INNOVATIVE WASTE MANAGEMENT FOR SMART CITY

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***Abstract*—This research aims to design smart techniques for garbage accumulation for bins. This system will replace the vehicle which used to collect garbage from garbage bins. It will replace that vehicle with automated bot which will collect garbage automatically from garbage bins and this system will be helpful in smart cities to makewaste management system automated**.

Keywords—microcontrollers, IR sensors, DC motor, motor driver, Garbage bins.

I. INTRODUCTION

Collecting municipal solid waste is an expensive and sometimes polluting proposition. It requires fleets of trucks that typically get poor gas mileage and spew emissions.Smart waste collection solutions offer relief in several ways. They can eliminate unnecessary pick-ups on collection routes, along with the associated operating and maintenance costs for collection vehicles. They can also monitor participation rates for waste reduction programs such as recycling.

With the total volume of waste generated globally expected to increase by nearly 50% over the next decade, the adoption of innovative technologies will result in more integrated waste management solutions that move beyond the traditional use of labour, diesel trucks and conventional landfills.

The launch of three mega urban schemes in India, i.e., Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), and Housing for All in urban areas, will set in motion the process of urban transformation to enable better living. Waste disposal and sewage treatment plants are missing in most Indian cities, around 60 million tonnes of municipal solid waste (MSW) is generated in urban India annually. With rapid urbanisation and changing lifestyle and food habits, the amount of municipal solid waste is increasing significantly. So, Smart city management do not complete without smart garbage management . Thereby arising a need of automated garbage accumulator.

In this paper we are presenting the technologies driving the emerging smart waste market and how they will lead to more sustainable cities.

II. PROBLEM DEFINITION

Municipal solid waste management is an expensive and polluting proposition. It requires an army of drivers who operate fleets of trucks that typically get poor gas mileage and spew emissions. This today's system uses the labor and manual working which is costlier and not effective. Dustbins are installed on the road side garbage collecting vehicles come and collect garbage , now this model is efficient for a big city but not for a small township so by making a small town ship model tried to reveal how garbage collection can be efficient for small to medium townships.

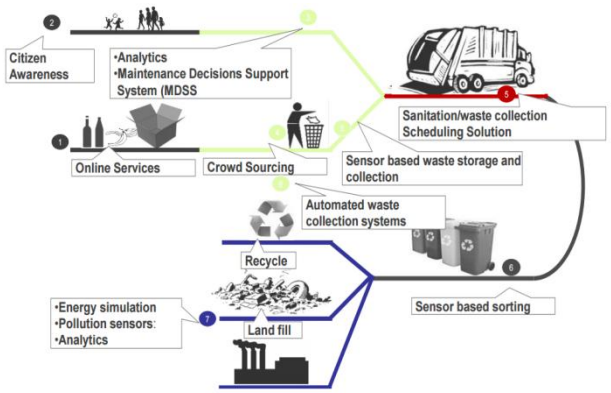

Fig.2.1 current scenario

Pune city for survey which is taken as one of the city in smart city mission of Ministry of urban development Government of india.Pune City is part of the Pune Urban Agglomeration (UA)

with a population of 5.05 million.Pune City, occupying 243 sq. km., is the jurisdiction of the Pune Municipal Corporation (PMC), which was established in 1959.Pune City has a population of 3.11 million.Per capita income is Rs. 1,11,637(US$1,993) per annum.Per capita waste generation is 364 gm across economic classes.The estimated daily waste generation in Pune is 1.400 metric tonnes

III. RELATED WORK

A smart city or smart township is always incomplete without a smart garbage accumulator, to achieve the goal of smart garbage accumulator some scholarly journals and literature some of are and how it will help to achieve less pollution and sustainable development. This project is mentioned in reference.

[1] Narayan Sharma, "Smart Bin Implemented for Smart City", International Journal of Scientific & Engineering Research, Volume 6, Issue 9, September-2015

This journals helps to give information about smart bins. How smart bins can be used in smart cities GSM based project. It used the PIC16F73 microcontroller, HC-SR04 ultrasonic sensor, SIM900A GSM module, IC 7805 voltage regulator, resistor, capacitor and a crystal oscillator. This paper gave idea about the importance of making dustbins smart and how it can be smart.

[2] Michael Batty , Kay Axhausen, et al., "Smart Cities of the Future," UCL centre for advanced spatial analysis on working paper series, ISSN 1467-1298, Paper 188

In this paper, they sketch the rudiments of what constitutes a smart city which they define a city in which ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies. They sketch their vision in seven goals and six research problem one of that is waste management .This journal help to understand what is really smart city is.

[3] Deepak Punetha, Neeraj Kumar, Vartika Mehta ,Development and Applications of Line Following Robot Based Health Care Management System (IJARCET)Volume 2, Issue 8, August 2013

This paper uses line following robot to meet their need.A Line follower robot is an electronic system that can detect and follow the line drawn on the floor. Generally, the line is specified a predefined path that can be either visible like a black line on a white surface with a high contrasted colour. Light dependent resistor sensor has been attached with the robot whose resistance varies with light intensity. When the LDR receives maximum amount of light then its resistance goes to its minimum value, ideally zero and when no light falling on the LDR then its resistance goes to its maximum value, ideally infinitive.

[4] Osiany Nurlansa, Dewi Anisa Istiqomah, and Mahendra Astu Sanggha Pawitra, "AGATOR (Automatic Garbage Collector) as Automatic Garbage Collector Robot Model," International Journal of Future Computer and Communication vol. 3, no. 5, pp. 367-371, 2014.

This research aims to design a rotor robot model as automatic garbage collector to counter accumulation of garbage.support devices of the robot are mechanical robot, robot control system, actuator and sensor system.

IV. WORKING PRINCIPLE

Basic components that used in this research are ATmega 328, IR sensors, Dc motor, Power supplier sensor etc. ATmega is a low power 8 bit microcontroller. When IR sensor based on the reception by the intensity of IR receiver the output of sensor is defined. Dc motor is used to convert electrical power in mechanical power. Motor controller IC is used to control DC motor.

In the block diagram for garbage collector , going to move robot with the help of dc motor which will be running by the microcontroller. The robot will detect its path with the help of an IR sensor. And the microcontroller will also control the robotic ARM mechanism.

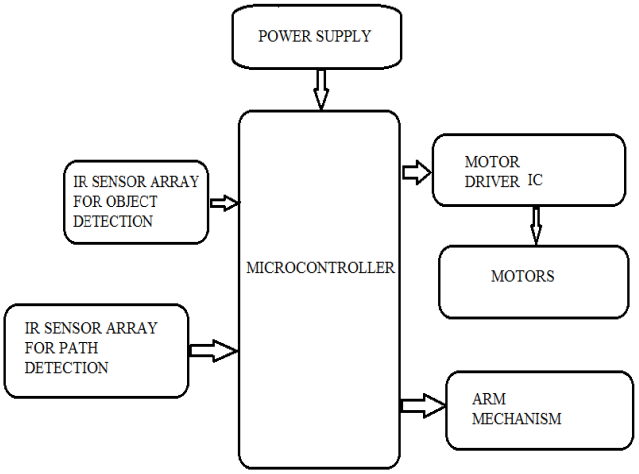

Fig 3.1 block diagram of system

There are multiple application for IR sensor array. IR sensor array is used for path detection, obstacle detection and level detection for dustbin. IR sensor work for obstacle detection. Microcontroller is used to control the collector robot .Here ATMEGA328 is used for this function. Microcontroller will move the robot from one place to another. Microcontroller also control movement of the robotic ARM. All the action will be taken by Microcontroller. 200rpm DC motors are used for the purpose of movement of robot from one place to other. And the stepper motors are used for the movements of robotic ARM. Even though microcontroller will control the motor which is driving the robot, the control voltage which the controller sends are of very low value, so the driver IC will allow external voltage and then it will send them to the motor .In this research, three axle robotic arm is used which will lift the dustbin and put the garbage in the container. The robotic arm will be of a light and sturdy material which will help to lift the container. The container will be designed according to the design specifications of the robotic ARM .

V. SYSTEM OVERVIEW

Basic components that used in circuit are ATmega 328, IR sensors, Dc motor, Power supply etc. ATmega is a low power 8 bit microcontroller.

A. ATMEGA328/P

The Atmel Pico Power ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs close to 1 MIPS per MHzthis empowers system designer to optimize the device for power consumption versus processing speed.

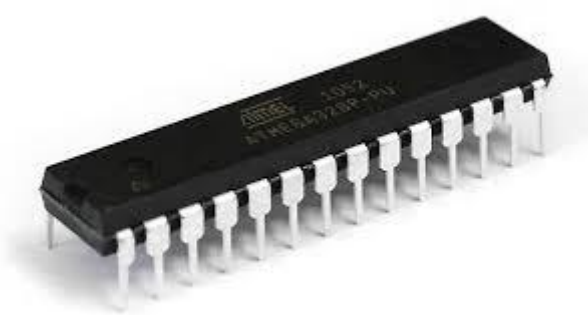

Fig 3.1 ATmega328/p

B. IR SENSORS

The principle of an IR sensor working as an Object Detection Sensor can be explained using the following figure. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo –Coupler or Opto – Coupler.

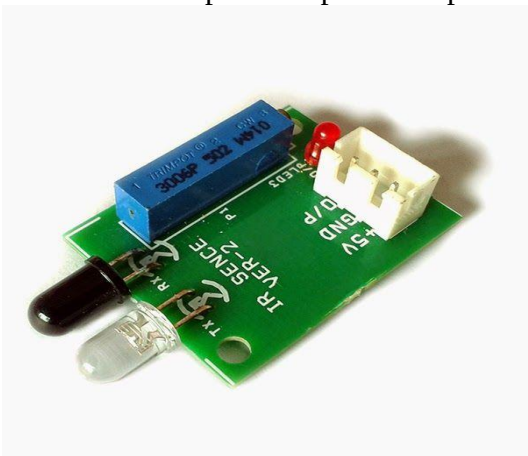

Fig 3.2 IR sensor

C. L293D MOTOR DRIVER IC

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction.L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge

Motor Driver integrated circuit (IC). L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

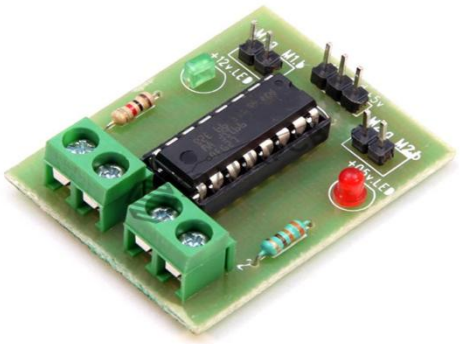

Fig.3.3 motor control IC L293D

D. DC MOTOR AND STEPPER MOTOR

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller).

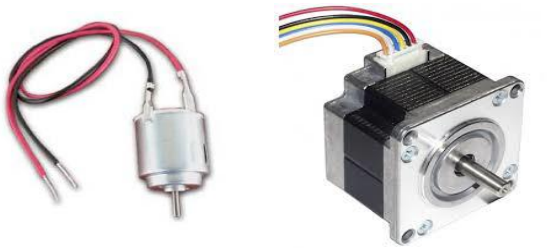

Fig.3.4 DC motor and stepper motor

VI. IMPLEMENTATION METHODOLOGY

The implementation of the system which is smart garbage collection aims to make accumulation automated with efficient energy utilization. Flow chart explains the working of the system step by step.

A. WORKING

The aim of this research is to automate garbage collection for smart cities along with efficient energyutilization. This is done by making a robot which efficiently accumulates garbage from garbage bins for smart city garbage management. Which consist of numbers of IR sensors, motors, robotic ARM and all of them are integrated and connected to ATMEGA328 microcontroller.

The line is detected by the array of IR sensors on that robot, and which will be followed by that robot. For the movement purpose DC motors of 200 rpm is used. At a certain position which is the position of garbage collector will be indicated by the cross mark on that line. When this condition appears controller gives instruction to Robotic arm to do its work. Which means Extend its ARM and pick up that collector bin and pour its west in a container on that robot and after doing that place the collector bin to its place.

After this process, the robot is allowed to move to the next garbage collector point. And doing these for all of the positions. If there is the obstacle in between that line, then with the help of IR sensors which in front of the robot will detect them and then the robot will stop at that point for some time and giving the warning to remove or move away from its path and again return to its work. The microcontroller is programmed to do mainly these functions. The function of line following is done by using IR sensor which takes the readings of the colour spaces (black & white).

This input is given to the microcontroller which compares the voltages or intensity taking from IR sensor of two colour black and white and accordingly these comparison values, performs the different actions, like moving left/right, go straight, stop, etc. and the function of pick and place of garbage bins are done by using Robotic ARM.Which uses the Stepper Motors, which will be the program in AdrianoIDE.

The function of the obstacle detection is also done by using IR sensor Array. Which detects the obstacle in the path and give input which compare the input and gives output as any one of the input is high.

B. FLOW CHART

This is flow chart of whole system which explains the decisions of system based on the conditions come to the robot based on microcontroller calculations. Main steps to follow are going forward, turning, obstacledetection, picking up the garbage bins etc.

as per shown in the fig 4.1,Robot first go forward by line tracing and if obstacle is detected buzzer will be on and when obstacle is removed, robot continued to move on its path and depending upon the position of dust bin robot will turn left or right.

In this way system implementation will be performed. Information from the image.

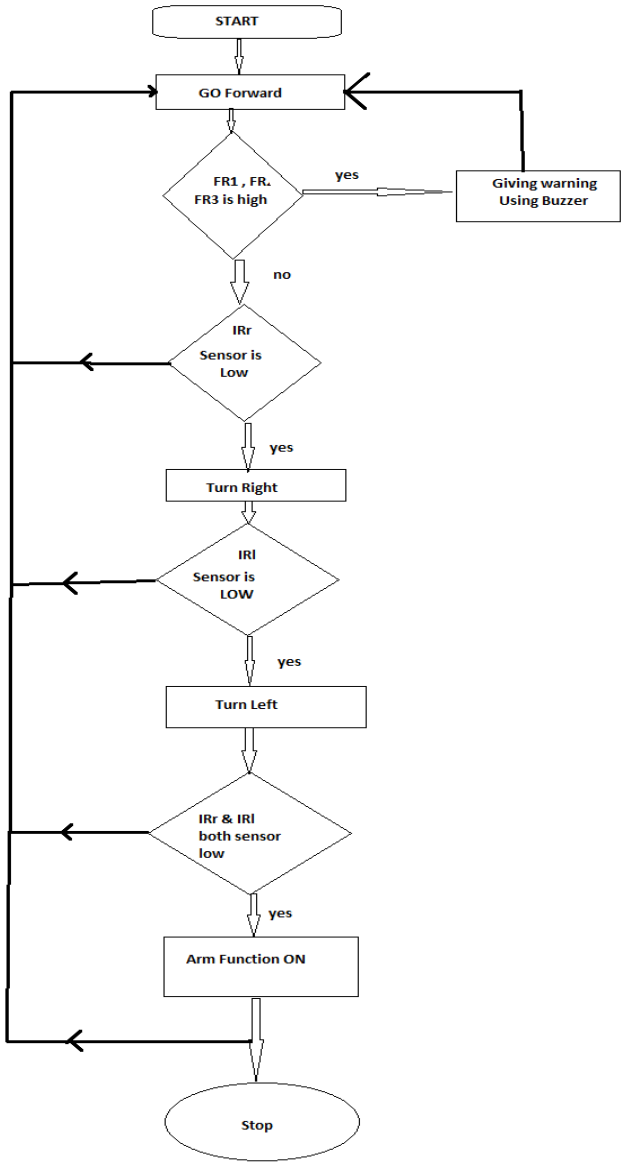

Fig 4.1 flowchart of the system

VII. EXPERIMENT RESULTS AND DISCUSSION

LDR is basically a variable resistor which changes with different intensity of light. With the help of comparator circuit it can give the output when it comes under the contact of that line drawn. By using motor driver it follows the line drawn on the floor. At the turn of the line drawn, LDR doesn't get any output. DC motor must be controlled by the motor driver for movement of the robot. For left movement the left side dc motor should be stop and the right side dc motor should be run in forward direction.

Serial no.	Observation and Result		
	ROBOT MOVEMENT	*LEFT MOTOR*	*RIGHT MOTOR*
1	Straight	Straight	Straight
2	Left	Stop	Straight
3	Sharp Left	Reverse	Straight
4	Right	Straight	Stop
5	Sharp Right	Straight	Reverse
6	Reverse	Reverse	Reverse

Table. 1 Direction movement of Robot

When the system detects any obstacle in its path then the dc motor stop rotating and a buzzer is activated with the help of microcontroller unit. Microcontroller can be used for controlling garbage accumulator system in every possible case. The robot detects the garbage bin by following the path provided.

VIII. CONCLUSION

Thus by designing and implementing automate garbage collection for a city prototype, this research designed a plan a township model which reveals efficient garbage accumulation which will make garbage collection less weary and time-consuming. By implementing this proposed system the cost reduction, resource optimization, Effective usage of smart dustbins can be done. Thereby taking a small step to contribute towards a clean India initiative to support our humble prime minister's ' SWATCH BHARAT ABHIYAN'.

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