Cleaning Robot

By Nikita Prashar, Tejashree Thorat, Abhishek Galande & Ritesh Durande

Pune University

Abstract - A new service robot designed for cleaning tasks in home environments is introduced. System has three subsystems: electrical, software and mechanical of which microcontroller, sensors (opponent and light) and motor are the electrical and mechanical subsystems respectively and the software subsystem is the brain of the robot.

The cleaning robot uses a microcontroller to detect obstacles and manipulates its direction as per the inputs . It is programmed to accept inputs to sense obstacles around it and control the robot to avoid any collisions. In case of an obstacle, or a potential collision, the microcontroller controls the wheels of the robot by a motor driver to avoid collision. The vacuum cleaner at the bottom of the robot performs the cleaning process.

Keywords : Service Robot, Odometric Correction, Path estimation, Microcontroller.

GJCST Classification: I.2.9

CLEANING ROBOT

Strictly as per the compliance and regulations of:

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I. INTRODUCTION

One of the basic requirements at household is cleaning which is an iterative process and required on daily basis consuming both time and energy. Cleaning Robot is an approach to make cleaning an easy and time efficient task also to give comfort to the human by doing the domestic works. The functions of a Cleaning Robot are: 1) Detecting the position of the area to is cleaned 2) Path estimation to reach that position 3) Cleaning the area with the help of Vacuum Cleaner which is attached to it.

II. SYSTEM OVERVIEW

The concept of this system is shown in *Fig. 1.* A camera is set in the ceiling of the room which is to be cleaned in a position in which it can have a complete view of the floor. Then, camera takes images of the floor and transmits them to the user's PC display. Next, the user is provided with two modes of cleaning a) Automatic Mode in which Robot automatically detects the dust and cleans it and b) Manual Mode in which user can select a desired position to be cleaned by clicking on it on the image being generated on the screen. In automatic mode the first the position of the robot is estimated and then the destination position i.e. area to be cleaned is calculated. Then, clicked

Author [α σ ρ ω] : Department Of Computer Engineering, Pune University Dhole Patil College Of Engineering, Ubale Nagar, Wagholi, Pune, Maharashtra, India
E-mail [α] : nikita.prashar@hotmail.com
E-mail [σ] : thorat.tejashree@gmail.com
E-mail [ρ] : abhishek.galande@yahoo.com
E-mail [ω] : ritesh.durande@gmail.com

coordinates are forwarded to the robot, and the robot moves to the location and cleans the dust. Moreover, it is possible to avoid robot approaching certain places one can predefine the areas where robot should restrict its movement. As web cameras became cheap, the installation cost is low.

When the robot moves in the indoor environment, there are plenty of obstacles around the robot making difficult to find and measure landmarks for correcting position. This system calculates a relative position of the robot by using the camera fixed to the ceiling. As a result, the position and posture can be measured and corrected. Odometric Correction is used for avoiding error free movement.
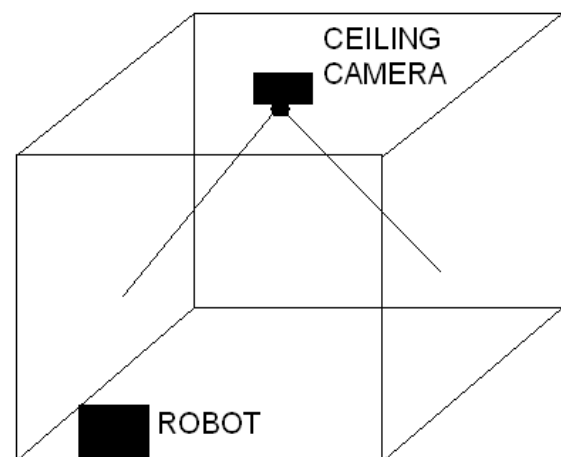

Fig 1. Room with the cleaning robot and ceiling mounted camera.

III. SYSTEM STRUCTURE

a) *Clean Assist_ The Cleaning Robot*

CLEAN ASSIST is an integrated Robot, a basic working robot is created and at the bottom of which a vacuum cleaner is attached which would suck the dust and clean the area.

b) *Web Camera*

Web camera with resolution 5 megapixel has been used for capturing the images and videos of the room to be cleaned

IV. SYSTEM WORKING

First of all the snap of the clean room is captured and saved for reference in the secondary storage in the monitor. The camera keeps capturing images continuously and Gaussian blur algorithm is applied to reduce the noise in the captured image after that if any change is encountered with respect to the reference image then blob algorithm is applied to detect points or regions in the image that are either brighter or darker than the surrounding that will be the dust which has to be cleaned as it is done with reference to the snap of the clean room already captured.
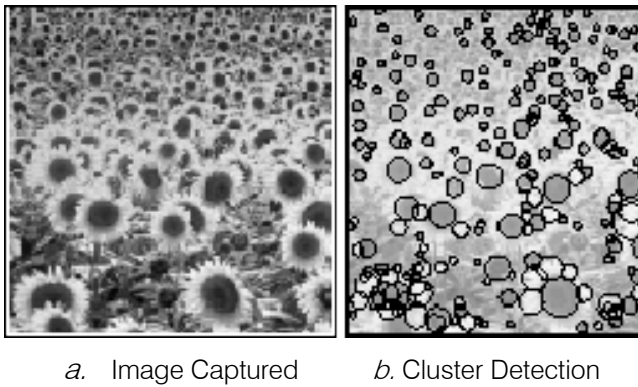

a. Image Captured   b. Cluster Detection

Fig 2. Blob Algorithm.

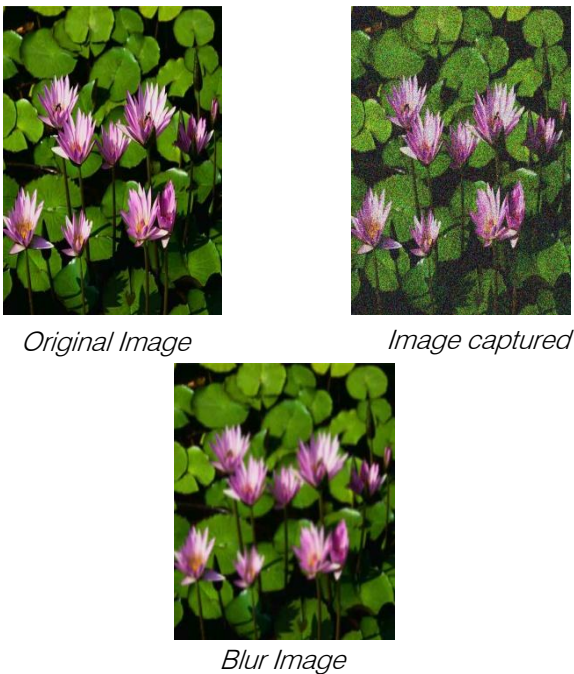*Original Image*   *Image captured*

Blur Image

Fig 2. Gaussian Blur Algorithm.

Now the monitor does the geometric transformation of the coordinates and then determines the shortest path between the robot and the garbage by locating the current position of the robot and the garbage and then calculating the distance between them. *Fig. 2.* Shows the basic concept of how cleaning takes place. Robot moves to the desired area and sucks the garbage using vacuum cleaner and makes a record of clean and unclean area and stores it in the secondary storage.
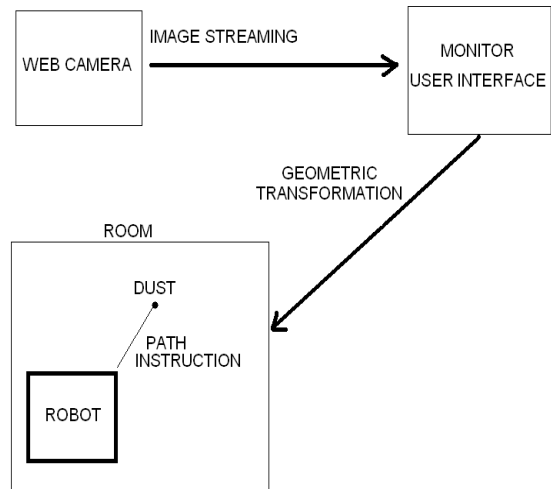

Fig 2. *Concept of house cleaning.*

V. APPLICATIONS

a) Cleaning

The robot can easily navigate an area using the camera which is mounted on the roof and with the help of the vacuum cleaner attached to it clean the room.

b) Defense

The robot can keep a check on trespassers in an restricted area on an event of any movement can raise an alarm to alert the forces

c) Autonomous Playing Robot

The robot can sense the movement and hence can be modified to play games in which an object has to be traced or a ball ca be followed.

d) Security

It can provide security as it constantly captures the images and videos and can sense movements; it can be used to raise an alarm in case an unwanted movement is noticed.

VI. CONCLUSIONS

The implementation of Clean Robot will provide quick clean-up of spills and concentrated messes and it will be easy to use. Following are the advantages of the above system:

a) Reach Remote Areas – It can clean in areas with hazardous environments; areas beyond the reach of humans as could be fatal.

b) Availability 24*7 – A machine can be used anytime and anywhere, it does not get tired and is never busy.

c) Cost Reduction – Saves on labour costs and time, as a single machine can do the work of multiple labourers in lesser time.

d) Record Maintained – Maintains a log of cleaned and un clean area in the secondary storage.

VII. ACKNOWLEDGMENT

REFERENCES RÉFÉRENCES REFERENCIAS

1. Chih-Hao Chen and Kai-Tai Song: "Complete Coverage Motion Control of a Cleaning Robot Using Infrared Sensors", Proceedings of the 2005 IEEE International Conference on Mechatronics July 10-\2, 2005, Taipei, Taiwan.

2. Johann Borenstein, Member, IEEE, and Liqiang Feng : "Measurement and Correction of Systematic Odometry Errors in Mobile Robots", Proceedings of IEEE Transactions on robotics and Automation, Vol. 12, No. 6, December 1996

3. Chaomin Luo & Simon X. Yang Deborah A. Stacey: "Real-time Path Planning with Deadlock Avoidance of Cleaning Robot", Proceedings of the 2003 IEEE International Conference on Robotics & Automation Taipei, Taiwan, September 14-19. 2003

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