Autonomous Lavatory Cleaning Robot

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Abstract— Health related issues are increasing day by day. New diseases are being identified in different places of India. One of the main causes of spreading diseases is unhealthy public toilets. There is a huge risk to get infected by various diseases while using such toilets. Unfortunately the mind set of people to keep toilets clean and hygienic is very poor. The negative approach of people is beyond our control. The idea presented in this paper seeks to provide a convenient and a hassle-free means of cleaning public toilets whilst maintaining hygienic and sanitary standards. Automatic Lavatory or Toilet cleaning robot is designed for the purpose of keeping lavatories hygienic in both public and private organizations and to replace the human effort to do such dirty jobs. It is automatically controlled using a Arduino UNO micro-controller, it is a three wheeled robot actuated by a DC gear motors, it travels in the predefined path (black lines)parallel to the mount toilet and takes cleaning action only when no human is present in the toilet using PIR sensors also avoids obstacles when found, it contains a movable mechanical linkage to produce motions which support the rotating brushes to clean the solid waste in toilets, also metering pump are employed to spray detergents/soap oil to the flow at the beginning of cleaning process respectively.

Key words: Line Follower, PIR Sensor Module, IR Sensor Module, Robotic Arm

I. INTRODUCTION

Urban sanitation is of prime importance in today's society and there exist a number of obstacles that need to be conquered. An easy to implement, yet effective method to facilitate the preservation of hygienic standards would be a welcome idea, and help overcome the various hurdles faced, such as human reluctance to engage in such a task. With this in mind, a viable idea would be to design a robot that is fully automated in functioning is competent in performance. Other considerations include ease of operation, power requirements and financial effectiveness. Using a low power microcontroller and a simple yet adequate line follower robot, this idea is very much practically realizable.

This lavatory cleaning robot is designed especially to clean urinals. It is equipped with different sensors which provides necessary control data and ensure the working of robot without harming human being. The robot has a line follower integrated with a manipulator.

II. ARDUINO UNO MICROCONTROLLER

A microcontroller often serves as the "brain" of a mechatronic system. Like a mini, self-contained computer, it can be programmed to interact with connected hardware and/or a user, much like a PC connected to a small network of hardware. As the computer industry has evolved, so has the technology associated with microcontrollers. Every year microcontrollers become much faster, have more memory, and extend their input and output feature sets, all the while becoming even cheaper and easier to use.

The Arduino Uno is a microcontroller board based on the ATmega328 datasheet. It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
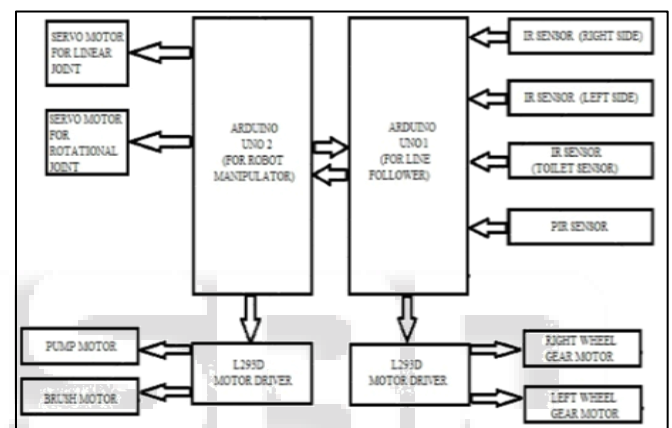
III. BLOCK DIAGRAM

Fig. 1: Block Diagram

IV. COMPONENT DESCRIPTION

A. Controller Used

Arduino UNO microcontroller is used in this project. It is the central processing unit of the project.

B. Motor Driver IC

L293D is a dual H-bridge motor driver integrated circuit. There are two motor driver used to control the two dc gear motor used in line folloer, pump motor and a dc motor .

C. IR Sensor

IR sensor is designed to detect and response to the presence of a object or a black line.

D. Water Pump

Water pump is a device that moves fluids by mechanical action. Pumps are commonly rated by flow rate, outlet pressure in meters of head etc.

E. Passive Infrared Sensor

Objects that generate heat also generate infrared radiation and those objects include animals and the human body.PIR detects such radiation generated.

F. DC Motors

A device that converts electrical energy into mechanical energy or imparts motion.

G. Servo Motor

It is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision. The output shaft of this motor can be moved to a particular angle.

H. Battery

A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.

V. WORKING

The robot has an PIR sensor which produces high output when there is a human present in the toilet, the arduino1 (i.e. the line follower controlling one) continually monitors PIR output to go low, if there is no human in toilet the PIR output goes low this voltage high is sensed by arduino1 (line follower controller) and takes action as programmed in flash memory.
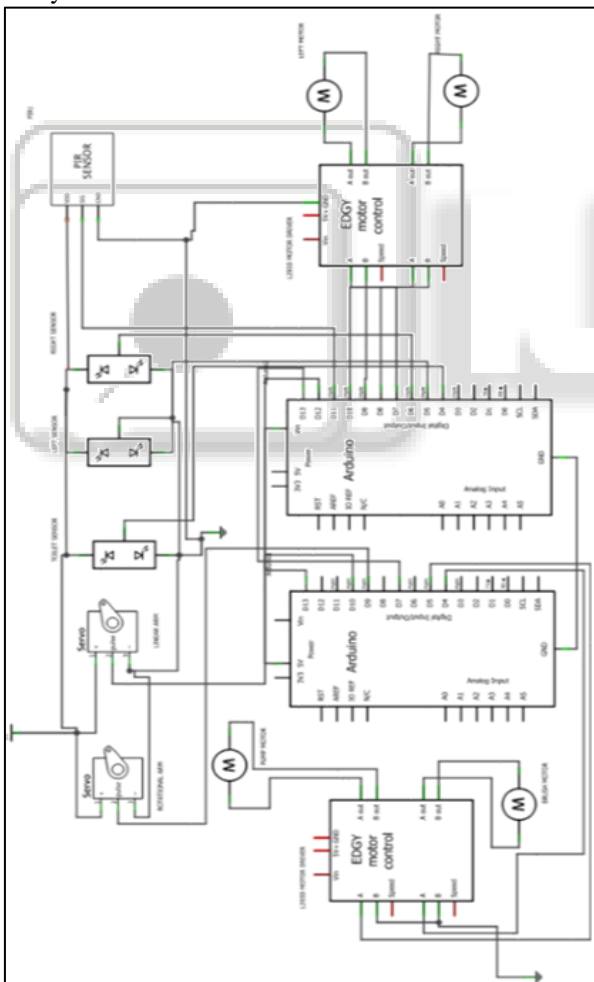

Fig. 2: Circuit Diagram

When the PIR is low the arduino1 is programmed to check the toilet sensor which is a typical IR sensor mounted on the side of the chassis in such a manner it keeps track for the black tape pasted on the toilet floor in-line with the mid-point of urinal's vertical surface, the output value is set to be high if the line follower is not in-line with the toilets midpoint, and is set to be low when the line follower reaches

the midpoint of toilet surface by detecting the black tape sticked on the floor.

Arduino1 is programmed to run the line follower motors in required direction based on right and left sensor outputs to follow the line drawn in front of urinal's parallel to the mounted wall. when the toilet sensor is set high it is programmed to stop the line follower gear motors when the toilet sensor is sensed to be low (i.e. when reaching the toilet) the toilet sensor output is also provided as input to arduino2 (i.e. the arduino used to control servo motor attached to robot links) this arduino2 is programmed to start the cleaning operation using the connected actuators (i.e. servo motors, brush motor and pump motor) , after finishing the cleaning operation it sends a signal to line follower to override the former logic of setting the line follower to motion by reading the toilet sensor output and move the line follower to the next toilet after reaching the next toilet the command signal is reset and continues the operation from first.
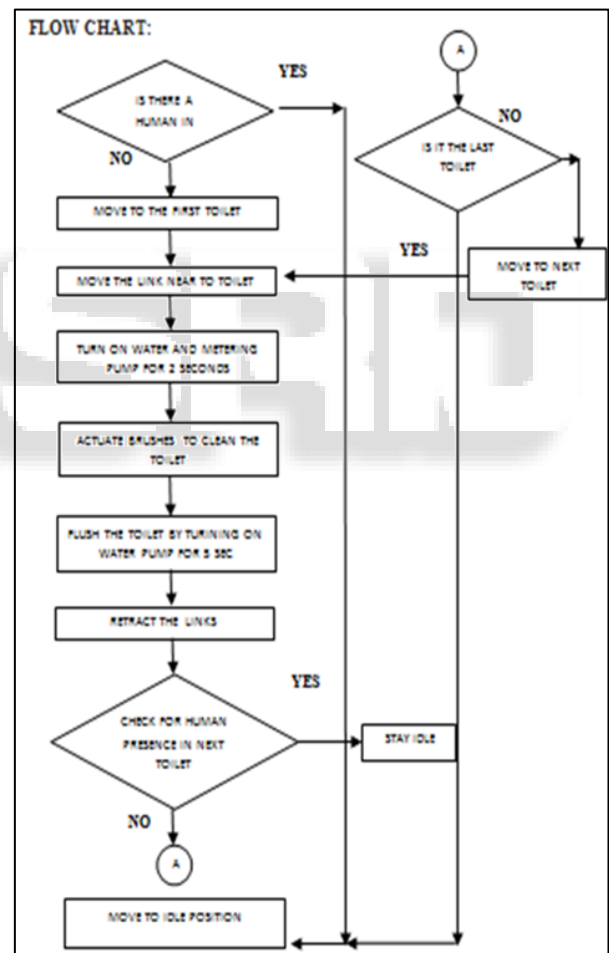
VI. FLOWCHART

Fig. 3. Flowchart

VII. SOFTWARE SECTION

A. Arduino IDE

Arduino IDE (Arduino Integrated Development Environment) Contains a text editor for writing codes, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine Hardware to upload program and communication with them.

Programs written using Arduino software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension (.ino). The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also display errors. The console display text output by Arduino software including complete error message and other information's.

VIII. APPLICATIONS

− In Large lavatories where human work becomes tedious.
− In Hospitals where healthy persons are viable to infection from toilets due to improper cleaning methods employed.
− Lavatories in schools, colleges, malls, theatres, stadiums which needs frequent cleaning.

IX. CONCLUSION

This project presents an autonomous lavatory cleaning robot using Arduino microcontroller and it is designed. Experimental work has been carried out carefully. The proposed method is verified to be highly beneficial. We can use them in our homes, labs, office, planes, trains etc.

At present the robot is capable of cleaning the urinals with a satisficed rate. At future the robot will also capable of throwing water with controlled robotic arms and object detection using camera on it. It can be used as further extension of the project to achieve all the features. Hence, this robot can play a crucial role.

X. FUTURE SCOPE

In future we can implement following factors:
− Using wireless remote control helps to control robot manually.
− Use of high resolution Zooming camera.
− Can use GSM (Global System for Mobile Communication)

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