Extended Abstract

Design and application of a community epidemic prevention intelligent collecting robot

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1. Abstract

This research is a medical waste treatment system executed by smart collection robots based on community epidemic prevention as research task. The purpose of this research is to seize the current opportunities for the rapid development of artificial intelligence and industrial robots, so we start to study smart collecting robots in response to the impact of the Covid-19 to solve problems such as hospital waste pollution and resource recovery, reduce human and financial investment, as well as reduce the risk of virus transmission during the epidemic.

Keywords: recycling, intelligence, industrial, robot

2. Introduction

In the context of rapid industrialization and with the spread of Covid-19, especially at the peak of the epidemic, we have designed an intelligent robot to assist the epidemic prevention procedures in various regions. Robots work during epidemics can reduce the risk of people's cross infection, save labor costs and improve work efficiency.

3. Research Plan

The work is divided into two parts, namely the community epidemic prevention smart collecting robot and the medical waste treatment system. The operation process of the work is shown below.

4. Scheme Design

Community epidemic prevention intelligent collecting robot. The hardware includes: designing robots and supporting objects: including maps (routes), objects with labels (assuming medical waste).

(1)The robot follows the route and looks for labelled medical waste (small objects are used to represent medical waste). (2)The labelled object adopts color recognition or

RFID. (3)All "small objects with specific labels" can be collected by the robot and installed in its storage box. (4)The robot runs according to the tracking trajectory. Every time it encounters a "small object with a specific label", it will stop and identify, identify the corresponding material, and then perform a retrieval operation and store the material in the robot's storage box and continue to move on. (5)When the storage box is full, the robot will stop collecting and will proceed to the end point (if the tracking line is a closed circuit, the end point can be set as the starting point) (6)After reaching the end point, the robot will automatically take out the "small objects with labels" and put them into the "medical waste treatment system" according to the label instructions.

5. Section System Design

5.1 Mechanical design

(1)Track and driven wheel, the omnidirectional wheel can be used like a normal wheel or roll sideways using a roller. (2)Six degrees DOF robotic arm, this manipulator is a six-degree-of-freedom manipulator with six steering gear,

type	torsional moment *kg/cm*	speed (*sec /60°)*	working voltage (V)	no-load current (mA)
LD-1501	17	0.16	6-8.4	100

which can operate bottom rotation, big boom pitch,

$$T = m_3 g l_3' + m_2 g l_2' + m_1 g l_1'$$

middle boom pitch,

$$T_m = m_2 g l_2'' + m_1 g l_1''$$

forearm pitch,

$$T_f = m_1 g l_1'''$$

and wrist rotation.

(3)Alloy mechanical claw, it has sufficient grip and sufficient strength. There is a certain opening and closing angle between the fingers. It ensures accurate positioning of the workpiece.

5.2 Hardware Design (1)11.1V 3500mA lithium ion battery, the maximum continuous discharge current of the battery far exceeds the current required for the operation of the robot, which meets the requirements of the robot.

$$I_{total} = 2 \times I_{electric\ motor} + 6 \times I_{steering\ gear} + I_{other}$$
$$= 2 \times 380 + 6 \times 100 + 100$$

$$= 1460mA$$

$$I_{out} = 3.5A \times 5 = 17.5A$$

(2)DC geared motor, simplify design, save space, and can be controlled easily.

Pwm+=Kp[e(k)-e(k-1)]+Ki*e(k)

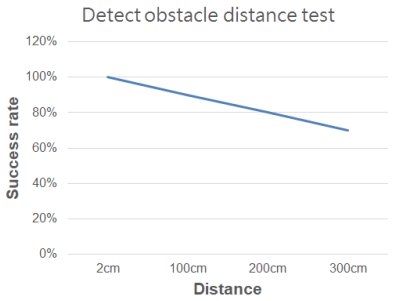
(3)STM32F407ZGT6 Master chip, the chip is very powerful in the STM32F407. Its resources include: integrated FPU and DSP instructions.

(4)TB6612FNG Motor driving chip, with high current MOSFET-H bridge structure, dual-channel circuit output, can drive 2 motors at the same time. It does not need an external heat sink, and the peripheral circuit is simple.

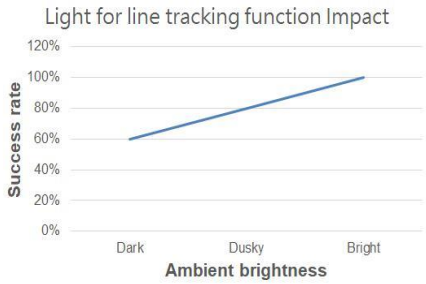
7. System Composition

7.1 Object collection: Through this test, the stability of the weight of the grasping object can be ensured, and the load-bearing capacity of the robot can be known. The maximum bearing capacity is up to 1kg The maximum lifting force of the mechanical gripper is up to 24N.

7.2 Ultrasonic follow & Obstacle avoidance: Ultrasonic distance detectors can effectively respond to the obstacle in the distance from 2cm to 300cm in front within the range of 15°, the obstacle avoidance system can avoid human and objects, greatly improving the safety of the robot.

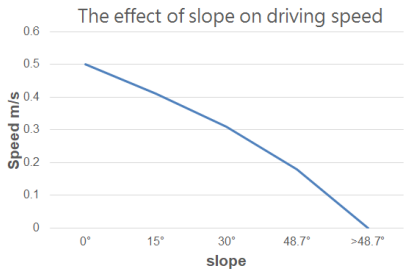


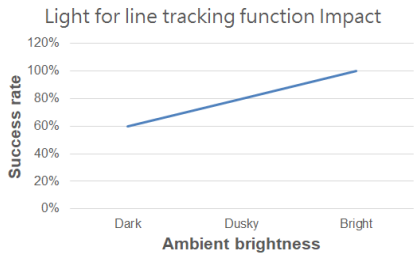
7.3 Object classification: The grayscale sensor can identify color labels in the environment, and effectively classifies them. It has better success rate in bright environment.



7.4 Route system: Maximum running speed on land is about 0.5 m/s. Under different slopes, the speed of the robot will also change. The method used by the tracking sensor is to control the light to

simulate bright, dim and dark ambient light respectively.





8.Innovation

Extensive Scope : the same set of hardware and software can be widely used in communities in various regions, such as hospitals, nursing homes and other communities. Simple program operation : just set a specific route, the robot can continuously transport objects back and forth. Route design : with existing ground guide lines commonly used in hospitals and other communities, a slight modification can turn those lines into the route of the robot. The function is practical, it can increase or decrease the functions of the robot according to the needs of different communities, and can adapt to different community work model.

9. Application

Robot can intelligently collect medical waste, thereby reducing people's exposure to medical waste and the risk of infection. For waste classification and disposal, color labels are used to improve the efficiency and accuracy of medical waste disposal. This robot can also collect tableware and transport food to quarantine areas and communities, thereby reducing the possibility of cross-infection. After the meal, robots can replace humans to collect tableware. The robot is unlikely to be infected by viruses and can be used to collect and distribute disinfection tools, thus saving medical staff time. Robots can be used to transport and collect goods, thereby reducing contact between the outside world and community residents.

10. Result

Using the above design, the robot can complete simple and repetitive collection actions according to a fixed tracking route. As long as the waste is placed in a fixed location, the robot can collect it.

11. Conclusion

The robot we designed does not need to be touched again to collect waste

in the above operation process. This feature reduces the work of staff and the chances of virus cross-infection during the epidemic prevention period. Taking into account the "human-to-human transmission" characteristics of the new coronavirus infection chain, the ideal way to contain this epidemic is to start by avoiding contact with people, so the transportation characteristics of the robot can solve the problem of cross-infection. It can also be used in multiple communities to achieve the effect of preventing epidemics while reducing the workload of each epidemic prevention staff.

12. References

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