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Swachh Yantramanav : (A Multipurpose Cleaning Robot)

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***Abstract*—Manual work is taken over the robot technology and many of the related robot appliances are being used extensively also. Here represents the technology that proposed the working of Cleaning Robot which picks up the plastic debris and other waste and litter from the terrain. The coordinates of the area to be cleaned is selected from centralized control system (CCS) which is controlled manually. The robot receives coordinate data through RF Module from the CCS to clean that particular area. . It works on four paddle wheel drive system and can perform sweeping task. This robot is incorporated with Ultrasonic Sensors for obstacle detection and automatic waste transfer. Apart from wheel driving system four motors are used, one for roller with brush mechanism, left and right movement link mechanism, waste transfer mechanism and rotavator mechanism. All motors are operated using relay switching on and off sequence. Initially the robot sweeps the waste to the primary collector, when primary collector is filled, it will automatically dump the waste to the secondary collector using sensor based controlled motor. If the garbage inside the secondary collector is filled up to the maximum level, it will alert the CSS. The data regarding amount of waste in each robot and the waste level present on the terrain is stored in the database and the cleaning can be monitored from CSS. It has anti-theft alert system which automatically alerts the operator if the robot crosses beyond the area under coordinates. All hardware and software operations are controlled by Arduino Mega2560, a Microcontroller Board based on ATMega1280 and whole circuitry is powered with 12V battery.**

Keywords—Centralized control system, Litter, RF link, robot,Main machine system

I. INTRODUCTION

Litter and plastic waste is an important environmental issue. It is amazing that 94% of people identify litter as a major environmental problem and yet people still litter. Carelessly discarded garbage affects every member of society: it causes harm to people and animals, damages our waterways, cost us money and suggests that we do not care for our environment.

A. Effects of litter and waste

Litter can cause a whole range of problems for everyone in our communities. Litter discarded in streets and parks can travel through the storm water system to our rivers and creeks, where it can cause harm to wildlife.

- Litter costs money. Removing litter from the environment costs everyone money.
- Litter is a threat to public health. Litter attracts vermin and is a breeding ground for bacteria. Items such as broken glass and syringes can be a health hazard in public places.
- Litter can be a fire hazard. Accumulated litter and careless discarded cigarette butts are potential fire hazards.
- Litter looks bad. Litter negatively affects the image of places, especially the appearance of communities.

A clean community, by contrast, can discourage littering and improve community appearance and quality of life. So our system provides a solution to automatically clean and collect waste from different terrains like beach terrain, parks, and road ways.

B. Existing Methodology/Techniques

*a)*Beach Cleaners

- Barber surf rake
- Solarino Sand Beach Cleaner
- Unicorn Beach Cleaner Troyer

*b)*Road/Other Cleaners

- Road Crafts Road Sweeper
- Manual Sweeping

C. Drawbacks in Existing Methodology

- No system is fully automated
- Cost is too high for purchase and implementation

II. ADVANTAGES OF PROPOSED METHODOLOGY

- Eco friendly
- Fully automatic
- Low cost
- Easy to operate and maintain
- Controlled cleaning

III. MECHANICAL DESIGN

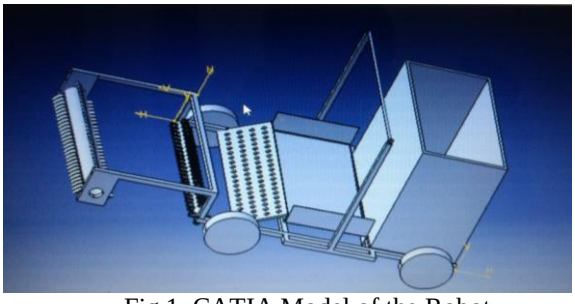

Fig.1. CATIA Model of the Robot

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Mechanical design involves construction of frame, Bin or Collector fabrication, Mesh system, Roller brush, DC Motors and Rotavator.

A. *Rotavator*

The purpose of a rotavator is to break up the soil so that planting (either of crops or plants, mostly seeds) can take place. They do not dig deeply into the soil, but will turn the soil up to about 9" in depth, although the depth will depend largely on the size of the machine and the type of soil it is being used on.

B. *Sweeping Brush Mechanism*

The unique feature of our robot lies in the way it sweeps away the waste. It basically consists of a roller fitted with three fibre brushes at angle of 120 each. Once the power is given to the robot, the roller starts sweeping the sand floors along with its rotation for 360 degree. In this way it rake debris from sand floors towards the primary collector.

C. *Bin or Collector*

Primary collector is a small bin used to store the waste immediately after being swept away by the roller brush sweeper. Secondary collector is a large bin used as a backup to store the large amount of waste. Debris from primary collector are moved on to secondary collector by vertical motion. Once the waste is collected in primary tray, the tray gradually moves upwards and tilts itself to flush out the waste to secondary collector.

D. *Mesh System*

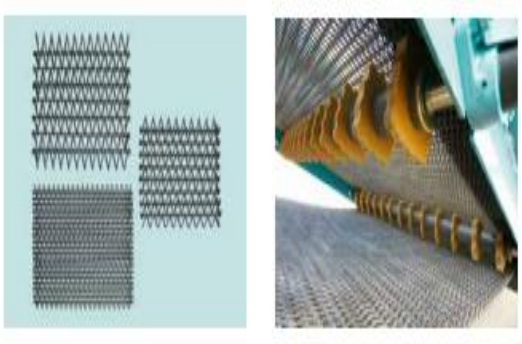

Fig.2.Variety of shapes, diameters of mesh to ensure optimum sand sifting

IV. ELECTRONIC CIRCUITRY

A. *Block Diagram*

The block diagram of the proposed Cleaning robot consists of two systems: Centralized control system (CSS) and Main machine System (Robot)

1) *Centralized Control System*

Centralized Control System consists of

a)Controller: Arduino Uno, microcontroller board based on ATmega328P.

b)LCD Display: 16x2 screen electronic display module with 5x7 pixel matrix.

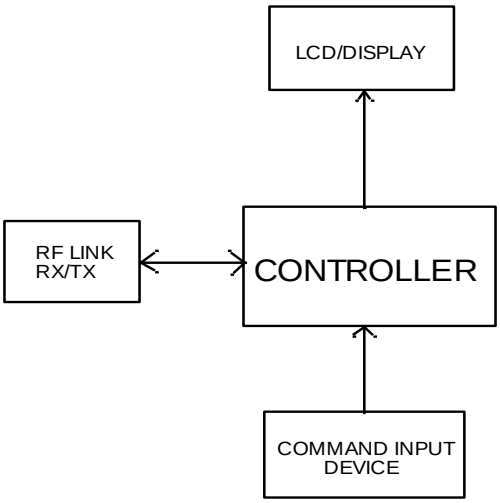

Fig.3. CSS-Block Diagram of Centralized Control System

c)Keypad(88JB2): A 5x4 Matrix Input device by Fairchild.

d)HC-12: Long range wireless serial port communication RF module

The Controller gets input data of coordinates from Keypad when entered manually. The data received is made to display simultaneously when it is entered. Further when the data is entry is complete, it is transmitted to Main Machine System through wireless serial port communication RF module.

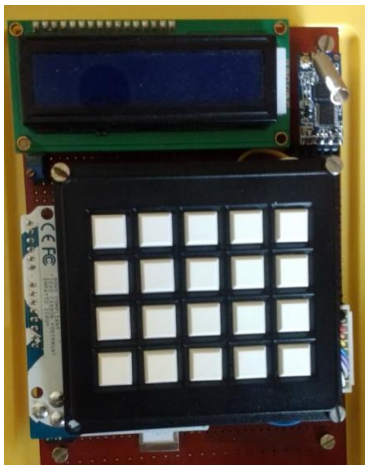

Fig.4. Part of Centralized Control System

2) *Main Machine System*

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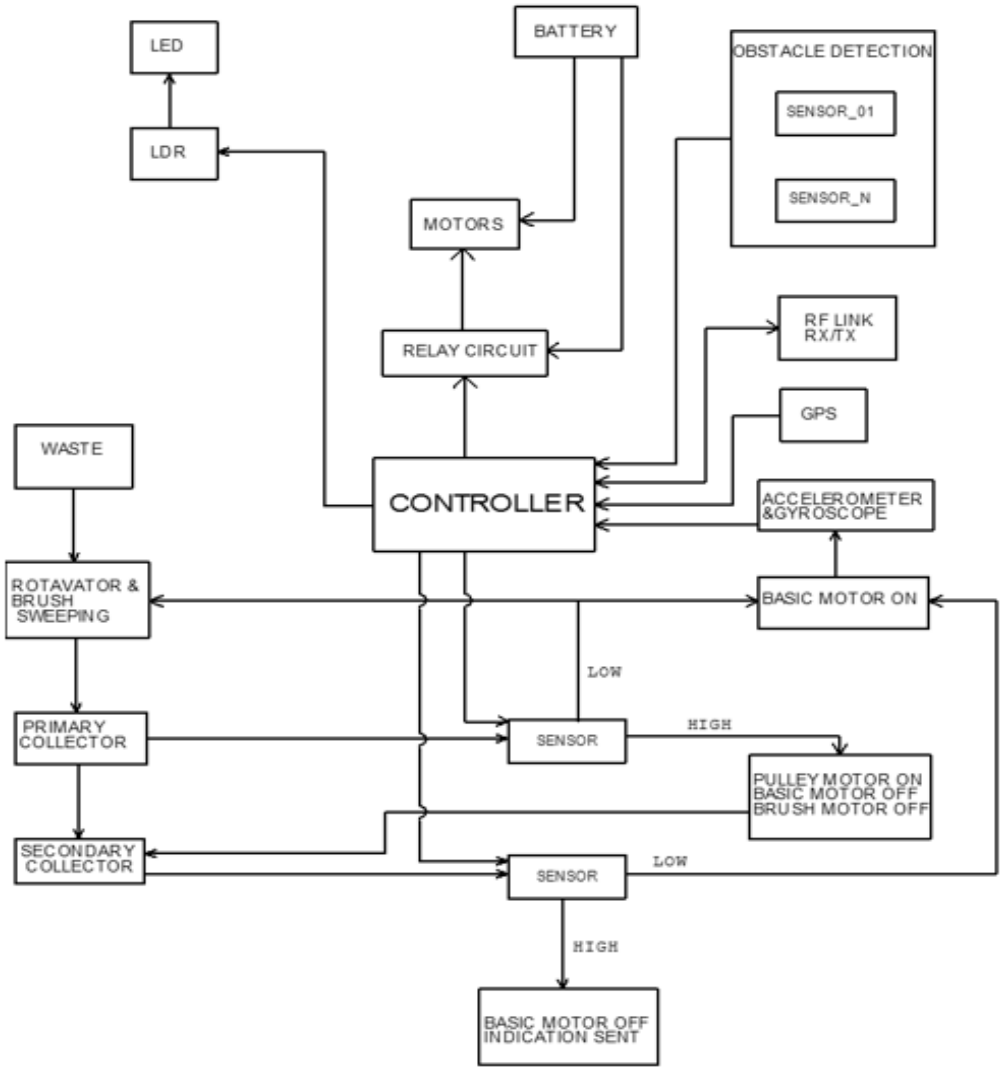

Fig.5. Block Diagram on Main machine system side

Main machine system consists of

a)HC-12: Long range wireless serial port communication RF module.

b) Optocoupler Relay Board: 12V, 10A relay circuit to control on and off of motors.

c) GPS Module: It is MT3339 Chipset with SMA external antenna.

*d)Accelerometer& Gyroscope:*MPU-6050 chip based 3-axis MEMS Gyroscope and 3-axis MEMS accelerometer

*e)HC-SR04:*Ultrasonic sensor, senses object distance by properties of acoustics waves

All hardware and software operations are controlled by Arduino Mega2560, a Microcontroller Board based on ATMega1280 and whole circuitry is powered with 12V, 9Ah battery.

Fig.6. Setup on Main machine system side

B. Working

The robot or main machine system starts from its initial position to the coordinate of the area designated to be cleaned. This coordinate data is given by the CSS manually through RF Tx/Rx Link. The wireless communication between the CSS and robot is possible only when they are set at same baud rate and frequency.

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Once the robot reaches the designated area, it starts the process of cleaning in a zigzag path. The basic four wheel drive system makes the robot to move on any terrain and is controlled by an optocoupler relay. Accelerometer and Gyroscope are incorporated in order to determine the distance travelled and angle of rotation about its axis while turning left or right by link mechanism .The robot automatically detects obstacle using the acoustic waves from the ultrasonic sensor.

When the robot moves the brush roller sweeps the waste and litter into the primary collector through a mesh system. Further, on primary collector full, it automatically initiates transfer mechanism and the waste is transferred to huge secondary collector. Secondary collector on reaching a maximum limit indicates the CSS by sending alert signal through RF Tx/Rx link. The system also sends alert signal to CSS when it crosses beyond the designate coordinate area i.e. during theft.

Fig.7. Proposed Model

Fig.8. Input Coordinates

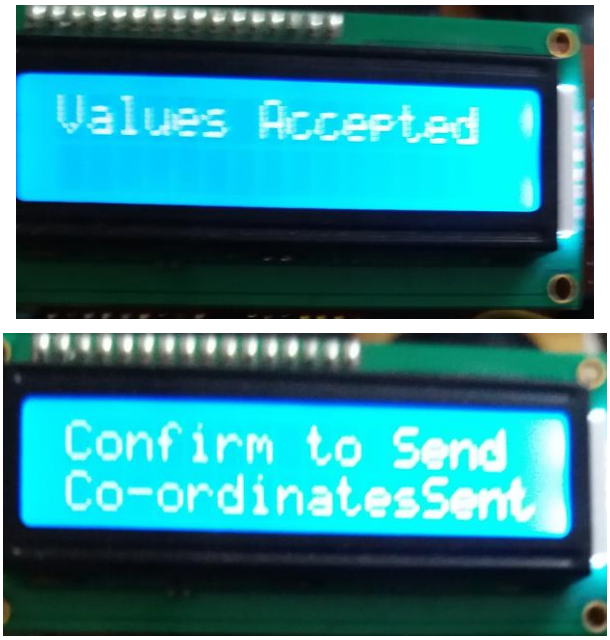

Fig.9. Confirmation on sending coordinates through RF link

V. CONCLUSION

This robot facilitates cleaning up of plastic debris, litter and waste. The proposed system provides the hurdle detection in case of any obstacle that comes in its way.RF module provide wireless communication between CSS and the robot and their range is 1.8Kms.If the secondary bin is full it sends information to the remote CSS.Operations such as sweeping ,changing path, obstacle detection and night light indication are performed automatically.

Nonetheless, there are still new ideas to improve the system and add new functionality to it. Camera based navigation, image processing using CV to distinguish between waste, plastic waste segregation for 3D printing and controlling swarm of robots through robot to robot communication.

So a prototype of a automatic cleaning machine which is capable of cleaning our roads, beaches, pavements, roads efficiently is developed. It is economic in nature and can be implemented easily. The proposed system is a significant step in achieving litter free country.

VI. ACKNOWLEDGMENT

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