SELF-NAVIGATING MOBILE ROBOT FOR ASSISTING WITH LOAD TRANSPORTATION FOR PHYSICALLY LIMITED USERS

Márcio Mendonça – UTFPR (BRAZIL)*

Wagner F. Godoy - UTFPR (BRAZIL)

Luigi L. Saito - UTFPR (BRAZIL)

Rodrigo H. C. Palácios - UTFPR (BRAZIL)

Janaína F. S. Gonçalves - UTFPR (BRAZIL)

Marco Antônio M. Laia- UTFPR (BRAZIL)

UTFPR

UNIVERSIDADE TECNOLÓGICA FEDERAL DO PARANÁ

RESUME PRESENTATION:

- This work details the development of a low-cost autonomous mobile robot capable of following its user and avoiding obstacles, analogous to a leader-following robot.
- Definition of the Problem (transporting small loads for individuals with physical limitations)
- Introduction (Motivation...)
- Multi-objectives (Avoid Obstacle, follow the user)
- Proposal (low-cost autonomous mobile robot)
- Comparative Results (Simulations) – First Objetive
- Initial Real Results (Prototype) – Second Objetive

INTRODUCTION: MOTIVATION

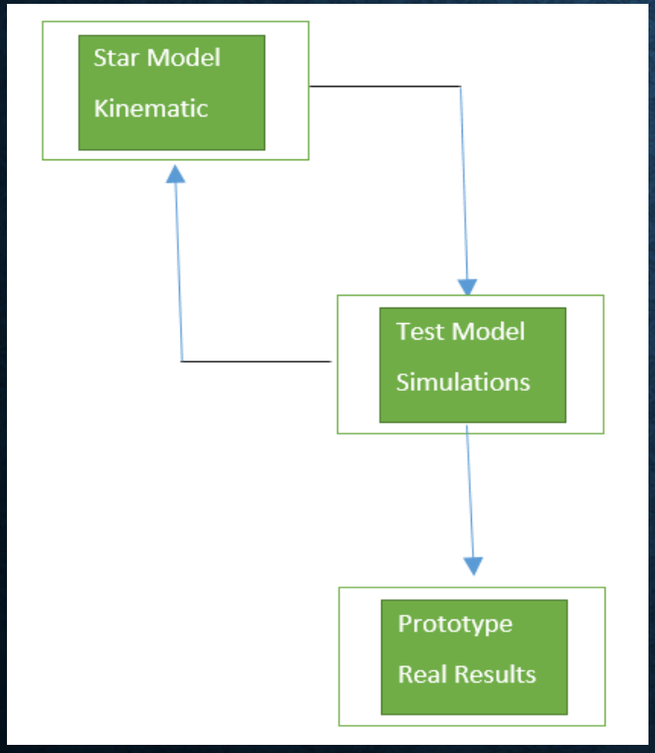
- Individuals with physical limitations (e.g., elderly, pregnant women) face difficulties in transporting small loads.
- A need exists for an autonomous, low-cost robot capable of assisting with load transportation and obstacle avoidance in real time.

INTRODUCTION –ROBOTIC OVERWIEW

- **The field of robotics is expanding, aiming to automate tasks traditionally performed by humans.**
- Mobile robotics focus on using mechanical systems, sensors, and AI for real-time navigation and task execution.
- Assistive robotics helps individuals with physical limitations by automating tasks, improving their quality of life.
- **The study focuses on creating a service robot that follows its user while avoiding obstacles to assist with load transportation.**

STATEGY

Simulation until prototype

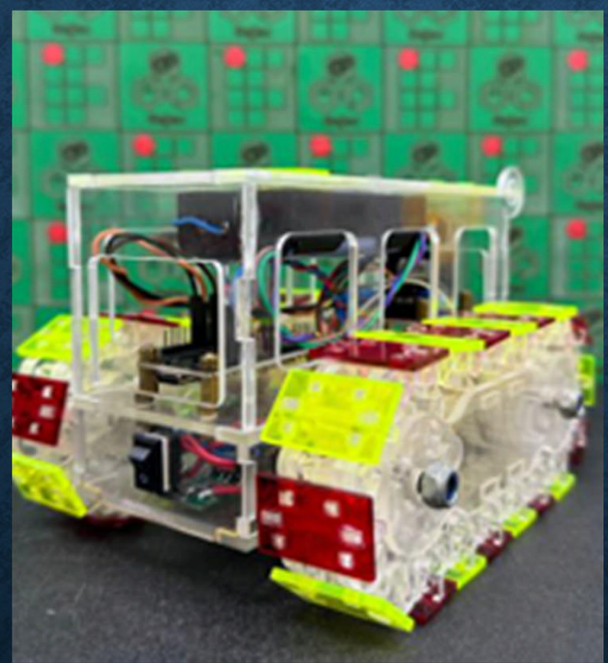


Development Prototype.

- The diagram outlines a process beginning with the "Star Model Kinematic" as the initial phase. This is followed by the "Test Model Simulations," where simulations will be executed exhaustively. The next step is the "Prototype Real Results" stage, which focuses on implementing and validating the prototype.

EXAMPLE “NON-AUTONOMOUS” NAVIGATION

The picture shows the prototype, developed using Arduino UNO R3 and an ESP-32 camera. Initial tests demonstrated satisfactory target detection capabilities

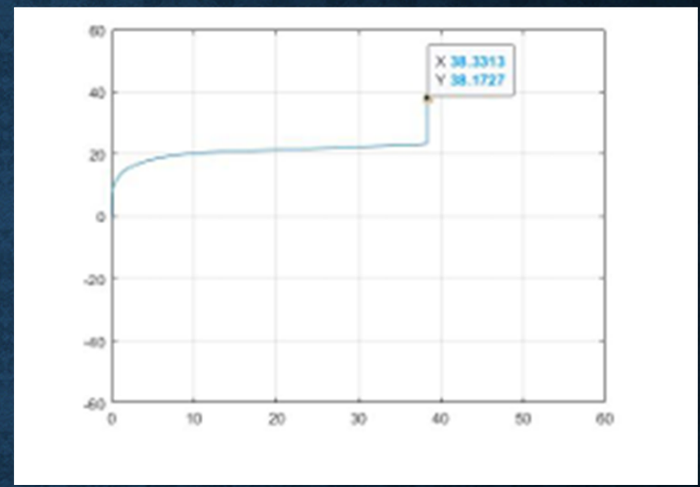


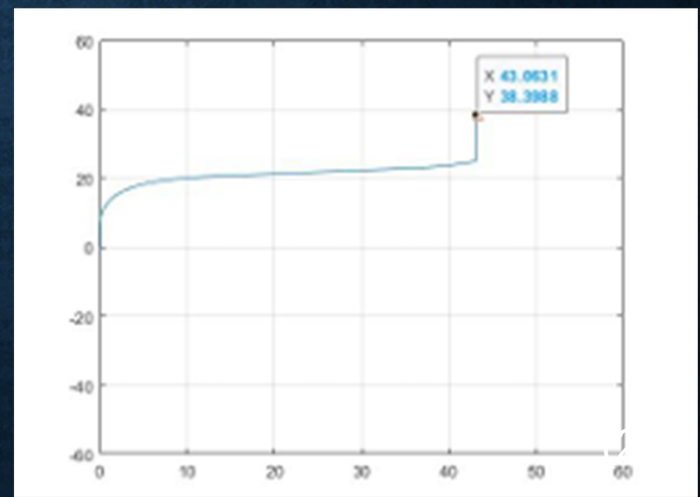
***Autonomous systems do not require human intervention**
If changes setup in the environment or scenario will be necessary a new program.

MULTIPLE OBJECTIVES

Main Objectives:

- **Develop a low-cost, autonomous robot to follow users and avoid obstacles in real-time.**
- **Ensure the robot can transport loads of up to 10 kg.**
- **Validate the control system through simulation and initial prototyping.**
- **Test the robot's ability to detect and track targets using sensors and cameras.**

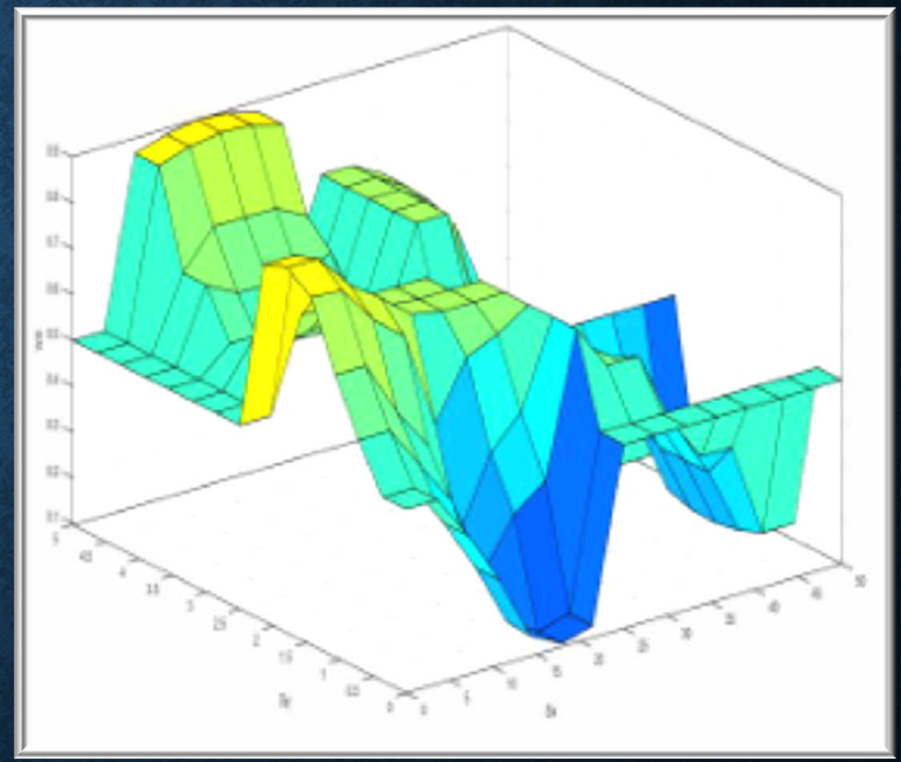




NON INEAR FUZZY SURFACE

- **Simulations:**
- MATLAB simulations compared fuzzy and multivalued logic controllers.
- Fuzzy controller performed well in tracking the target with minimal computational complexity.

- **Prototyping:**
- Initial tests showed successful target detection but highlighted software stability issues, necessitating further refinement.



Fuzzy Controller Surface

DEVELOPMENT

Simulations:

The control model validation involved MATLAB simulations comparing fuzzy and multivalued logic controllers, with the fuzzy controller determining wheel pulses based on the Euclidean distance between the robot and the target. Simulation results demonstrated satisfactory performance in target tracking while maintaining acceptable computational complexity. This control logic will be implemented in the prototype after preliminary results indicated good accuracy in target pursuit.

Prototyping:

A prototype using Arduino UNO R3 and an ESP-32 camera showed promising target detection capabilities, but software stability issues highlighted the need for further refinement. Future efforts will prioritize optimizing software algorithms and upgrading hardware components to enhance system reliability and ensure robust performance in real-world applications.

MARKER DETECTION

These tests involved assessing the system's ability to accurately identify and track predefined markers. While the results were promising, the observed software instabilities highlight the necessity for additional refinement and optimization.

Marker filtering

Marker detection.

CONCLUSIONS

- The autonomous robot successfully demonstrated target tracking and obstacle avoidance capabilities.
- Future work will focus on improving system robustness and exploring advanced algorithms for decision-making in dynamic environments.
- Potential Applications: Logistics, healthcare, and personal assistance, with significant impact on enhancing quality of life and productivity.

FUTURE WORK

- Improving Fuzzy Systen robustness and stability.
- Upgrading hardware for faster processing and complex computations.
- Complete and test prototype
- Exploring advanced algorithms for adaptive learning and decision-making.

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UNIVERSIDADE TECNOLÓGICA FEDERAL DO PARANÁ

THANKS FOR YOUR ATTENTION !!!!!

- E-mail:
- mendonca@utfpr.edu.br
- wagner.godoy@utfpr.edu.br