

A STUDY ABOUT MICRO AND MINI SUMO ROBOTS

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ABSTRACT: The purpose of this study is to make a real comparison between two models of mobile robots, namely mini sumo and micro sumo. The main characteristics of each robot model are presented, as well as their advantages and disadvantages. In summary, while both micro and mini sumo robots are designed for sumo-style competitions, they differ in size, weight, arena dimensions, competition rules, component selection, and programming considerations.

KEYWORDS: mobile robots, mini sumo, micro sumo, control algorithms, sensors

1. INTRODUCTION

In recent years, complex models of mobile robots have been equipped with LINUX and ROS (Robot Operating System) computers, which help to implement more advanced control algorithms [1-3]. For example, for the sports field, a lot of mobile robots have been developed for applications such as: RC racing, drone racing and robot sumo [4-5]. Due to the popularization of these disciplines, sumo robot competitions have become more popular every year and attract even small children. However, designing robots is still a challenge, given that it is a combination of electronics, mechanics, and programming [6].

Sumo robots are small robots designed to compete in sumo-style matches. These matches typically take place on a circular platform called a "dohyo." The goal is for one robot to push the other out of the ring or to disable it within a specified time frame.

Sumo robots are often equipped with sensors, such as infrared or ultrasonic sensors, to detect the edge of the dohyo or the opponent robot. They may also use motors and wheels for movement and various strategies for navigation and pushing opponents.

Building and programming sumo robots can be a popular activity in robotics competitions and educational settings, as it combines mechanical design, electronics, and programming skills. Competitions can range from informal matches between hobbyists to organized events with specific rules and regulations.

2. THEORETICAL BACKGROUND OF THE MICRO & MINI SUMO ROBOT

Micro and mini sumo robots are both designed for sumo-style competitions, but they differ in size, weight, and specific competition rules. Here's a comparison between micro and mini sumo robots:

Micro Sumo Robot:

a) **Size and Weight:**

- Micro sumo robots are typically smaller and lighter compared to mini sumo robots.
- They often have dimensions limited to a smaller size, such as a maximum length and width of 10 centimeters and a maximum height of 5 centimeters.

- Weight restrictions for micro sumo robots are usually around 500 grams or less.
- b) **Competition Rules:**
- Micro sumo competitions typically take place on a smaller arena compared to mini sumo competitions.
 - The rules regarding the size of the arena, the dimensions of the robots, and the duration of matches are specific to micro sumo competitions.
 - Micro sumo competitions may have additional rules related to sensor types, programming limitations, or other technical aspects.
- c) **Components:**
- Due to their smaller size and weight restrictions, micro sumo robots often use smaller motors, lighter chassis materials, and compact sensor setups.
 - Components such as motors, wheels, sensors, and batteries need to be carefully selected to meet the size and weight constraints while still providing sufficient performance.
- d) **Programming:**
- Programming micro sumo robots involves designing algorithms that can efficiently navigate the smaller arena, detect opponents, and execute strategies within the specified constraints.
 - Micro sumo robot programmers need to optimize their code to operate with limited processing power and memory resources.

Mini Sumo Robot:

- a) **Size and Weight:**
- Mini sumo robots are larger and heavier compared to micro sumo robots.
 - They typically have larger dimensions, such as a maximum length and width of 20 centimeters and a maximum height of 30 centimeters.
 - Weight restrictions for mini sumo robots are usually around 500 grams to 3 kilograms, depending on the competition rules.
- b) **Competition Rules:**
- Mini sumo competitions take place on larger arenas compared to micro sumo competitions.
 - The rules regarding the size of the arena, the dimensions of the robots, and the duration of matches are specific to mini sumo competitions.
 - Mini sumo competitions may have additional rules related to pushing force limits, starting positions, or other technical aspects.
- c) **Components:**
- Mini sumo robots can use larger motors, stronger chassis materials, and more robust sensor setups compared to micro sumo robots.
 - Components may be selected based on performance criteria such as speed, torque, and durability rather than strict size and weight limitations.
- d) **Programming:**
- Programming mini sumo robots involves designing algorithms that can effectively navigate the larger arena, detect opponents, and implement advanced strategies.
 - Mini sumo robot programmers may have more flexibility in terms of code complexity and computational resources compared to micro sumo robot programmers.

3. PROGRAMMING OF THE MICRO AND MINI SUMO ROBOTS

The software differences between micro and mini sumo robots primarily stem from the differences in their size, weight, and the sensors they use. Here are some key distinctions:

a) **Control Algorithms:**

- Micro sumo robots often require fast and agile control algorithms to navigate the arena and react quickly to opponent movements. These algorithms prioritize speed and responsiveness.
- Mini sumo robots may use more robust control algorithms, focusing on stability and precision in movement. These algorithms must handle the increased weight and inertia of the larger robot.

b) **Sensor Integration:**

- Micro sumo robots typically use compact sensors such as infrared or ultrasonic sensors due to their smaller size and weight constraints. These sensors provide proximity detection and help the robot identify opponents and the ring's boundary.
- Mini sumo robots may incorporate larger or more sophisticated sensor arrays, including additional sensors like gyroscopes or accelerometers for more precise navigation and orientation control. These sensors contribute to the robot's ability to push opponents strategically and avoid being pushed out of the ring.

c) **Path Planning and Strategy:**

- Micro sumo robots often rely on reactive control strategies, where they respond to sensory input and adjust their movements in real-time to outmaneuver opponents. Path planning algorithms may prioritize finding the quickest route to push the opponent out of the ring.
- Mini sumo robots may employ more advanced path planning and strategy algorithms, considering factors such as opponent analysis, pushing force optimization, and ring position awareness. These algorithms may involve longer-term planning and decision-making processes to gain an advantage over the opponent.

d) **Programming Complexity:**

- The programming complexity for both micro and mini sumo robots can vary depending on the specific requirements and features of the robot. However, mini sumo robots may involve more complex software due to the larger number of sensors and the need for more sophisticated control strategies.

e) **Simulation and Testing:**

- Both micro and mini sumo robots may benefit from simulation tools for testing and refining their software algorithms. Micro sumo robots may focus more on simulation environments that emphasize speed and agility, while mini sumo robots may require simulations that accurately represent the dynamics of pushing matches and interaction with opponents.

4. TESTING OF THE MICRO SUMO ROBOT

The general short definition of the robot was that it processes the external world data it receives from the sensors and transfers it to the movement organs (motors, pistons etc..). So in the project we are doing this. Sensor datas coming to main controller (Arduino enabled XMotion Micro Board) and processed here and after that we send new commands to motors but we need to amplify the motor signals to more higher current levels. And at that we use motor driver ICs or modules.

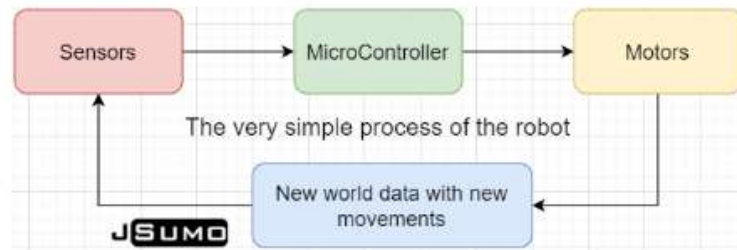


Figure 1. Block diagram of the robot control

Table 1 shows the XMotion Micro Robot Controller Board connections with the other components.

Table 1.Pin table

Pin	Definition	I/O Type	Signal Type
D6	User Led 1	Output	Digital
D4	User Led 2	Output	Digital
D8	User Button 1	Input	Digital
D12	User Button 2	Input	Digital
D13	Motor 1	Output	Digital
D5	Motor 1	Output	Digital
D10	Motor 2	Output	Digital
D9	Motor 2	Output	Digital
A2	Left Opponent Sensor	Input	Digital
A1	Middle Opponent Sensor	Input	Digital
A0	Right Opponent Sensor	Input	Digital
A3	Bottom Line Sensor	Input	Analog

The source code used to program the two micro sumo robots is presented below.

```

/* JSumo Micro Sumo Robot Code
 * Model Number: XS1
 * Board Model: XMotion Micro
 /// Opponent Sensors Declaration ///
 #define Right_Op_Sensor A0
 #define Front_Op_Sensor A1
 #define Left_Op_Sensor A2
 /// Line Sensor Declaration ///
 #define Line_Sensor A3
 /// User Buttons & User Leds Declaration ///
 #define Right_Button 8
 #define Left_Button 12
 #define Led1 4
 #define Led2 6
 /// Motor Control Pins Declaration ///
 #define Right_Motor_Direction 10
 #define Right_Motor_Speed 9
 #define Left_Motor_Direction 13
 #define Left_Motor_Speed 5
  
```

```

//// Speed & Last Remembered Sensor Variables ////
    int Speed2=200;
    int Last_Value=1;
//// Main Motor Control Function ////
    void Motor(int LeftMotorValue, int RightMotorValue) {
if (LeftMotorValue < 0) {
    LeftMotorValue = abs(LeftMotorValue);
    digitalWrite(Right_Motor_Direction, LOW);
    analogWrite(Right_Motor_Speed, LeftMotorValue);
}
else if (LeftMotorValue > 0){
    digitalWrite(Right_Motor_Direction, HIGH);
    analogWrite(Right_Motor_Speed, 255 -LeftMotorValue);
}
else
{
    digitalWrite(Right_Motor_Direction, HIGH);
    analogWrite(Right_Motor_Speed, 255);
}
if (RightMotorValue < 0) {
    RightMotorValue = abs(RightMotorValue);
    digitalWrite(Left_Motor_Direction, LOW);
    analogWrite(Left_Motor_Speed, RightMotorValue);
}
else if (RightMotorValue > 0) {
    digitalWrite(Left_Motor_Direction, HIGH);
    analogWrite(Left_Motor_Speed, 255 – RightMotorValue);
}
else
{
    digitalWrite(Left_Motor_Direction, HIGH);
    analogWrite(Left_Motor_Speed, 255);
}
}
//// Main Setup Function for Defining Input & Outputs ////
    void setup() {
    pinMode(Left_Button, INPUT_PULLUP);
    pinMode(Right_Button, INPUT_PULLUP);
    pinMode(Left_Op_Sensor, INPUT_PULLUP);
    pinMode(Right_Op_Sensor, INPUT_PULLUP);
    pinMode(Left_Motor_Direction, OUTPUT);
    pinMode(Right_Motor_Direction, OUTPUT);
    pinMode(Left_Motor_Speed, OUTPUT);
    pinMode(Right_Motor_Speed, OUTPUT);
    //Serial.begin(9600);
}

```

Figure 2 shows the duel between 2 micro sumo robots. They are notable for their agility, quick finding of the opponent and simple programming.



Figure 2. Testing of the micro sumo robots in dohyo circuit

5. CONCLUSIONS

In summary, while both micro and mini sumo robots are designed for sumo-style competitions, they differ in size, weight, arena dimensions, competition rules, component selection, and programming considerations. Micro sumo robots are smaller and lighter with specific size and weight constraints, while mini sumo robots are larger and more versatile with potentially more powerful components and advanced programming capabilities.

In summary, while both micro and mini sumo robots share similar software goals of navigating the arena and pushing opponents out of the ring, their software implementations differ in terms of control algorithms, sensor integration, path planning, programming complexity, and simulation/testing approaches. These differences arise from the unique characteristics and challenges posed by each robot category.

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