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EECE 404 – Senior Design II

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Final Report Bison Bot

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Abstract

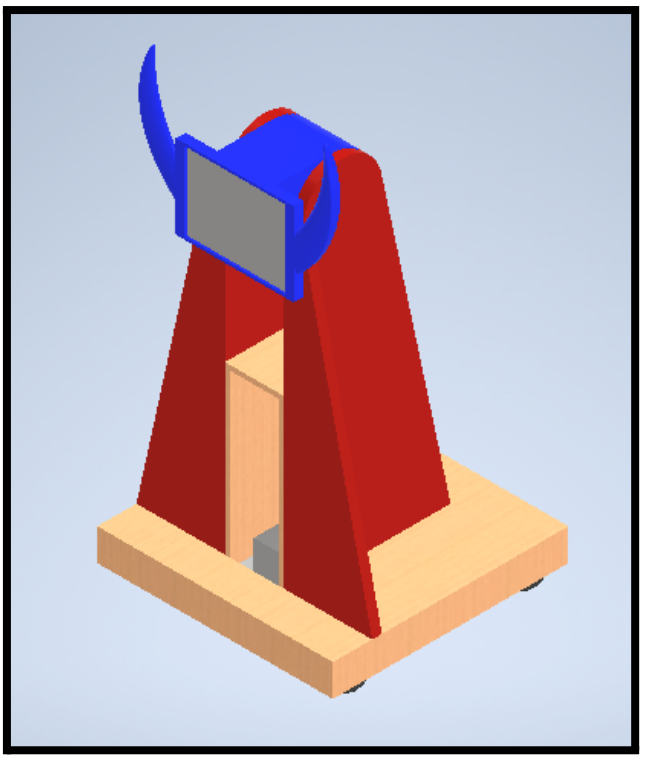
The Bison Bot is a voice-responsive, autonomous robot designed to help students and visitors find their way around the LKD building at Howard University. Over the course of eight months, a team of senior Electrical and Computer Engineering students led the design, prototyping, and development of this helpful guide. The bot's main job is to make navigation easier by providing room directions through a touchscreen interface and smart mobility features. It runs on a Raspberry Pi, uses rechargeable batteries, and is equipped with sensors that allow it to recognize voice commands, steer clear of obstacles, and guide users efficiently. The project addresses a common frustration among students getting lost in LKD and offers a tech-forward solution that makes navigating the building much simpler.

Problem Statement

Newcomers to the LKD building often feel overwhelmed due to the lack of signage and directional tools. It's easy to get lost. The Bison Bot aims to solve that by combining voice command capabilities, sensor-based mobility, and an intuitive touchscreen interface. With it, students and visitors can quickly and confidently find their way to classrooms and offices.

Design Requirements

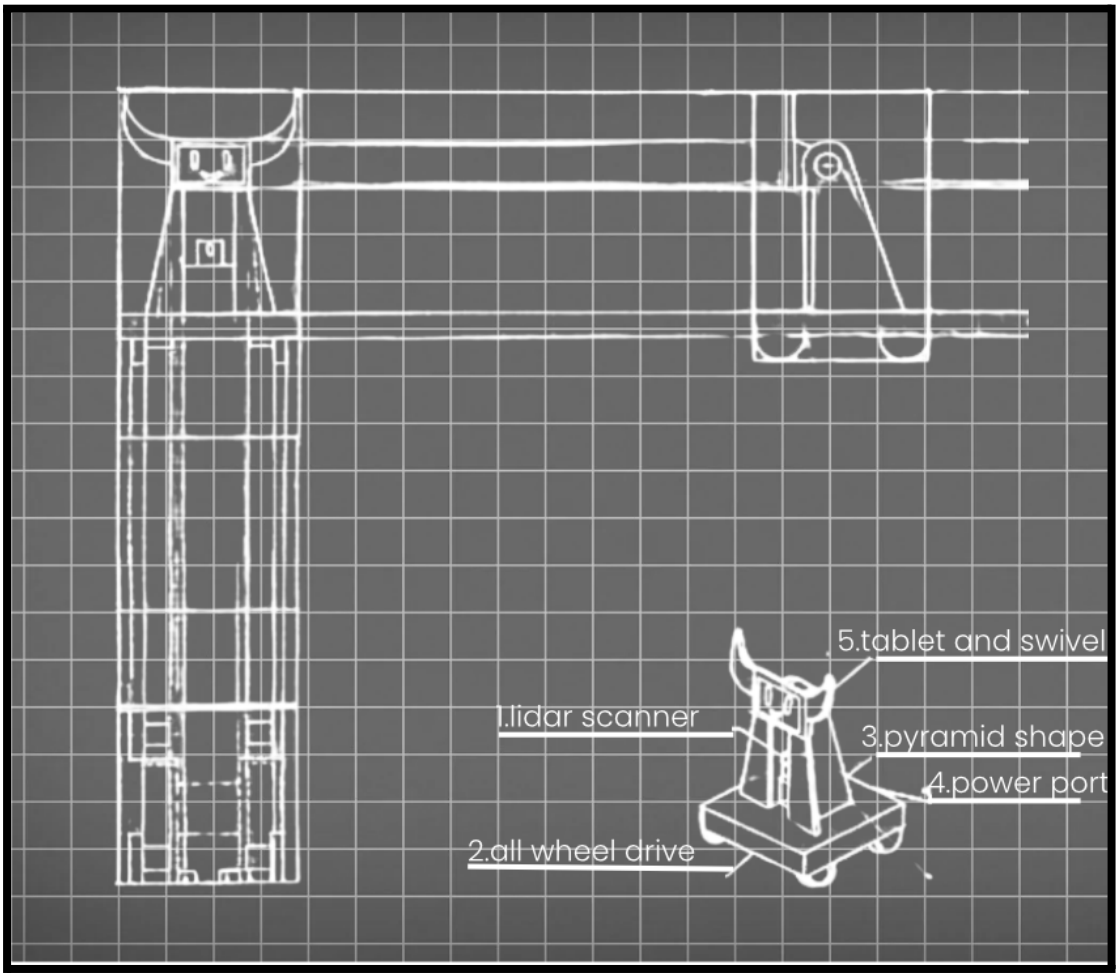
The Bison Bot is designed to be compact and agile standing about 4 feet tall, weighing around 40 pounds, and moving at a walking pace (between 2.5 and 4 mph). It relies on a Raspberry Pi microcontroller, has a wooden frame, and uses rechargeable batteries for power. It is also equipped with omnidirectional wheels, a lidar scanner, and touchscreen display.



Design constraints play a key role into how the Bison Bot is designed. Excessive noise from the device would scare consumers as well as disturb classes. A power constraint in order to reduce repetitive charging time also is beneficial to the robots function. In addition to being efficient and quiet, it needs to meet safety standards (ANSI/RIA R15.06-2012) and be culturally appropriate for its environment. The Bison Bot is here to make navigating LKD easier for everyone. With voice commands, smart sensors, and a simple interface, it helps students and visitors find their way without feeling lost or overwhelmed. It's designed to be user-friendly, inclusive, and a reflection of Howard's welcoming and innovative spirit. Durability and structural integrity are also key.

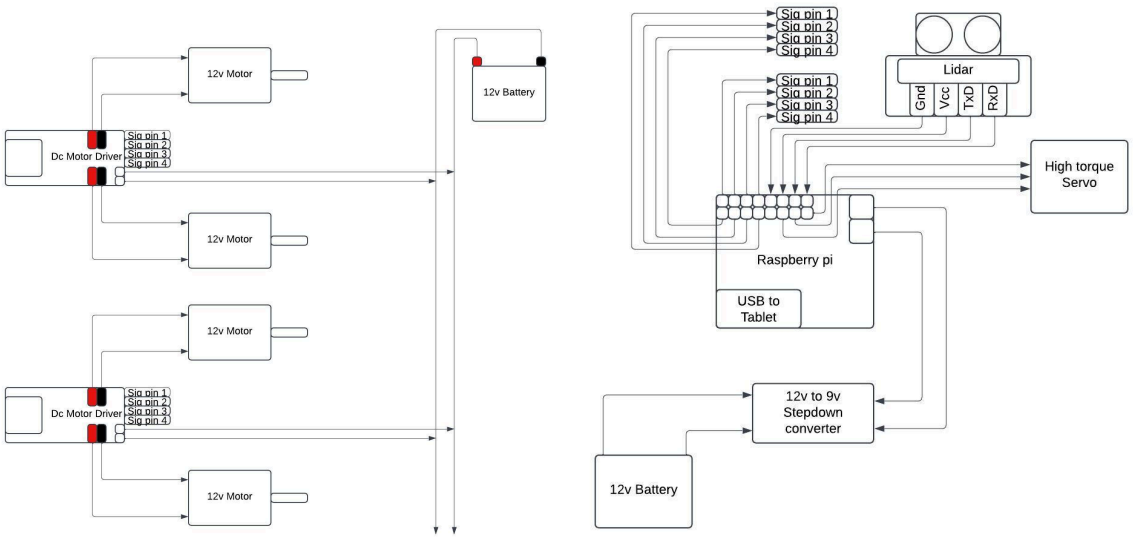
-5 Deficiency in Patent-style description

Solution Design



The robot features a swivel head for engaging interaction and a mounted tablet for receiving commands. Its mobility comes from Mecanum wheels and a dual-motor drivetrain, all controlled through an H-Bridge circuit. For navigation and obstacle avoidance, it uses LIDAR and ultrasonic sensors. The system was tested and fine-tuned using the Gazebo simulation environment. To keep things quiet, the bot's wooden casing includes insulation around noisy components. It docks to recharge, eliminating the need to frequently swap out batteries. Users interact through the tablet, which gives real-time directions, while an external light display shows battery levels.

We documented everything from wiring diagrams and UI sketches to mapping screenshots and decision flowcharts to support our design decisions and track our progress:



Agile Workflow and Weekly Plan

We followed an Agile development process, breaking work into sprints and meeting weekly Wednesdays at 7:30 PM in the LKD smart room to stay on track. Early sprints focused on defining the problem and understanding user needs. Mid-phase work included buying hardware, integrating systems, and writing the core software. The final sprints were all about testing, debugging, and preparing for live demos.

Project Implementation Process

The work was split into 3 sprints:

Sprint 1: In order to reach our goal of fabricating a digital twin, we collected a university laptop with gazebo and ROS software installed. Then we made calculations to ensure the compatibility of the components. Towards the end of the sprint, we made precise wood dimensions so that the frame could be cut out in the next sprint.

Sprint 2: The Bison Bot assembly was the goal of this sprint. We began by assembling the drive train and wooden frame. A week was spent in the fabrication lab cutting and gluing together the pieces. We then attached the lidar, converters, and

battery to ensure the components would function together. Lastly, we were able to start programming the hardware.

Sprint 3: The last sprint consisted of testing and debugging. The user interface was also programmed during the sprint. We used a flowchart to brainstorm its functions and designs. The completion of the full assembly of the bison bot led to final debugging and testing.

Conclusions

The Bison Bot is a smart and user-friendly solution to a real issue faced by many in the LKD building. Its blend of interactive technology, autonomous navigation, and thoughtful design highlights the team's engineering skills and commitment to solving practical problems. With further testing and development, the Bison Bot could easily be adapted for use in other campus buildings—or even beyond.

References

- ANSI/RIA R15.06-2012 Safety Standards for Industrial Robots
- Raspberry Pi Foundation Documentation
- Gazebo Robotics Simulator
- Amazon Product Listings for Components (Wheels, Batteries, Controllers)
- Maximo Technology Patent Dispute Reference (for Layman's Legal Learning)