SMART WASTE MANAGEMENT SYSTEM USING IOT

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Abstract: Humanity has always struggled to get authentic qualities to its rarely in an attempt to find standby for himself to fetch out his orders. The popular concept of a smart waste management using mobile robot is of a machine that mostly works like human arm. The industry is growing from current circumstances of automation to robotization, for enhancing productivity and also to bring out uniform quality. Now a days management of waste from collecting to dumping and disruption has become one of the greatest challenge and arduous chore for municipal corporations all around the globe. This includes collection transportation, treatment and disposal of waste with monitoring and regulation. Waste management methods differs amongst different countries and areas. Moreover domestic waste collection service are often provided by government authorities but there is always a human perception to find more towards perfection. Moreover, cities with growing economy experience exhausted waste management services and uncontrolled dumping sites and problems results in increasing. This smart system enhances the use of robotized technique embedded with arm mechanics and also alarms if dustbin gets full.

Index Terms **– ESP-NodeMCU, Waste management, Arduino, Bluetooth communication, Waste collecting robot, IOT gecko, Ultrasonic Sensor.**

I. INTRODUCTION

There is great energy crisis in current situation of our country. Moreover, people have become negligent for waste management and at the same time the worker those are responsible for collecting and gathering the garbage feels unhygienic and takes numerous number of workers. People often throw the garbage carelessly on the street side or walk paths. Even in those situations, application of smart garbage management system makes it possible to control the entire work from a distant place in easy way with our smart phone. The garbage in the roads are usually picked up by hand by the workers. This can be very tiresome for the workers and can be time consuming. This project is about the Smart Waste Management System using IOT. It uses a pick and place robot to pick up garbage from streets. A pick and place robot are the one which is used to pick up an object and place it in the desired location. The principle for robot follows a cylindrical body providing motion in horizontal, vertical and rotational axes, hence this robot provides two rotational and one linear variation, an articulate robot or a scara robot which are kind of stabled robots with three vertical axes rotary arms. The smart waste management system is designed to collect garbage at foot path, public places mostly cemented paths and beach. The movable robot cannot be used on muddy surfaces. Overall, in this smart system the concept of mobile robot is built in such a way that, when it is started it will move on the path defined by user or operator. When it encounters the obstacle (known by operator), depending on the conditions applied in the program the robot proceeds with further motion or movements with arm and then robot picks up the waste and puts it in the smart bin embedded on the robot body. When the bin is full, it sends a notification in form of variation on the application through the server using the Wi-Fi module and IOT that, the bin is full.

Figure 1: Common practice of waste management

The objective of this system is to implement a low cost, reliable and scalable smart switching that can be used to remotely control the collection and gathering of waste, using the Wi-Fi module ESP8266 and bluetooth connectivity with Arduino also as a controller and also one can monitor the status of dustbin using sensors too. Moreover few features of this smart system are mentioned as below:

1. Hygiene and reduces human efforts: Comparing to normal practices instead of picking garbage with hands can cause diseases as well as human efforts needed to accomplish. But the smart waste management system reduces the human efforts as well more hygiene.
2. Ease to use: This system includes monitoring and controlling which deduct the human interface to very less. So only just need to direct the robot to encounter the waste and if bin gets full specify its dumping process.

3. Easy communication: This system uses bluetooth and most important Wi-Fi module where this module act as a controller as well as Wi-Fi server as well.
4. Reduced cost: In compared to common practice where more number of workers need to hire as well as to carry the waste a different vehicle, this system includes both embedded together collecting as well as gathering of waste under only one operator.

II. RELATED WORK

As per survey, there exist many system that can control waste management using certain technology. Each system has unique features. Currently certain companies are officially registered and are working to provide better smart waste control systems. There are a lot of ways to serve this system purpose the same but this system is uniquely that the technology served with automation and less efforts with help of application and also using Wi-Fi module that sends notification through server on operator's application.

III. COMPONENTS REQUIRED:

This smart system is divided in two parts:

1. Robot - collection of garbage
   a. Robotic arm
   b. Robotic chassis
   c. Arduino Uno R3 board
   d. Bluetooth module(HC05 or HC06)
   e. Motor driver IC(2 X L293D)
   f. Battery – 12V
2. Smart dustbin
   a. HC-SR04 Sensor
   b. Wi-Fi Module
   c. IOT gecko

A. ROBOTIC ARM:

Figure 2: Robotic arm

A robotic arm has a mechanical formation that replaces its form using a group of servo motors. They helps to generate movements similar to a human arm. A common word that is used when a robotic arm is manufactured which is the DOF (degrees of freedom). It is related to roll, yaw, and pitch. The basic function of a robot is done by its joints. Joints are analogous to human joints and are used to join the two consecutive rigid bodies in the robot. They can be rotary joint or linear joint. DOF implements the linear and rotational variations of the body and Degrees of movement employee the number of axis the body can shift. A pick and place robotic arm consists of two rigid bodies on a rotating base, together with rotary joint. This rotary provides rotation in 360 degrees around any one of the axes. The links of the manipulator can be considered to form a kinetic chain of the manipulator is called the end effect and it is analogous to the human hand. When a button is pressed, a character is sent through Bluetooth and the Arduino rotates the servomotor one degree in one cycle.

B. ROBOTIC CHASSIS:

One of the most important parts of robot is the chassis. This piece ties all of the components together, and determines many of the operating characteristics of the robot. A robotic chassis is a substructure of an artificial object, which supports the robotic arm on its construction. It uses series of two motors and two wheels. A third uni-ball wheel is multi-directional and is only used to avoid fluctuations occurs at the front load of chassis. By this smart robot will perform obvious movements that the motors will make are forward and backwards. Also at the time of picking up the motors spin in opposite directions, while the robot actually stays in place.

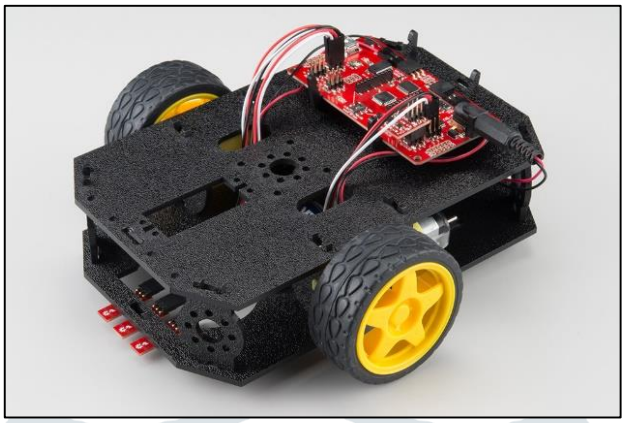


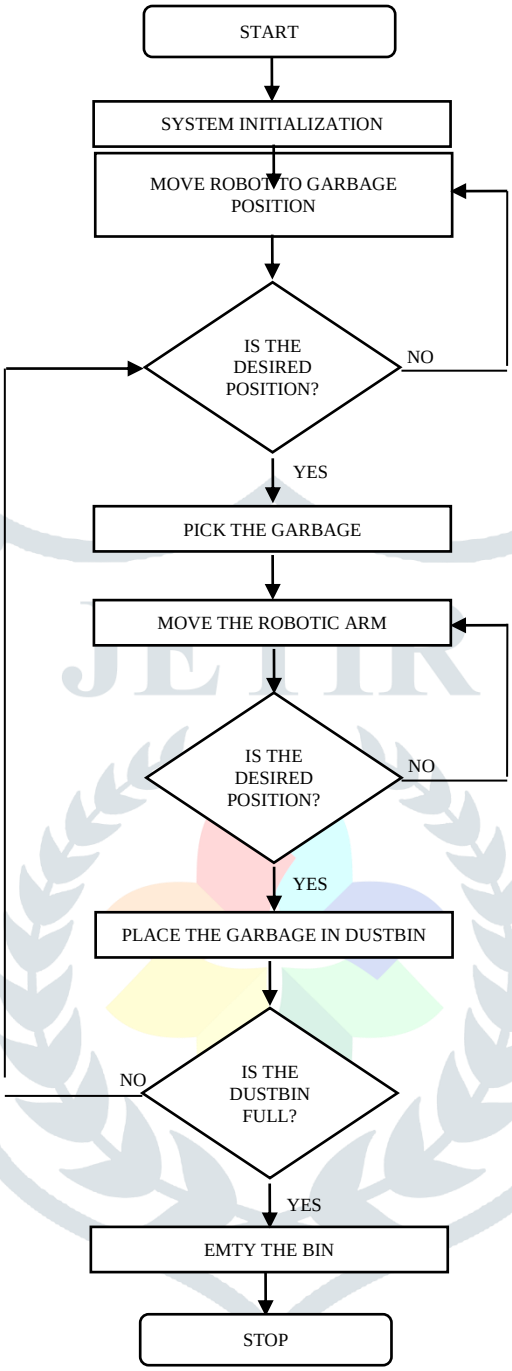
Figure 3: Robotic Chassis

C. ARDUINO UNO R3 BOARD:

Table 1: Pin Description for Arduino Uno R3 Board

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply needed to power the system on board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the Board.
Analog Pins	A0 – A5	Used to establish an analog input in the range of 0-5V.
I/O Pins	Digital Pins 0 – 13	Used for input or output purpose.
Serial	0(Rx), 1(Tx)	To receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Delivers 8-bit PWM output.
SPI	10(SS), 11(MOSI), 12(MISO) and 13(SCK)	For SPI communication.
Inbuilt LED	13	To blink the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	For TWI communication.
AREF	AREF	To supply reference voltage for input voltage.

IV. FLOWCHART:



V. RESEARCH METHODOLOGY:

As initially explained that this smart waste management system mainly divided into two main states. They are :

1. Collecting of waste by robotic arm.
2. Gathering waste to smart bin.

The most basic working of this system is based on the robotic arm that is picking up the garbage. So as one operator is initially needed at encountering or detecting the garbage on streets or any location. As it detects the garbage it coordinates with the robot via an application installed on operating device which mainly includes movements and variation for arm mount on robotic chassis. With the help of that application not only robotic arm can be controlled but robotic chassis also for moving forward, backward, turn left or right as well. The robotic arm is controlled via Arduino Uno R3 board. The connection and be easily explained from figure 4. Moreover the same structure(figure 4) further combines with bluetooth module. So, for communication of application through operating device is done on bluetooth connectivity. As application opens it searches for near by available

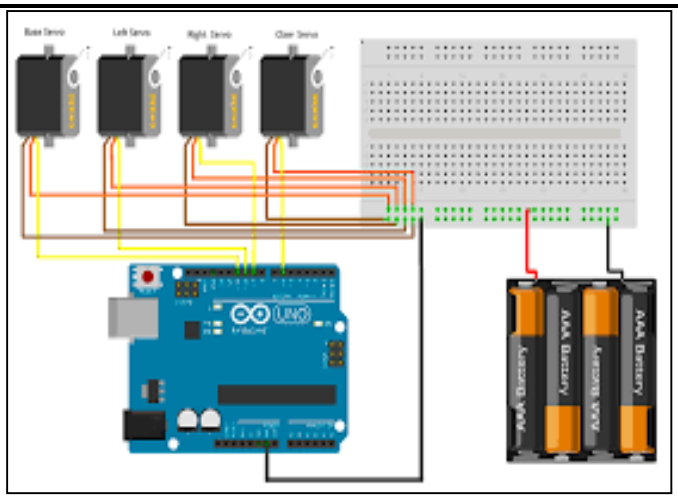


Figure 4: Connect Arduino with Arm

bluetooth connectivity and operator can select the desired one. The bluetooth module used in this system is HC06 module. In this system, operator has to provide an external device to connect to a slave PC or an android device. Bi-directional data can be sent and received in a healthy way. After connecting the device to the Bluetooth instrument, a virtual kind of com port associated with the module will be created on the operating device. Further it becomes possible to communicate via Bluetooth through the module. The codes or controlling commands that operator sends via microcontroller can be received via Bluetooth with PC, which is connected to the BT module. Data sent from the PC and COM overreaches the microcontroller.

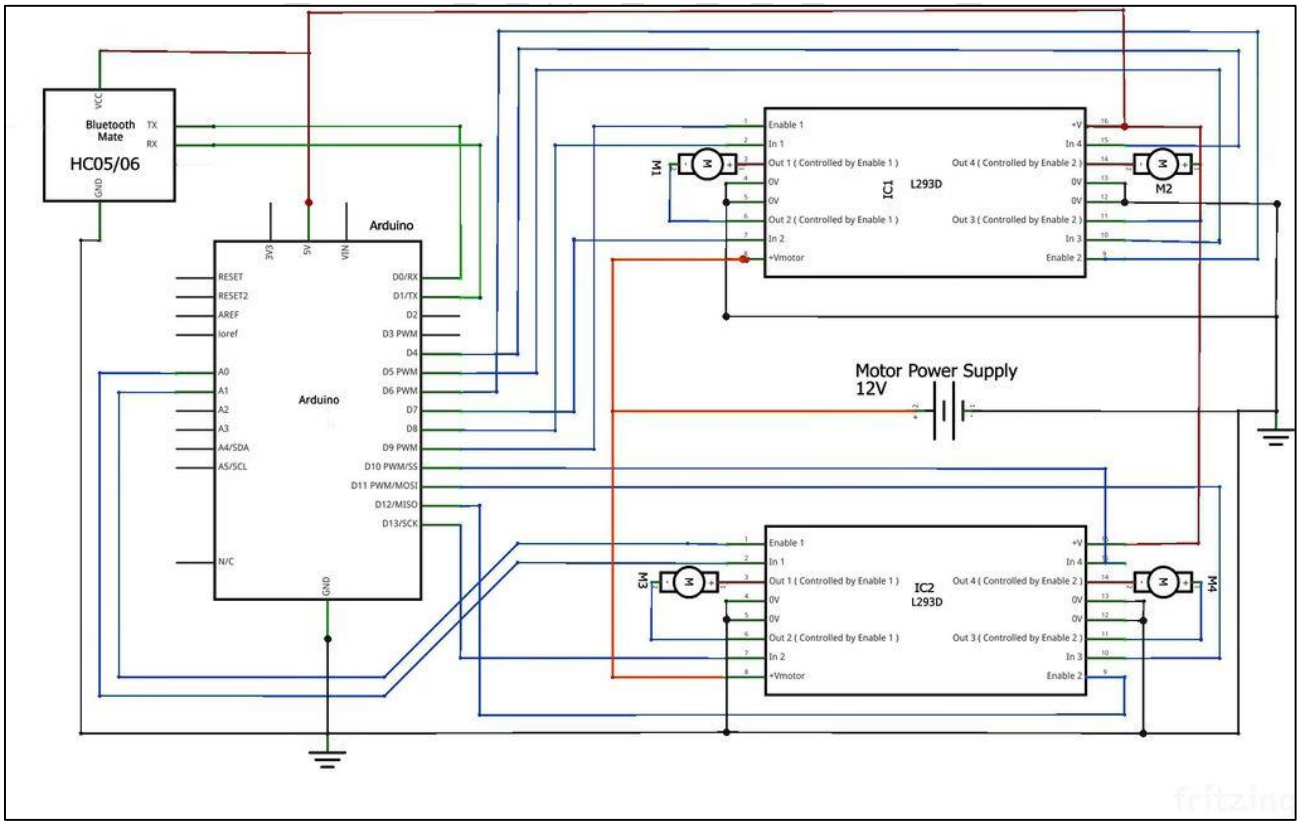


Figure 5: Schematic Diagram

Now the second state comes the way that is, after picking up the garbage there is smart bin mounted on the robotic chassis body. The arm will rotate and place the garbage into the smart bin. Now this system names the bin as “smart bin” because the bin includes an ultrasonic sensor and most important connected on Wi-Fi server. Now communication between smart bin and the operating devices is done through Wi-Fi module. The Wi-Fi module used in this system is ESPNode-MCU. Through which an another application runs on the operating device which informs the operator about the status of the smart bin. So, the sensor simply measures the level of smart bin and further let informs the operator whether the bin is full or empty. There is an another way to show the status of the smart bin that is showing the level into numbers instead of “Full” or “Empty”. As we are using ESP module because this module have tendency to act as a Wi-Fi module as well as an controller itself. So, no other software required after once dumping the program to ESP module.

VI. BLOCK DIAGRAM:

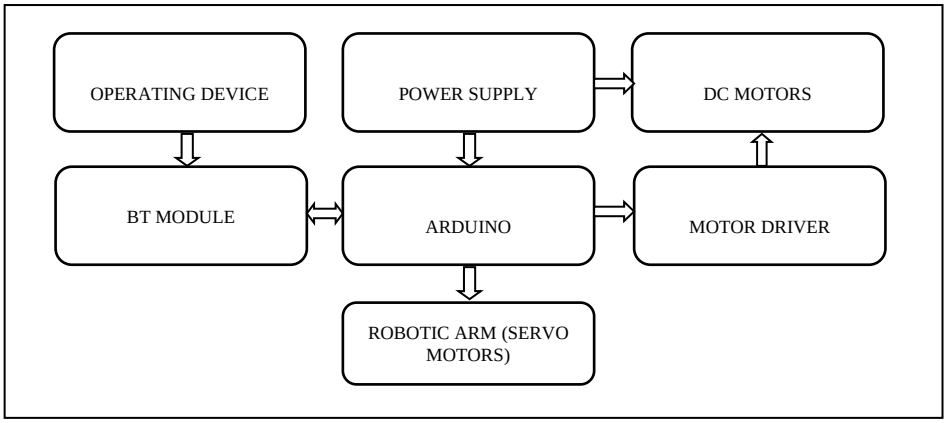


Figure 6: Block diagram of state 1

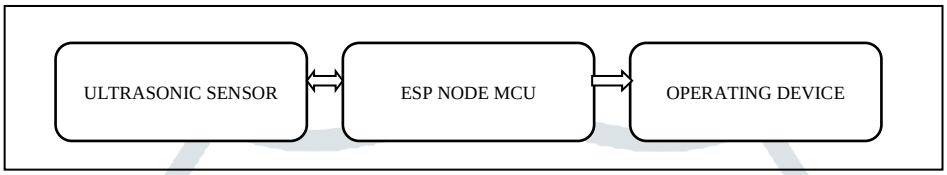


Figure 7: Block diagram of state 2

VII. RESULTS:

As operator starts the system initially the power is needed to the entire system. Further add the device to BT module and then application will be able to see on operating device.

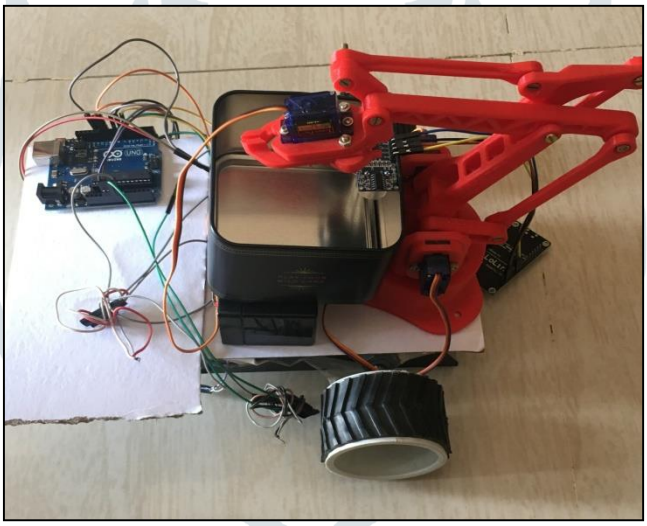


Figure 8: Robotic arm on chassis

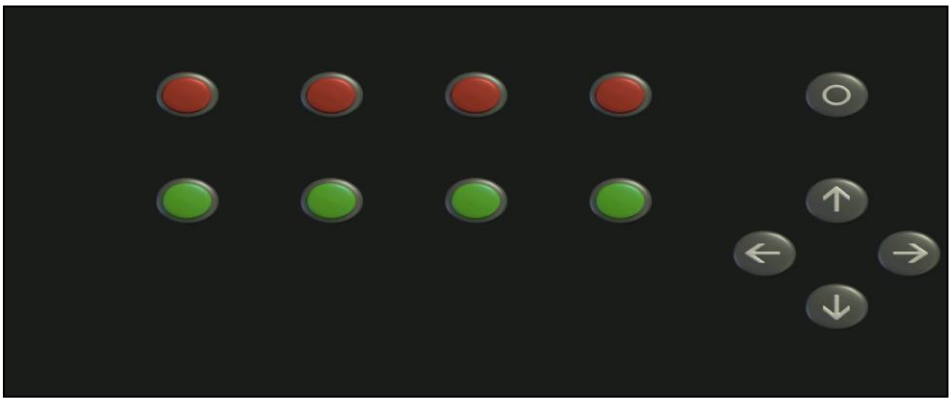


Figure 9: Application controls the robot and chassis movements

Figure 10: smart bin is "full"

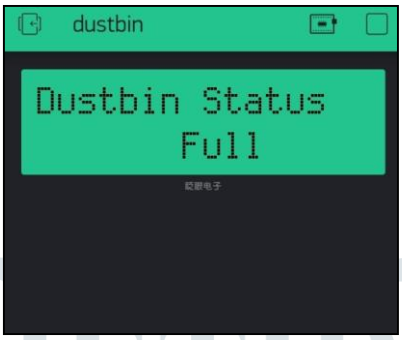


Figure 11: Status of smart bin on Application

CONCLUSION AND FUTURE SCOPES:

As we can conclude that this system is to develop a smart way to manage garbage using a Wi-Fi module and BT with application being controlled by operator. It integrates robotic arm chassis and collecting bin with each other. In today's world, smart switching and controlling is being most popular due to easiness, flexible means of viewing and controlling the appliances and other things according to user's comfort and needs. Presently, common practice of collecting waste or garbage located in different parts of any location makes it difficult for the user to go near them to operate. Even it becomes more difficult for workers to do continuously and more time consuming too. Hence smart waste management system provides a most modern solution. Further for later phases there can be a great introduction to this system with enhanced parameters lie integrating it with GSM and GPS to localize the robot as well as cameras mounted on the robot where operator can operate from a distance place. It also can integrate more number of locations together and expanding the number of robots makes a smart waste management system for any entire city or town.

REFERENCES:

[1] Kristýna Rybová, Jan Slavík, "Smart cities and ageing population– Implications for waste management in the Czech Republic " -IEEE 2016.
[2] Shambala S Salunkhe1, Madhuri D Yadav2,Vrushali V Kulkarni3 (2015) IOT Based Waste Monitoring For Smart City .
[3] M F Omar1*, A A A Termizi1, D Zainal1, N A Wahap1, N M Ismail2, N Ahmad1(2016) Implementation of spatial smart waste management system in Malaysia.
[4] Smart Waste Management Solution, https://www.youtube.com/watch?v=iQqlGsLddB8 Published on Jul 22, 2015
[5] Hogland W, Visvanathan C, Marques M, Manahdhar D.R. . Filling the waste management gap: Landfill management in low- and medium income countries in Asia. The waste management world, 2005. pp. 87-96.
[6] JICA. The study on the solid waste management in Dhaka City, Volume 2: Main Report, Dhaka City Corporation, The People‟s Republic of Bangladesh, JICA, Clean Dhaka Master Plan, March, 2005.
[7] Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammed Aledhari, Moussa Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols and Applications" -IEEE-2015.
[8] Cointreau-Levine, S. Public Sector Participation in municipal solid waste management, Part II: Guidance Note, St. Gallen: SKAT, 2000, 2000.
[9] Fachmin Folianto, Yong Sheng Low,Wai Leong Yeow, "Smart bin: Smart Waste Management System" -IEEE-April 2015.
[10] Clarabellejoanna ,Sathiyavathi.R, "Quota based routing protocol in disruption tolerant networks",in International conference on information communication embedded systems (icices2014)", Isbn no.978-1- 4799-3834- 6/14©2014.
[11] Sandeep Saurav Singh,Y.Bevish Jinila," Sensor Node Failure Detection using Check Point Recovery Algorithm", Fifth International conference on recent trends in Information Technology (ICRTIT 2016)", pp.1-4, 10.1109/ICRTIT.2016.7569585.