

# Design of Bluetooth Wireless Transporter Mecanum Wheeled Robot with Android Smartphone Controller for Moving Item

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**Abstract** – Technology development are going so fast. One of technology development on purposed reasearch is moving item technology. Moving item can be dangerous works for human. There are some dangerous case of moving item, heavy weight items, hazardous chemical compounds, etc. Purposed research is to fixed previous statement problem, to reduce work load energy and minimize an accident in terms of moving items which are often encountered in the industry sector. Purposed research was made wireless transporter mecanum wheeled robot with android smartphone controller for moving item. Robot made in prototype scale. Robot size is 28x13x15 cm(s). Robot made based on arduino uno and L293D driver motor with android smartphone controller. Using android controller was made user easier to use. This robot design equipped with 4 mecanum wheel (4 DC motors), two 1850 battery, Arduino Uno, L293D driver motor shield, HC-06 bluetooth module, LCD and two M90s Servos for gripper. Gripper has two motions, shift and lift motions. After several test of purposed transporter robot, it can conclude that purposed transporter robot can controlled wireless from 0 to 20 meters. Purposed robot gripper has two motion. Gripper test result, purposed transporter robot can shift item up to 350 grams weight load and lift an item up to 200 grams.

**Keywords:** *Transporter Robot, Bluetooth, Mecanum Wheel, Android, L293D.*

## I. INTRODUCTION

Technology development are going so fast. Society 5.0 era had began [1]. Indonesia needs technology improvement. In any sectors. Nowadays, it is impossible not to use technology. There are many benefits that can be utilized by technology. It helping and facilitating human works [2]. Technology made work so much easier. One of technology development on purposed reasearch is moving item technology.

Moving item technology implements in many sector, there are logistic[3], distributed in industrial area [4], [5], etc. Moving item with human, needs more power, especially for heavy weight item [5]. Another case, it can more dangerous when human have to distribute hazardous chemical compounds [6]. Many employees are not careful in moving high-risk items, it makes work accidents such as poisoned hands[6]. Something can replace human to do dangerous work is robot [7][8][9]. From previous statement, purposed research was made. This research was conducted in order to reduce work load energy and minimize an accident in terms of moving items which are often encountered in the industry Purposed

research made a robot that can controlled wireless by smartphone. Purposed research's scale is prototype.

On previous research [10], it made wireless transporter robot with joystick controller. It made based on arduino and L298N driver motor. It has 4 wheel, gripper, force cencitive resistor (FSR) sensor, cause it controlled by joystick, it has RX joystick to communicate robot with joystick controller. In [10], robot gripper grab items received input from FSR sensor. FSR sensor used for strength or pressure analysis and these sensors have a value that varies according to the applied pressure. The FSR (Force Sensitive Resistor) sensor is used to capture the incoming pressure[11]. [10] transporter robot can be controlled remotely using a wireless joystick, the speed of moving the robot forward, backward, turn left and turn right can be controlled with five variations of speed set on the joystick, the gripper on the transporter robot will stop clamping if the resistance value on the existing FSR sensor on the jaw gripper reaches the pressure value set by the program, the farthest control distance on [10] is 17 meters. Previous research [10] was

From previous research [10], purposed research made wireless transporter mecanum wheeled robot with android smartphone controller. Robot made based on arduino uno and L293D driver motor with android smartphone controller. Using android controller was made user easier to use. From statistic, android is most active user in the world [12][13]. This robot can easily paired to another android device cause it works with bluetooth connection. This robot design equipped with 4 mecanum wheel (4 DC motors), two 1850 battery, Arduino Uno, L293D driver motor, HC-06 bluetooth module, LCD and two M90s Servos for gripper. Gripper has two motions. Mecanum wheel chosen cause it has very adaptive movement[14].

## II. METHODOLOGY

### A. Diagram Block

How Wireless Transporter Mecanum Wheeled Robot with Android Smartphone Controller, can be explained in Figure 1.

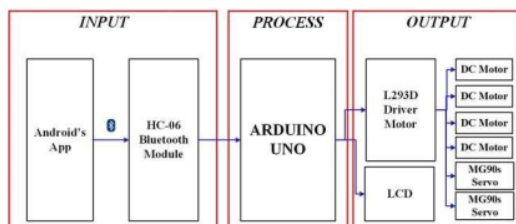


Figure 1. Diagram block of robot (source: Author, 2023)

Figure 2 used to describe the work system of robot: input unit, processing unit, and output unit. Input unit uses an Android smartphone connected to HC-06 bluetooth module through bluetooth connection. "Bluetooth RC Car" app which can be downloaded via Google Playstore. The process unit uses Arduino Uno as the processing unit. Output unit contains LCD and L293D driver motor for 4 DC motors used as 4 mecanum wheels and 2 M90S servo motors used for gripper with grab items and moved up motions.

B. Flowchart system

Flowchart is visual diagrams that outline the separate steps of a process in sequential order. Figure 2 is flowchart system for purposed research.

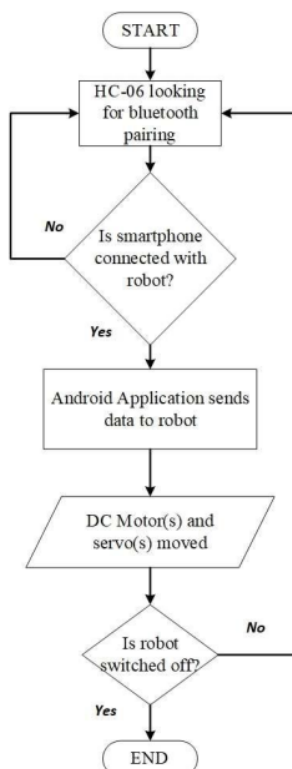


Figure 2. Flowchart system of robot (source: Author, 2023)

Flowchart system starts with robot being turned on using a switch, when the robot is turned on, the HC-06 bluetooth module sends out bluetooth signal. Next, the android smartphone is connected to the HC-06 bluetooth module, after bluetooth signal is connected, when application button is pressed, it will send commands to the DC motor(s) and servo (s), so that the robot can be moved. Next step when the robot is turned off, the robot system stops, and when the robot is not turned off then the system will repeat continuously.

C. Robot Design

Design of purposed research shown in figure 3.

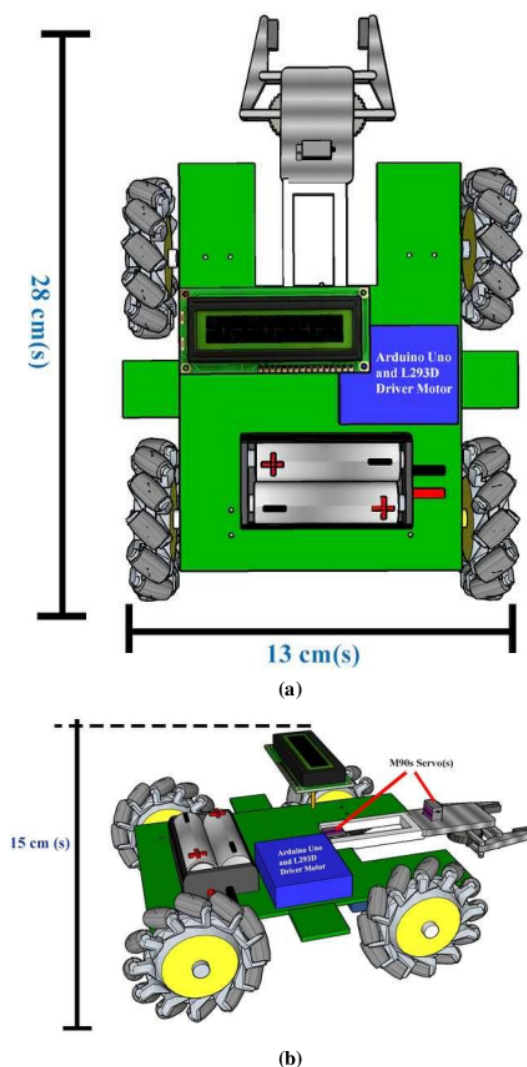


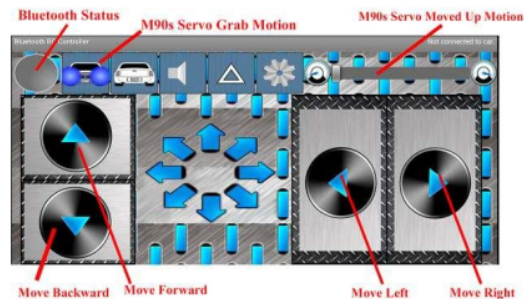
Figure 3. Robot design (a) Above Angle (b) Side Angle. (source: Author, 2023)

Figure3(a) shown robot design from above angle, and 3(b) shown robot design from side angle. Robot design

size is 28 x 13 x 15 cm(s) (length x width x height). Robot base made from 3mm acrylic. Robot moved with 4 motor DC paired with 4 mecanum wheels. Mecanum wheel has specific setup to move smoothly, it setup for purposed robot bas eon [15]. One of benefits of mecanum wheel is when robot make a turn, it's no needs to make a forward then make a turn. Mecanum wheel can move right or left directly[14]. Gripper is using 2 M90s Servo(s) for two motion (shift and lift motion). Lift motion is for moving item to higher place. Robot powered with two 18650 battery (around 7,2-9 Volts). Blue box in figure 3 is Arduino and L293D driver motor position. Arduino and L293D driver motor are paired, L293D driver motor connected directly into arduino uno. LCD is for shown bluetooth status connected or not.

#### D. Android Application

Android apps for purposed research is using "Bluetooth RC Car" app, develop by Andi.co. It can downloaded via google Playstore. It works based on bluetooth connection. Android apps shown in figure 4.



**Figure 4.** "Bluetooth RC Car" android app based on bluetooth (source: Andi.Co app, downloaded via google playstore and captured in 2023)

Figure 4 shown android app's layout and distribution button function for robot. This apps send data to HC-06 bluetooth module. Data that apps send are in alphabetical form (example F for forward, B for Backward ,etc.). Beside arrow button, this apps also contain upper button and slider. Gripper grab motion used left-upper button and gripper moved up motion using slider.

#### E. L293D Driver Motor Shield

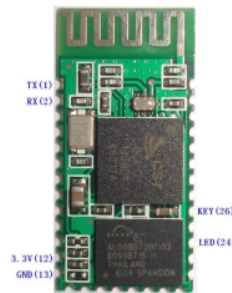
Purposed robot uses L293D driver motor shield, because its very compact robot, because L293 driver motor shield connected above arduino uno. L293D driver motor shield had provided port for 4 DC motors and 2 servo motors. L293D driver motor shield and arduino powered by two 18650 battery. L293D driver motor shield and arduino uno its connected shown at figure 5.



**Figure 5.** L293D Driver Motor Shield (source[16], 2023)

#### F. HC-06 Bluetooth Module

HC-06 Bluetooth module can operate in two modes, there is master or slave. Master is the first device to provide synchronization, and the others are considered recipients only (slave). There are two types of Bluetooth modules, odd and even version. The Bluetooth module with odd series (HC-05 or HC-03) is a approved version of the even series (HC-06 or HC-04). The HC-05 module can be set as a master or slave, while the HC-06 can only be used as a slave [17]. Purposed robot uses HC-06 cause its only received data from android. HC-06 and its architectures shown on figure 6.



**Figure 6.** HC-06 Bluetooth Module (source: HC-06 datasheet [18], 2011)

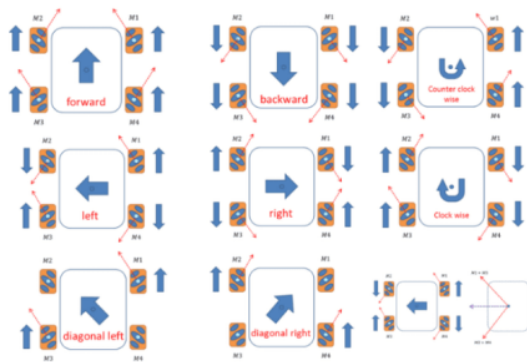
#### G. Mecanum Wheel

Mecanum Wheels were chosen because the movement of the robot is freer than using ordinary wheels which are often called Differential Wheeled motion. The movement of the robot utilizes the speed of each wheel to be able to move in all directions without having to change its facing direction first. Mecanum wheel has lot of directional operation.



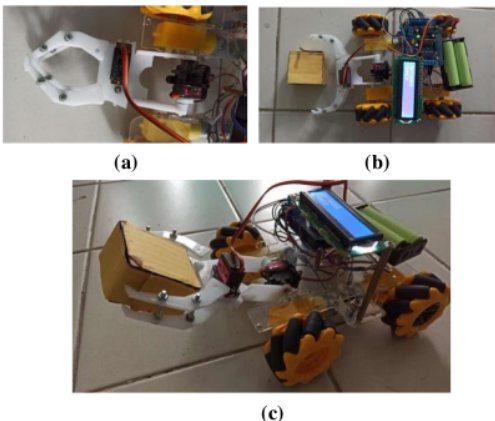
**Figure 7.** Mecanum Wheel  
(source: [19], 2022)

Mecanum wheel has specific configuration to robot drive. Purposed robot has four mecanum wheel. Every wheel has configuration. The configuration shown on figure 7.



**Figure 8.** Four Mecanum Wheel Configuration  
(source: [19], 2022)

### III. RESULTS AND DISCUSSION



**Figure 9.** Purposed Robot (a) Gripper (b) Ready to grab (c) Lift motion (source: Author, 2023)



**Figure 10.** Item for robot test  
(source: Author, 2023)

Figure 5 shown purposed robot. Fig 9(a) is the gripper, 9(b) robot ready to grab items and 9(c) robot grab item and moved up (lift motion). Robot performance depends on bluetooth distance. Robot performance are depend how far distance between robot and controller which is android smartphone. In table 1, shown robot performance based on bluetooth distance.

**Table 1.** Robot performance based on Bluetooth Distance

| Distance (meters) | Bluetooth Status | Robot Performance |
|-------------------|------------------|-------------------|
| 0-15              | Connected        | Works Fine        |
| 15-17             | Connected        | 1 sec delay       |
| 17-19             | Connected        | 2-3 sec(s) delay  |
| 19-20             | Connected        | 3-4 sec(s) delay  |
| >20               | Disconnected     | Not working       |

Table 1 shown bluetooth distance test with five various distance from 0 to >20 meters. Robot have No. problem at 0 to 15 meters, robot feels responsive. 15 to 20 meters bluetooth status still connected, but power signal has more farther bluetooth object gave lower signal. Robot delay at 15-17 meters, 1 sec delay, it feel No. annoying yet. Bluetooth test 17-19 meters starts annoying, because it have around 2-3 secs delay. At 19-20 meters test, bluetooth status is still connected but it feel very annoying, because it have around 3 to 4 secs delay. At more than 20 meters test, bluetooth status is disconnected and robot cannot working anymore, to make robot move again, robot have to connected with android smartphone again. Table 1 robot test performance based distance happens at all app's button.

Main purposed of this robot is to moving items to another place / position. Gripper is the most important part to moving an item. Gripper has 2 motion. There are grab item then forward (shift) and moved up (lift) motion. In this research, gripper test is using paper shaped into box and filled with some weight loads. It will give gripper performance of this research. Table 2 shown a gripper performance based on item's weight. Gripper test is only use one type dimension of box (50x50x30 mm) with different weight. It shown on figure 10.

Table 2. Gripper Performance based Weight's item

| Weight Item (grams) | Grab and Forward (Shift) Motion | Moved Up (lift) Motion |
|---------------------|---------------------------------|------------------------|
| 20                  | ✓                               | ✓                      |
| 50                  | ✓                               | ✓                      |
| 100                 | ✓                               | ✓                      |
| 200                 | ✓                               | ✓                      |
| 350                 | ✓                               | ✗                      |
| 500                 | ✗                               | ✗                      |

Notes: ✓ : Test success ✗ : Test Failed

Table 2 shown gripper performance based weight's item. There are 6 weight for gripper test. Around 20 to 200 grams there aren't problem for gripper doing two motions. Around 350 grams, there are problem for lift motion. Gripper didn't strong enough to lift the item, but for shift motion there aren't problem. Around 500 grams gripper didn't strong enough to doing any motions.

Comparison purposed robot with [10], our purposed had better distance robot controlled. Purposed robot has 0 to 20 meters control. Android controller made easier to paired to another device. [10] has more easier controller, cause it use joystick controller. It more fun to control using joystick than smartphone controller. [10] more advance with FSR sensor, robot is more intellegent to grab item helped with FSR sensor.

#### IV. CONCLUSION

Purposed robot already doing its main purposed. It moving item to other place. After several test of purposed transporter robot, it can conclude that purposed transporter robot can controlled with wireless bluetooth connection. Bluetooth distance test works up to 20 meters, but 15 to 20 meters have 1 to 4 seconds delay. Purposed robot gripper has two motion. Gripper test result, purposed transporter robot can shift item up to 350 grams weight load and lift an item up to 200 grams. Limitation of this purposed transporter robot, M90s servos get heat up if robot switch on for around 15 minutes, otherwise robot didn't do anything. So, purposed transporter robot have took a rest for a while after 15 minutes operation. For future work, purposed transporter robot can upgraded to wifi connection for longer distance range. It can make bigger robot for bigger item to move. Purposed transporter robot is only prototype, for future works it can implement to big scale of real moving items.

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