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Demo Abstract:
Cost-Effective Rover for Farms

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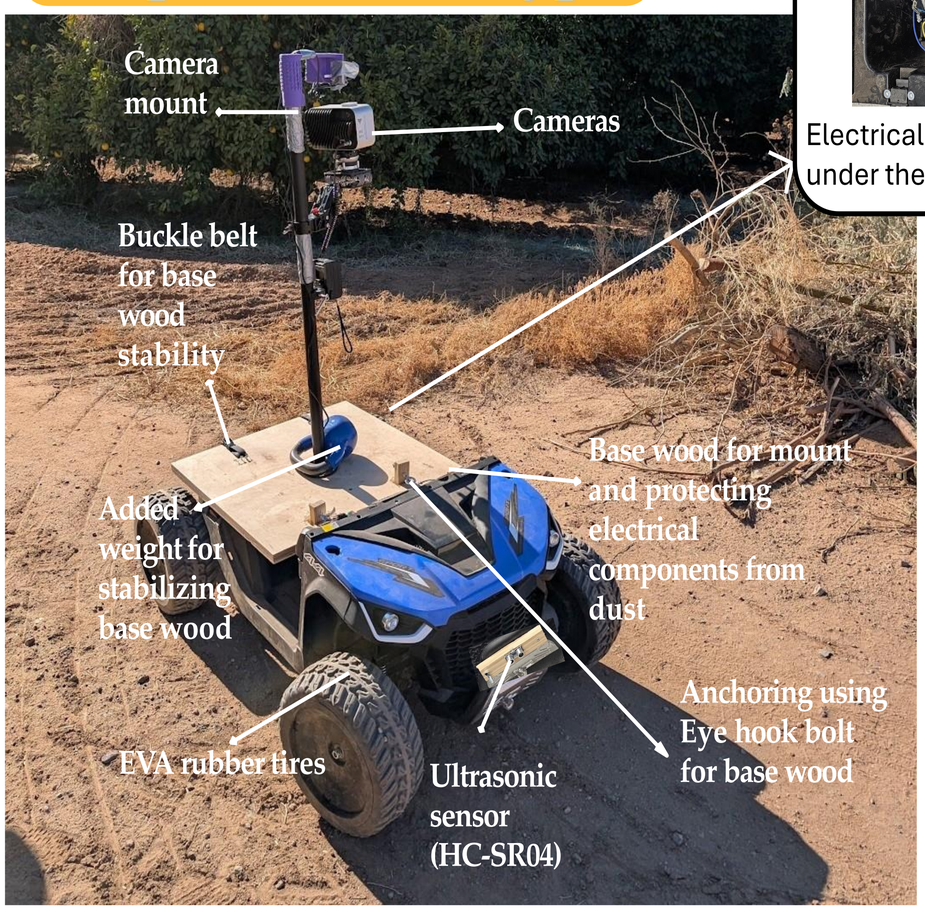
Motivation

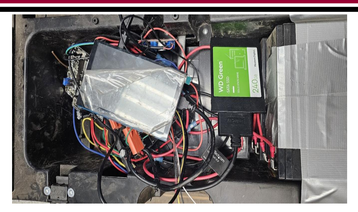
To develop a cost-effective prototype rover for precision agriculture

- Helping farmers via machine intelligence.
- Affordable solution for small and medium farms.
- Promoting sustainable farming practices.
- With clear cost breakdowns (not in existing solutions).
- Customizable design.

https://humphreymalone.com/wp-content/uploads/2024/01/A-modern-farm-showcasing-precision-agriculture-technology.-The-scene-includes-high-tech-tractors-with-GPS-systems-drones-flying-overhead-surveying-th.webp

Proposed Prototype

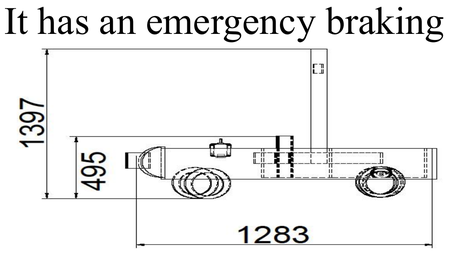


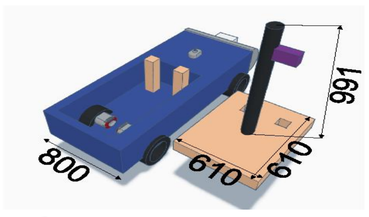


Electrical Components connected under the base wood

Proposed Prototype Rover

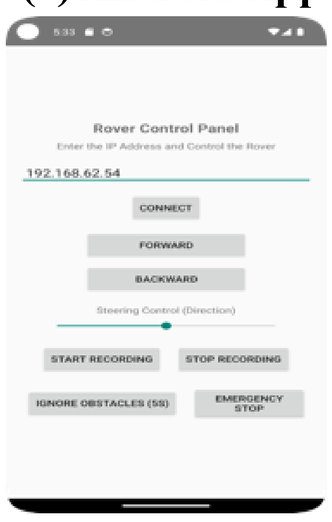
- With ethylene vinyl acetate (EVA) tires, more durable on various surfaces.
- It has an emergency braking feature.



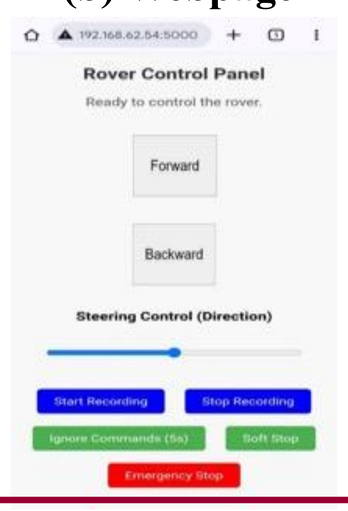


Dimensions (in mm) of our rover.

(a) Android App



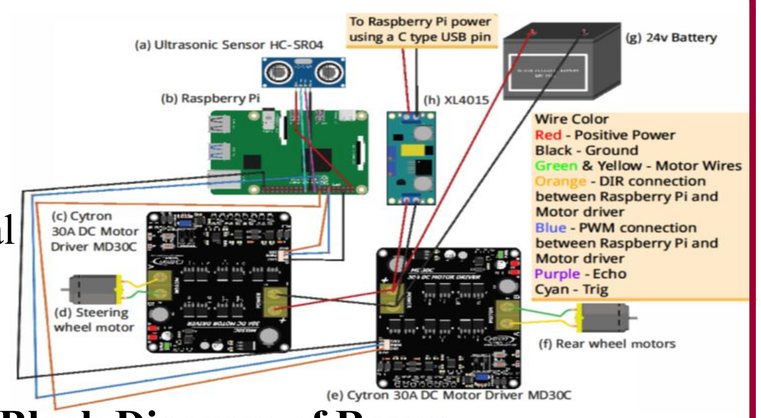
(b) Webpage



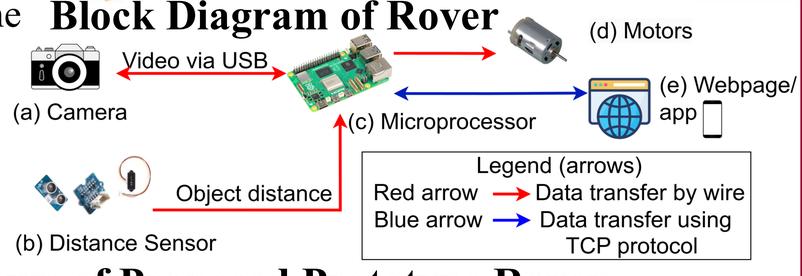
- Total cost of our prototype rover: $782.03 (USD)
  vs.
- Average cost of the commercial agricultural robots: $7,887 (USD)
  - Based on our calculations and analysis using the data in *Gil et al.**

* Gil et al., Smart Agricultural Technology (2024)

Circuit Diagram of Rover



Block Diagram of Rover



Cost Breakdown of Proposed Prototype Rover

Equipment	Qty.	Unit Cost (USD)
24V Ride on Toy Car (Includes a 24V battery)	1	349.99
Raspberry Pi 4B 8GB	1	75.00
Cytron 30A DC Motor Driver MD30C	2	35.00
XL4015 DC/DC Converter	1	7.89
22AWG USB Type C Male Pigtail	1	4.29
12V Battery	2	29.99
24" x 24" x 1" Thick Wood	1	87.01
ELP Sony IMX323 Sensor Mini USB Camera	1	64.99
Monitor stand	1	34.99
15lb Kettlebell weight	1	18.99
Ultrasonic Sensor HC-SR04	1	1.91
Breadboard and jumper wires	1	6.98
Total		**782.03**

Application

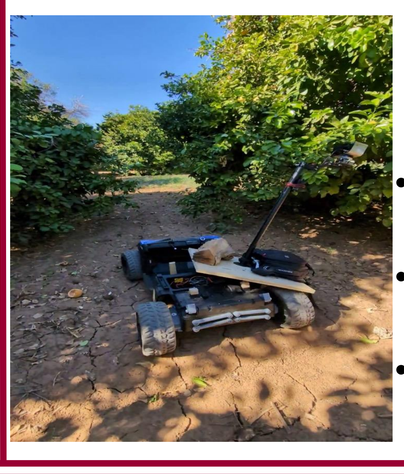
Example Application Using YOLO

Some of the applications that can be implemented according to *Ghazal et al.*+

- Automated weed detection and mapping.
- Crop yield prediction through fruit/plant counting and growth tracking.
- Crop type and growth stage identification via spectral imaging.
- Harvest timing optimization using growth stage analysis.

+ Ghazal et al., Artificial Intelligence in Agriculture (2024)

Challenges



Challenges with the initial design:

- Tires wore out too quickly on rough terrain.
- High power consumption.
- Lacked space to add extra batteries

Initial rover

- Wood was used for the pole mount due to its availability and sustainability.
- The camera's weight caused instability at high speeds.
- To ensure stability, extra sawing and drilling were needed to secure the wood.

Remaining Challenges

- Limited traction in muddy soil.
- Bulky design makes maneuvering in narrow spaces (e.g., indoor or row crop farms) hard.
- Overly sensitive obstacle detection can misinterpret large weeds as obstacles.
- Unable to capture top-down views, limiting visibility above tree canopies.
- Requires training on diverse crop types & environments for most applications to function effectively.

Future Work

- Add autonomous navigation and speed control to enhance mobility.
- Use drones alongside the rover to improve field coverage and efficiency.
- Design space exploration for rovers and drones.
- Investigate and develop application-specific functionalities tailored to different crops and farm environments.