SMART GARBAGE COLLECTOR AND CLEANER*

BY

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ABSTRACT

This study describes an innovative and low cost method to collect the waste and clean the path especially at the public areas like park, gardens, societies, etc. The dustbins at these places are filled within a very short time. Hence, they need frequent evacuation and clean-up. Therefore, smart garbage collector and cleaner is proposed to collect the waste from the dustbins and at the same time it will also sweeps the path. This system provides the autonomy of self-cleaning at crowded places with minimum utilization of human resources. The garbage collector is based on the line following concept to move in a designated path using help of IR sensors. Ultrasonic sensors are used for detecting the level of waste filled in the dustbin and as an obstacle avoiding for the system. RFID technology is used for controlling the operation of the dustbins and the container of the smart garbage collector (SGC). Servo motor, integrated with a broom, takes care of cleaning the pathway.

KEYWORDS

Autonomy Self-Cleaning, Line Following, RFID Technology, Smart Garbage Collector (SGC).

I.INTRODUCTION

Now-a-days public parks and societies face the challenge of regular waste collection and cleaning [1]. This is because of the timely supervision and manual toil in cleaning repeatedly. Moreover, these type of processes involve high labor cost and man power [2]. Therefore, a smart garbage collector and cleaner is proposed that can perform the concurrent tasks of monitoring, cleaning and waste disposal. This electro-mechanical system can be installed at public places, namely, parks, joggers' park and societies. This is an auto-responsive SGC which can be triggered through the garbage-filled indication by smart dustbins installed at certain locations in its vicinity. The device follows a particular path (line-following) to reach at the calling dustbin[3]. While doing so, the device equipped with auto swiping system to clean the path. The location of the dustbin is detected by the garbage collector through RFID-based detection[4]. The garbage is dumped into the garbage collector which takes it to the dumping section and

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disposes. The entire system is automated and is made possible due to integration of the intelligent environment mapping sensors like US sensor (for garbage level detection and obstacle avoiding), IR sensors (path following) and RFID sensors (location tracking)[5]. The SGC can also be triggered through human intervention. The proposed system is low-cost, robust, offers ease-of installation and flawless operation.

II.MATERIALS

Arduino-Mega AT mega 2560 and Arduino-Uno because it provides analog and digital control (Arduino, Italy), Bluetooth HC-05 because of its connectivity and range (Pioneer, India), Relay module to control motor precisely (Elmex, India), Ultrasonic Sensor HC-SR04 for obstacle avoidance in respective area (FUT, China), Motor driver L298 (Mac-Net technology, India), IR sensor for following the path (OEM, India), RFID Scanner RC522 for getting correct ID detection of SGC (Omatom, India), Johnson motor 12V 200rpm (Johnson Motors, USA0. Servo Motor MG-996r for sweeping purpose (Bombay Electronics, India), Lipo Battery 2200mAh for onboard supply to SGC (orange, china), and passive components (e.g. Breadboard, jumper wires, Wheels, etc.) were used in this study.

III.METHODOLOGY

The path to be followed by the SGC should be black in color to facilitate line-following technique. The black strips can be designed or painted on the jogger's track or at any designated places. This mechanism was achieved by selective placement of Infrared (IR) sensors at the front side of the SGC. The IR sensors were placed 0.5 cm above the ground for effective working [6]. As soon as the emitted IR light falls on the path (black strip), it gets absorbed. Hence, the receiver receives no signal. The reverse is true for non-absorbing condition which conveys a low input trigger to the Arduino Mega connected to the IR sensor array. The received and detected low signal was used to control the motors which were connected to the Arduino Mega through motor driver. The modes of operation of the motors are explained in Table 1.

IR readings	US readings	Motor command
1	1	Backward
1	0	Forward
0	1	Stop
0	0	Stop

Table 1 – Motor Command through input of sensor

The motors were connected to the motor driver L298. Which is for controlling the rotation of the motor. Which was connected to the Arduino-Mega to the PWM pins[7]. As per they are used as

digital input/output pins. The motor was connected at the bottom of the SGC via clamp to move the SGC. By doing this SGC was able to manage movement of the motor i.e. move forward, move backward, take left, take right, etc.

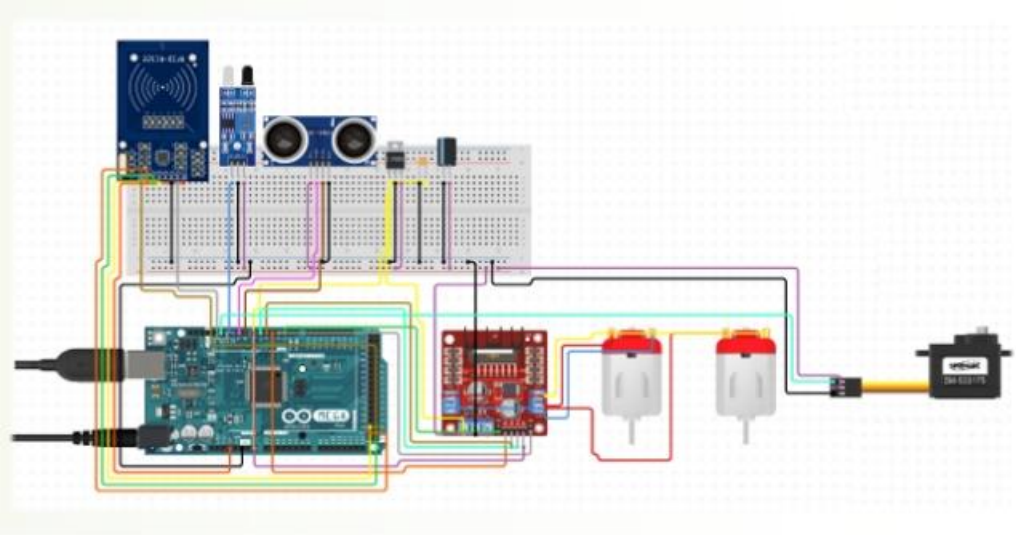

Fig. 1 Circuit diagram for smart garbage collector

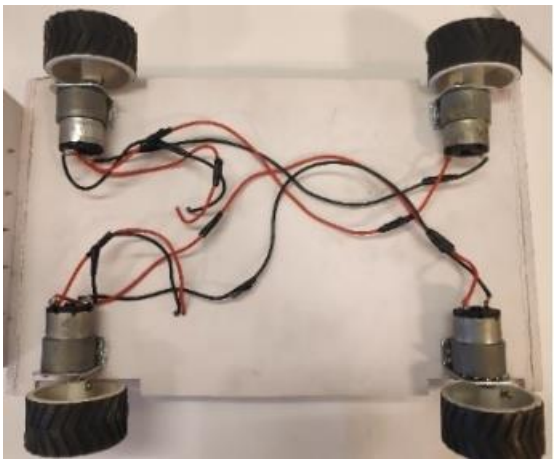

Fig. 2 Motor arrangement

For the power to the circuit there is a Li-po battery of 2200 mAh capacity. As per the battery is capable to give output 11 volts and 2.2A the Arduino-Mega does not require an external power source.

Above the surface of the SGC Arduino-Mega, breadboard, Motor driver L298 were placed [8]. They are the main components for controlling the SGC. On the top side of the SGC which contains the two garbage container which were fixed on a layer connected to the two BO motors for tiling the container at disposable area at the park. In extended front of the SGC there is

detachable triangular shaped sweeping unit which contains the arrangement of drawer present on the upper side of lower base.

Fig. 3 SGC design with container

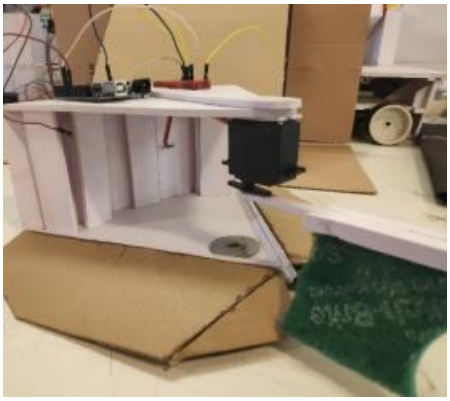

Fig. 4 Broom with Servo Motor

In this unit at extended front side there is a Servo motor attached which controls the movement of the broom through certain angles. In extended front of the SGC at some height there was an Ultrasonic sensor attached which will be detecting the obstacle interrupting in the way of the SGC. Which is connected to the Arduino-Mega.

At the garbage bins which were located across the park they are placed on the rack and pinion arrangement which helps in up-down movement of the garbage bins and at bottom side of the bins there is sliding mechanism for opening the bins by the bottom part as well to empty its garbage when it is needed. At the top of the bins there is arrangement of Ultrasonic sensors which will detect the level of garbage filled in the bins. If it is filled by its 3/4th capacity ultrasonic sensor will give signal to the Arduino-Uno which is present near the garbage bin. Then after Arduino-Uno will send the signal to the control room in the form LED blinking. This signal will be send through the Bluetooth module hc 05. In this process we have used two Bluetooth modules one as a transmitter and another as receiver. Transmitter is present at dustbins to transmit the data of garbage filled and receiver is present at controlling unit to give signal to start the SGC for collecting garbage.

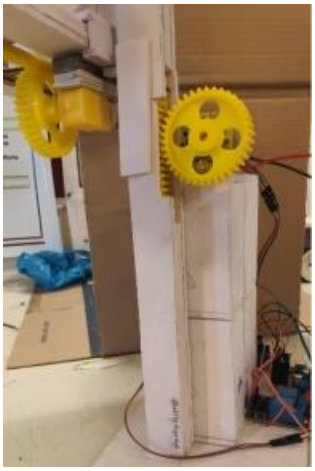

Fig. 5 Lifting of dustbin setup

As soon as Ultrasonic sensor gives the signal to the SGC via Bluetooth module then the SGC starts. While going to the location through the black strip it also cleans the path by using broom which was connected to the servo motor. To give a commands to the dustbin for the upwards movement when the SGC reaches near it for this system used RFID system. The RFID scanner were placed on the path before the dustbins according to that arrangement RFID tag were placed on side of the SGC, so as soon as the tag detected through scanner it gives command for the uplift movement of the dustbins and after the dustbins there is an another RFID scanner placed which will be used for stopping the SGC below the dustbins for certain period of time.

Afterwards the slider mechanism which is present at the bottom of the bin gets activated and the garbage present inside the bin drops down into the garbage container present bellow the bins. Then after the slider closes back and the SGC moves ahead by following its path. And this process continuous followed by the SGC till it covers the complete path present in that park. And while doing so dust collected by the broom was continuously get filled in the bottom drawer which is present in the triangular shaped structure. Which is slightly curved from inside to fill more amount of the dust in small place.

At the disposable area it not only disposes the dust which is present in the drawer but also empties the garbage which is present inside the garbage container by tilting the container. For disposing the dust from the drawer SGC have command for the servo motor to turn by 3600. So as it removes the dust by sweeping. And for the garbage which is present in garbage container it gets tilted by using two BO motor connected to them. So they get completely empty in the disposable area so that it becomes ready to collect newly collected garbage.

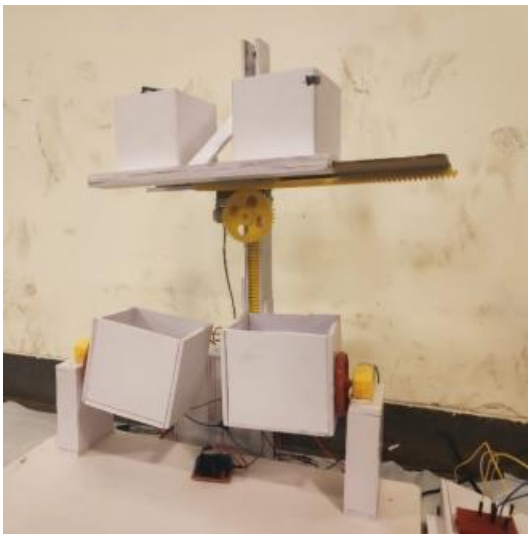

Fig. 6 Alignment of container and dustbin

In the park we can also place the switches at certain distance, which will be used for giving the commands to the system manually by someone if they need the system to do the job assigned to it whenever they think, but to implement this type of methodology in country like India, it is quite too difficult because misuse of this function is more than its proper use.

Now coming to the key point of proposed work i.e. programming which was done on the Arduino module. Arduino is the first and foremost company to introduce an open source development board which are based on microcontrollers these development boards are known as Arduino module. It requires the most common programming approach which utilizes the c++ programming language and many of them prefer this because it is user handy and an open source. Arduino IDE was built on the Language and Language processing that we use in the Arduino IDE. .so you can say Processing and Wiring have made the Arduino Project. In real fact, C/C++ Language is not Arduino. It utilises the reduced form of C/C++ Language cable language frame work. Proposed work on the Arduino IDE as an environment to program microcontrollers i.e. Arduino modules.

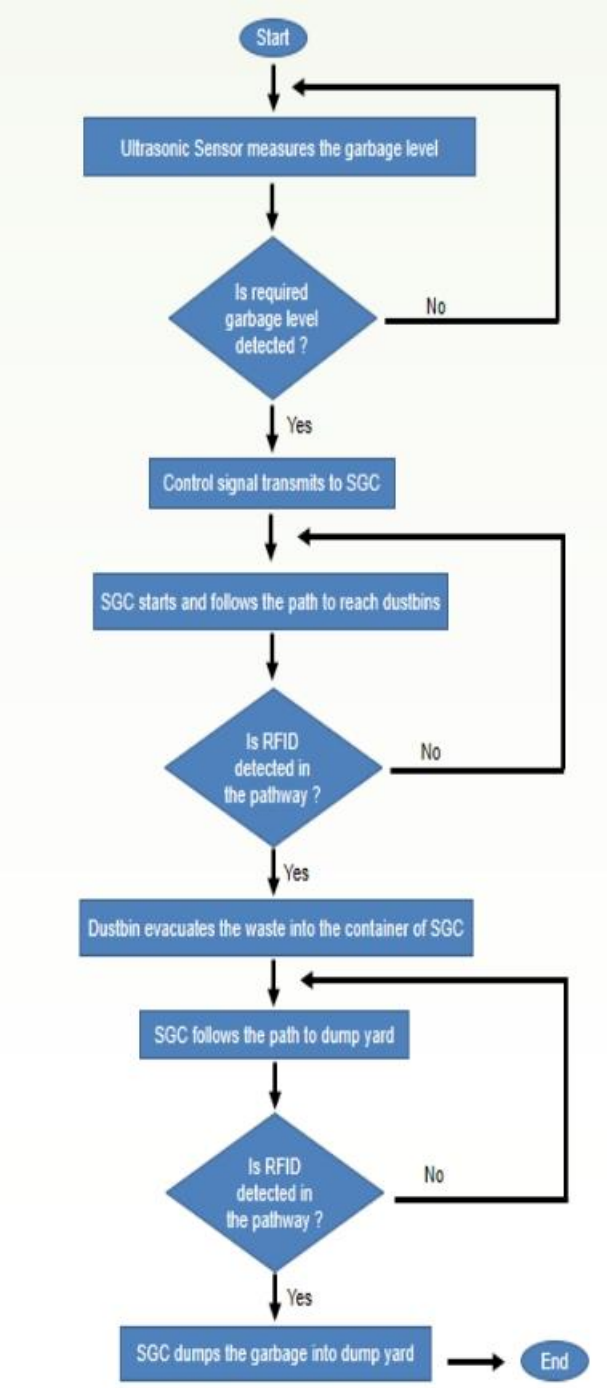

Fig. 7 Flowchart

IV.RESULT

After executing successfully, the SGC was moving on its assigned path to do the task of collecting the waste from the dustbin and sweeps the path and at last dispose all the waste at disposal unit and again reaches to the control unit for its next job.

Fig. 8 Containers

V.CONCLUSION

The purpose of this proposed work is to make a such type of system which will help to reduce the job work of person doing the tasks of sweeping and garbage collection. This system is eco-friendly and may play the sustainable role in future in the area of cleaning and garbage collection. After successfully executing of this system we come to conclusion that this system can be implement in public societies, public parks, and different types of manageable area to overcome the problems of cleaning and garbage collection.

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