

# Establishing the Interface for G-Bot Monitoring and Controlling System

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## ABSTRACT

Garbage is a worldwide problem that has not been fully handled, including in Indonesia. As citizens, the human has an obligation to dispose the garbage properly, however, there are so many people who still do not care about this problem. In this situation, The author introduces the Garbage Robot (G-Bot) which can be controlled from further place. This G-Bot works based on the Internet of Things (IoT) in which it can connect things so that they may operate together. This G-Bot can be controlled using some devices, such as: mobile phone, PC, and laptop. However, how to establish the interface for the G-Bot monitoring and controlling system is still a problem. Therefore, this paper proposes the interface design for the G-Bot. Using this interface, it is hoped that the G-Bot can be monitored and controlled using the user's devices from further place. The G-Bot may go from one place to another place using speech recognition, human followers, and user manuals instructions that have been integrated in the devices. In addition, the interface design in this proposed method also includes the menu of the environmental monitoring, such as temperature, humidity, and air quality.

**Keywords:** *Garbage, G-Bot, IoT, Environmental Monitoring, Controlling, Human Follower, Speech Recognition*

## 1. INTRODUCTION

Garbage is a material that comes from sources resulting from human or natural activities which is a major global problem and has not been completely resolved [1], [2], including in Indonesia. Many people still is not aware of the effect of the garbage to the health [3]–[6]. The habit of throwing the garbage to the improper place poses a serious threat to human life [7]–[10].

Actually, the habit of disposing garbage to its place is the obligation of all of the citizens. However, the habits are sometimes still be constrained by human limitations. Therefore, an effective, efficient and innovative way should be made to help the community in disposing the waste. In this research, garbage robots (G-Bots) that provide organic and inorganic garbage compartments are introduced. The G-Bot also provides an indicator if the waste capacity is almost full. In addition, it also displays the information of the temperature, humidity, and the air quality.

The G-Bot works based on the Internet of Things (IoT). It is designed to increase the efficiency and the

effectiveness in controlling G-Bot remotely. Through this system, the G-Bot can be controlled through android software. It can be moved from one place to another either through speech recognition, human followers, or user manuals commands. The G-Bot also provides the information of temperature (°C), humidity (RH), air quality (PPM), organic and inorganic waste capacity (%) via android software and platform that can be monitored in real-time. However, how to establish the interface so that the users device can communicate with the G-bot is still a problem. Thus, this paper proposes the interfaces that can be applied to the G-bot.

## 2. METHODOLOGY

The G-bot is designed using some electronic components as shown in **Figure 1**. The voltage source comes from the Battery, which supplies all components, except for the Raspberry Pi 4, which uses a PowerBank with a voltage of 3V. The input sensors from the G-Bot are Ultrasonic HC-SR04 sensor, DHT22 sensor, MQ-8 sensor, Compass sensor HMC5883L, TCS3200 color sensor and Webcam. While the outputs of the G-Bot are

a 20x4 LCD display, PG45 Motor and MG996 Servo. The input sensor value data will be read by the Arduino Mega 2650 microcontroller and sent to the Raspberry Pi 4. Then, the collected data is sent in real-time using an internet connection to the data cloud, which in this case it is the hosting. Then, it will be displayed on the web interface and mobile software phone. In this case, the access for monitoring can be done through devices, such as: mobile phones, laptops and Personal Computers (PCs) that have a browser installed and connected to the internet. As for controlling the Garbage Robot (G-Bot), the mobile phone must have a G-Bot application installed and connected to the internet, so that it can monitor the Garbage Robot (G-Bot) anytime and anywhere.

In the G-Bot monitoring block diagram, **Figure 2**, there are inputs in the IoT device, namely temperature (°C) and humidity (RH), DHT-22 sensor, air quality (PPM), MQ-8 sensor, the capacity of organic and inorganic garbage(%), and sensor HC-SR04. All this input data will be read by the Arduino Mega 2650 microcontroller and sent to the Raspberry Pi 4 using serial communication. In this case the Raspberry Pi 4 which is connected to the internet will directly transmit the collected data in real-time using an internet connection to the data cloud, namely hosting which will be received in the MySQL database and web interface every three seconds. In order to transfer data and interact, the JavaScript Object Notation (JSON) format in the PHP and Java programming languages is used. Then, Application Programming Interface (API) software is also used to integrate two applications so that they can be connected to each other (which in this case is the web interface and mobile phone software, and Ajax. This is done so that data can enter in real-time on the web interface without having to reload the page. Users can

monitor through the G-Bot application and the website with the www.g-bot.id domain

The controlling of the G-Bot can be processed using 3 methods, i.e., speech recognition, human follower, and user manual. In the G-Bot application, the user gives the command, in which it can enter the data cloud and be sent to the Raspberry Pi 4 via an internet connection which is then forwarded to the Arduino Mega 2560 and the G-Bot will perform the action of changing classes according to the command.

The user can move the robot from class one to class thirteenth class using the speech recognition method through human voice commands by detecting the last word. If it successful, the success alert appears. If the class serial number when ordered is at the beginning or the middle word and the mention of the class number more than thirteen, then it will appear the alert “failed”.

In this research, the G-Bot can move using human follower in which the control of the G-Bot which moves to its destination can be established by following the human objects. Besides that, the robot navigation can be set using the user manual. It is a method of changing classes by clicking on the destination class button. When the command is successful with the indicator on the hosting, namely by entering data on the MySQL database and on the Raspberry Pi 4 which is connected to a router that is connected to the internet, it will give the robot a command to move to the destination class. In order to transfer data or interact, the JavaScript Object Notation (JSON) format in the Java programming language is used. Then, the Application Programming Interface (API) software to integrate the two applications can be connected to each other.

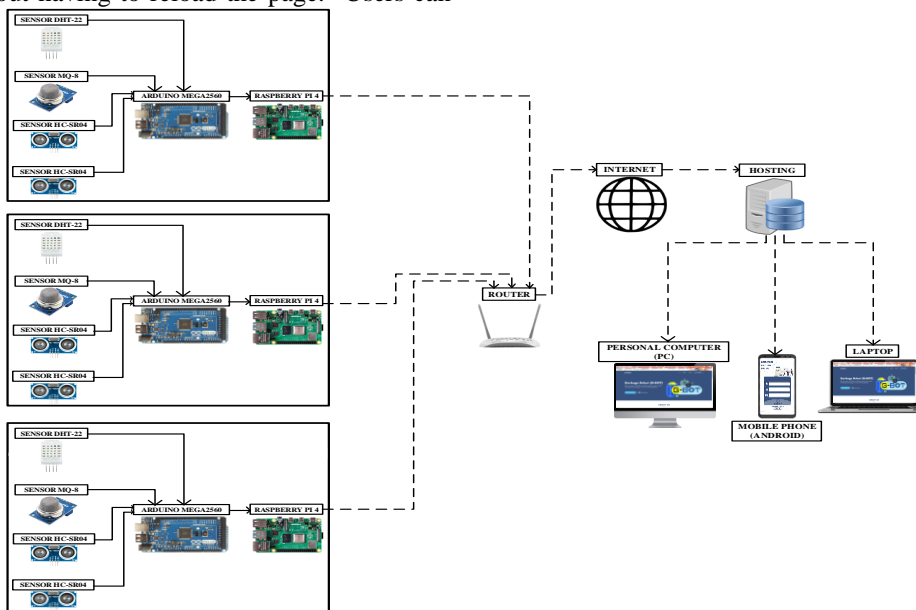


Figure 1 Block Diagram of G-Bot monitoring

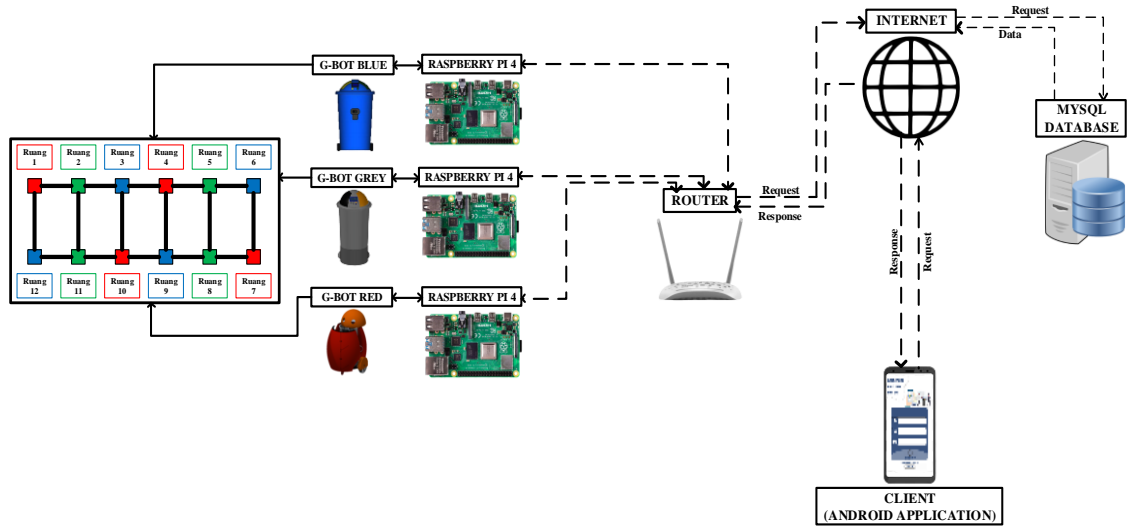


Figure 2 Block Diagram of G-Bot Controlling

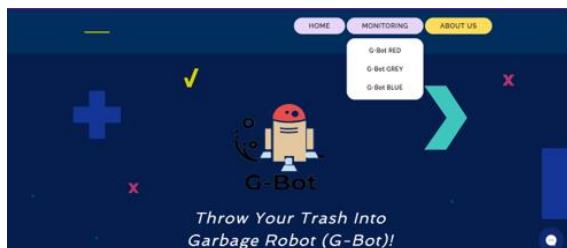


Figure 3 Interface Design on Mobile phone

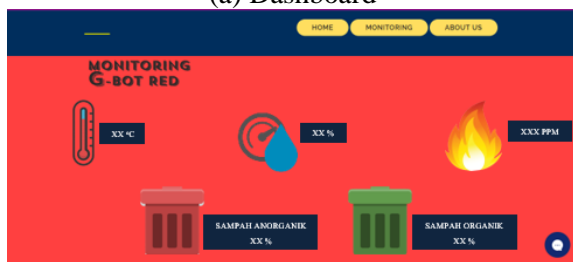
### 3. PROPOSED INTERFACE

The proposed interface is shown in **Figure 3** and **Figure 4**. In web interface design for G-Bot monitoring, the design uses monitoring and controlling features for the three robots. The monitoring consists of temperature, humidity, air quality, organic waste capacity and inorganic waste capacity. Then the controlling robot can be conducted through speech recognition, human followers and user manuals commands.

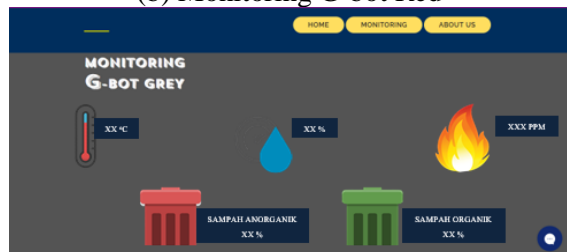
### 4. CONCLUSIONS



(a) Dashboard



(b) Monitoring G-bot Red



(c) Monitoring G-bot Grey



(d) Monitoring G-bot Blue

**Figure 4 Interface Design on the Web**

The interface of the G-Bot has been established well. It can be connected to the mobile phone and also the

computers, or laptop. The controlling of the G-Bot can be conducted using speech recognition system, human follower, and user manual that can be controlled through the mobile phone interface. While the interface in the monitoring system of the mobile phone, PC, and also laptop, can display the status of temperature, humidity, air quality, organic and inorganic capacity of the garbage.

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