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Design of Automatic Organic Fertilizer Processing Tools by Utilizing the Internet of Things (IOT) as a Monitoring System

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ABSTRACT

This paper aims to design an automatic organic fertilizer processing tool by utilizing the Internet Of Things (IOT) as a monitoring system. The proposed tool system aims to make it easier to sort organic waste or inorganic waste which can then also automatically process organic waste into organic fertilizer. The method used is a literature survey conducted to solve relevant problems. At this stage, a data collection survey is carried out by utilizing previous research sources from books, journals, and the internet. We used this literature review to enable us to update the tool from previous research. The proposed system uses ESP 32 module as a microcontroller that can connect to WiFi. In addition, it has also been introduced in the Internet of Things (IOT) as an automatic monitoring system for organic fertilizer processing plants. Garbage download information is sent via the internet and returned to the Android application. However, in this study, one application, namely WhatsApp, was used. Garbage has long been a social problem, especially in big cities, polluting the environment, endangering public health, and reducing environmental aesthetics. Therefore, waste management is important to minimize the negative impact of waste. Finally, the research results obtained can be useful as technological development in the future of automatic organic waste processing equipment.

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1. INTRODUCTION

The best trash bin is one that can accommodate both wet and dry waste. In 2016, 56% or 423 million tonnes of household waste were recycled in the European Union. Also in 2016, 24% or 179 million tonnes of locally produced waste was disposed of in the European Union. The report does an excellent job of showing the importance of proper waste management in the recycling process [1]-[5].

Android based Trash Tracker [6]. Trash download information is sent via the internet and returned to the Android application [7]. However, one of the applications used in this study is WhatsApp. Waste segregation is one way to improve waste management. Waste that has been separated can be better processed and reused as raw material for new products or as fertilizer to nourish plants. Automatic waste separation is an innovative solution for more efficient waste disposal [8]-[10]. These bins automatically separate waste with the help of camera and sensor technology.

Built-in machine learning algorithms also help sort more waste into the bin over time. Majalengka has an automatic waste sorting box titled “Smart Waste Sorting Prototype Design for Organic and Inorganic Waste Using Arduino” by Muhammad Yunus. An automatic waste sorting system is a system designed to automatically sort waste by type using technologies such as cameras, sensors, and machine learning algorithms. In this final project, the author makes an automatic waste sorting box and adds automatic processing of organic

waste as fertilizer. Organic waste processing is one way to reduce environmental impact and improve waste management efficiency.

According to the World Bank.org, in 2018 the biggest waste was food waste, 44% from leaves and vegetables, 17% from paper and cardboard, and 12% from plastic waste. Organic waste, paper and plastic waste are the three most common types of municipal solid waste composition. Solutions for waste sorting, disposal or reuse are essential. Of all waste, at least 4% is recycled plastic waste, 34% paper waste and 22% metal and glass waste [11]. By processing organic waste into compost or biogas, not only can this waste be utilized as a useful raw material, but also the amount of waste processed can be reduced [12]. Disposing of organic waste is one way to reduce environmental impact and improve waste management. With professional separation and treatment of organic waste, organic waste can be utilized as reusable raw materials such as compost and biogas [13].

Compost is a product obtained from the decomposition of organic waste by microbes. Inorganic waste is waste that consists of substances that cannot be decomposed by microorganisms. Inorganic waste is one of the most damaging types of waste and can cause environmental pollution if treated properly [14]-[16].

Sensors are devices for detecting and measuring various physical parameters such as temperature, pressure, humidity, and brightness. These sensors can be used in various applications such as security systems, navigation systems, and climate control systems. A photodiode proximity sensor is a kind of proximity sensor that uses optical principles to detect nearby objects. This sensor consists of a light emitting diode used to receive light and a light source used to emit light. Ultrasonic sensors are sensors that convert physical variables (sound) into electrical variables and vice versa [17]. The operation of this sensor is based on the principle of reflecting sound waves and is used to interpret the presence (distance) of objects at certain frequencies.

Microcontroller is a microcomputer circuit that is physically provided in the form of an IC (Integrated Circuit) [18]. Microcontrollers are usually used in systems that are small, inexpensive, and do not require very complex computing, such as computer applications [19]-[21]. The ESP32 is a microcontroller introduced by Espressif System and the successor to the ESP8266 microcontroller. One of the advantages of ESP32 is that it already has Wi- Fi and Bluetooth, making it easier to build IoT systems that require wireless connectivity [22]. The ESP32 version is an upgrade from the ESP8266 as this feature was not present in the ESP8266 [23]. Motors consist of AC motors, servo motors and pump motors. An alternating current (AC) motor is a type of motor that uses alternating current as its power source.

A servo motor is a rotating device or drive (motor) with a closed-loop feedback control system (servo) that can be set or adjusted to determine and ensure the angular position of the motor output shaft. A pump motor is a motor that drives a pump. Motor pumps are used in a variety of applications such as sanitation, mining, agriculture, fishing, construction and industry [24]-[25]. A monitor is an output device for displaying visual information on your computer. A 16×2 LCD (liquid crystal display) is a display device or screen made of liquid crystal material as the main display device. A 16×2 LCD can display up to 32 characters in two lines with 16 characters per line. Android provides developers with an open platform for building applications. The Android SDK is an API (Application Programming Interface) tool required to develop Android platform applications using the Java programming language [26]-[28]. Internet of Things (IoT) is a concept/scenario in which objects can transmit information over a network without requiring human-to-human or human-to-computer interaction [29]-[32].

The basic concept of IoT is the presence of node devices in the form of embedded intelligent systems that detect and control various physical objects around a person [33]-[36]. These nodes are interconnected through the internet network and are able to communicate and work together to achieve common goals [37]-[40].

In this final project, it is different from previous research, namely using the Whatsapp application which is used as a monitoring system that sends notifications where the notification is in the form of a report received by the tool. In addition, this tool adds automatic processing of organic waste which has never been made before.

2. METHODS

The research begins with the methods used ranging from research time, type of research to data collection which is then consulted. After that, the design is carried out where in this design method the tools and circuits are designed in the form of input, process, and output system designs which can be seen in Fig. 1. Furthermore, the tool testing method includes collecting data on the test results by testing the capabilities of the tool.

a. Time and place of research
   The research began in April to June, located in Jl Ariodillah 1 Palembang.
b. Literature review

Literature study is the steps to solve related problems. A data collection survey is conducted at this time to identify previous research sources from books, journals and the internet. To enable this literature review to update previous research tools.

c. Observation
The observation method is an appropriate data collection method applied, direct observation and investigation to capture the situation in the research field and to demonstrate the correctness of the research plan to be carried out.

d. Consultation
The consultation method is a way to share insights and exchange ideas to reach a solution or conclusion. This consultation method allows us to create a more functional tool.

e. Design
In this design method, tools and circuits are designed in the form of input, process, and output system designs. The design stage consists of two stages, namely: hardware design and software design the flowchart of the desired tool work system is as follows. Flowchart of the circuit shown in Fig. 1.

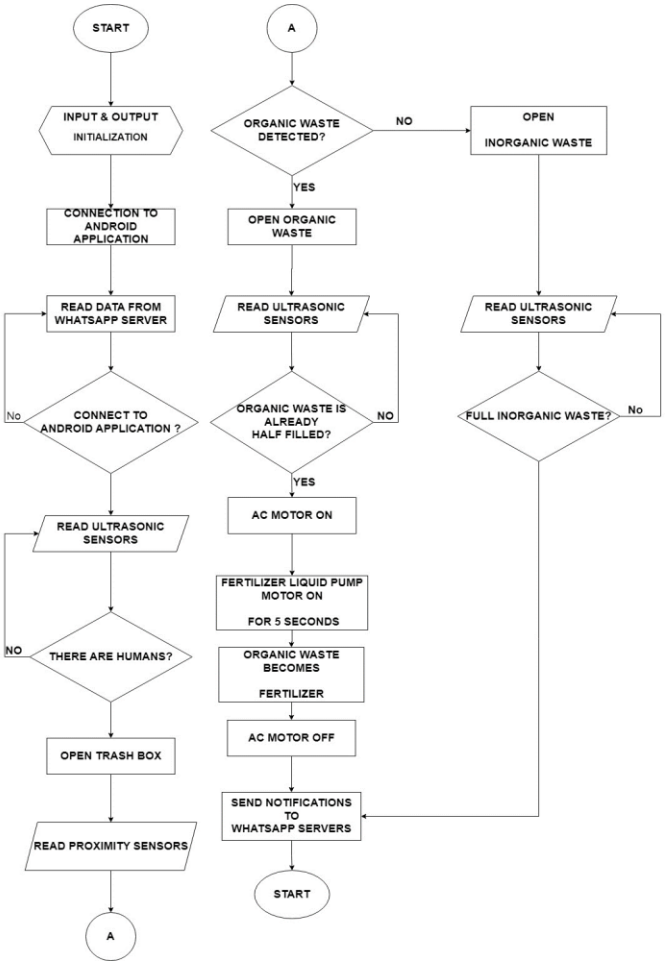

Fig. 1. Flowchart of the circuit

f. Tool Testing
The tool testing method includes collecting data on the test results by testing the ability of the tool to distinguish between organic and inorganic waste, testing the accuracy of the sensor, and testing the ability of the tool to convert organic waste into fertilizer.

2.1. Hardware Design

Hardware design begins with the creation of a system design scheme. Hardware design block diagram shown in Fig. 2. The hardware design is designed using an ESP32 microcontroller connected to a proximity

sensor, ultrasonic sensor, android, 16×2 LCD, relay module that drives servo motors, ac motors, pump motors which are then connected to a power supply directly connected to PLN.

2.2. Software Design

The software is designed as a monitoring tool for automatic organic waste processing using the internet of things (IOT) as a monitoring system in the form of direct notification to android on the whatsapp application. To connect the whatsapp application to the ESP32, an API code in the form of a whatsapp message is required.

The software design is divided into several stages, as follows: Software design is divided into several stages, namely:

a. Creating a user interface on Whatsapp bot.
b. Open the Playstore menu on the Smartphone and search for the Whatsapp application then install it until it is complete.
c. Open the Whatsapp application, the login screen will appear and click Create New Account. Enter an active cellphone number. After that, the Whatsapp application will send activation to the previously registered number.
d. After logging in successfully type Whatsapp Bot, fill in the destination cellphone number and select the device used, namely ESP32.
e. Then a reply Whatsapp message will appear in the form of an API code.
f. This API code will later be used to connect ESP32 with the Whatsapp Bot application.

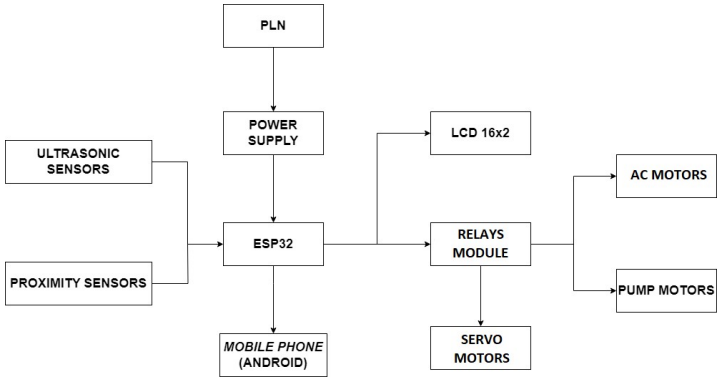

Fig. 2. Hardware design block diagram

3. RESULTS AND DISCUSSION

The design of an automatic organic fertilizer processing device using the Internet of Things (IOT) as a monitoring system has produced a device that can automatically separate organic and inorganic waste, and process organic waste into fertilizer automatically. The organic and inorganic waste separator has already been made by previous researchers, which I then developed by adding organic fertilizer processing automatically In addition, the tool can provide automatic notifications on WhatsApp when the inorganic waste bin is full, organic waste has been processed, and organic fertilizer is ready for use. Below is an image of the result of the proposed toolkit.

The Fig 3 is a series of components of an automatic organic fertilizer processing tool by utilizing the Internet Of Things (IOT) as a monitoring system. From the circuit in Fig 3, it can be seen the connection from one component to another so that the tool can be run.

Fig. 4 shows the results of components that have been assembled and connected to run an automatic organic fertilizer processing tool by utilizing the Internet Of Things (IOT) as a monitoring system. In the circuit there is an ESP 32, 16×2 LCD, relay, stepdown and cables that connect these components.

Fig. 5 is the front of an automatic organic fertilizer processing tool using the Internet Of Things (IOT) as a monitoring system. On the front of this tool there is an ultrasonic sensor that is useful for detecting people who will throw away garbage.

Fig. 6 shows the inside of the automatic organic fertilizer processing tool by utilizing the Internet Of Things (IOT). In this section there are two garbage boxes, namely organic waste boxes and inorganic waste boxes, besides that there are AC motors, motor pumps, servos and cables that connect to the component boxes.

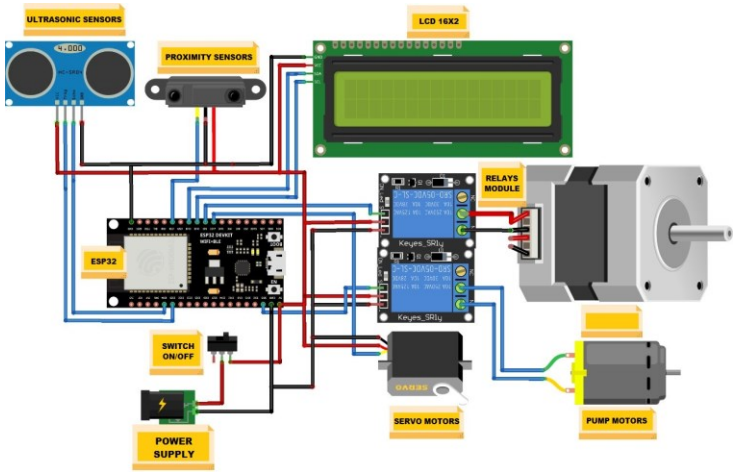

Fig. 3. Tool set results

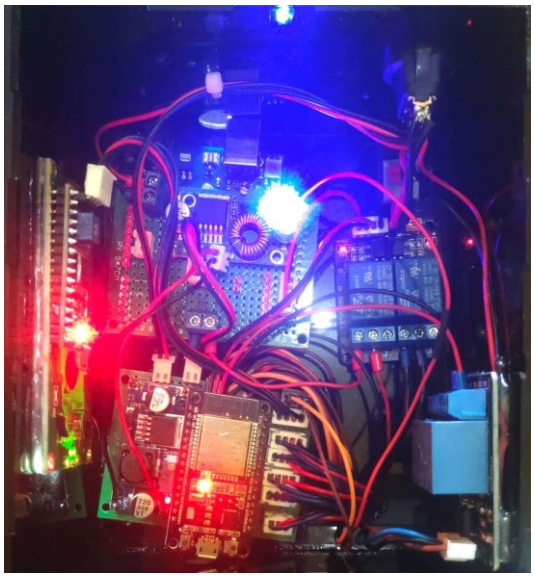

Fig. 4. Results of the automatic organic fertilizer processing tool range

Fig. 5. Front view of automatic organic fertilizer processing tool design results

Fig. 6. Inside view of the design of automatic organic fertilizer processing tool

The results of the waste sorting test were carried out by adding organic and inorganic waste alternately, and at the same time experimenting with feeding organic and inorganic waste simultaneously. The capacitive proximity sensor will detect incoming organic waste while the infrared sensor will detect incoming inorganic waste. Waste that has been detected by the capacitive or infrared proximity sensor will be moved by a servo motor which will then enter the organic or inorganic waste box. Waste sorting test results shown in Table 1.

Table 1. Waste sorting test results

No	Waste		Capacitive Proximity/Infrared Sensor	Servo Motor	Total Waste	
	Organic	Inorganic			Organic	Inorganic
1	Yes	-	Detected Capacitive Proximity Sensor	Yes	1/4	-
2	-	Yes	Infrared Sensor Detected	Yes	1/4	1/4
3	Yes	Yes	Infrared Sensor Detected	Yes	1/4	1/2
4	-	-	Not Detected	-	-	-

The test results of organic waste processing are carried out by looking at the condition of the waste detected by the ultrasonic sensor, when the ultrasonic sensor detects the condition of the waste, the AC motor and pump motor will turn on automatically. Testing results of organic waste processing shown in Table 2.

The results of testing the data sent to the Whatsapp application using the Internet Of Things (IOT) with NodeMCU Esp32. Data transmission in the form of this notification occurs if organic waste or inorganic waste enters and is detected by a capacitive proximity sensor and an infrared sensor. Then the data sent is also in the form of notification that inorganic waste is full, organic waste is being processed and organic fertilizer is ready. Results of incoming notification data to Whatsapp App shown in Fig. 7.

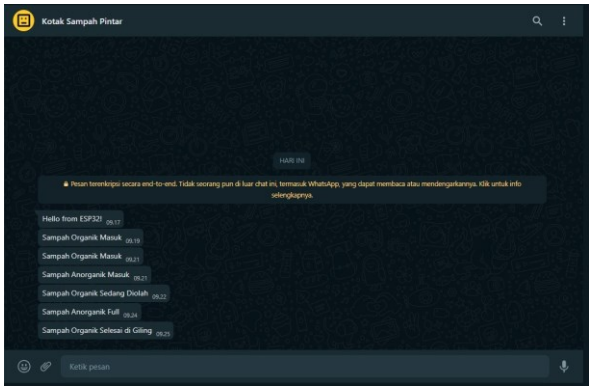

Fig. 7. Results of incoming notification data to Whatsapp App

Table 2. Testing results of organic waste processing

No	Garbage Condition	Ultrasonic Sensor	AC Motor	Pump Motor
1	1/4	Successful	OFF	OFF
2	1/2	Successful	OFF	OFF
3	3/4	Successful	ON	ON

The test results of sending notification of the organic waste processing process were successfully sent with 30 seconds and the notification of full inorganic waste detection was successfully sent with 45 seconds. Testing results of organic waste processing shown in Table 3.

Table 3. Testing results of organic waste processing

No	Testing	Notification Delivery Time	Description
1	Organic Waste Processing Process	30 sec	Successful
2	Full Inorganic Waste Detected Process	45 sec	Successful

4. CONCLUSION

The design of an automatic organic fertilizer processing tool by utilizing the Internet Of Things (IOT) as a monoring system from the results of testing and analysis can be concluded that the tool can sort organic and inorganic waste automatically which is sorted by capacitive proximity sensors and infrared sensors to facilitate waste processing. Waste detected by a capacitive or infrared proximity sensor will be moved by a sevo motor which is then inserted into an organic or inorganic waste box. In addition, the tool can automatically process organic waste into fertilizer which is processed using an AC motor which is also given fertilizer liquid using a motor pump. The results of testing the processing of organic waste that starts after the ultrasonic sensor detects garbage in 3/4, the AC motor and pump motor turn on automatically and work properly.

The results of testing the automatic organic fertilizer spreader using IoT as a monitoring system through Nodemcu ESP32 connected to WhatsApp show successful notification. Notifications are sent in the form of reports when organic and anoragic waste is detected which then goes into organic or inorganic waste, in addition to notifications in the form of reports when organic waste is processed into fertilizer and organic waste has become fertilizer.

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