methods and the Vector Field Histogram method. By fusing technologies or schemes, a more robust framework for use to achieve autonomous navigation in any setting can be built by taking advantage of the benefits of the different systems while reducing their disadvantages [9].

DESIGN METHOD

Overall System Design

The external information obtained by various sensing modules in the device is transmitted via the signal terminal to the main control unit, and then evaluated by the Arduino controller in the main control unit. The wheeled robot is then taken to the desired action by processing the information transmitted by each module. The Arduino controller is responsible for data reception and processing, and communicates commands based on the specific data content to the various wheeled robot modules, so that the wheeled robot can complete the tracking and obstacle avoidance commands correctly.

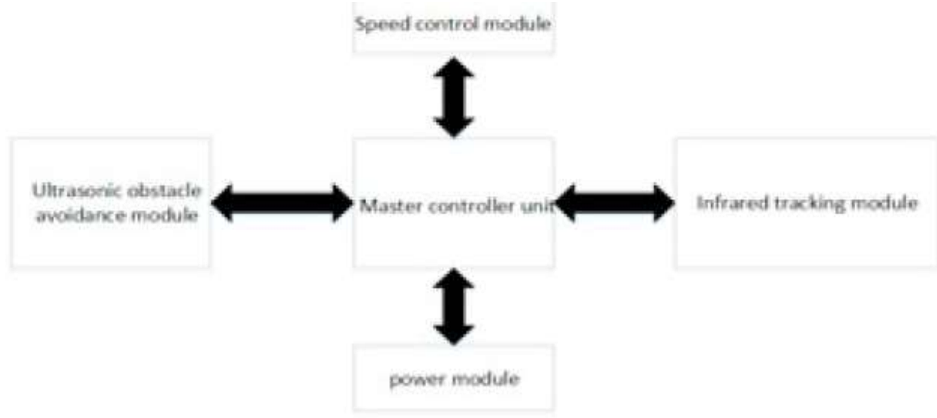

FIGURE.1 System structure

System Hardware Wiring Diagram

The control system of the robot style smart tracking obstacle avoidance wheel is based on the Arduino development board's control system. It needs to operate some embedded facilities and equipment capable of signal recognition, and infrared signal transmitting and receiving equipment to perform signal recognition and transmitting.

Five parts of the motor drive module, ultrasonic obstacle avoidance module, photoelectric sensor tracking module, automatic velocity control module and power module have been designed and completed in the construction of the device. Each module has been carefully developed and tested many times before being completely incorporated into the overall design structure of the smart wheel robot.

Implementation of Ultrasonic Obstacle Avoidance Module

It primarily uses the Vcc pin as the ultrasonic module's power supply. After the master chip's TTL trigger signal transmission reaches the TRIG pin, it can produce eight cycle rates of 40 kHZ and emit an acoustic signal. The ECHO pin sends a high-level reverberation signal to the master chip when the signal is sent to reach the smart car's ultrasonic range. It can be seen that this inexpensive and realistic smart tracking and obstacle avoidance trolley takes the single chip as the control center and uses the ultrasonic sensor to detect road obstacles. It can make the smart car automatically avoid obstacles and perform different driving speeds, and has automatic search. Trace and finder features, automatic travel time, mileage and speed tracking, have very large prospects for use. Table 1 below is the logic table for the ultrasonic obstacle avoidance.

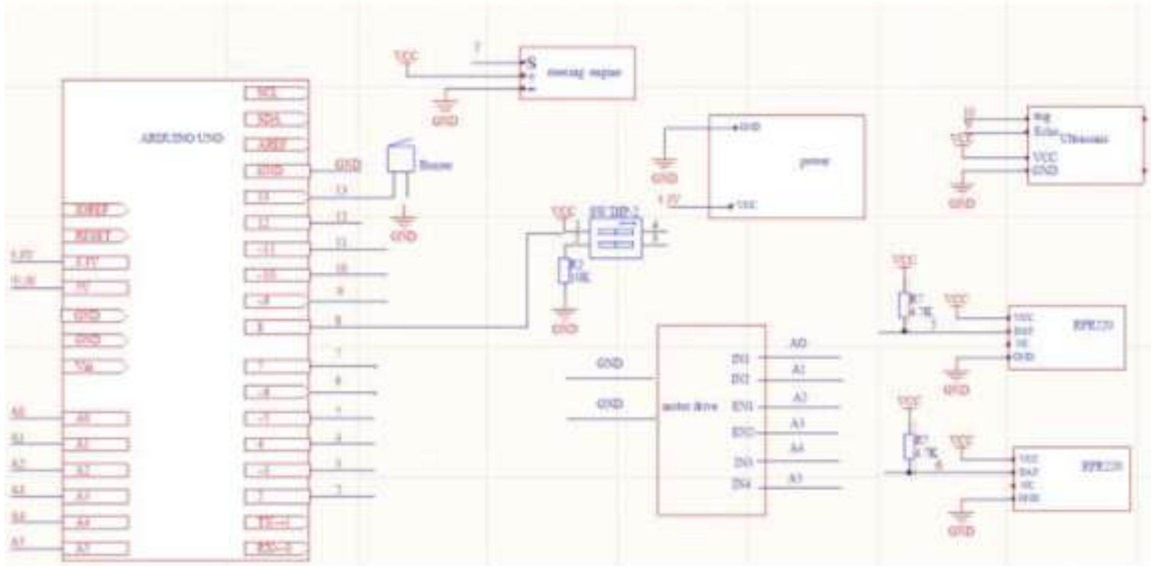

FIGURE 2: System wiring diagram.

Left direction obstacles	Straight ahead to the obstacle	Right direction obstacles	Control Policy	Left wheel	Right Wheel
No	No	No	Forward	Reverse Turn	Positive Turn
No	>25cm	>25cm	Turn left	Stop	Positive turn
>25cm	>25cm	No	Turn right.	Reverse Turn	Stop
>25cm	>25cm	>25cm	Back off	Positive turn	Reverse Turn
			Reverse Turn	Reverse Turn	Stop
			Forward	Reverse Turn	Positive turn

TABLE 1: The ultrasonic obstacle avoidance logic table

Implementation Application Monitoring System

To locate the black line, the realization of the intelligent wheeled robot's tracking feature relies primarily on the infrared photoelectric sensor in front of the robot. The center of the photoelectric infrared module consists of a diode for transmitting and receiving infrared rays, and an analog comparator circuit is implemented within, and the analog quantity obtained by the infrared sensor is converted into a digital quantity o, and the n input is inserted into the control chip to determine rotation direction. The concept is based on the above two photoelectric sensors for tracking mounted at the front end of the vehicle, respectively.

Software design

The device design is divided into four modules: infrared tracking module, ultrasonic obstacle avoidance module, motor drive module, power module, etc. According to the photoelectric sensor tracking logic and the car tracking system hardware review, a flow chart of the tracking module software design of the robot style smart wheel shown in figure 3 is finished.

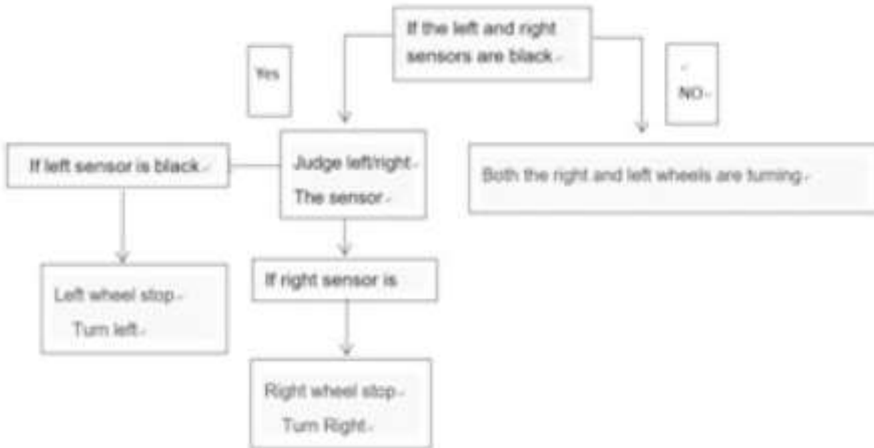

FIGURE.3 System tracking module flow chart

Power module

This design's power supply consists of two 3.7V, 1300mAh recyclable rechargeable battery power supplies, which are connected directly to the Arduino control board and motor drive supply to power them via DuPont panel. However, if you don't have a 3.7V lithium battery, you would need to use a DC-DC boost module. By changing the DC-DC boost module's SVR1 variable resistor, the output voltage is 5V, and then connected via the DuPont line to the Arduino control board and motor drive module.

Speed Control Module

In the process of monitoring the smart wheel style robot, if the car's running speed is too high, the car will not be able to change the direction and will deviate from the specified track. The motor cannot therefore be maintained at full speed at all times, which allows the cart speed to be managed to perform such functions.

CONCLUSION

Generally speaking, the wheeled robot designed this time is considering intelligent monitoring, preventing obstacles and improving protection. It also offers assurance and feasibility for the realization of unmanned intelligence in the future, and the overall task from hardware to software has also been realization. Combining the current development status of intelligent robots, obstacle avoidance and automatic tracking are the focal points of robot travel problems. Based on the development status of domestic intelligent control systems, current technology, etc., this paper uses Arduino as the core control system combined with an infrared tracking module.

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