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Smart Garbage Based on Internet of Things (IoT)

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Abstract. Trash is one of serious problems in Indonesia. It leads to another problems which deal with social, culture and economic, most of cities inindonesia have some problems in managing the trush. It is because the government doesn't have the standard of trash management. The schedule to take the trash usually discover a problems with a lateness. The lack of trashmanagement and people's habbit who don't care about the trash impact effect to more serious problems that dealwith the trash. Such as, enviromental problems. Based on the problems the researcher makes a system called "Smart Garbage Based On *Internet of things*". The system applies the technology of temporary garbage used internal system. This system creates in order to fix the problem of punctuality. Which makes the trash management more effective and afficient. The process of uploading the information in the internal awerness of based on the "real time" ativity this system can increase the peurity and health. Because the trash is controlled and not aculamulated arround people. The ultrasonic sensor and nodeMCU are used as a module of IoT to discover the temporary garbage. Grapical user Interface dekstop and android are also used in order to observe the level of trash in temporary garbage. The notification system can be access in mobile and dekstop interface. Furthermore the temporary garbage location can find by using google map the result of research shows that the system is running well. The system can onilne 12 hours/day along 2 weeks in exsperiment. The data sent by online based on "real time" activity and the result of mapping and tracking on android show the location of garbage.

1. Introduction

Indonesia is the one of the country which has problem surroundings, especially of trash. Eventually, trash become the serious problem to all of the society, it's caused, the amount of the trash which resulted pile up from day to day. It's caused by the high of human productivity, increasing the amount of society, and the availability of the human living space which limited. The trash problem is often ignored by the. The trash is often thrown away or trash and or burned without think about how the effect to the environment. [1] Until now, trash still the problem surrounding which not yet solved to the big cities in Indonesia like as Jakarta, Surabaya, Bandung etc. This problem appear because the increasing of trash productivities, the limited land to final elimination, as well as delays of the schedules of removal garbage until the garbage pile up and cause many problem in the environment. [2] According to survey department oh hygiene Surabaya stated that the problem encountered in transporting waste as follows [3]:

1. The using of work time which is not efficient
2. The using load capacity of the vehicle which is not right
3. The route of carriage of which is not efficient

The problem which will discuss in this research is the delays in garbage transportation which full in the shelter trash temporary (garbage) and act of determining the route trash transportation which

efficiently. The system of trash transportation which there now is trash employee just trade on the week schedule whereas if trade on this schedule there are probability the trash in the a matter of days had been full but still is not yet picked up to TPA (final shelter trash) as well as the route which pass by trash employee just trade on the stripe which appropriate with only the trash location. It's cause the trash will pile up in the city and caused many problem environment as follows, [1]

1. The decrease healthy of the society
2. Occur many disease which caused by trash.
3. The trash which had been the maximum place will spilled out from the container of trash and very disturb hygiene and beauty surroundings

From this problem, made the system smart garbage which the basis internet of things. It is the system organizer trash which give priority to precision time in take the trash which had been full on the shelter trash temporary. Without must to wait the trash pile up or exceed limit. The reading condition of when the trash is full using the ultrasonic sensor and arduino as the data organizer. The system of notification when the trash must take which had been full using online monitoring with exploit the internet connection. When the trash in the garbage was full so the trash employee that directly take this trash. In addition there are notification the full of the trash with automatic, the system also can directly determine the near stripe at trash can which was full with google map.

2. Methods
2.1. Trash
The trash is outcast which the result of the process of production either industrial or domestic. While in UU no 18 year 2008 about the organizer trash, mentioned that trash is the residue of the human daily activity or the nature process which solid or semi-solid like organic or anorganic essence is able to decompose or may not decompose which that are considered not useful anymore and thrown away into the environment [4]. The trash comes from some place that is waste from the residential area, the kind of waste produced usually tend to be organic such as food waste or garbage that is wet, dry, grey, plastic etc. The type of trash that is produced generally in the form of leftover food, rotten vegetables, dry waste, grey, paper plastic and cans as well as other junk. Inorganic trash can be divided into: metal trash and dairy products trash plastic, trash paper, trash glass and ceramics [2].

2.2. Internet of things
The internet of things (loT) was first introduced by Asthon in 2009. loT can be described as 1 set of things connected through the internet . Things here can be in the form of tags, sensors, human etc. Internet of things or also known by the acronym loT, is a concept that aims to extend the benefits of internet connectivity which is connected continuously [5]. As for capabilities such as data sharing, remote control, monitoring and so on, including also on objects in the real world. For example food, electronic, collection, equipment anything, including living things everything is connected to local and global networks trough sensors embedded and always active [6]. The ability of the loT to communicate with each other this makes the loT can be applied in all fields [7]. In field of health, sensors, the loT can be used to monitor the condition of the patient, so that the condition of the patient remains monitored for 24 hoursS [8]. In agriculture, the loT can be used as sensors to monitor soil conditions, temperature and moisture are important for plants. In the field of smart building loT can be used to monitor the electricity usage of each building [9]. In addition, loT can also be used in the fields of automation, transportation, smart grid and other [10]. The concept of the loT is quite simple with the way of working refers to the 3 main elements on the architecture of loT, namely: Physical goods that are equipped module loT. Devices connection to the internet such as a modem and router wirless speedy as at home, and the cloud data center is an ideal place for storing application and data base [11].

3. Results and Discussion

3.1. Sensory test

Testing of ultrasonic sensor on the type of trash is find out how precision sensors when the surface and properties of the detected objects are different. The experiments were starting from the type of plastic waste, Paper, Foliage, Iron and mixed waste. Here is the documentation of sensor testing shown in Figure 2.

Figure 1. Sensory test

The experiment by measuring one by one type of trash and comparing the measurement result of the sensor before it was filled with the result of sensor after being filled with different types of trash. Here is the result of sensor readings shown in table 2.

Table 1. Ultrasonic Sensor Testing Results.

No	Type of Trash	Set Level (cm)	Sensor readings (cm)	Difference (cm)
1	Plastic	20	20 ± 2 (18 - 22)	4
2	Papers	20	20 ± 1 (19 - 21)	2
3	foliage	20	20 - 21	1
4	Iron	20	20 + 21	1
5	Mixing	20	20 ± 2 (18 - 22)	4

From the results of table 2 above can be concluded that the readings of sensor that show the most precise value is when measuring the type of waste foliage and iron. This is because the surface of the waste is more flat, while the sensor readings on the type of plastic waste, paper and mixture shows the difference in larger numbers. This is due to the irregular trash surface.

3.2. Delay Communication Testing

Delay is a time lapse comparison that occurs when there is data sent from one system to another. Delay testing in this study aims to find out how long the time lapse that occurs when the sensor sends data from the field to the show in the GUI. Delay System test results are shown in table 3.

Table 2. Testing Delay Communication

No	Data	Delay (s)
1	Sensor – Ubidots	2
2	Ubidots – GUI	4
3	Sensor - GUI	1-3

From table 3 can be concluded that the system delay has a value between 1 - 3 second. It is also influenced by the speed of the internet.

3.3. GPS Tracking Testing

In addition to displaying the location where the full TPSS GUI android can also do tracking the full garbage of google map. Here is a GUI view when tracking the path taken at the location of TPSS Telkom Kamal.

Figure 2. Testing GPS Tracking

3.4. Implementation Testing

Tests on 3 prototypes in 3 locations, Kampus, Perumnas Kamal and Telkom Kamal. Goals of Testing is the system can work or not. Here is the result of system testing.

3.4.1 The first test was at the Trunojoyo Madura University Electrical Laboraturium for 5 days.

Figure 3. Testing on Campus

And here are the tables 4 that show the test results on campus.

Table 3. Campus Testing Results

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	63	10	Fillled
3	13	60	Full
4	70	0	Empty
5	10	64	Full

From the results of the test obtained that during the test on Campus Trash has been full as much as 2 times.

3.4.2 The second test was in Perumnas Kamal for 5 days.

Figure 4. Test at Perumnas

And here is table 5 that shows the test results during the perumnas.

Table 4. Perumnas Testing Results

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	65	6	Fillled
3	65	6	Fillled
4	53	25	Fillled
5	15	64	Full

From the results of the test obtained that during the 5-day test in Prumanas Kamal Trash has been full as much as 1 times.

3.4.3 The last test was conducted in Telkom Kamal for 5 days.

Figure 5. Testing in Telkom

And here is table 6 which shows test result during Telkom.

Table 5. Results Telkom Testing

Day Of	Sensor (cm)	Level (cm)	Condition
1	70	0	Empty
2	75	0	Fillled
3	65	6	Fillled
4	60	12	Fillled
5	35	32	Fillled

From the test results obtained that during the 5-day test at Telkom Kamal Trash Can not show full condition.

3.4.4 Testing when 3 full together

In this test phase the authors conducted experiments by giving the full condition at 3 TPSS available. That is TPSS Campus, Telkom, and Perum. This experiment to see what the system will do when the 3rd TPSS is full together. In the testing process 3 TPSS reports the full state to the android and desktop interfaces.
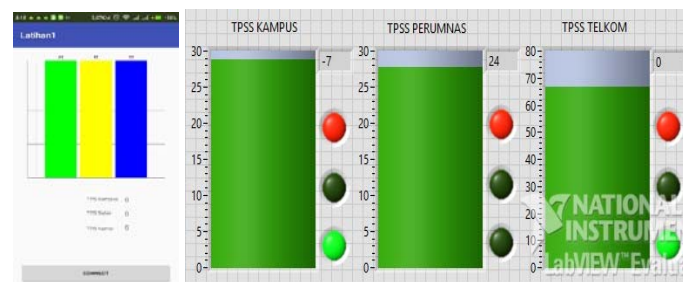

Figure 6. Android and dekstop Interface

Test results in the interface andarioid show there are 3 notifiers at once and each notif will connect to google map to show the location where garbage is full. In this case the system does not show which garbage location full first but the system only gives notif depending on the condition of garbage. Whereas in the desktop interface the full TPSS location appearance is only selected whichever TPSS is first, if there is more than one location indicated there will be only one garbage.

4. Conclusion

Based on the results of design, implementation, and exsperiment of the system that has been made conclusion as follows:

1. The results of this research can create a temporary garbage system (TPSS) in a timely.
2. Delivery of data in real time can be used the method of Internet of things, the method of sending data via the Internet that will be stored in the cloud server and can be accessed again at any time.
3. The results of ultrasonic sensor readings the type of trash show different results, the average error obtained is worth 1-2 cm. It is influenced by the surface of waste that is not always flat.
4. The results of the testing delay delivery of the data shows that in every change of data between a sensor contained in the field to appear in the GUI desktop and andarioid has a value of 1-2 seconds.
5. Resistance of the system shows satisfactory results because the system can survive during the testing period i.e. for 2 weeks. Resistance of the system shows satisfactory results because the system can survive 12 hours per during the 2 weeks of testing.

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