College of Engineering
LAMAR UNIVERSITY

LNVA
LOWER NECHES VALLEY AUTHORITY

MechGenius Creations

The Yellow Floating Heart is an invasive aquatic plant that threatens local waterways by spreading quickly and disrupting native ecosystems.

BACKGROUND

- LNVA manages hundreds of miles of waterways.
- Yellow Floating Heart spreads quickly, covering 20–30% of infested areas.
- Can reduce water flow by up to 60%.
- Removal costs $500–$2,000 per acre yearly.
- Early detection is limited and inefficient.

APPROACH

Develop an AI model to detect Yellow Floating Heart and distinguish it from similar local plant species.

PROTOTYPE

Built and tested using local aquatic plant datasets.

FIELD DATA COLLECTION & VERIFICATION

Local field imagery and structured datasets were used to compare species and support model validation.

FIELD DATA COLLECTION

Date Collected:
4/3/26 – Canal Site
SW of Winnie, TX

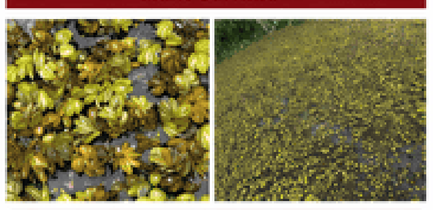
- Site data collection in local waterways
- Species comparison between invasive and non-invasive aquatic plants
- Image dataset support for training and validation
- Verification methods to confirm model reliability

LOCAL DATA COLLECTED

110	3	6	JPEG	45
images collected	datasets used	plant species represented	image format	total trials completed

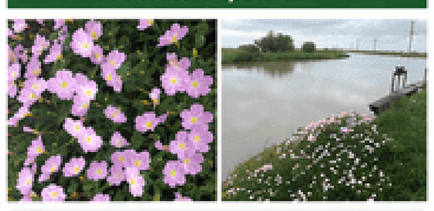
ACTIVE INFESTATION SAMPLES

Giant Salvinia



Plant classification: Invasive
Aquatic impact: Disrupts ecosystems
Ecological concern: Rapid spread and surface coverage

Oenothera speciosa



Plant classification: Non-invasive
Aquatic impact: Limited disruption
Ecological note: Useful comparison species

VERIFICATION SUPPORT

Average Accuracy	Average Process Time	Average Confidence Score
77.67%	0.021 s	90.06%

Giant Salvinia	Oenothera speciosa	Yellow Floating Heart
87.67%	97.75%	81.17%

Validation across multiple datasets helped confirm the model's ability to distinguish invasive and non-invasive species.

References / Image Credits | Invasive plant photos courtesy of Adolfo.

AI Detection System Development

The detection system was built using an open-source PyTorch workflow and organized into three core stages: training, identification, and analysis.

Model Build

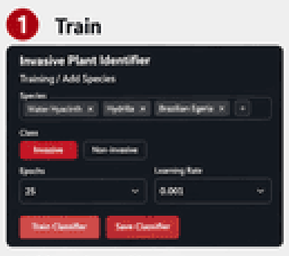
- Open-source PyTorch framework
- Runs on a local computer or through Streamlit
- Coding support from Copilot and Qwen AI
- Available on GitHub for development and testing

Compared with Google AI Studio, the PyTorch build offers more flexibility, public access, and scalability for local dataset growth.

python | PyTorch | GitHub

System Workflow

1 Train



- Add species and images
- Label invasive vs non-invasive classes
- Train and save the classifier

2 Identify

- Upload images or zip files
- Set confidence threshold and run detection
- Generate a quick summary of findings

3 Analyze

- Review detections by run
- Edit invasive status and export CSV
- Track time, confidence, and image records

Workflow Output: The final system supports model training, image-based identification, and detection record analysis in one interface.

Model Evaluation and Design Verification

Evaluating model performance, validation results, and workflow reliability.

45 Trials | **3 Datasets** | **6 Plant Species**

Validation was completed using local aquatic plant datasets and multiple test runs.

Test Results Summary

Average Accuracy	Average Process Time (s)	Average Confidence Score
79.82%	0.032	89.91%

Metric	Yellow Floating Heart	Spatterdock
Accuracy	88.57%	81.82%
Recall/Sensitivity	90.91%	85.00%
Specificity	89.17%	80.43%
Precision	65.90%	65.00%

Full results available; Yellow Floating Heart and Spatterdock shown as primary targets.

Model Evaluation

- **Accuracy** = overall correctness of predictions
- **Precision** = ratio of true positives to predicted positives
- **Recall** = ratio of true positives to actual positives
- **Specificity** = ability to correctly reject negatives

Confusion Matrix

Actual Class \ Predicted Class	Positive	Negative
Positive	True Positive (TP)	False Positive (FP)
Negative	False Negative (FN)	True Negative (TN)

Accuracy | Precision | Recall (Sensitivity) | Specificity

Design Verification

Training Interface
- training images
- validation images
- epochs

→ **Identification**
- upload images
- set confidence threshold

→ **Predictions**
- classify images
- label low-confidence as other

→ **Database**
- store results
- export CSV

- Verified across multiple datasets
- Supports invasive and non-invasive species distinction
- Repeated runs confirmed consistent performance
- Suitable for field-based identification support

Sources: Local test results, system workflow, and evaluation methods compiled from project development materials.

FINAL SYSTEM EVALUATION & FUTURE WORK

Key outcomes, GIS integration potential, and next development steps.

FINAL SYSTEM EVALUATION

- Achieved 79.82% overall accuracy
- Successfully identified invasive plant species from image data
- System runs locally and can operate offline
- Built as a scalable prototype for future expansion

Plant Identification | GIS Mapping Potential | Scalable Local Build

GIS MAPPING INTEGRATION

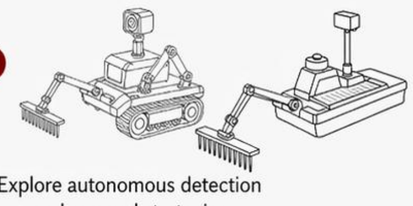
- AI detections can be applied to drone mapping imagery
- Orthomosaic layers can be created in ArcGIS
- Approximate GSD: 3 cm/px
- New GIS layers can be compared over time to monitor invasive plant growth

SAMPLE MISSION PARAMETERS

Altitude:	Overlap:	Camera angle:	Speed:
200 ft	70%	90°	11 - 12 mph

FUTURE WORK

1. Expand dataset size and field data
2. Improve the user interface and automate training
3. Integrate the AI model with GIS mapping workflows
4. Explore autonomous detection and removal strategies



Based on project evaluation, GIS mapping studies, and future system concepts.

GITHUB FOR AI MODEL

SCAN FOR MORE

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