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To cite this article: Alfaroq *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **619** 012019View the [article online](#) for updates and enhancements.

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1 Garbage Compaction Mechanism of Three-Wheels Electrical Motorcycle

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1 Abstract. This research aims to design a trash in a three-wheels electric motor with a compaction mechanism so that it can increase the volume of the trash than usual and the jack mechanism that reduces human power for waste management. This developed also includes a garbage cover with a cover mechanism that can block the smell of garbage when open or closed. The mechanism is controlled using a microcontroller and the actuator used a stepper motor. This tool has been tested using garbage and the equipment is running well.

1. Introduction

The increasing purchasing power of the various kinds of staples, research and technology support activities of a region's economic growth by increasing consumer dynamics that impacted negatively on the exhaust of waste products or so-called junk tend to show increased rates.

In the middle of current technological developments in human civilization, garbage management has reached the recycling utilization to change shape into electrical energy. As the case in many developed countries that manage the garbage that can benefit return.

In 2016 by Jaery Joenedhil Akib, Festo Andre Hardinsi & Akri, alumni of Polytechnic of Ujung Pandang in 2016 has made Prototype Motorcycle Electric Tricycle, and in 2017 by Rusliadi, Eddy Kurniawan Pasaribu and Harbin, alumni of Polytechnic of Ujung Pandang 2017 already develop Motorcycle Electric Tricycle Carrier Trash. Three Wheel Electric Motorcycles Waste Transporters has a specification that is, BLDC electric motors 350 [Watt] high torque, the battery is 48V. [1]

The final project is made aims to:

1. Develop draft trash on the electric motor tricycle.
2. Designing and building a trash compacting mechanism in the tub electric three-wheeled motorcycle with the addition of the volume of waste by 25%.
3. Designing and building systems on garbage jack electric motor tricycle.

2. Garbage Compaction

Garbage is unwanted residual material after the end of a process. Trash is defined by humans according to the degree of wear ability, in natural processes is not actually a trash concept, only products produced after and during the natural process takes place. However, because the human defined the concept of environment then waste can be divided according to the types. According to the definition of the World Health Organization (WHO) trash is something that is not being used, not



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used, not liked or something dumped derived from human activities and does not happen by itself [2][11].

Waste management is all the activities carried out in dealing with garbage since brought to the final disposal. Broadly speaking, the activities in waste management includes control of waste generation, waste collection, transfer and transport, treatment and disposal.

2.1. Components

2.1.1. *Microcontroller.* microcontroller family name which was originally created by the company Smart Projects. One of the figures is the creator Massimo Banzi. These boards are hardware devices that are open source systems [15].

Microcontroller we used is a microcontroller board based ATmega328. This microcontroller has a lot of input / output pins between pin which can be used as PWM output, analog input, 16 MHz crystal oscillator, a USB connection, a power jack, ICSP head and the reset button. Microcontroller is able to support the microcontroller, can be connected to a computer using a USB cable. Microcontroller is an electronic circuit that is open source, and has hardware and software that is easy to use. Microcontroller can recognize the surrounding environment through various types of sensors and can control lights, motors, and various other types of actuators. Microcontroller has many types, including Uno, Mega 2560, Fio and others [4].



Figure 1. Board Microcontroller

2.1.2. *Step Down.* Step down is a component which acts as a regulator in the electrical circuit. In the present state of this module is used to regulate the voltage into the circuit and is supplied to the controller component that is Microcontroller.



Figure 2. Step Down Module lm2596

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4.1.3. *Stepper Motors*. Stepper motors are one type of dc motor controlled by digital pulses[5]. stepper motor is a digital actuator whose input is in the form of programmed energization of the stator windings and whose output is in the form of discrete angular rotation [6].

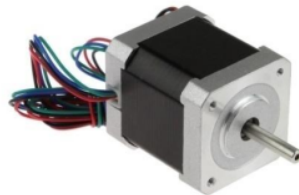


Figure 3. Stepper Motor

¹²
2.1.4. *Batteries*. Batteries are energy storage medium that is capable of converting chemical energy into electrical energy through an electrochemical oxidation-reduction reaction or so-called redox reactions. Unlike heat engines (in motorcycles or engine coolant) which has a low efficiency limitation as the second law of thermodynamics consequence, the battery has a higher efficiency because the mechanism of energy conversion takes place electrochemically [7]. Lithium Ion Batteries able to provide greater power, can be made with small size and light weight[8].

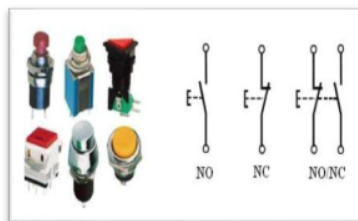


Figure 4. Symbol Push Button

2.1.5. *Button*. Button is to control the ON or OFF condition of an electric circuit, especially in the control. The working principle of working momentary pushbutton is meant when a button on tap for a moment then the contact of the button will return to its original position [9].

2.1.6. *Lead Screw*. Leadscrew is a mechanical component that serves as the successor to the rotational force of the motor into a translational force to push the ³urden of the plate in a compacting mechanism or mechanisms such as levers in the trash. Lead screw are used in various motion delivery systems where power is transmitted by converting rotary to linear motion[10].



Figure 5. Lead Screw

3. Methodology

3.1. Mechanical design

The basic point that many changes or development is the mechanism of compaction itself contained in the basin and consists of two mechanisms to be split into two parts, the mechanism of the jack which exists between the tub with the framework of the motorcycle, and the cover mechanism which is at the top of the tub with an additional some parts to support additional forms on the cover mechanism.

3.1.1. Compaction mechanism. In this mechanism, the use of stepper motors and transmission systems leadscrew or screw shaft we use to support the movement of plate compactor that will encourage and solidify the waste that goes into the tub. The materials that we use into a compactor plate is acrylic and buffer the motor and the leadscrew mechanism is incorporated strip plate welding method.



Figure 6. Compaction Mechanism

3.1.2. Jack Mechanism.

Supporting one of the trashes that we have developed is the existence of a mechanism whereby the jack can maximize processing waste that has meet the bath and then be discarded.

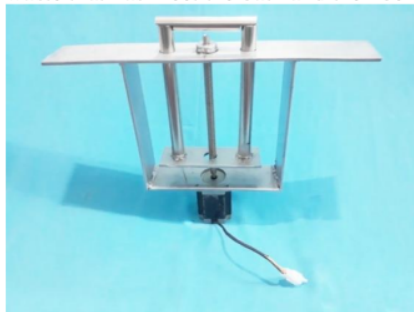


Figure 7. Jack Mechanism

As with the compactor mechanism, in this mechanism also uses a stepper motor actuators and leadscrew transmission system in order to support the process of appointing the trash to the disposal process.

3.1.3. Closing Mechanism.

At the closing mechanism in the series this thesis intends to eliminate odors that might come out of the tub when the tub is opened to insert the trash. As we know that the problems that often arise in waste transportation that smell out of the landfill due to release of the smell that came through the door of the shelter that does not have a mechanism to prevent the release of doors from the tub.

Therefore, we make the closing mechanism bins that are likely able to block the smell out of the bath when done transporting waste. The method we use is by using two half-cylinder composite tub as initial shelter before it is put into a tub. Then the next half-cylindrical containers that are smaller will be closed first so that the position is still in a state tub covered by a half-cylinder container larger. And in the end after the first container is closed, then the container is then sealed as well as its original state so that trash will never be in the open state and the smell would not be exposed out.



Figure 8. Closing Mechanism (Closed)



Figure 9. Closing Mechanism (Open)

3.2. Electronic Scheme

In this final project using the panel box / box control that serves as a control center and other electrical circuits. With the assistance from the voltage source 12 V battery and connecting the small wires, circuit consists of an Arduino Mega, motor drivers, bride board, and step down are packed in a box of acrylic.

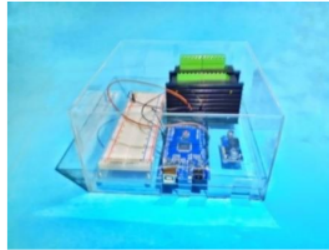


Figure 10. Box Control Panel

3.3. Control Scheme

3.3.1. *Block Diagram.* Based on the depiction on the block diagram below is known through the groove feedback to control system to run the mechanism in an automatic way[11][12]. So just by pressing the push button mechanism operates during all cycles.

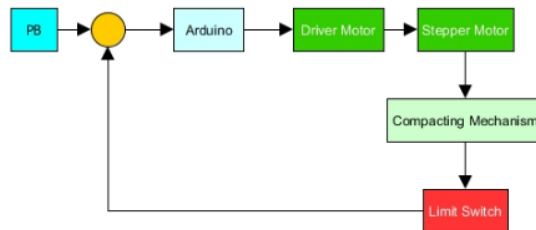


Figure 11. Block Diagram Control

3.3.2. *Algorithm.* The control scheme on this tool uses Arduino software that is inherited from the Arduino hardware as a whole with the provisions of the device used is the Arduino Mega. Used in its use logic function "if", "do", and "while" for the selection decision to execute the program. The completeness of the other program uses a simple formula language C.

```
TEST
int PUL = 12;
int DIR = 11;
//int mPin = 0;
int box = 7;

void setup() {
  pinMode(PUL, OUTPUT);
  pinMode(DIR, OUTPUT);
  pinMode(box, INPUT);
}

void loop() {
  //int box = digitalRead(boxSwitch);
  digitalWrite(DIR, LOW);
  do {
    digitalWrite(PUL, HIGH);
    delayMicroseconds(1000);
    digitalWrite(PUL, LOW);
    delayMicroseconds(1000);
  }
  while (digitalRead(box) == HIGH);
  delay(100);
  digitalWrite(DIR, HIGH);
  for(int i = 0; i < 200; i++){
```

Figure 12. Program on software

3.4. Experiments Setup

In collecting data on the mechanism of this final project is done by inserting a container of waste in starting a closure mechanism, and garbage will be entered into concurrently with closing the tub retraced to the early part of the cover. Furthermore trash into the tub and the plate will push the waste

towards the back of the tub. And so it goes waste from many and indirectly the compactor mechanism will solidify the waste that goes into the tub.

4. Result and Discussion

4.1. Method of Manufacture

Starting from the improvements that will be implemented tub compacting mechanism therein with another plate is coated on the inside and a little hollow as the framework for the second floor. Compactor mechanism is the next stage, which is by stringing together several plate strips made by the method of welding as a buffer from the motor and leadscrew by the two systems as needed in a bath which is divided into two floors. In this same mechanism we use a chain and gear system to transfer power from the motor to the leadscrew. Liaison between the motor shaft to the gear used clutch made using the method of turning. Continued jack mechanism that the mechanical system consisting of a strip plate frame, stepper motors as actuators driving mechanism,

4.2. Efficiency place on the vessel

In the data collection has been done, it is known that basically the trash compaction mechanism has a significant role in the efficiency of space, whether it is at the bottom of the tub and the top of the trash. Can be seen in the table below of the results of data collection that we do show the numbers prove that in the tub where maximum efficiency when using a compaction mechanism.

Table 1. Comparison of Volume With and Without junkie

No.	Body parts	Without compactors (cm3)	Using compactors (cm3)
1.	Floor 1 (Bottom)	51 840	64 800
2.	Level 2 (Top)	34 560	41 480

Based on the above calculation of volume expansion bathtub, obtained information that the additional volume of garbage if using a compacting mechanism that is 25% lower and 20% at the top, and if the calculated overall efficiency of trash that some 22.5%.

4.3. Voltage Graphic

Based on the results of measurements of the amount of usage of each trial voltage operation of the compacting mechanism, it is known that the use of voltage is not too large due to the need for motor actuator which is also not too great to see the difference between the initial voltage and a final voltage generated from the data that has been taken.

Table 2. Consumption Tension Experiment and movement of compactors

Movement	Initial Voltage (V _o)		Final Voltage (V _i)
1	24.06		24.01
2	24.01		23.94
3	23.94		23.88
4	23.88		23.82
5	23.81		23.75

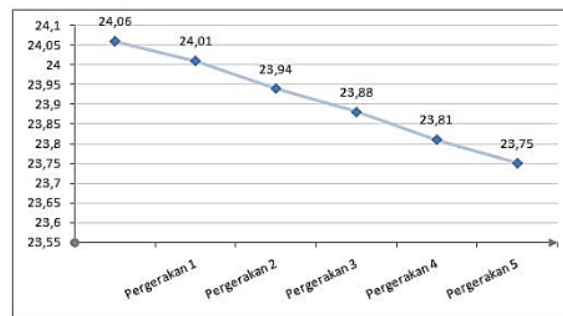


Figure 13. Voltage Graphic

2 5. Conclusion

Based on the results and discussion on this research can be concluded as follows:

- 1) Garbage bins designed development on three-wheeled electric motorcycle successfully made using economical materials and in accordance with the initial planning research manufacture.
- 2) Making the compaction mechanism has been created and prove additional volume of waste can be increased by 25%, as it is attached to the results.
- 3) Making the jack mechanism successfully fabricated using stepper motors as actuators and leadscrew.

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