# Dagozilla Mechanical Description 2021

Muhammad Abyan Raff Hardiwinata, Willy Wahyanto, Made Yogga Anggara Pangestu, Michael Patrick Andoko, Riswansyah Imawan, Wasito Pawoko Jati, Shirley, Muhammad Bintang Pananjung, Agung Kurniawan, and Adonis Thirafi Hugo Mafaza

Institut Teknologi Bandung,
Jl. Ganesha No. 10, Bandung, Indonesia
krsbiberodaitb@gmail.com
https://dagozilla.itb.ac.id

**Abstract.** In order to participate in the 2021 RoboCup Middle Size League (MSL), Dagozilla designed and manufactured a new generation of MSL robots. This paper will cover the mechanical systems and structures used in the robots. The systems and structure includes the robot platform, kicker mechanism, ball dribbling mechanism, and vision system structure.

**Keywords:** Middle-size League, RoboCup.

## 1 Mechanical System Overview

The new, third generation Dagozilla MSL robots are designed with the old robots' weaknesses and shortcomings in mind. As such, the new Dagozilla MSL robots are an all around improved version of the old robots. The improvements include a greater mobility and agility, a better ball handling ability, a better kicking ability, and an improved vision system.

## 2 Four-Wheeled Platform

In 2019 our team made a change from the three-wheeled platform to a four-wheeled platform. This change has been made to increase our robots speed and acceleration. The new version (Gen 4) of our robot development initially reduced the dimension from the previous version (Gen 3), but the smaller robot size result in several complications therefore we increased the robot dimension to 50 cm x 50 cm x 77 cm. The increase in dimension also leads to an increase in weight to 37 kg. The full assembled form of the robot can be seen in Fig. 1.

The body of our robots consist mainly of aluminium sheets that was manufactured by bending and laser-cutting process. To improve accessibility for installation and maintenance, we abandoned the old 'sandwich' structure that was used in previous robot generation and adopt the new 'two-base only' structural configuration. The two bases will be called the 'lower base' and the 'upper base', shown in Fig. 2 and Fig. 3 respectively.

**Fig. 1.** Front and Isometric View of the Third Generation Dagozilla MSL Robot

The upper base is used to house our personal computer (PC), battery, compass, and the robot's hardware interface while maintaining the PC's temperature using four fans. The upper base structure is designed for the ease of access while maintaining a rigid structure for supporting the vision system. The vision system itself will be covered later in this paper.

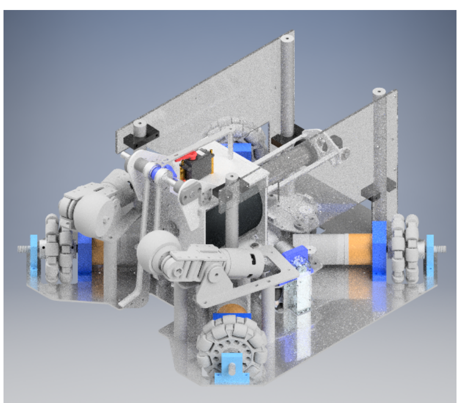

**Fig. 2.** Lower Base Structure

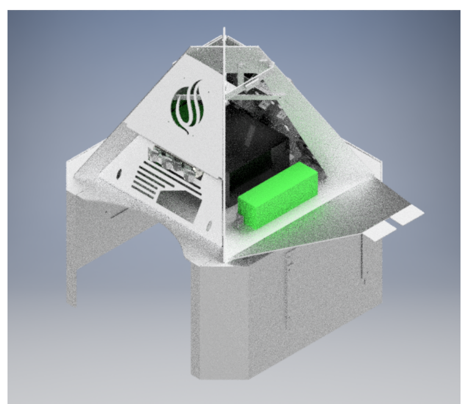

**Fig. 3.** Upper Base Structure

The lower base consisted of several mechanical systems of locomotion, kicker, and dribbler system. This base also used to store the electrical board and odometry sensor system. As mentioned in the beginning the locomotion system for the robot is using 4 motors (PG 45) rather than 3 motors from the previous robot version. The odometry system is using 3 motor encoder sensor each paired to a 60 mm omnidirectional wheel to track 2 translational motions and 1 rotational motion of the robot. The configuration is shown in Fig. 4. The kicking mechanism, and ball dribbling mechanism will be covered later in this paper.

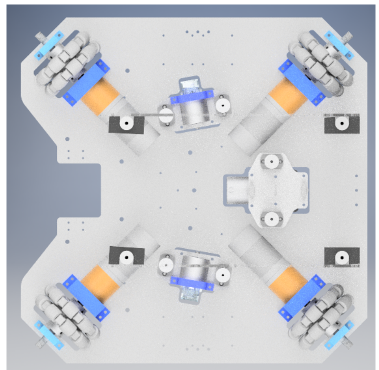

**Fig. 4.** Locomotion and Encoder System Configuration

## 3 Kicking Mechanism

We use solenoid-plunger mechanism for our kicking system and we implement two kicking modes: flat shoot and lob shoot, for the use of giving passes and shooting at goal respectively. To implement the two modes, we use two levers differing in length. To change between the modes we use a servo motor to move the levers' axis horizontally. We also compacted the solenoid shielding by using a steel tube instead of a box as used in the previous robots. This change of shape is also beneficial to the kicking strength as it leaves little to no air gap between the solenoid and the shielding hence it could contain the magnetic field better. The completed kicking mechanism set design is shown in Fig. 5.

## 4 Dribbling Mechanism

In the dribbler system, we use a bevel and pinion gear set with a 1:3.5 reduction ratio along with a high rotation-per-minute ungeared brushed DC motor. The main materials used in this dribbler are duralumin and 3D-printed plastic parts. It gives the tough structure and the lower-inertial rotating parts so it can reach a higher speed in no time. We also adjust the dribbler angle to be relatively facing the front of the robot to allow for the dribbler to rotate around its housing in the event of a front collision. This movement allowance will reduce the impact energy absorbed by the dribbler and shifting it to the robot's armour which is specifically designed to withstand huge impact energy. Based on the rule, the ball

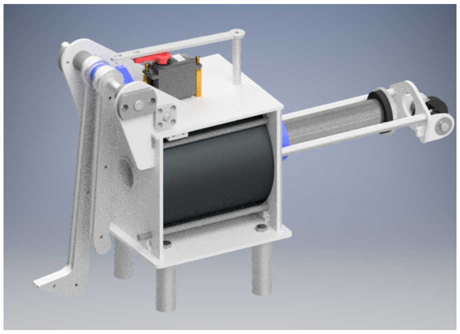

**Fig. 5.** Kicking Mechanism

**Fig. 6.** Dribbling Mechanism

should be able to roll naturally in the field based on the speed and direction of the translation of the robot. The dribbler is designed to get the best control over the ball using the geometrical-based velocity analysis of the ball. The dribblers are designed to able to control the ball at a higher translational speed than the robot itself can reach. Half of the designed dribbling mechanism is shown in Fig. 6.

## 5 Vision System

In the vision system, we've improved the design by using an acrylic tube to isolate our camera and mirror. This design significantly improves the robot field of view by removing the three steel pillar that was used in the last generation, thus eliminating the blind spot. We manufactured our own mirror using aluminium shaped with CNC machining process and surface-finished by coating it with chrome to get a reflective surface. We also added a 3D-printed nail to the center of the mirror to eliminate any reflection on the tube's wall. Below, the design of the vision system, with the tube removed, is shown in Fig. 7.

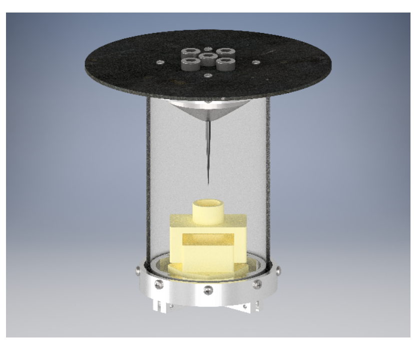

**Fig. 7.** Vision System