

# Dagozilla Mechanical Description 2020

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**Abstract.** In order to participate in the 2020 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

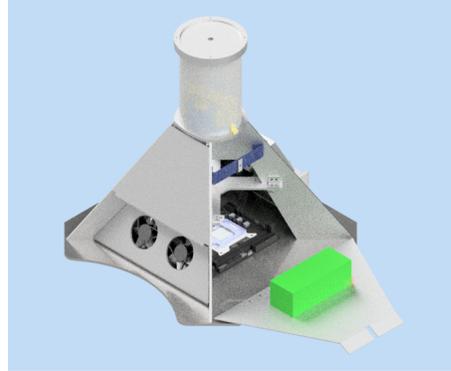
This year, our team made a move from the three-wheeled platform to four-wheeled platform. This change has been made to increase our robots' top speed and acceleration, and in order to further improve these aspects, we've reduced our robots dimension to 43 cm x 43 cm x 70 cm. With the decrease in dimensions, our robot now weighs around 28 kg, weighing around 5 kg less than the previous robots. 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 'upper base' and the 'lower base', shown in Fig. 2 and Fig. 3 respectively.

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



**Fig. 1.** Third Generation Dagozilla MSL Robot



**Fig. 2.** Upper Base Structure

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. 3.** Lower Base Structure

The lower base is used to house the electric boards, locomotion system, kicking mechanism, and ball dribbling mechanism. Some of the electric boards are installed lying flat on the lower base, while the rest of it are set on acrylic sheets installed between the supporting spacers. We also discarded the standalone rotary encoders used in the previous robots and chose to rely solely on

the locomotion motor's encoder for odometry purposes. The kicking mechanism, and ball dribbling mechanism will be covered later in this paper.

### 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. 4.



**Fig. 4.** Kicking Mechanism



**Fig. 5.** Dribbling Mechanism

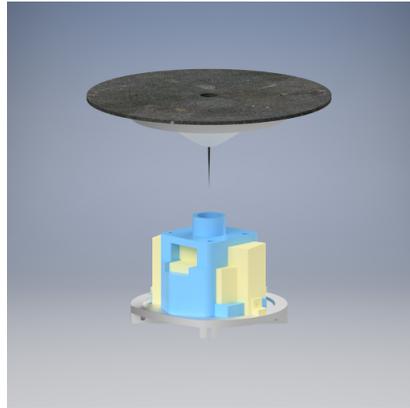
### 4 Dribbling Mechanism

In the dribbler system, we use 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 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 be 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. 5.

## 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. 6.



**Fig. 6.** Vision System