Agent of Chaos: A Combat Robot

Project Report

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1. Introduction

The field of combat robotics is extremely fascinating where different robots fight with the aim of destroying each other. The robots are developed using microcontrollers and various actuators. They are not fully automated and are mainly controlled by a person remotely. Figure 1 highlights some of the popular combat robots.

Figure 1: Some examples of combat robots (source [1] and [2])

Just like normal human fighting competitions, these combat robot competitions also have weight categories. The higher the weight category, the more deadly weapons and capabilities the robots possess. Table 1 illustrates various weight categories:

Table 1: Various weight categories of combat robots

Sr #	Weight Category	Minimum Weight (kg)	Maximum Weight (kg)
1	Featherweight	0	10
2	Lightweight	10	22
3	Middleweight	22	45
4	Heavyweight	45	80

The main purpose of this endeavor is to develop a lightweight category combat robot. The robot should be lethal enough to incapacitate the opponents and win the competition. We named the robot “Agent of Chaos: A Combat Robot”.

2. Problem Statement

The cornerstone of this project is to design a combat robot capable of incapacitating the opponent robots in the robot-fighting competition.

3. Weapon

The weapon is the paramount component of the whole robot. It knocks off the opponent robot and also provides a defensive mechanism against the onslaught from the opponent. There are different types of options available as weapons. The basher robot shown in Figure 2 uses an 11kg electric-driven hammer as the primary weapon. The primary focus of this type of weapon is to destroy the opponent with constant strikes.

Figure 2: Basher robot with a hammer as a weapon (source [3])

Similarly, the flipper is also a very famous type of weapon. It uses hydraulics or other electro-mechanical mechanisms to flip the enemy over in the air. Figure 3 shows Bronco, a 113kg robot that utilizes a pneumatic flipper as the primary weapon.

Figure 3: Bronco robot with a flipper as a weapon (source: [4])

There are various types of weapons [5] but we are using a grinder and passive flipper as primary weapons for the agent of chaos. The grinder uses a cordless drill motor coupled with a five-inch blade to crush the opponent. Figure 4 shows the grinder and the disc.

A) B)

Figure 4: A) Cordless drill motor used for the grinder (source: [6]), B) Grinder disc

Furthermore, we also introduced the passive flipper. This turns over the opponent robot and knocks it down. The introduction of two weapons on the both front and rear sides of the robot makes its

sides secured as well as lethal. In other combat robots, on the other hand, there is usually a single weapon on the front side. This makes its rear side wide open for the opponent robot to attack, but our robot has both sides covered.

4. Construction

The overall blueprint of the robot is shown in Figure 5. It will be operated through an Android app.

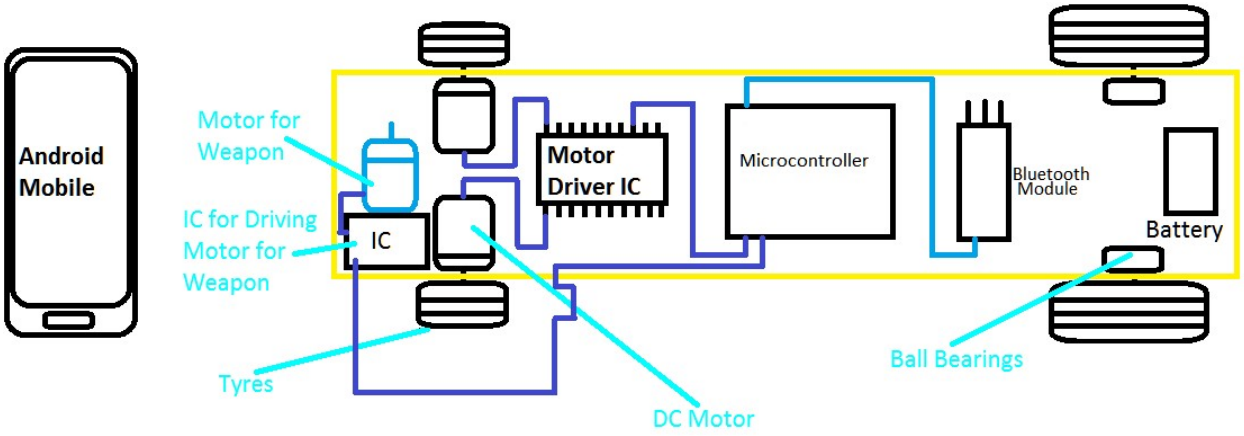

Figure 5: The blueprint of the robot

As far as the robot body is concerned, it will use an Arduino microcontroller to operate the robot. The app is interfaced with the robot through a Bluetooth module. The following section delves into more details of the robot.

5. Electrical Specification:

5.1 Microcontroller:

The microcontroller is like the brain of the robot. It receives the commands from the robot operator and translates them into action by manipulating the different components. We are using the Arduino microcontroller.

5.2 DC Motor:

There are four tires in this robot. However, only two rear tires are connected with DC motors to control the overall movement of the robot. While the front tires are swivel casters and are not controlled by the Arduino. We use the brushed DC motor from AmpFlow. Figure 6 shows the DC motor, and Table 2 shows its specifications.

Figure 6: DC motor used to control the tires (source: [7])

Table 2: Specifications of the DC motor

Sr #	Property	Value
1	Diameter	3.1 in.
2	Length	4 in.
3	Peak Horsepower	1.0
4	Peak Torque	710 oz-in
5	RPM at 24V	5600 rpm
6	Weight	1.6 kg

5.3 Battery:

DC motors and other important electrical equipment are powered by powerful DC Batteries. We used two 12V dry batteries. The two batteries were used in series to enhance the current to the DC motors. Figure 7 illustrates the DC battery and Table 3 outlines its specifications.

Figure 7: 12V DC battery (source: [8])

Table 3: Specifications of the DC battery

Sr #	Property	Value
1	Volts	12
2	Ampere	12 Ah
3	Weight	3.75 Kg

4	Dimensions	(15 x 6.5 x 9.5) cm

The DC battery is quite heavy as highlighted in Table 3. The combined weight of the two batteries accounts for 7.5kg. To turn this excess weight into an asset rather than a liability, we have placed the two batteries at both ends of the body. This introduces stability and prevents the robot from flipping.

5.4 Motor Driver IC:

The main function of motor driver IC is to reverse the polarity of current on the terminals of motors to reverse its direction. Hence it is a fundamental device to move the robot in any direction by changing the polarity. We used the L298N motor driver module for this purpose which is shown in Figure 8.

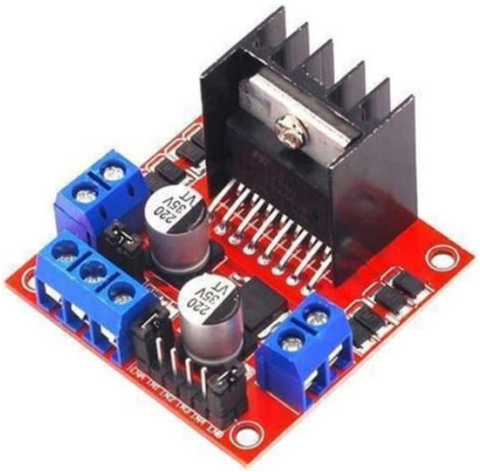

Figure 8: L298N motor driver module (source: [9])

6. Mechanical Specifications:

6.1 Wheels:

This robot is a four-wheel combat robot. The rear wheels are bigger and mainly control the movement of the robot. They are six inches in diameter. The front wheels are swivel casters and move freely.

6.2 Body:

Initially, the robot's body was made of steel only. But it increased its weight a lot to nearly 27kg. so, to address the 25kg category constraint, the steel body was replaced with a combination of steel and lightweight fiberglass.

7. Bluetooth Control:

One important aspect of combat roboting is the remote control by the operator. For this, we are using Bluetooth control through the HC-05 Bluetooth Module and an Android app. We used the Bluetooth RC Car app [10]. The module is shown in Figure 9.

The Bluetooth module is interfaced with the Arduino, and communicates with it through serial communication.

Figure 9: HC-05 Bluetooth Module (source: [11])

8. The Final Robot:

The complete agent of chaos robot is shown in Figure 9. An operating video of the robot is also available on YouTube [12]. It is operated through the Android app.

A) B) C)

Figure 10: Images of the robot; A) Side view; B) Lid is opened to show the internal circuitry; and C) Top view

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