The prototype of automatic garbage carrier from a small scale drain using Arduino Uno

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Abstract. As the downpour keeps coming continuously, overflowing water is emerged from a small scale drain due to the garbage that clogs the culvert on the drain. The purpose of this research was to overcome or reduce the incidence of the overflowing water on the culvert. The method used in this research was the prototypemethod using microprocessor of Arduino Uno and load cell sensor. The results achieved in creating this system had already facilitated the transport of garbage and automatically detected full garbage. Therefore, this could reduce the amount of garbage located on a small scale drain and the risk of occurrence of overflowing water. This prototyping could be used for large scale in addition to the culvert.

1. Introduction
Electronic technology is currently very rapidly growing in Indonesia, since so many new electronic technologies keep emerging. Electronic technology cannot be separated from the so-called component. Electronic technology is arranged from several components and produces an electronic item which has a function

There are so many kinds of electronic devices, one of which is Arduino. Arduino is an electronic device that can be called a brain or a device which is able to set and activate electronic devices. The Arduino is almost similar to the Microcontroller, but the use of Arduino is easier than the Microcontroller. By inserting the program into the Arduino and connecting it to other components, Arduino will be able to control the other components so that the electronic device can function as it should be. Arduino can also be connected with a number of circuits as well as with sensors.

Nowadays, in Indonesia a long rainy season frequently occurs. This leads to the occurrence of so many floods which hit several areas in Indonesia. One causative factor of flooding was that people always throw litter anywhere including throwing it into the drains. As a result, when the rain falls, the drains are clogged and cause water to overflow and rise to the surface and this leads to a flood in the area. Hence, people must immediately clean up the garbage which clogs the water flow.

Floods frequently come at night. Therefore, people have to clean the drains which are clogged by the garbage at night. If the drains are left clogged with garbage, the overflowing water will be getting increased. There are so many areas in Indonesia where floods often occur due to overflowing water in the drains, especially in small-scale drains. Water that overflows continuously will be very dangerous if left overflowing in spite of small scale size. This is because the overflow of water may expand and it is feared that the overflowing water will reach people's residences. Therefore, a device is required to
overcome this problem, such as by making a prototype of an automatic garbage carrier which operates the Arduino Uno R3 Electronic device.

The device is designed like a robotic arm which is able to lift garbage up. The arm's movement goes against the flow of water from the culvert. The arm is driven using a 180-degree servo motor or servo motor with a semicircular movement with a torque of 15 kg/cm. The arm moves by lifting the garbage up with the aid of a weight sensor (load cell) with a maximum capacity of 20 kg. The load cell is programmed with a certain weight limit of garbage which has been measured. Hence, if the garbage weight exceeds the weight limit, the load cell will provide detection. The load cell is integrated with Arduino Uno, so that when there is a detection of the load cell, the servo motor will slowly move the arm of the garbage carrier. After the garbage carrier has lifted up the arm, the arm will return to its original position and re-accommodate garbage until the maximum weight limit. The lifted up garbage will be directed to a garbage container which is located above the drainage. The HC-SR04 Ultrasonic sensor is placed in the garbage bin to find out whether the garbage bin is full. When the garbage bin is full notification in the form of an SMS will be sent to the cellphone using the GSM SIM 800 L Module which is connected to Arduino UNO.

2. Method
The design stage in this paper used a prototype method, i.e., gathering needs.

2.1. Load cell
Load cell required an additional module to maximize its performance with the HX711 Module. HX711 is a weighing module, which has the working principle of converting measured changes in the resistance changes and converting them into voltage quantities through existing circuits [1].

![HX711 module circuit scheme](image)

**Figure 1.** HX711 module circuit scheme.

2.2. HCSR-04 ultrasonic
HC-SR04 sensor is an ultrasonic wave based distance measuring sensor. The working principle of this sensor is similar to ultrasonic radar. Ultrasonic waves are emitted and then received by an ultrasonic receiver. The distance between transmission time and reception time is a representation of the distance of the object. The sound wave speed of an ultrasonic sensor is 340 m/s or 29 microseconds per cm or the sound speed is 1130 feet per second or 73,746 microseconds per inch. This sensor is suitable for electronic applications which require distance detection. The display image of HC-SR04 sensor is presented in the following figure [2].

2.3. MG 995 R servo motor
Servo motor is a motor a closed feedback system where the position of the motor is fed to the control circuit in the servo motor. This motor consists of a motor, gear circuit, potentiometer and control circuit. Potentiometer serves to determine the angle limit of the servo rotation. The angle of the servo motor axis is set based on the width of the pulse sent through the signal foot of the motor cable. Meanwhile, the servo motor used is the MG 995 Pro Tower servo motor which has a torque of 15 kg and a voltage of 4.8 - 6 V [3].
2.4. **GSM SIM 800 L module**
SIM 800L GSM / GPRS is a GSM module which matches Arduino. SIM 800L GSM / GPRS can be used to send and receive data using SMS (Short Message Service). SIM 800L GSM / GPRS can be controlled using AT commands. AT commands are commands that can be given GSM/CDMA modems such as sending and receiving GSM / GPRS based data, or sending and receiving SMS or can be interpreted as a collection of commands that are combined with other characters after the "AT" character which is usually used in serial communication [4].

2.5. **Arduino Uno**
*UNO* is derived from Italian language which means one. Arduino UNO is a board which uses the ATmega328 microcontroller chip as its control center. Arduino UNO has 14 digital input/output pins, also equipped with 6 analog inputs, external oscillator using Crystal 16 MHz, USB connector, jack for power supply, header for ICSP, and reset button [5].

2.6. **Arduino software IDE**
In addition to hardware in the form of a board or PCB kit in which the supporting components have installed, Arduino also provides software to create an application program sketch by using a commonly known programming language, such as C/C++ programming language that has been optimized. It is said to be optimized since complex configurations do not need to be performed and the appearance and features are made simple in order to be easy to use but do not eliminate its reliability [5].

3. **Results**

3.1. **Load cell testing**
From the measurement of the load weight with a weight of 50 grams, 100 grams, 200 grams, 500 grams, and 1000 grams, the comparison between the analog and load cell scales displayed in the serial monitor produced several different errors. The causative factor of the error was the load factor and stand on the load cell, but overall the load cell was able to work and to measure according to the weight of the load. The biggest error occurred in the measurement of weight of 20 grams with an error of 4.715%; while the average error of the measurement of the load cell was 1.3%.

The result of this load cell measurement was that the load cell could measure the load according to its weight even though there was a slight error. Therefore, the load cell can be used to detect the weight of garbage which was limited to 100 grams in the programming of this device.

3.2. **Servo motor testing**
The servo motor rotation angle was measured using a protractor with an angle of 50 °, 90 °, 130 °, 160 °, 180 °. The biggest measurement of error angle occurred at an angle of 50 degrees which was equal to 40%. Meanwhile, the average error of angle measurement on a servo motor was 16% and according to the data, the measurement had an angle error of +20 degrees. So as to reach a 180-degree angle on the servo motor rotation, angle data of 160 degrees was inserted into Arduino programming.

3.3. **The Implementation of load cell and servo motor**
It was known in the Arduino programming that if load cell detected more than 100 grams of garbage, the Relay Module would switch on, and the servo motor also automatically switched on because the servo motor was connected to the relay module. The following is a trial of load weight detection in the implementations of load cell, relay module and servo motor.
In accordance with the experiments above, programming on load cells, relay modules, and servo motors ran according to the program.

3.4. Ultrasonic testing
Measurements on ultrasonic sensors used a meter measuring instrument with measurements at a distance of 10 cm, 20 cm, 30 cm, 40 cm, 50 cm, compared to the results of an ultrasonic sensor and displayed through the serial monitor. From the results of measurements, variant errors were obtained and some even had no errors. The error was due to the storage of measured objects. Therefore, the storage of the objects being measured had to match the distance to be measured. Hence, from the measurement results above the average error obtained was 0.9%.

The ultrasonic sensor was able to measure the distance from 2-200 cm. After measurement above the ultrasonic sensor was able to run well according to its function. Thus, the ultrasonic sensor could be used to detect distances from 2-5 cm.

3.5. Implementation of Ultrasonic programming with the GSM Module
In Ultrasonic programming with the GSM Module, it was known that if Ultrasonic obtained garbage detection at a distance of less than 5 cm.

After detection of an Ultrasonic sensor was obtained, the GSM Module then sent an SMS to the destination number.
The information sent by the GSM Module was in the form of an SMS sent to the destination number.

In the picture above is the form of SMS sent by the GSM module. The speed with which the SMS was sent or not was affected by the sim card and the signal used on the GSM module, the SMS receiver's sim card also affected the sending of SMS.

4. Conclusion
Testing the comparison of load weights of 50 grams, 100 grams, 200 grams, 500 grams, and 1000 grams using analog scales and load cells produced an average error of 1.3%. Testing the comparison of distances measured by using ultrasonic sensors and meter measuring instrument with various distances such as 10 cm, 20 cm, 30 cm, 40 cm, and 50 cm produced an average error of 0.9%. Testing the comparison of angles measured by using servo motor and protractor with angles of 50 °, 90 °, 130 °, 160 °, and 180 °, produced an average error of 16%. The garbage filter made was able to lift up the garbage with the aid of a servo motor and planned mechanical design. As the weight of the garbage held by the load cell and the garbage filter exceeded 100 grams, the servo motor automatically switched on, and moved the garbage filter and lifted up the garbage and finally transported the garbage to the garbage bin.

As the condition of the garbage was full, then the garbage would accumulate to the top and would be detected by an ultrasonic sensor. The GSM Module (SIM800L) automatically sent an SMS containing "FULL GARBAGE". The device continued to run automatically because in the device programming, it was set to perform performance repeatedly. To activate the GSM Module (SIM800L) and servo motor additional power supply namely DC to DC converter was required. The Arduino voltage source only
had a 5 Volt and 3.3 Volt voltage source; meanwhile, the GSM Module (SIM800L) required 3.7 Volt voltage and a servo motor required a voltage of 6 Volt.

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