

Check Developing And Evaluating Prototype Of Waste Volume Monitoring Using Internet Of Things.pdf

by Arta Moro Sundjaja

Submission date: 24-Jan-2019 01:32PM (UTC+0700)

Submission ID: 649644242

File name: rototype_Of_Waste_Volume_Monitoring_Using_Internet_Of_Things.pdf (689.85K)

Word count: 3008

Character count: 14835

PAPER • OPEN ACCESS

DEVELOPING AND EVALUATING PROTOTYPE OF WASTE VOLUME MONITORING USING INTERNET OF THINGS

To cite this article: Mohamad Fathhan Arief and Ford Lumban Gaol 2017 *IOP Conf. Ser.: Mater. Sci. Eng.* **215** 012038

View the [article online](#) for updates and enhancements.

Related content

- 1 - [Liquid volume monitoring based on ultrasonic sensor and Arduino microcontroller](#)
M Husni, D O Siahaan, H T Ciptaningtyas et al.
- 5 - [BIG data based on healthcare analysis using IOT devices](#)
A. Priyanka, M. Parimala, K. Sudheer et al.
- 3 - [Electro-resistive bands for non-invasive cardiac and respiration monitoring: a feasibility study](#)
Gaetano D Gargiulo, Aiden O'Loughlin and Paul P Breen

DEVELOPING AND EVALUATING PROTOTYPE OF WASTE VOLUME MONITORING USING INTERNET OF THINGS

Mohamad Fathhan Arief¹ and Ford Lumban Gaol²

¹Master of Information Technology
Bina Nusantara University, Indonesia

²Doctor of Computer Science
Bina Nusantara University, Indonesia

Email :

¹fathhan.arief@gmail.com

²fgaol@binus.edu

Abstract. *In Indonesia, especially Jakarta have a lot of garbage strewn that can be an eyesore and also cause pollution that can carry diseases. Garbage strewn can cause many things, one of her dues is bins are overflowing due to the full so it can not accommodate the waste dumped from other people. Thus, the author created a new method for waste disposal more systematic. In creating new method requires a technology to supports, then the author makes a prototype for waste volume monitoring. By using the internet of things prototype of waste volume monitoring may give notification to the sanitary agency that waste in the trash bin needs to be disposal. In this study, conducted the design and manufactured of prototype waste volume monitoring using LinkItONE board based by Arduino and an ultrasonic sensor for appliance senses. Once the prototype is completed, evaluation in order to determine whether the prototype will function properly. The result showed that the expected function of a prototype waste volume monitoring can work well.*

1. Introduction

Waste strewn on the street can be an eyesore and also cause pollution, especially pollution which can carry diseases. all those problems existed in Jakarta. Therefore, the author had the idea to devise a method of transporting waste more systematic. When creating new method requires a technology that can provide the ability to give notification to the sanitary agency that waste in the trash bin needs to be disposed, so waste would not be overflow from the trash bin. Given this capabilities, the sanitary agency can inform decision more efficiency such as how many human resources and truck should be sent to the location, and when the sanitary agency could deploy for disposing the waste in that location without disturbing the activities of other people that live in that area.



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd

When constructing the waste volume monitoring prototype the author required a platform like the internet of things. Internet of things (IoT) is the latest communication model, where objects and tools of daily life will be equipped with technology to communicate, and the appropriate protocol that will enable them to communicate with each other and the user, which become an integral part of the internet [1]. In the recent paper of Harmon said [2], that IoT can describe the architecture of the integrated system between sensors, software, networks, and the appropriate interfaces that will provide real-time awareness, process, and knowledge to gather intelligence to be able to make good decisions. IoT will encourage the development of applications that has great potential in a wide range of data generated by those objects to simplify the use of the old and new services to citizen, companies and public administration, with allows easy access and interaction with a wide range of devices.

The application of IoT can be classified into various types based on network availability, size, coverage, and repeatability [3].

- Smart Home / Smart Building
- Healthcare
- Smart Business
- Utilities
- Mobile
- Environmental monitoring

The focus of this prototype is the internet of things for environmental monitoring and utilities. This waste volume monitoring prototype have a capability of sensing and distributing data so they can give an information to the sanitary agency, so they can make a better decision to manage their resources.

In order to make this new system for waste disposal, the author need an IoT platform for its base, In this paper the author used Sensor-Cloud Platform [4], this platform aims to manage physical sensor by connecting them to the cloud - or can be called cloud computing as a computing paradigm where many systems are connected each other, to provide scalable infrastructure of application and file storage [5]. And provide services such as automation data retrieval which will be submitted to the cloud to be processed and can be part of a resource.

this paper will explain of developing and evaluating waste volume monitoring prototype. what kind of devices and application this prototype used, and then the author will evaluate the function to determine whether the prototype will work properly as expected.

2. Monitoring of Waste Volume

In order to conserve the environment, important features were needed to make the environment has a degree of autonomy, adjusting to changes in the environment, and communicate with humans in a natural way. Automation that can affect the amount of interaction required by the population, as well as reducing the consumption of utilities and other potential losses [3][6].

In such an environment, waste disposal is important in order to society to live hygienically. To safeguard public health and the environment from potential harm because of the delay in disposing the waste/garbage, environmental management must be developed and implemented. Waste management is an important requirement for ecologically sustainable development in many countries [7].

With this kind of technology- waste volume monitoring prototype, will give a lot of advantages Like Bashir, A. has written, such as [8]:

1. Intelligent planning. with the waste volume monitoring technology, sanitary agency can schedule the departure for transporting waste [9].
2. Business efficiency increases. When sanitary agency can schedule their work, the use of resources can be used appropriately [10].
3. Increase the quality of life (reducing pollution due to the waste was strewn). With the reduction of pollution, the environment would be more comfortable than ever.

¹ That point shows that the new method of managing waste in an efficient way may reduce the inappropriate use of human resource, time and cost [8][10]. And also by comparing to the conventional static scheduling of transporting waste, this system scheduling are said to allow cost reduction, by reducing the number of trucks, and manual labor cost [10].

To create the prototype, the author used one sensor, which is sensor ultrasonic, a LinkItONE board, and ubidots application as a server to collect data, analyze and sending the notification.

2.1. Ultrasonic Sensor (HC-SR04)

Just like the authors of [10][11] did, in this paper the author using an ultrasonic sensor. The workings of this sensor is automatically send a signal ultrasonic periodically and will detect whether there will be a signal ultrasonic that will be reflected back to the ultrasonic sensor, if the sensor receives the reflection, the author could mentioned the time signal sent by the sensor until the sensor detects the reflected signal is called duration / time. After the authors obtain data duration / time, the author could find the distance between waste and ultrasonic sensor using this formula:

$$s = t \times v$$

which,

t = duration / time (second)

v = velocity (m/s)

s = distance (m)

in this case the author need to use the speed of sound which is 344 m/s, because sensor ultrasonic using ultrasonic sound when release a signal. After that the author need to divide by 2 because the sound had travel 2 times, one from sensor to garbage/waste, and one more from garbage/waste to sensor. And the formula becomes like this:

$$s = (t \times 344 \text{ m/s}) / 2$$

2.2. LinkItONE Board

According to wiki.seeed.cc [12] LinkIt One is a PCB board made by collaboration of Seeed Studio and MediaTek to made a prototype of devices embedded with internet of things. The specifications of LinkIt One PCB board are listed on table below.

Table 1 LinkItONE Specification

Specification	Value
Dimensions	3.3 x 2.1 inches
RAM	4 MB
Digital Output	3.3v
Analog Input	5v
DC Current per I/O pin	1mA

2.3. Ubidots

According to www.ubidots.com [13] Ubidots is an engineering services firm, specializing in hardware and software development for internet of things projects. In ubidots, the data from sensor will be analyzed and presented as a line diagram. Ubidots also provide the feature to send SMS and e-mail.

3. Methodology

By using the prototype, the author constructs a new process for new waste disposal method, there are 5 step for the new method [14][15].

Step 1 : Using the ultrasonic sensor to obtain data duration of the round trip of signal ultrasonic to the trash and back to the sensor again. This phase will be carried out periodically, so the available data will continue to generate real-time data.

Step 2 : after that, the data of duration receive by the PCB, then the PCB will do the calculation process to obtain the distance between the sensor and waste/garbage.

Step 3 : Distance data will be received by the ubidots to be managed and processed so it can be seen and read by users with ease.

Step 4 : Then Ubidots will process the distance data to be measured, if the distance data exceed or equals to the predetermined value of the limit, it will proceed to the next step, but if it turns out not reach out to the predetermined value, then it will go back to the first step.

Step 5 : Ubidots will generate notification alert if waste bin already reached the point of full and the garbage/waste need to be disposed.

3.1. Data Resources

In this study the author conducted trials using waste volume monitoring prototype that the authors created. The data consist of time, distance, and the sent of notification alerts. 3 sessions will be conducted trials which have different condition, ie:

1. At the time when waste bin is empty
2. At the time when waste bin will be filled with trash periodically until half full.
3. At the time when waste bin will be filled with trash periodically until reach the limit value that have been set.

Where, the first session will take 30 data based on roscoe said that in the experimental study recommended 30 samples or more [16]. As for the trial of the 2nd and 3rd only done 10 times due simply to see whether the function of waste volume monitoring are work properly.

3.2. Evaluation

When conducting this evaluation the author has a target whether the waste volume monitoring technology would function properly. therefore in this study the author conducted three trials, in which trial has a different assessment requirements.

In the first trial whether the monitoring waste volume prototype can give the exact distance data as expected, by calculating the accuracy of the results using this formula:

$$Accuracy = \frac{b}{a} * 100\%$$

Where,

- b is number of correct data
- a is amount of data from the trial

The second trial is whether this prototype can give actual distance data in real time. And for the 3rd trial the author wanted to know whether the function of notification alert will be sent successfully in accordance with a predetermined distance.

4. Result

In this study the author use a container that has a length of 30 cm, width 27 cm, and 36.5 cm high with volume of 29565 cm³. In the first trial the author get a result like in the table below:

Table 2 Result of the second trial

No.	Time	Distance of trash with sensor (in cm)	Notification alert
1	8:00	36.50	-
2	8:05	36.50	-
3	8:10	36.51	-
4	8:15	36.50	-
5	8:20	36.47	-
6	8:25	36.50	-
7	8:30	36.50	-

8	8:35	36.50	-
9	8:40	36.50	-
10	8:45	36.52	-
11	8:50	36.50	-
12	8:55	36.50	-
13	9:00	36.50	-
14	9:05	36.52	-
15	9:10	36.50	-
16	9:15	36.50	-
17	9:20	36.50	-
18	9:25	36.50	-
19	9:30	36.50	-
20	9:35	36.50	-
21	9:40	36.49	-
22	9:45	36.50	-
23	9:50	36.50	-
24	9:55	36.50	-
25	10:00	36.50	-
26	10:05	36.50	-
27	10:10	36.42	-
28	10:15	36.50	-
29	10:20	36.50	-
30	10:25	36.50	-

From the table above can be seen that, this prototype get the numbers 36.50 cm for 24 times (result with red font) from 30 result data, With the height of the container used is 36.50 cm. with the calculation of accuracy that have been discussed in the evaluation, this prototype have 80% of accuracy.

In the 2nd trial the author get result like the table below:

Table 3 Result of the second trial

No.	Time	Distance of trash with sensor (in cm)	Notification alert
1	11:00	36.47	-
2	11:05	33.38	-
3	11:10	30.47	-
4	11:15	28.52	-
5	11:20	26.49	-
6	11:25	25.58	-
7	11:30	24.43	-
8	11:35	24.43	-
9	11:40	22.52	-
10	11:45	23.42	-

From the table above can be seen that distance from sensor and trash are going smaller from 36.47 cm to 23.42 cm. prove that the prototype can provide data in real time without error.

And for the last trial the result are like this:

table 3 Result of the third trial

No.	Time	Distance of trash with sensor (in cm)	Notification alert
1	12:00	22.51	-
2	12:05	20.37	-

3	12:10	17.45	-
4	12:15	15.57	-
5	12:20	14.49	-
6	12:25	13.49	-
7	12:30	12.51	-
8	12:35	10.43	-
9	12:40	8.58	✓
10	12:45	8.43	✓

Can be seen that at the result of number 9 and 10 the notification has been sent. Prove that the main function of this prototype is work properly.

5. Conclusion and Suggestion

Based on the research that has been done, the prototype of monitoring the waste volume can function well up to receives notifications alert when a container filled up, Can be seen from the table in chapter 4. So with this prototype sanitary agency can use a new method of waste disposal.

Although the prototype of monitoring the waste volume had given a good results, there remains some suggestions for development. As it takes its expert systems in order to make a better system and prevent errors that might occur later. It also calls for additional technologies such as GPS to detect trash anywhere and temperature sensor for more actual data of distance calculation.

References

- [1] Zanella, A., & Bui, N. (2014). Internet of Things for Smart Cities. IEEE INTERNET OF THINGS JOURNAL, Vol. 1, No. 1, pp. 22 - 32
- [2] Harmon, R.R., Enrique, G., & Bhide, S. (2015). *Internet of Things. 2015 Proceedings of PICMET '15: Management of the Technology Age*, pp. 485 -494
- [3] Hallaj Asghar, M., Mohammadzadeh, N., & Negi, A (2015). Principle Application and Vision in Internet of Things (IoT)
- [4] Petrolo, R., Loscri, V., & Mitton, N. (2014). *Towards a Smart City based on Cloud of Things*. Inria Lille – Nord Europe, France.
- [5] Torry Harris. CLOUD COMPUTING – An Overview. <http://www.thbs.com/downloads/Cloud-Computing-Overview.pdf>
- [6] Sajal, K., & Cook, J. (2010). *Designing Smart Environments: A Paradigm Based on Learning and Prediction*. Department of Computer Science and Engineering University of Texas at Arlington.
- [7] Glouche, Y., & Couderc, P. (2013). *A Smart Waste Management with Self-Describing objects*. The Second International Conference on Smart System, Device and Technologies, No.1, pp. 63 – 70
- [8] Bashir, A. (2013). *Concept, Design and Implementation of Automatic Waste Management System*. International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 1, Issue. 7, pp. 604 – 609
- [9] Navghane S.S., Killedar M.S. (2016). IoT Based Smart Garbage and Waste Collection Bin. IJARECE, Vol 5, Issue 5
- [10] Yusof, N.M., Jidin, A.Z., & Rahim, M.I. (2016). Smart Garbage Monitoring System for Waste Management. MATEC Web of Conferences 97, 01098 (2017).
- [11] Monika, K.A., Nikitha Rao, Prapulla, S.B., & Shobha, G. (2016). Smart Dustbin-An Efficient Garbage Monitoring System. IJESC Volume 6 Issue No. 6
- [12] http://wiki.seeed.cc/LinkIt_ONE/
- [13] <http://www.ubidots.com/about>
- [14] Parkash, Prabu. V. (2016). IoT Based Waste Management for Smart City. IJRCCE, Vol. 4 Issue 2
- [15] Vikrant Bhor. (2015). Smart Garbage Management System. IJERT, Vol. 4 Issue 03

[16] Roscoe. (1975). <http://sola.siu.ac.th/sola/public/FacSites/GE1701/reading/Sampling.pdf>

Check Developing And Evaluating Prototype Of Waste Volume Monitoring Using Internet Of Things.pdf

ORIGINALITY REPORT

81%

SIMILARITY INDEX

10%

INTERNET SOURCES

79%

PUBLICATIONS

9%

STUDENT PAPERS

PRIMARY SOURCES

- 1 Mohamad Fathhan Arief, Ford Lumban Gaol. "DEVELOPING AND EVALUATING PROTOTYPE OF WASTE VOLUME MONITORING USING INTERNET OF THINGS", IOP Conference Series: Materials Science and Engineering, 2017 **74%**
Publication
- 2 Submitted to Universitas Negeri Surabaya The State University of Surabaya **4%**
Student Paper
- 3 china.iopscience.iop.org **1%**
Internet Source
- 4 Submitted to Universitas Diponegoro **1%**
Student Paper
- 5 H Bahron. "Research Frontiers and Way Forward", IOP Conference Series: Earth and Environmental Science, 2018 **1%**
Publication

Dr. Haider Kadhim Hoomod, Sadeem Marouf

6

M. Al-Chalabi. "Achieving Real-Time Tracking
Mobile Wireless Sensors Using SE-KFA",
Journal of Physics: Conference Series, 2018

Publication

<1%

7

www.scribd.com

Internet Source

<1%

Exclude quotes On

Exclude matches < 5 words

Exclude bibliography On