



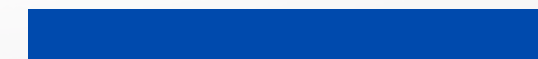
POWER TRANSMISSION LINE INSPECTION ROBOT

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PROBLEM STATEMENT

Power lines operate 24/7 under extreme stress. Corrosion, vibration, heat, and harsh weather degrade them silently over time — and when faults go undetected, the consequences are catastrophic.

Undetected faults on power lines have caused some of history's worst energy disasters — from the 2018 Camp Fire that killed 85 people, to the 2003 Northeast Blackout that cut power to 55 million people.



LIMITATIONS

OF CURRENT INSPECTION METHODS

- Manual Labor — High safety risks for workers on energized lines at height
- Helicopter Surveys — Effective but far too costly for frequent use
- UAVs / Drones — Safer alternative but limited battery life makes long-span inspection impractical



Develop a low-cost autonomous robot capable of traversing overhead power transmission lines

1

Detect defects such as wire damage, foreign objects and insulator faults

2

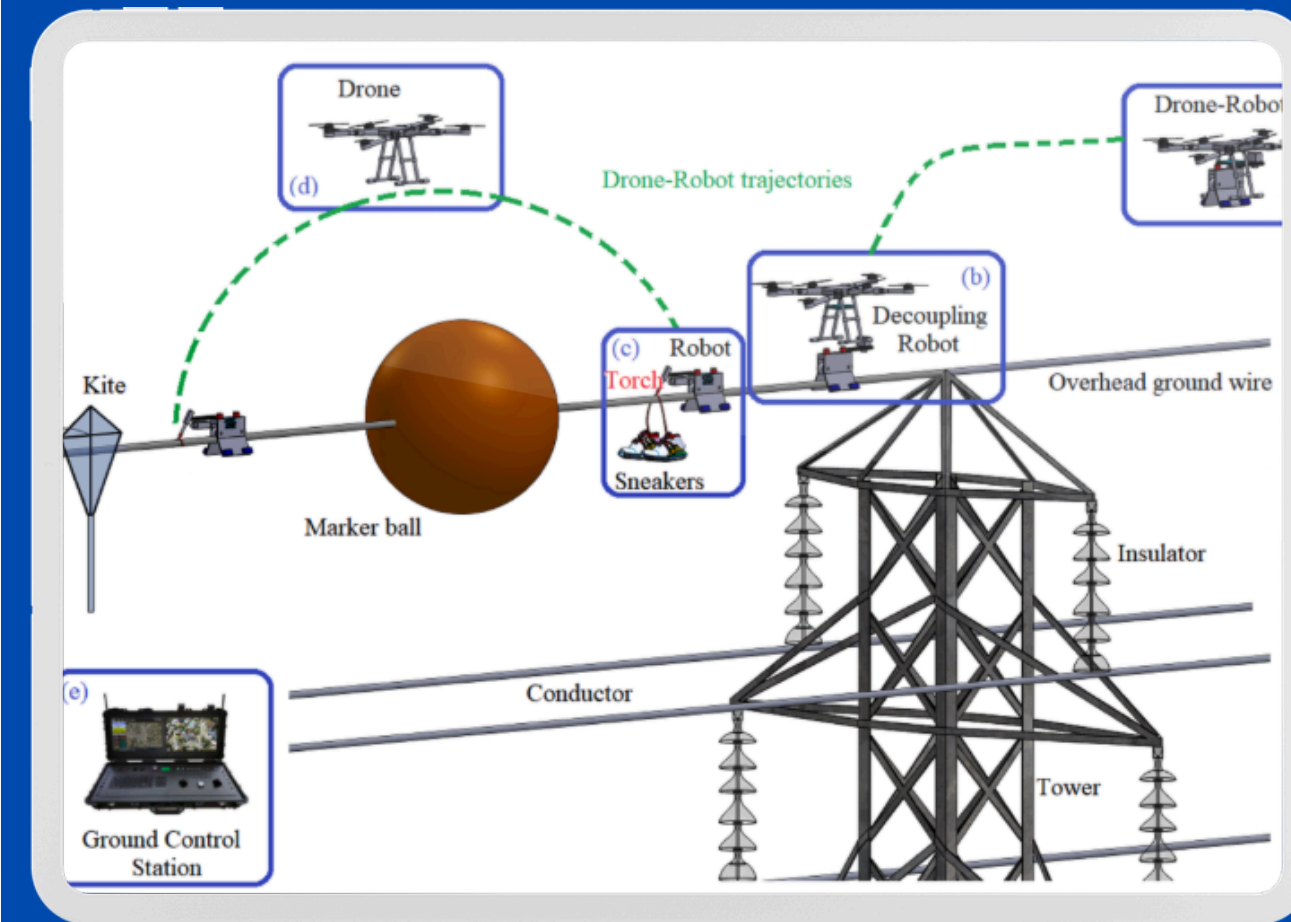
Eliminate the need for manual inspection, reducing cost and human risk

3

Transmit inspection data wirelessly to a ground operator for remote monitoring

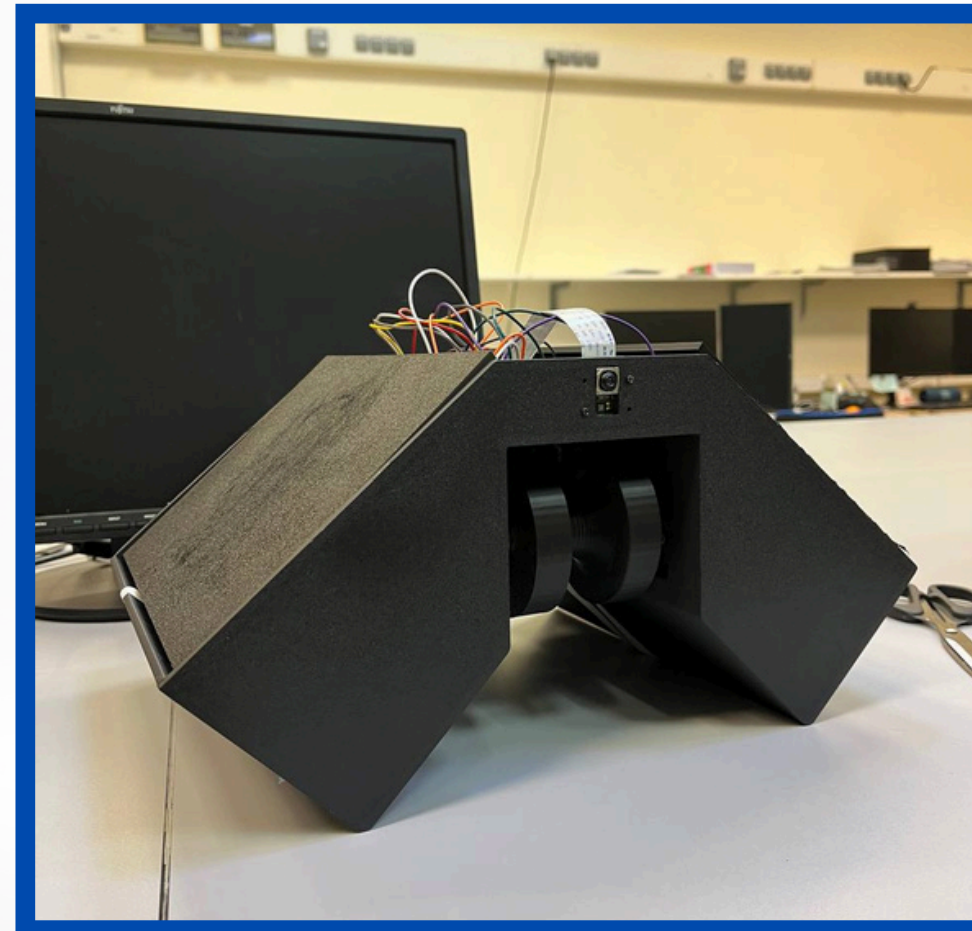
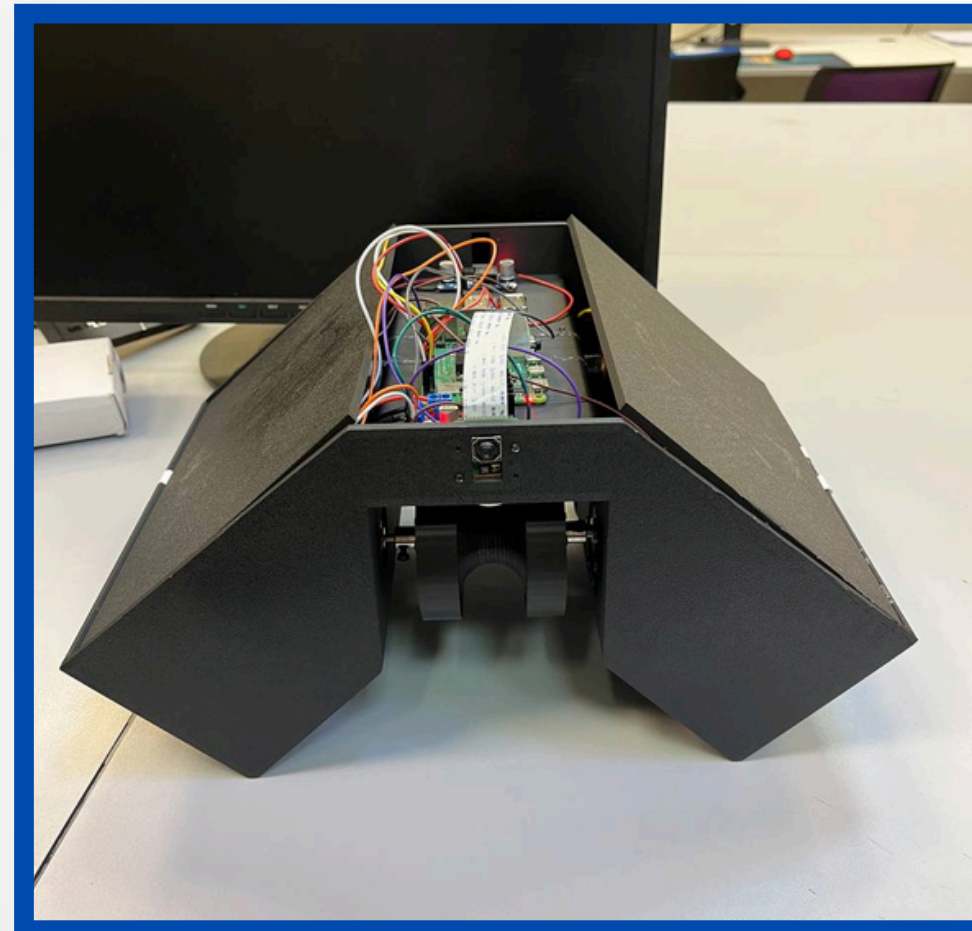
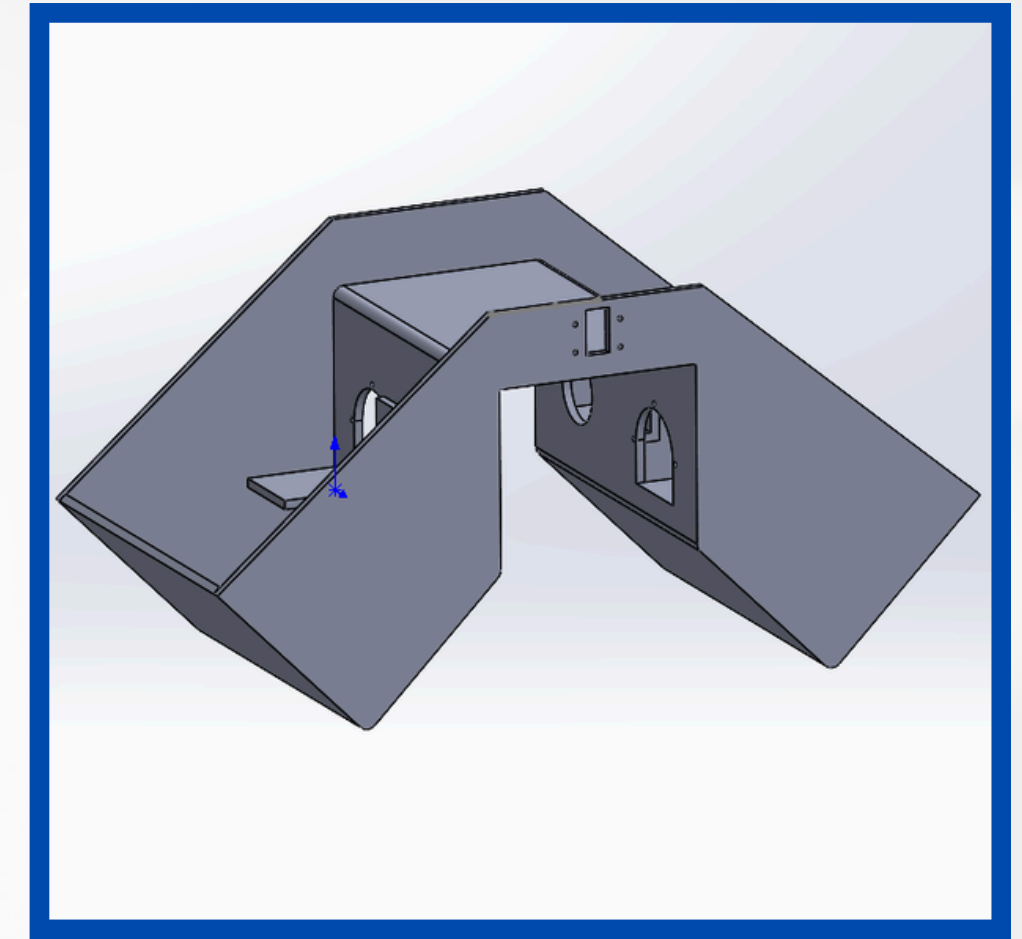
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PROJECT OBJECTIVE



MECHANICAL DESIGN

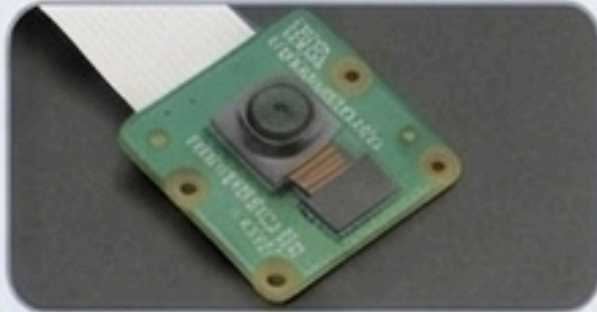
V-shaped chassis designed to sit on top of the wire and use gravity to center itself naturally on the conductor



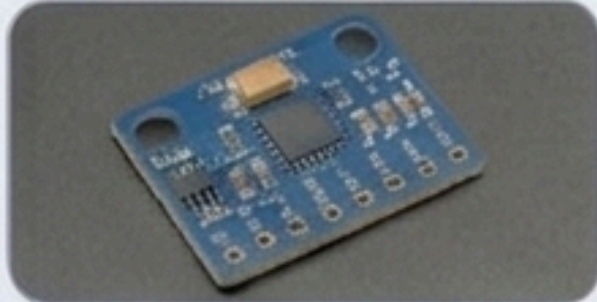
- A two-wheeled design ensures stable, balanced traversal along the conductor
- Wheels are designed with a 30 mm diameter profile to perfectly grip standardized high-voltage power transmission line conductors.

CONTROL ARCHITECTURE: POWER TRANSMISSION LINE INSPECTION ROBOT

INPUTS & SENSING



- **Pi Camera Module 3**
(visual data for defect detection & line tracking)



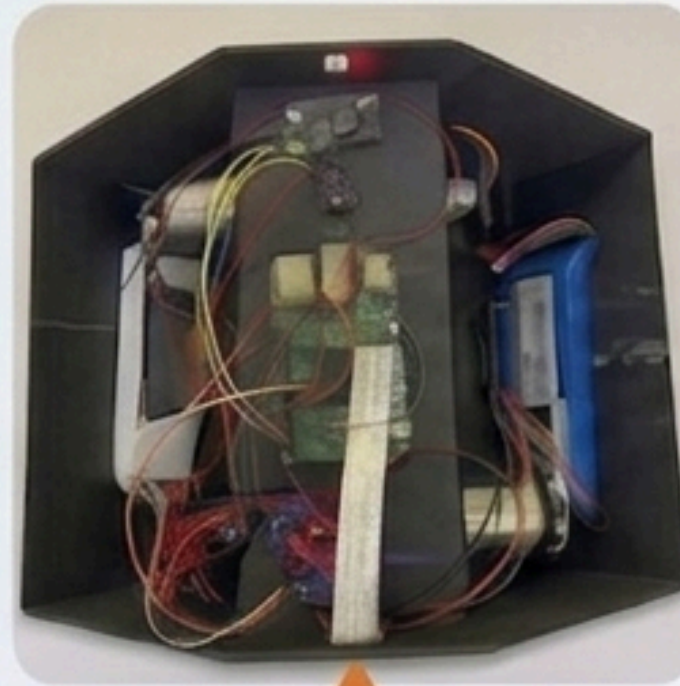
- **MPU-6050 Gyroscope**
(orientation & position data)



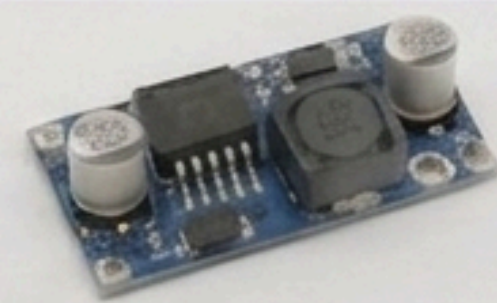
- **Wireless Joystick**
(2.4 GHz manual override)

MAIN PROCESSING & POWER MANAGEMENT

SYSTEM INTEGRATION



Raspberry Pi 4B
(Integrated)



- **Power Supply System**
(LiPo 3S Battery, LM2596 Buck Converter)



- **Raspberry Pi 4B**
(Handles sensor fusion, LiPo 3S Battery, LM2596 Buck Converter)

ACTUATION & OUTPUTS



- **L298N Motor Driver**
(Translates PI logic into high-current PWM motor control)



- **JGB37-520 Drive Motor**
(High-torque, used for conductor traversal)

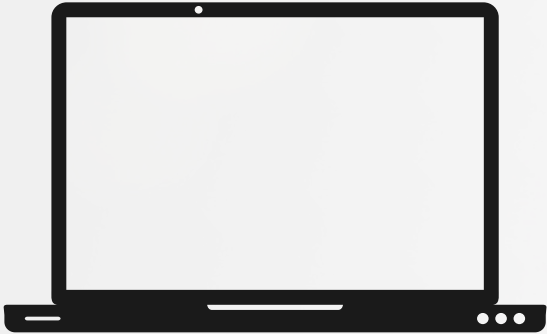
PROTOTYPE WALKING TEST



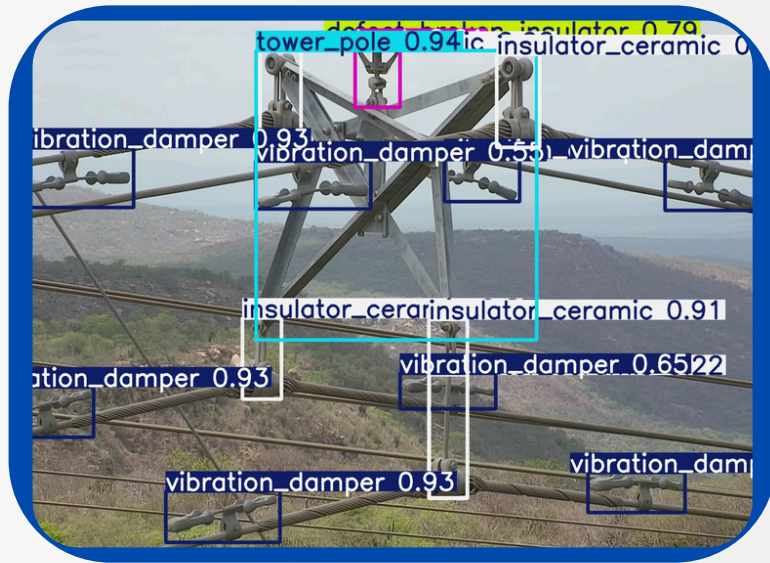
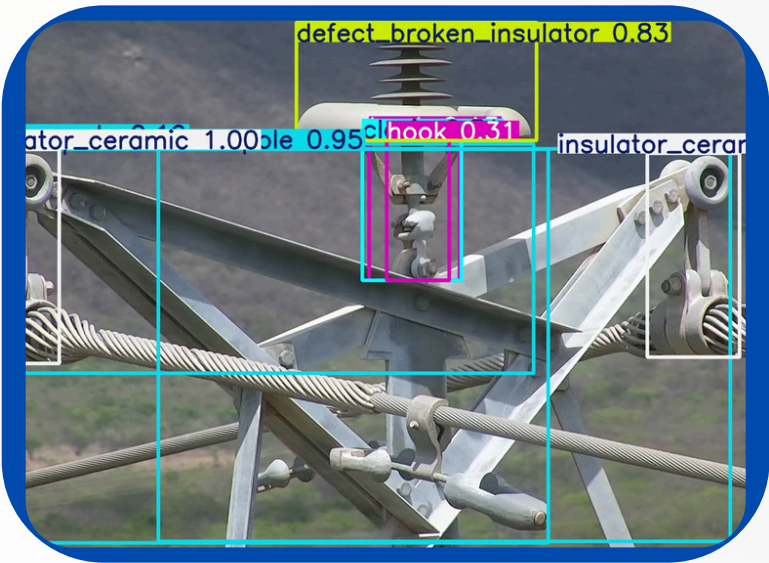
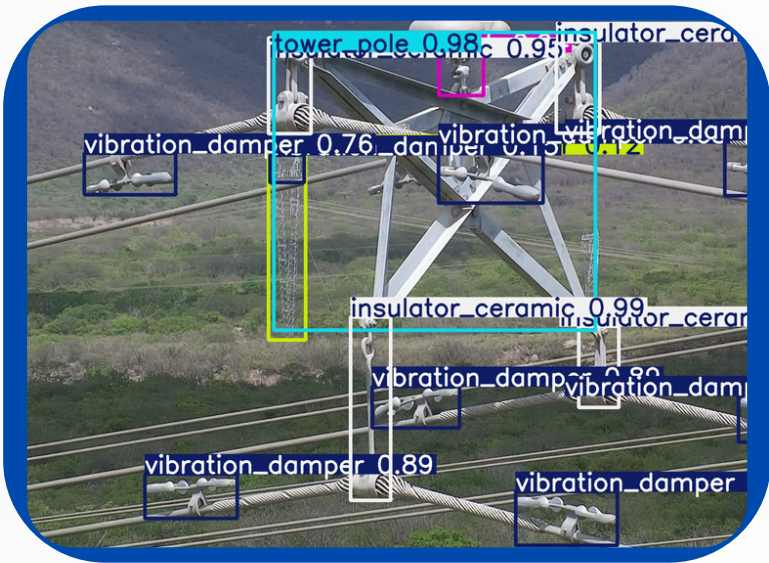
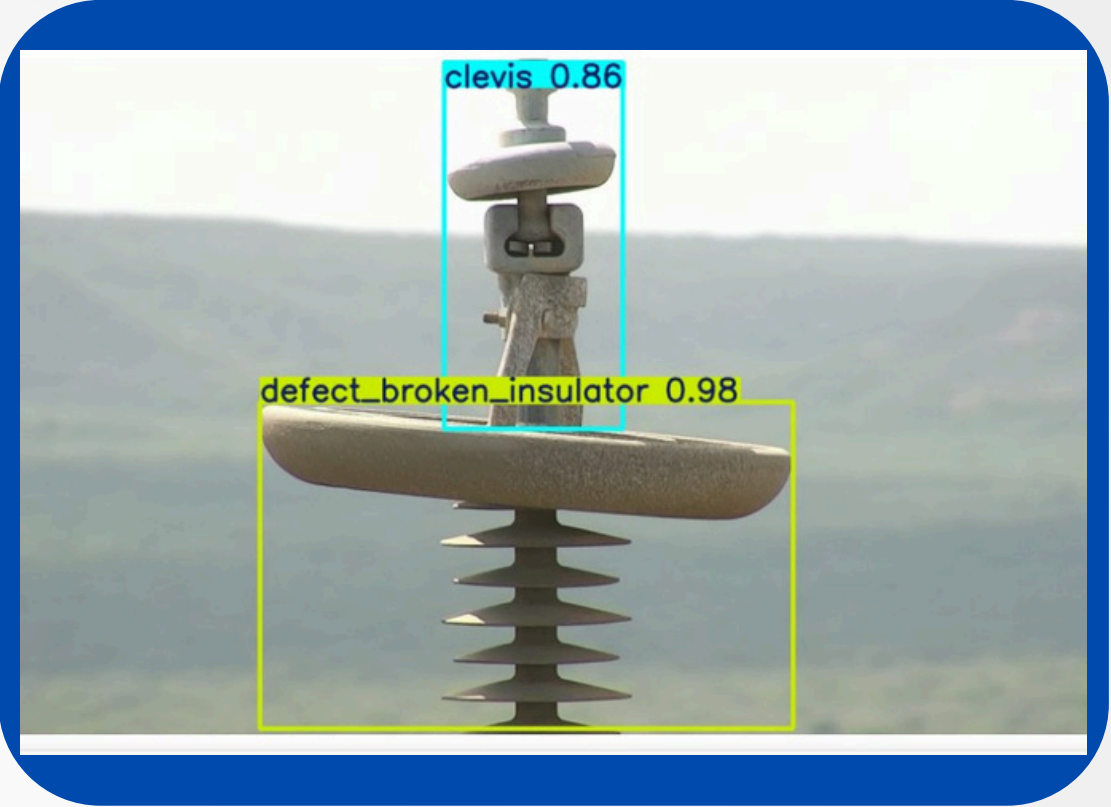
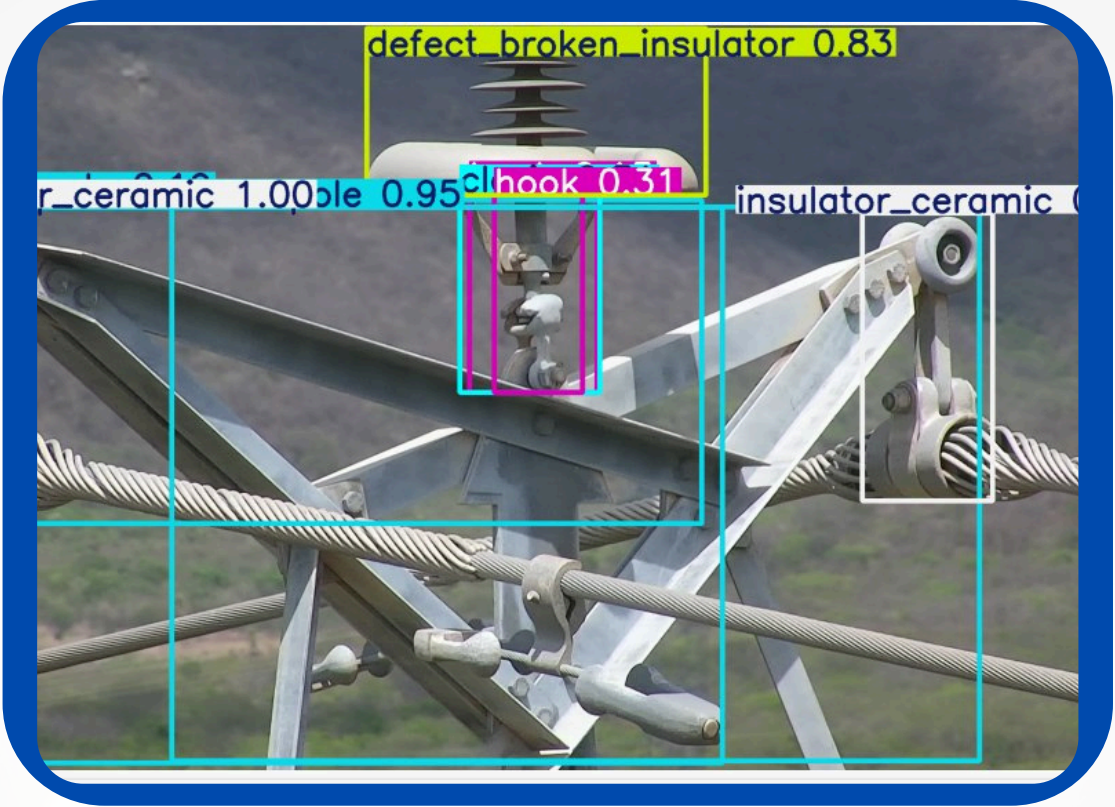
IMAGE PROCESSING



mAP@50 **50.6%**
Precision **65.1%**
Recall **52.8%**



mAP@50 **60.47%**
Precision **90.44%**
Recall **55.63%**

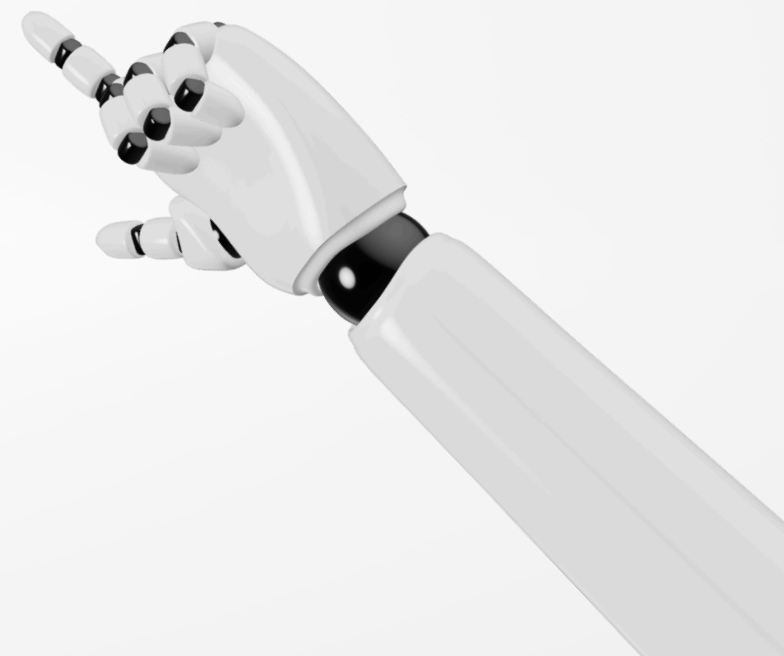


Main focus was on identifying the following items:

- Tower — Alerts the robot of an approaching obstacle, allowing it to slow down or stop before reaching the structure.
- Insulator — Identifies cracks and contamination on one of the most failure-prone components, preventing dangerous flashovers and outages.

CONCLUSION

We have successfully reached all of our project objectives — building a low-cost robot capable of traversing power lines, detecting wire damage and insulator faults, and wirelessly streaming live footage to a remote operator. Future research can focus on improved weight balancing, additional actuators for obstacle negotiation, and further AI enhancements for more robust real-world deployment.





THANK YOU!

ANY QUESTIONS?