**IOT Garbage Monitoring Using Arduino**

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Literature Notes:

* **Smart Garbage Monitoring System for Waste Management**

Published in MATEC Web of Conferences at 2016 [[1](https://www.researchgate.net/publication/313252675_Smart_Garbage_Monitoring_System_for_Waste_Management)]

* The proposed system is consisted by the ultrasonic sensor to measure the waste level, the GSM module to send the SMS, and an Arduino Uno which controls the system operation. It supposes to generate and send the warning messages to the municipality via SMS when the waste bin is full or almost full, so the garbage can be collected immediately
* an alternative in managing domestic waste especially in flat areas via a smart garbage monitoring system, which is developed based on Arduino Uno. This system will automatically monitor the garbage level at each bin and will alert
* The ultrasonic sensors are used to detect the level of garbage in each bin, and it will send this information to the Arduino Uno, which acts as the system controller. In the case where the bins are already full or almost full, then it will generate a warning message which will be sent to the municipality via SMS, by using the GSM module. Moreover, this system is also connected to several LEDs, in green or red colors, in order to alert all the residents regarding the bin status.
* two threshold levels set: the first threshold is at 70% of the bin height, and the second threshold is set at 90% of the bin height. If the garbage level in the bin is crossing the first threshold level, then the first warning message is generated and sent to the municipality. Besides, the green LEDs will be turned ON in order to alert all the residents at every floor. Next, if the garbage level in the bin is crossing the second threshold level, then the second warning message is generated and sent to the municipality. In this case, all the residents will be alerted when the red LEDs are turned ON.
* An Arduino Uno board is connected to the HC-SR04 ultrasonic sensor via digital I/O pin. Besides, the SIM900A GSM Module is serially connected to the Arduino Uno board, where the TX port of the GSM Module is connected to the RX port (PIN 2) of the Arduino Uno, while RX port of the former is tied to the TX port (PIN 3) of the latter. Moreover, a green LED and a red LED are also connected to the Arduino Uno.
* **Petrol Level Indicator with Automated Audio Alert System**

presented at the IEEE WiSPNET 2017 conference [[2](https://ieeexplore.ieee.org/document/8299814)]

* The sensors are fastened at nominal locations on the container. A floating magnet glides on the liquid and triggers the magnetic sensors one-by-one relying upon the level of the liquid.
* A transmitter module, a receiver module and a power supply unit.
* The transmitter module has magnetic sensors, a Radio frequency encoder and a transmitter. The magnetic sensors are placed at three different levels of the tank: bottom, middle and top of the tank. A floating magnet is allowed to float on the liquid. On the basis of the level of petroleum in the tank, the floating magnet triggers the magnetic sensors one by one.
* The receiver module comprises three Light Emitting Diodes (LED) one each for the corresponding level in the tank, a siren which can be activated when the level of petroleum in the tank reaches the top most sensor, radio frequency decoder and receiver. On the off chance of the liquid reaching the lower level, LED is switched ON. Likewise, LED will be switched ON when the liquid is halfway through the storage tank. When the third magnetic sensor is actuated, the extreme level is shown with LED which activates the siren circuit to alarm the operator
* The input circuit is made from the regulated power supply. The transformer helps  
  the step down for AC input, 230 V from the main supply to 12 V and is fed to a rectifier. The output from the rectifier is a pulsating DC voltage. The output voltage from the rectifier is  
  fed to a filter for getting a pure DC voltage and removing any AC components present even after rectification. This voltage is then provided to a voltage regulator for obtaining a constant DC voltage. Supply of power is made from the regulator and given to all components
* *PIC Microcontroller (PIC16F877A)*, *Level Sensor*,*RF Encoder and Decoder*,*RF Transmitter and Receiver*,*Light Emitting Diode*,*Siren.*
* **Garbage Monitoring System UsingInternet of Things**

Springer Nature Singapore Pte Ltd. 2019 [[3](https://www.researchgate.net/publication/330428120_Garbage_Monitoring_System_Using_Internet_of_Things_Methods_and_Protocols)]

* IoT-based garbage monitoring system which checks the level of garbage in bins and sends that information to authorized worker through SMS. Information contains level of garbage and Google map link of bin
* After starting NodeMCU, it will connect to router then it will request to ultrasonic sensor for information. Ultrasonic sensor collects the information and lends that information to NodeMCU. Afterward, NodeMCU checks that information and figures out whether the information reaches the garbage limit or not. Nevertheless, if garbage level is less than 70% then NodeMCU will stop for some time and check again for newly arrived data from ultrasonic sensor. If garbage level is greater than 70% but less than 90%, then NodeMCU will get the longitude and latitude of that bin using geolocation API and send the message, “bin is 70% full,” with “Google map link” of that particular bin to authorized worker. If garbage level is greater than 90%, then it sends the message, “bin is full,” with “Google map link” of that particular bin to authorized worker.
* **Ultrasonic Sensor:** This module is connected to NodeMCU and waits for NodeMCU reply. When it gets a reply from NodeMCU, it sends the signal and waits for receiving that signal and calculates that amount of time and gives it to NodeMCU.  
  **NodeMCU** (Esp8266 12-E)**:** This module gives the instruction to ultrasonic sensor to sense the time. After retrieving that time, it performs some operations and calculates distance. If distance is more than 70%, then this module is connected to geolocation API and gets the longitude and latitude of that location and sends the Google map link through IFTTT service.  
  **Geolocation API:** NodeMCU connects to geolocation API server and gives the information about nearby Wi-Fi network or cell tower. Geolocation API performs the calculation and gives the longitude and latitude with accuracy.  
  **IFTTT Service: After** getting longitude and latitude, NodeMCU connects to IFTTT service and triggers the message using Webhook service to assign number with value. Value contains percentage of garbage level and location of garbage bin.
* **IOT Based Waste Management System with Metering for Smart  
  Village Project Application**

International Journal of Research Studies in Electrical and Electronics Engineering (IJRSEEE) 2019 [[4](https://www.researchgate.net/publication/332779949_IOT_Based_Waste_Management_System_with_Metering_for_Smart_Village_Project_Application)]

* IoT based sensors and micro zonation survey initiatives for a cleaner and garbage concentration in areas and dustbins has been formulated and have used IoT and near field communication devices which are blue tooth and NFC enabled that can establish a metering system for cleaning the garbage of the roads and also alert the central gateway when the garbage is excessively high and needs to be cleaned immediately
* Servo meter implemented with rain sensor, if rain occurs then lid will be closed, else lid will be open. In case of wet trash can we are using dc motor and blades for decomposing it and it is used for crops. In case of street lights, we are monitoring it by using ambient sensor, if luminous value is more, lights will be turned OFF else it will be ON. If any obstacle is detected then all the lights will be ON else alternate lights will be ON.
* **Arduino Uno (Atmege328):** The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to- serial converter.  
  **Ultrasonic Sensors:** used to detect the level of bin. A set of 2 ultrasonic sensors are been placed at an angle of 120 degrees from each other so that the whole area of the bin is covered. The range of ultrasonic sensor may be varying according to the size of the dustbin.  
  **PIR Sensors:** an electronic sensor that measures infrared light radiating from objects in its field of view. It is most used in PIR-based motion detectors  
  **Ambient Sensors:** It is a digital Ambient light sensor I for I2C bus interface. This IC is the most suitable to obtain the ambient light data for adjusting LCD and keypad back light power of mobile phone. It is possible to detect wide range at high resolution. **GSM:** GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine SIM900A, works on frequencies 900/1800MHz. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface.  
  **GPS :** global navigation system that provides geo-location and time information to a GPS receiver anywhere on or near the earth where there is an unobstructed line of sight to four more GPS satellites.  
  **WIFI Module :** It allows either to host the application or to off load, all WIFI networking functions from anther application processor. It contains powerful on board processing and storage capabilities that allows it to be integrated with the sensors and other-application.  
  **Servo Motor :** We are using this for the linear actuator that allows to move both in clockwise and in anticlockwise direction.  
  **Rain Sensor :** The rain sensor module is an easy mechanism for rain detection. It can be used as a switch when raindrop falls on the board.
* **IoT Based Smart Trash Bins – A Step Toward Smart City**

International Research Journal of Engineering and Technology (IRJET) 2017 [[5](https://www.researchgate.net/publication/332564972_IoT_Based_Smart_Trash_Bins_-A_Step_Toward_Smart_City)]

* The ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the garbage bin and sends the alert to the municipal web server once if garbage is 90% filled via IoT. Once the alert is received, Municipal Corporation takes initiative to clean the same. After cleaning the garbage bin, municipal web server gets updated about the garbage bin been cleaned
* Tltra sonic sensors, an Arduino microcontroller and an Wi-Fi modem. ESP8266Wi-Fi module is used for connecting the Arduino to the web server
* The ultra-sonic sensors so used in this project, are used for detecting whether the trash can is filled with garbage or not. When the distance measured by the ultra-sonic sensors is less than the threshold value programmed in microcontroller it depicts that the thrash can is filled. The same is intimated to the municipal corporation via Wi-Fi modem (IoT) by displaying the message on server as “Basket is Full” and if the distance will be more than the threshold value set, then the message on server is displayed as “Basket is Empty”. To avoid false triggering of the message to municipal corporation three sensors are installed in the system.
* The ESP8266 is interfaced with the Arduino as ESP8266 operates at 3.3V, the VCC and the  
  CH\_PD pin were connected to the 3.3V pin of Arduino. The RX pin of ESP8266 operates at 3.3V hence a voltage divider was designed where in three 1k resistors were connected in series and further the RX was connected to the pin 11 of the Arduino through the resistors and also the TX was connected to the pin 10 of the Arduino. Further the HC-SR04 ultrasonic sensor was interfaced to the Arduino. Further VCC and the ground of the ultrasonic sensor were connected to the 5V and the ground of the Arduino respectively. Lastly the TRIG and ECHO pin of ultrasonic sensor were connected to the pin 8 and pin 9 of the Arduino respectively.
* **Intelligent System for Garbage collection: IoT technology with  
  Ultrasonic sensor and Arduino Mega**

IJCSNS International Journal of Computer Science and Network Security, 2018 [[6](https://www.researchgate.net/publication/331676073_Intelligent_System_for_Garbage_collection_IoT_technology_with_Ultrasonic_sensor_and_Arduino_Mega)]

* The level of garbage in the dustbins is detected from ultrasonic sensor and the ultrasonic sensor provide the real time results with using ESP8266 Wi-Fi Module send it to the web application. The  
  Web Application show the sensor results in graphical form. In case if the dustbin fill with garbage like 80 to 100 % then Web Application automatic send the SMS to specific mobile number and show the location of specific dustbin and also provide the optimize route for reduce the time and fuel cost
* HC-SRO4 Ultra Sonic sensor used to detect the level of garbage in dustbins. This shows real time  
  result on our web page through other hardware connections.
* This esp826612e is being used for the purpose of connecting ultrasonic sensor with web application through WI-FI module esp8266. This sensor is placed on the board at which ultrasonic sensor and esp8266 is connected.
* An ESP8266 12E board is connected to the HC-SR04 Ultrasonic Sensor via digital input/output pins. The Ultrasonic sensor is attached with dustbin and detect the garbage on the dustbin. The ESP8266 Wi-Fi Module take the data from Ultrasonic sensor and send the data to the server for web application and show the garbage data in real time results
* **Smart Dustbins for Smart Cities**

International Journal of Trend in Scientific Research and Development (IJTSRD), 2019 [[7](https://www.researchgate.net/publication/333687640_Smart_Dustbins_for_Smart_Cities)]

* A system which gives greater access to the garbage disposing points (public dustbins), efficient in terms of time and fuel cost, and provide data collection facility on how much a city generates garbage and accordingly plan disposing process, and to detect wet and dry garbage in dustbin.
* Dustbin Layer: It consists of internet and Wi-Fi enabled dustbins. Ultrasonic sensor senses the fill up status of dustbin and sends it to server.  
  Server layer: Server gets the fill status of dustbin. It processes the clients query and responds with nearest dustbin location to the client and with direction to access dustbin.  
  Client layer: Clients request for the nearest location of the IoT enabled dustbin to the server using Mobile Application designed for this purpose.
* **Fixed Scheduling:** With fixed priority preemptive scheduling, the scheduler ensures that at any given time, the processor executes the highest priority task of all those tasks that are currently ready to execute. Fixed scheduling is a scheduling system commonly used in real-time systems. With fixed scheduling, the scheduler ensures that at any given time, the garbage collection van follows its schedule. In this type of scheduling no matter how much the dustbin is fill after a fixed interval van comes and collect the garbage.  
  **Priority Scheduling**: Here based on Priority that means the fill up status of the dustbin is checked and accordingly garbage gets collected. This can be used for routine check of bins for saving resources. In this scheduling according to the status of the dustbins, their priority is decided and collection of garbage is carried out accordingly. In this method, the scheduler  
  chooses the tasks to work as per the priority, which is different from other types of scheduling, for example, a simple round robin.  
  **Average Threshold Scheduling**: This type of scheduling has its own advantages and  
  disadvantages. According to the average threshold value set by the authority, if the dustbin capacity reaches this value, only than the van will collect the garbage from it. There are some drawbacks in this scheduling, as if one of the dustbins in the area reaches to its full capacity while the average of all the dustbins in the area has not reached the threshold value, the dustbin will remain unattended. To overcome that drawback we can add one algorithm as while calculating average we will only consider the dustbins which are above 50 percent filled.  
  **Full Dustbin Capacity Utilization Scheduling:** This type of scheduling is most efficient in terms of cost because garbage is collected only when all the dustbins are filled. Until all the dustbins in the area are filled to its full capacity, the garbage collection van will not come. Some dustbins which are filled to its full capacity will remain unattended. Thus, it refers to the relationship between actual output produced and potential output that could be produced with installed equipment, if capacity was fully used.

Reference:

[[1]](https://www.researchgate.net/publication/313252675_Smart_Garbage_Monitoring_System_for_Waste_Management) Smart\_Garbage\_Monitoring\_System\_for\_Waste\_Management

[[2]](https://ieeexplore.ieee.org/document/8299814) Petrol\_Level Indicator\_with\_Automated\_Audio\_Alert\_System

[[3]](https://www.researchgate.net/publication/330428120_Garbage_Monitoring_System_Using_Internet_of_Things_Methods_and_Protocols) Garbage\_Monitoring\_System\_Using\_Internet\_of\_Things\_Methods\_and\_Protocols

[[4]](https://www.researchgate.net/publication/332779949_IOT_Based_Waste_Management_System_with_Metering_for_Smart_Village_Project_Application)IOT\_Based\_Waste\_Management\_System\_with\_Metering\_for\_Smart\_Village\_Project\_Application

[[5]](https://www.researchgate.net/publication/332564972_IoT_Based_Smart_Trash_Bins_-A_Step_Toward_Smart_City) IoT\_Based\_Smart\_Trash\_Bins\_–\_A\_Step\_Toward\_Smart\_City

[[6]](https://www.researchgate.net/publication/331676073_Intelligent_System_for_Garbage_collection_IoT_technology_with_Ultrasonic_sensor_and_Arduino_Mega) Intelligent\_System\_for\_Garbage\_collection\_IoT\_with\_Ultrasonic\_sensor\_and\_Arduino\_Mega

[[7]](https://www.researchgate.net/publication/333687640_Smart_Dustbins_for_Smart_Cities) Smart\_Dustbins\_for\_Smart\_Cities