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Robust Vision-Based Control of Cleaning Robot

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ABSTRACT: Service robots such as vaccum cleaning robots are finding their places in the household appliances. This paper presents the human computer interaction method (HCI) for the user to command the robot to move to the specific location in the home environment to perform the specific task. The performances of the proposed detectors are validated with a set of test images with cluttered background. The proposed method controls the robot without the need for the user to wear any input devices.

KEYWORDS: Service robots, Gesture recognition, Human computer interaction, ZigBee.

I.INTRODUCTION

Recently, many consumer electronics, including digital game devices, provide an easy and intuitive environment for users by adapting input technology which recognizes behaviors. These interface technologies which recognize user behaviors can be classified as sensor-based or vision-based methods. Maneuvering of robots in home or office environment is an active research area, recently. Automatic maneuvering of the robot requires human-machine interaction. Human computer interaction (HCI) technologies are used for the purpose of interaction. Vision-based HCI technology is preferred in household appliances as it will reduce the complication of wearing any external sensors or using specific input devices. Hand detections are the important building block for vision-based HCI

In this paper, we propose the vision-based HCI method to control the robot. In this method, we use different hand postures to specify different commands. Based on the detected command, the robot moves to the room and completes the task. We assume a robot is in home or office environment where rooms are separated by walls. We use different hand postures to specify six different commands. Based on these commands the robot moves. Detection of typical objects such as faces, eyes, or license plates is not usually affected by background. For the gesture recognition the image processing concept is used.

II.GESTURE RECOGNITION

Gesture recognition is the process by which gestures made by the user are used to convey the information or for device control. In everyday life, physical gestures are a powerful means of communication. A set of physical gestures may constitute an entire language, as in sign languages. They can economically convey a rich set of facts and feelings. A primary goal of Gesture recognition research is to create a system which can identify specific human gestures and use them to convey information or for device control. Interface with computers using gestures of the human body, typically hand movements. In gesture recognition technology, a camera reads the movements of the human body and communicates the data to a computer that uses the gestures as input to control devices or applications. Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. There are different types of gestures such as hand, face (emotion), body gestures etc. To identify and recognize these gestures there are different ways of gesture recognition such as:

- Hand Gesture Recognition
- Face (Emotion) Gesture Recognition

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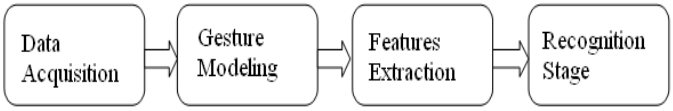
- Body Gesture Recognition



III.SYSTEM DESIGN

In this system, we propose a vision-based human computer interface method to control cleaning robots. We assume a cleaning robot is in home or office environment where rooms are separated by walls. A user points to a specific room with his or her hand, and the robot understands the user's gesture.

Here, different hand postures are used to specify different commands, which are combinations of three directions and an over the wall flag. Base on the detected command, the robot determines which room to move to and to clean. The cleaning robot is equipped with the android device on the front side, the device will capture the hand gesture and the result will be transmitted to the hardware kit through Zigbee connectivity. According to the instructions the robot will reach the destination and perform the desired task. As this system is robust, the user is not required to wear any input devices over his body parts.

The detailed description can be explained with the help of block diagram.

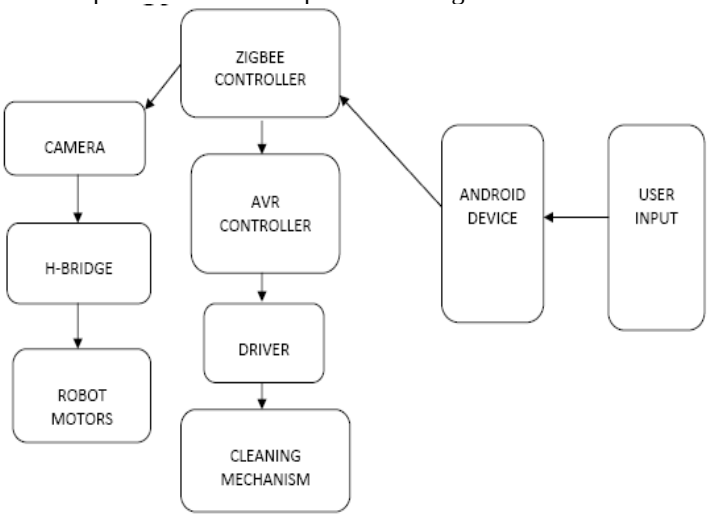


Fig. 2 Block diagram

The cleaning robot consists of a camera which is required for capturing the hand directions provided by the user. This is the interface of the robot with the user. The hand gestures captured will be transmitted to the hardware kit. The communication between the android device and the hardware kit is by ZigBee. Once the gesture is recognized, the driver will move the robot motors.

The controller used for this purpose is Atmega 32. A device driver is a computer program that operates or controls a particular type of device that is attached to a system. Here, it will provide a software interface to the hardware device enabling the system to access the hardware functions. An H-bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. In the robotics it is used to allow the DC motor to run forwards and backwards. The H-bridge arrangement is generally used to reverse the polarity of the motor.

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IV.SOFTWARE DESIGN

The hand gesture will be recognized and a unique code will be sent to the AVR controller. The instructions according to the code will be sent to the robot, and the robot will perform the desired task.

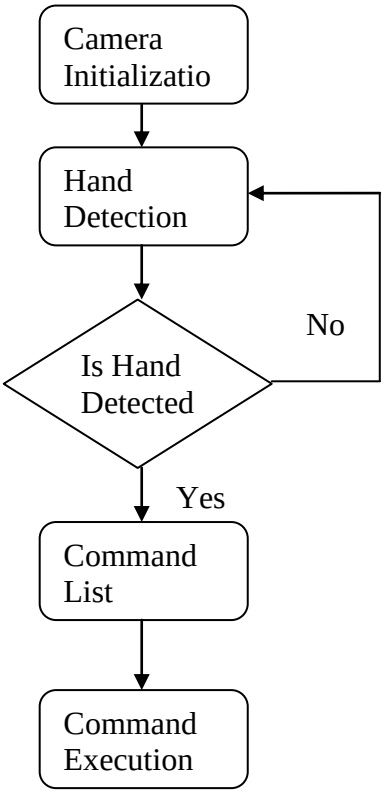

Fig. 3 Flowchart

The hand gesture recognition system consists of three major parts: palm detection, hand tracking, and trajectory recognition. The hand tracking function is trigged when the system detects an opened hand before the camera. The java code is written for gesture recognition.

V. CONCLUSION

This project provides a vision based control method for a cleaning robot to navigate to a specific location in home environment. The cleaning area control is simulated with real-world video sequences. The proposed method effectively controls a cleaning robot without the need for a user to wear or employ any input devices.

In recent years, the gesture control technique has become a new developmental trend for many human-based electronics products. This technique let people can control these products more naturally, intuitively and conveniently. This scheme can be applied to be the human-machine interface for users to control some service system just by their hands.

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