Intelligent Driving System for an Electric Four-wheeled Cart

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Abstract : **An electric four-wheeled cart is useful for senior citizens and physically handicapped persons. To drive the cart is difficult for them because the characteristic of four-wheeled cart is complicated. In this paper, we develop an intelligent driving system which consists of a touch panel display and a predictive fuzzy controller, and prove that the system can support these people.**

Keywords : **Intelligent control, Predictive fuzzy control, Electric cart.**

1. Introduction

Senior citizens and physically handicapped persons use an electric cart of four wheels to move. However, they need to be supported, because it is difficult for them to drive. On the other hand, we have developed a driving system [1] which operates the steering wheel by dividing the drive process of man into the hierarchy of the strategy and the tactics. In this paper, we develop the system to which man inputs a strategy target. Because the senior citizen and the physically handicapped person use it, the usage to operate should be intelligible. A touch panel display is adopted for the user interface of this system.

2. System Configuration

Figure 1 shows the developed intelligent driving system. This system is constituted by two personal computers (for the cart control and the user interface), a camera in the front of the cart, a touch panel display (to input strategy target on the auto driving mode, to switch of driving modes) and a joystick (accelerator and steering operation on the manual driving mode). This system has two encoders (on the both wheels) for measuring the speed and has a potentiometer (on the right wheel) for measuring the steering angle. And, this system calculates the state by the speed and the steering angle.

The good points of this system is "Choose a driving mode in manual or automatic", "Include human's driving strategy", and "Has an intelligible user interface". As for the operation by the user when driving automatically, the instruction to drive the cart that was done on the touch panel display, and calculated by the controller is input to the accelerator and the steering of this electric cart.

2.1 Predictive fuzzy controller

The driver sets some strategy targets on the way of the final target [2]. In this system, a strategy target is set by a user. The strategy target (taken from user interface personal computer) and the car state (given by sensors) are input to the predictive fuzzy controller. The detector part is observing whether to be advancing toward the tactical target set in the target setting part, or to have reached the strategy target. A present target is maintained if the cart is not reaching the tactical target. And a target setting instruction is sent to the following the target setting part if the cart reached it. When an instruction of the detector part was input into the target setting part, it sets a tactical target. The auto driving part foresees the state in the future

Fig. 1. Intelligent Driving System

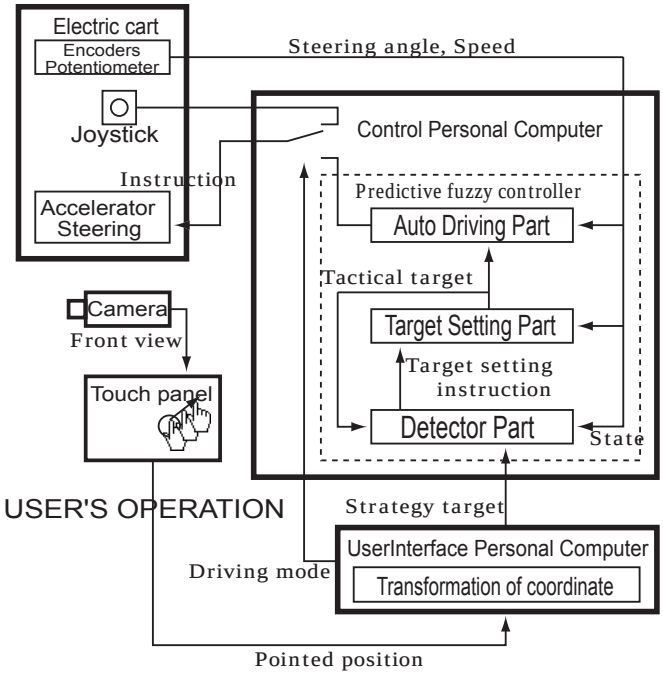

Fig. 2. Outline of the system

by using the predictive fuzzy control, and decides instructions for the accelerator and the steering.

2.2 User interface

A user need input the destination called the strategy target based on human's driving strategy into the intelligent driving system. The method of input by a keyboard and a mouse is not accepted to the senior citizen and the physically handicapped person. Then, we enabled inputting a target by a touch panel display that projected front view. The screen image of the touch panel is figure 3, there are some buttons (to choose automatic and manual driving) and the image taken by the camera at front end of the car. When starting, the driving mode is set to the manual driving mode. The mode can be changed at any time. When the automatic driving mode has been selected, the user input the destination by pointing and dragging on the area of camera image. Coordinates on the touch panel pointed by the user is converted into plane coordinates which make the car a starting point [3], and is input to the controller as a destination.

The procedure for operating this system in the automatic driving mode is as follows.

The procedure to operate the system

(default the manual driving mode)

STEP1 : Push the button of the automatic driving mode.

STEP2 : Point the destination from the camera image ①. A strategy target ground coordinates (x_t, y_t) are input by this operation.

STEP3 : Drag it to input the direction of the cart at the destination ②. θ_t is input by this operation, and

Fig. 3. Layout of the touch panel display

then automatic driving starts.

STEP4 : Thereafter, it returns to STEP2 when the destination is changed. If the manual driving button is pushed, automatic driving is stopped.

STEP5 : A message is displayed on the touch panel display when the target reached, and the procedure returns to STEP2.

3. Evaluation by experiment

3.1 Conditions

Table 1 shows the specification of this cart.

TABLE I
THE SPECIFICATION OF THE ELECTRIC CART

wheelbase		$0.80[m]$
tirewidth		$0.435[m]$
smallest radius		$0.95[m]$
steering angle		$50.0[deg]$
velocity	forward	$0.35[m/s]$
	stop	$0.0[m/s]$
	backforward	-0.19$[m/s]$

3.2 Result

An operator on the car input a strategy target as figure 3(① to ②) to the system. This target means a garage 5m away. Figure 4 shows the running tracks of the cart.

As a result, the destination was input into the predictive fuzzy controller from the proposed user interface by pointing and dragging. And we confirmed the system drove the cart to the destination correctly.

4. Conclusion

In this paper, we developed the intelligent driving system that consists of a touch panel display and a pre-

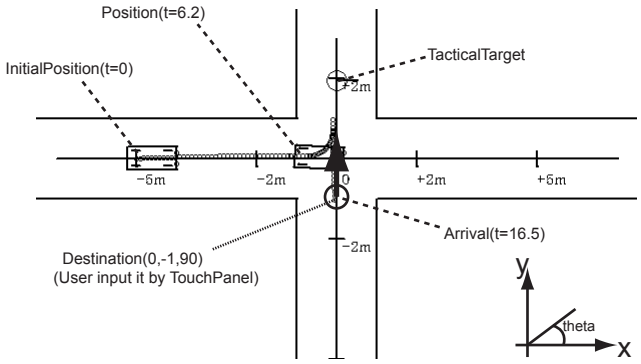

Fig. 4. Trajectory of the experiment

dictive fuzzy controller in order to make an intelligible user interface.

The result of the experiment proved that this system support the movement of senior citizens and physically handicapped persons.

References

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