NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Integration of Machine Learning in Autonomous Devices

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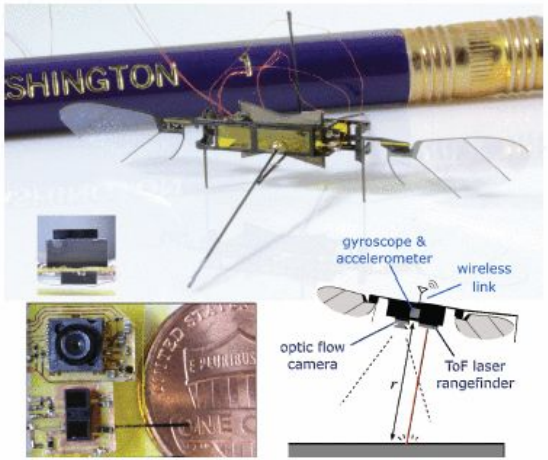
AGGIES DO

Small Scale Autonomy



[1] Marshall, A. (2019, October 5). These small cars can help drive the Autonomous Future. Wired. https://www.wired.com/story/small-cars-help-drive-autonomous-future/

[2] Sidhartha. (2016, December 8). Different applications of Microcontroller. VLSIFacts. https://www.vlsifacts.com/different-applications-microcontroller/

[3] Y. P. Talwekar, A. Adie, V. Iyer and S. B. Fuller, "Towards Sensor Autonomy in Sub-Gram Flying Insect Robots: A Lightweight and Power-Efficient Avionics System," 2022 International Conference on Robotics and Automation (ICRA), Philadelphia, PA, USA, 2022, pp. 9675-9681, doi: 10.1109/ICRA46639.2022.9811918.

Motivation

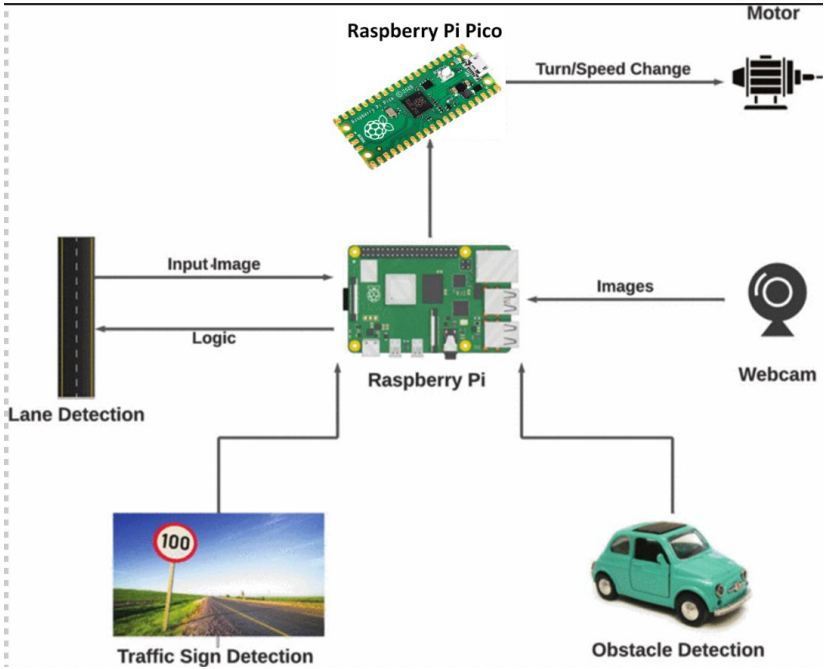
- Cost-effective and accessible platform for autonomous vehicular experimentation
- Low power consumption of microcontrollers
- Utilization of machine learning and deep learning
- Testing for faults on microcontrollers with fault injection studies
- Desire for a search and rescue (SAR) robot

Minority Report (2002) Spider Robots

Starship Autonomous Delivery Robot

Training Methods

- Using the RPi 4 as the host server
- Using the Pico as the client/controller
- Federated Learning
  - A model is trained on the Pico and that model will be sent to the RPi 4



Modified from A Self-Driving Car Platform Using Raspberry Pi and Arduino [1]

[1] V. Shahane, H. Jadhav, M. Sansare and P. Gunjgur, "A Self-Driving Car Platform Using Raspberry Pi and Arduino," *2022 6th International Conference On Computing, Communication, Control And Automation (ICCUBEA*, Pune, India, 2022, pp. 1-6

imagenet/mobilenet_v3_large_075_224/classification/5/metadata

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Results Latency: 47ms

Type	Score
street sign	12.216
traffic light	7.385
cinema	6.568
parking meter	6.406

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Results Latency: 881ms

Type	Score
street sign	9.181
traffic light	5.273
chainlink fence	5.001
birdhouse	4.253

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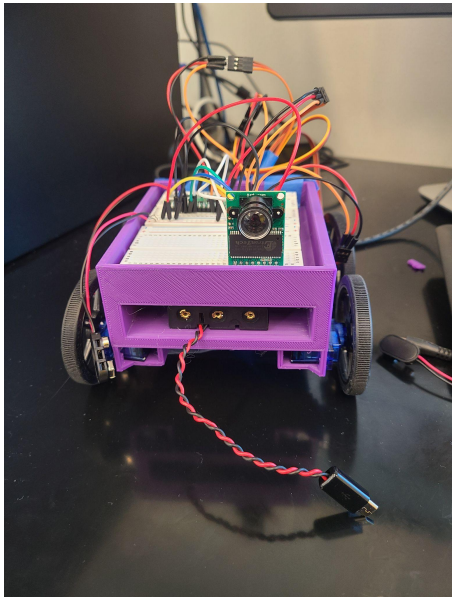
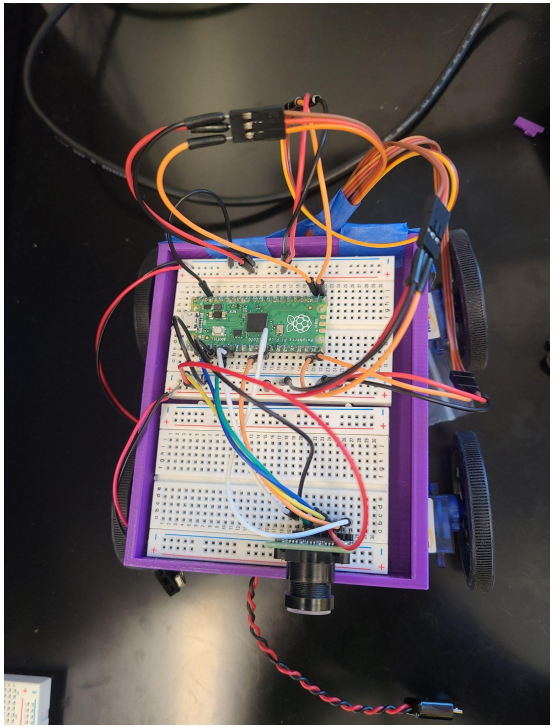
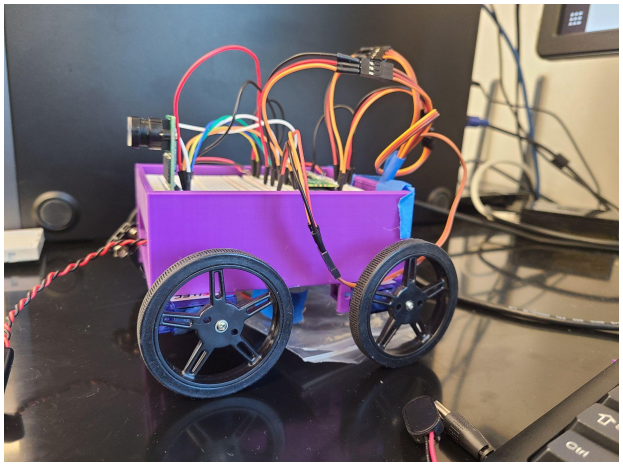
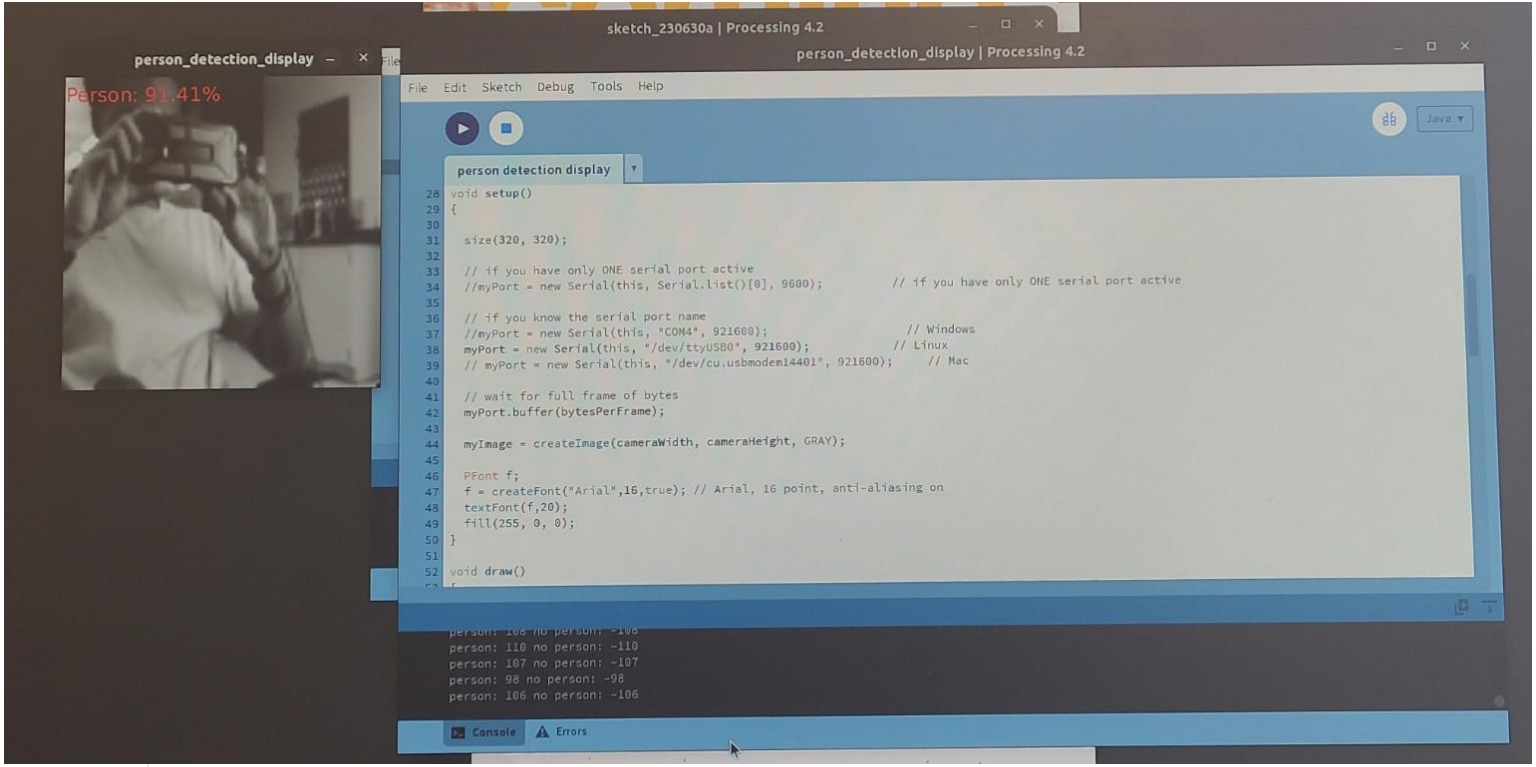






Front, Top, and Side views of Model

Progress so Far



Next Steps

- Currently implementing Raspberry Pi 4 as host server
- Goal of training exclusively on Raspberry Pi Pico W
- Making a second model of the autonomous car model for federated learning
- Creating a miniature city for the car model to maneuver and navigate through