King Abdullah II School of Engineering
كليـــــة الملك عبد الله الثاني للهندســـة

Princess Sumaya University for Technology

King Abdullah II School for Engineering

Computer Engineering Department

Microprocessors & Embedded Systems

Sumo PICwarrior

Microprocessors & Embedded Systems Project

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Abstract

The focal point of the Sumo Robot project centers on constructing a self-sufficient combat robot utilizing the PIC16F877A microcontroller. Our innovative team has successfully incorporated two distinct control modes, including a Bluetooth option for manual manipulation and an autonomous mode utilizing onboard sensors. This detailed report offers a comprehensive look at our hardware and software endeavors, highlighting both hurdles and achievements along the way. Overall, our Sumo Robot project serves as a testament to our technical prowess and paves the way for advancements in the realm of autonomous robotics.

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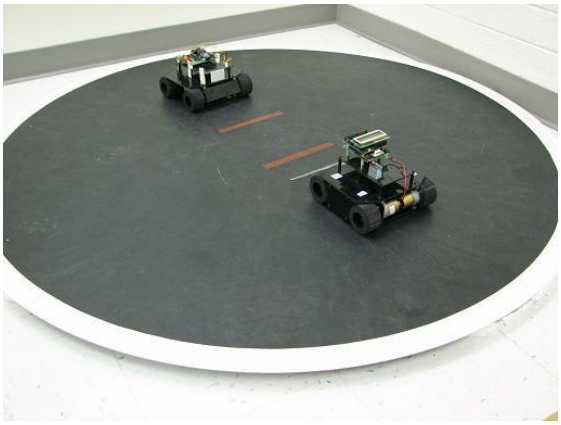
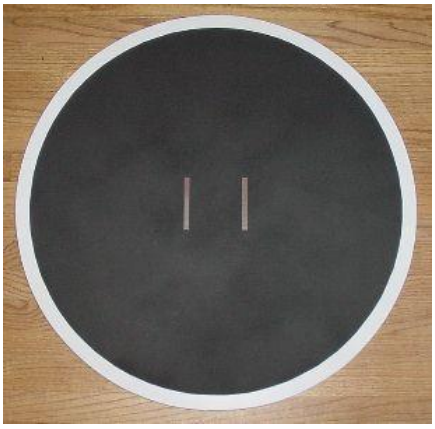
1 INTRODUCTION

The "Sumo PICwarrior" project is a showcase of embedded systems technology, featuring a smart robotic system with manual and autonomous control modes. Using the PIC16F877A microcontroller, the robot integrates sensors for effective navigation and precise motor control. The inclusion of Bluetooth communication allows for remote control, demonstrating the versatility of the system. This project highlights the seamless collaboration between hardware and software components, offering insights into the innovative applications of embedded systems in robotics.

1.1 THEORY

In the realm of the Sumo Robot project, inspired by traditional sumo wrestling, the competition is reimagined within a circular ring with a diameter of 1.5 meters. Within this constrained arena, where the goal remains to push opponents out or force them to touch the ground, the design considerations for the sumo robot take on a new dimension. Adhering to a weight limit of 3 units and a compact size of 20cm x 20cm, the robot's design strategically balances power and agility to navigate the circular space effectively. Integral to its functionality are sensors for opponent detection and fine-tuned control algorithms to ensure responsiveness within the defined boundaries. Creating a versatile robot that encapsulates the spirit of sumo wrestling, while meeting the specified weight, size, and circular arena dynamics, becomes the central focus of this innovative project.





1.2 OBJECTIVE

Autonomous Navigation: Develop algorithms and strategies to enable the robot to autonomously navigate within a sumo wrestling arena, avoiding obstacles and making strategic decisions.

Opponent Detection: Implement sensor technologies that allow the robot to detect opponents within its vicinity accurately, enabling it to engage in competitive sumo matches effectively.

Dual-Control Implementation: Design and integrate both Bluetooth control and autonomous control modes to provide flexibility in operation, allowing users to manually control the robot or allow it to function independently.

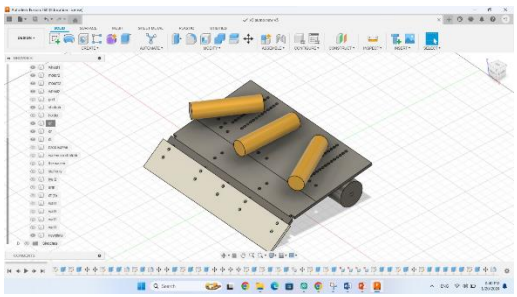
Hardware Integration: Ensure seamless integration of components, focusing on the PIC16F877A microcontroller, sensors, and actuators, to create a robust and efficient robotic system.

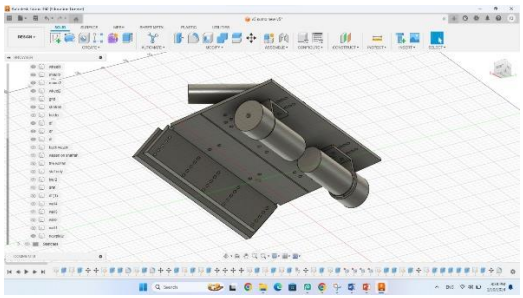
Versatility: Create a robot that can adapt to various scenarios and applications beyond sumo wrestling, showcasing the versatility of autonomous robotics.

2 DESIGN

2.1 MECHANICAL DESIGN:

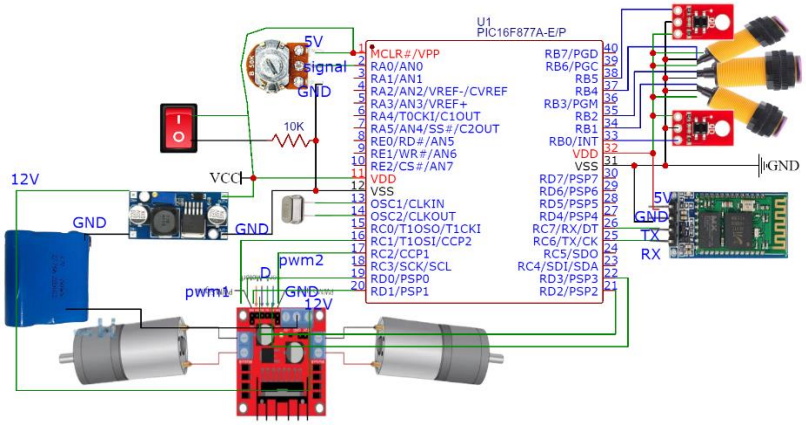
In crafting the design for our Sumo Robot, we kicked things off by brainstorming the look and features we wanted. **Fusion 360** played a big role in turning these ideas into a 3D reality. This awesome tool helped us create the main parts like the chassis, wheels, and motor mounts, making sure everything fit together just right. We also used it to figure out where to place sensors for spotting opponents during matches. **Fusion 360** helped us balance the weight and make sure the robot stays steady and nimble in the arena. We didn't get it perfect on the first try; we tweaked and tested the design until it worked like a charm.

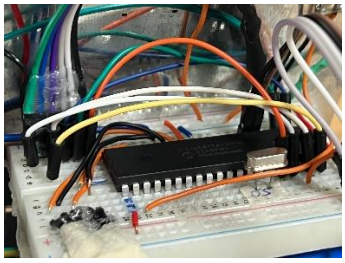


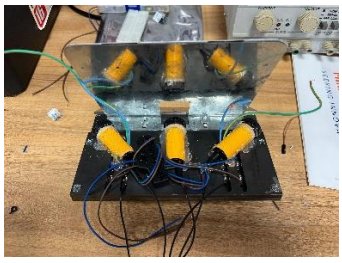


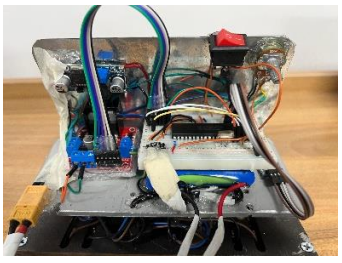
2.2 HARDWARE DESIGN:

For our Sumo Robot, we worked on creating a smart circuit that powers and controls everything smoothly. The PIC16F877A microcontroller is like the brain, managing the robot's movements and reactions. We made sure the circuit connects well with motors for moving around and sensors for spotting opponents. The design ensures that power is distributed efficiently, and all parts communicate effectively. We kept the wiring tidy to avoid any confusion or problems. From the power supply to the sensors, everything is neatly connected to make sure our robot works seamlessly. Our goal was to make a strong and simple hardware setup that suits the needs of the Sumo Robot project.



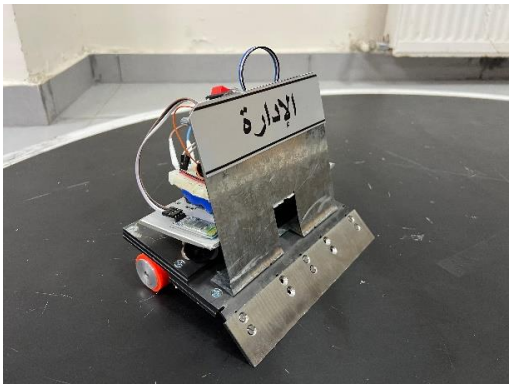


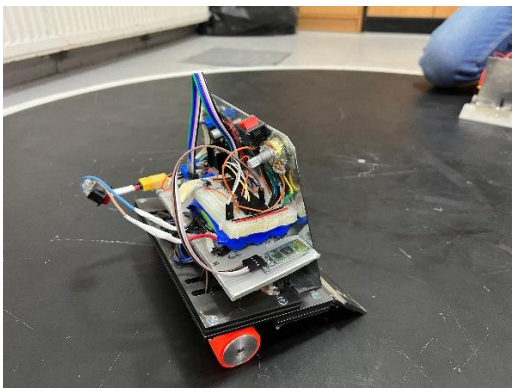




3 RESULTS

Our Sumo Robot project had some awesome outcomes! We tested it in two cool ways: using a remote control (Bluetooth mode) and letting it make its own decisions (autonomous mode). The tests went really well, showing that our robot can handle different situations like a champ. It moved around smoothly, spotted opponents effectively, and even strategized in sumo matches. It was like our robot knew what to do! Plus, it easily switched between modes thanks to the PIC16F877A microcontroller. These successes mean our Sumo Robot is reliable and versatile, and we're excited about what we can do with it in the future!





Youtube Video link: https://youtu.be/kKgIpCF7U9g?si=abiFl21MEo4_1gd

Github link: https://github.com/Inshasi/Sumo_PICwarrior/blob/main/README.md

4 PROBLEMS AND RECOMMENDATIONS

1. Bluetooth Module Connection:

- **Issue:** Initially, we faced difficulties connecting the Bluetooth module, mistakenly swapping the TX and RX connections.
- **Recommendation:** Ensure clear documentation and double-check connection diagrams for precise module integration.

2. Port Misconfiguration:

- **Issue:** Initially connecting sensors to PORTC caused complications, as it conflicted with PWM requirements (RC1&2). Shifting to PORTA introduced complexity due to analog pins.
- **Recommendation:** Plan port allocations strategically, considering both digital and analog requirements. Finalizing on PORTB for sensors and using RA0 for the potentiometer streamlined connections.

3. Wheel Size Selection:

- **Issue:** Identifying the correct wheel size proved challenging until acquiring wheels with 3mm holes, necessitating modification for a proper fit (4mm).
- **Recommendation:** Prioritize thorough research on compatible wheel sizes and collaborate with the workshop for precision adjustments, avoiding last-minute modifications.

5 CONCLUSION

Creating our SUMO PIC Warrior brought about challenges, but the joy of crafting a functional robot for sumo battles was truly rewarding. While there's room for improvement, especially in enhancing sensor capabilities, we successfully maximized our resources within the given time and knowledge constraints. Despite the hurdles, the process of designing and assembling the robot was enjoyable, fostering a collaborative and satisfying experience for our team.

6 REFERENCES

1- Course Slides
2- PSUT eLearning site, http://www.elearning.psut.edu.jo/
3- PIC16F877A Datasheet