GATEWAYS TO BLUESKIES

Houston Community College

“Hog Aerial Mitigation System (H.A..M.S.)”

The Houston Community College Presentation will begin at 11:30 AM Pacific Time.
View the 2025 Finalists’ Infographics: **https://blueskies.nianet.org/finalists/**

H.A.M.S.
Hog Aerial Mitigation System


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HCC

GATEWAYS TO BLUESKIES

Situation Assessment

Use Case and Concept of Operations

Technical Analysis

Deployment Timeline and TRL

Conclusions

Presentation Outline

- $1.5 billion in damages and management costs
- $750 million in agricultural damage
- > 30 diseases and 40 types of parasites
- Damage soil, pollute water sources
- Extinction of at least 14 species and the decline of 672 taxa

Figure 1

Impacts of Hogs

Figure 2

Aerial Gunning

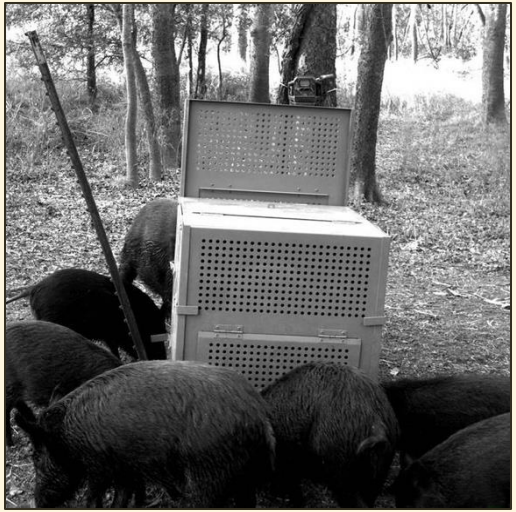

Figure 3

Toxicant Bait

Figure 4

Trapping

Current Methods

- Incentivised hog bounties are easily abused
- Hunting preference for male hogs
- Lack of a centralized effort
- Lack of enforcement on illegal transportation
- Lack of a response time
- Hogs are inaccessible in forests

Management Problems

H.A.M.S. will...

… use cutting edge technology to identify and track hogs.

… target hogs in inaccessible areas, where other methods fail.

… be an easy-to-use integrated system.

… incentivize the participation of landowners.

… make use of already existing methods and organizations, increasing their efficiency.

ConOp Overview


H.A.M.S.
Concept of Operations Overview


Hogs Spotted!
• 1-800-END-HOGS
• Pertinent information such as # of hogs, nature of damages, etc.
• Land use consent


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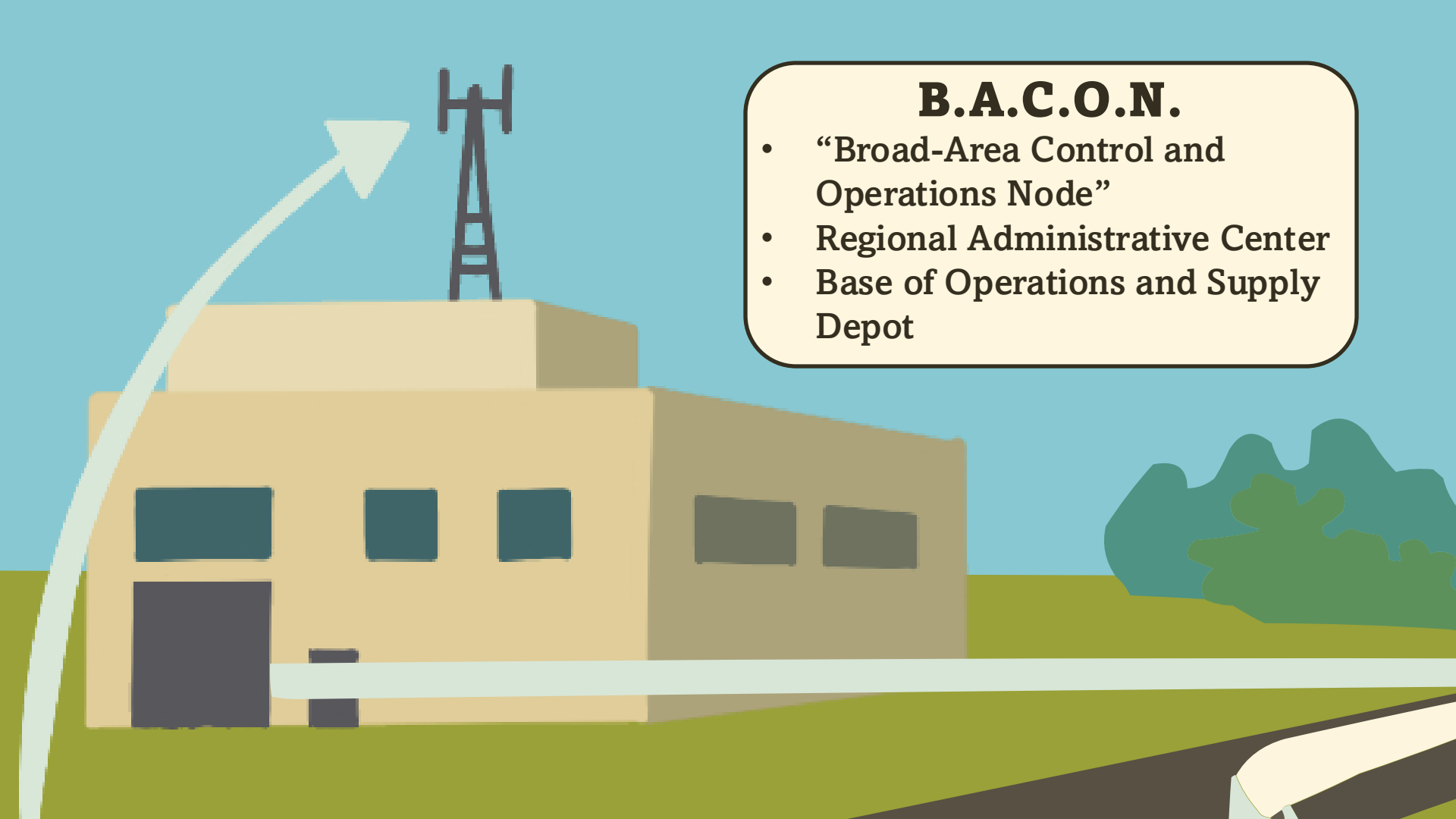
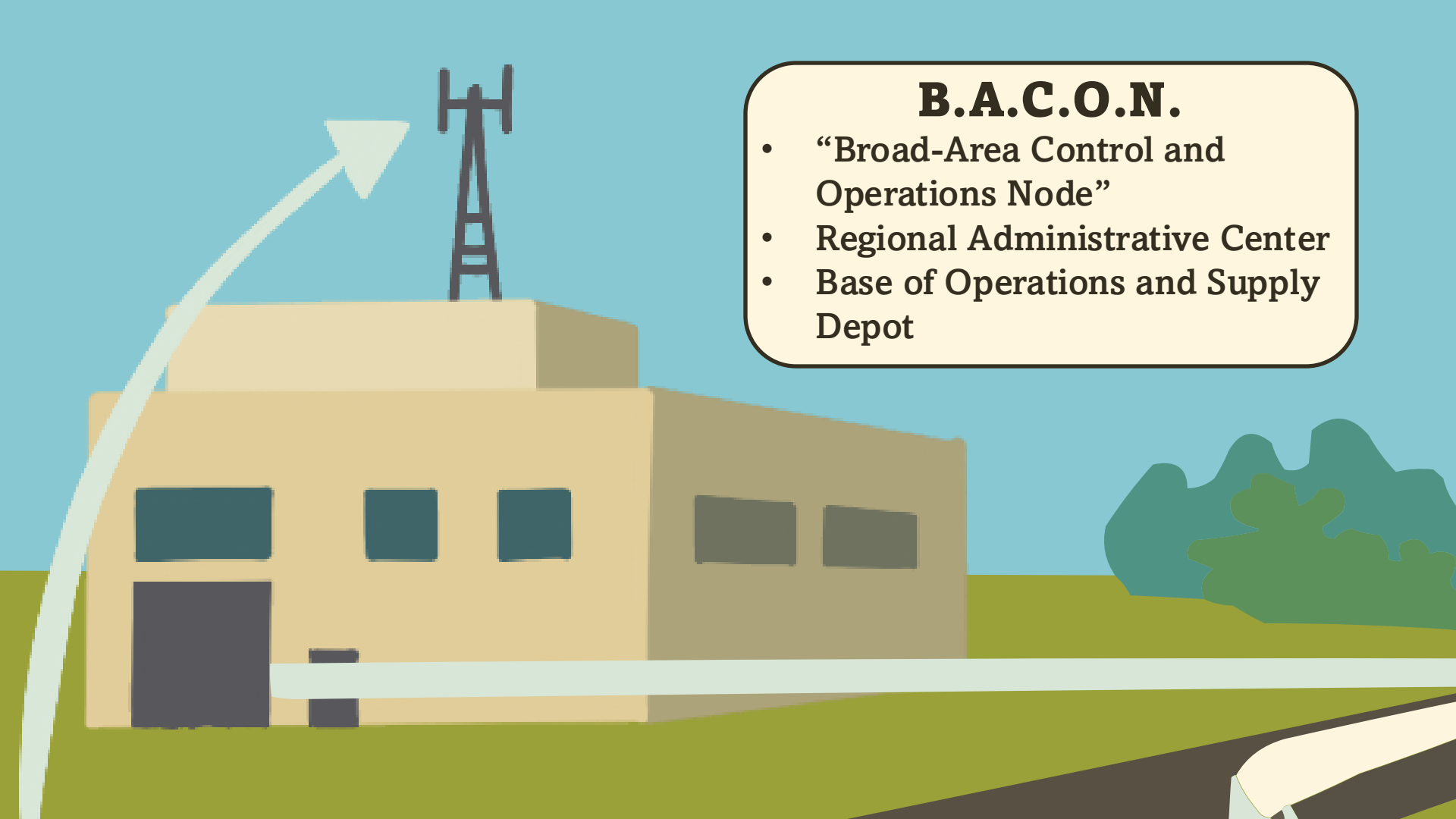

B.A.C.O.N.
• “Broad-Area Control and Operations Node”
• Regional Administrative Center
• Base of Operations and Supply Depot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H.A.W.G.S.
and C.U.R.L.I.
• “Hog Aerial Watch Ground Station”
• “Computer User Regulated Live Interface”


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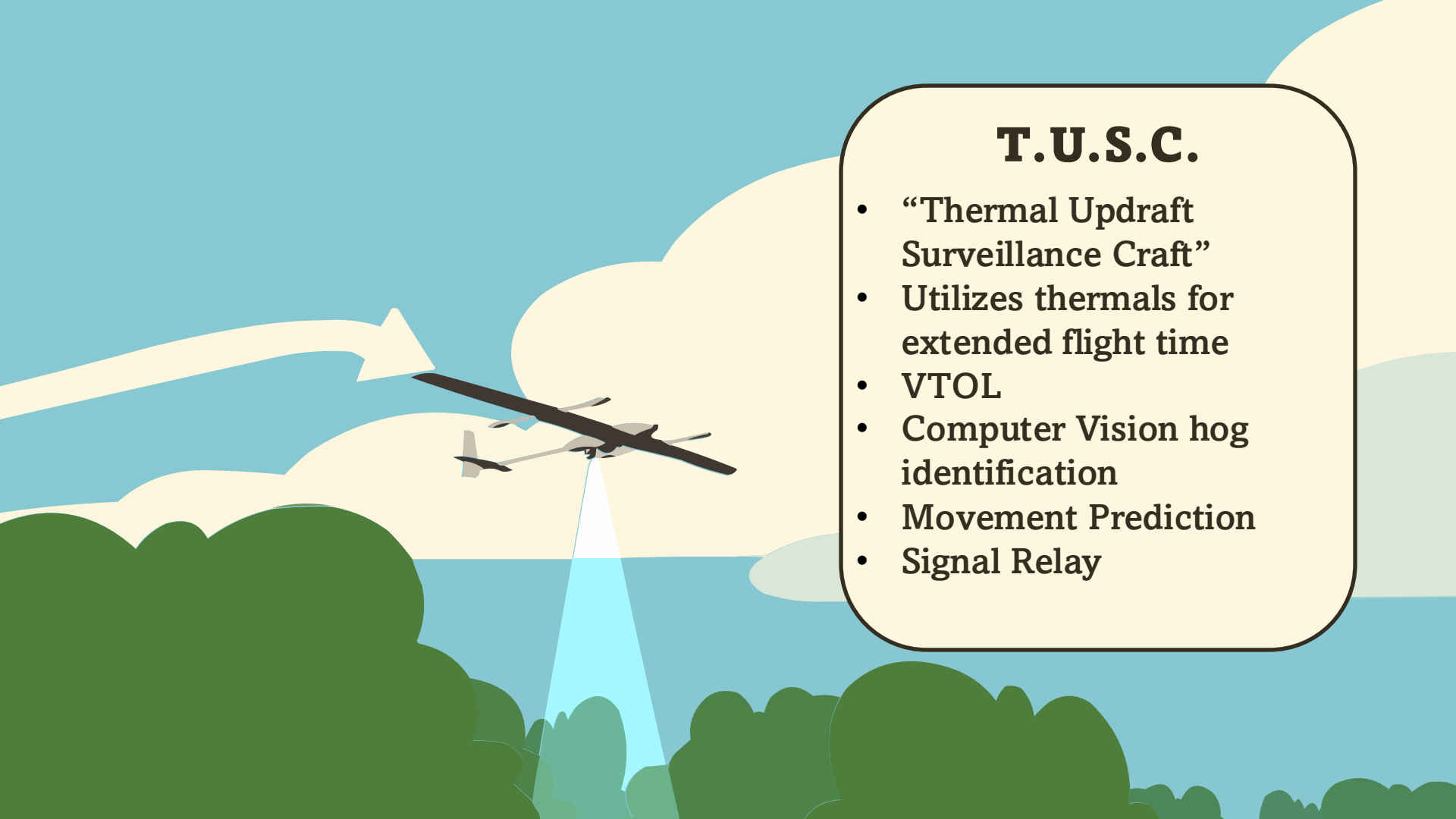
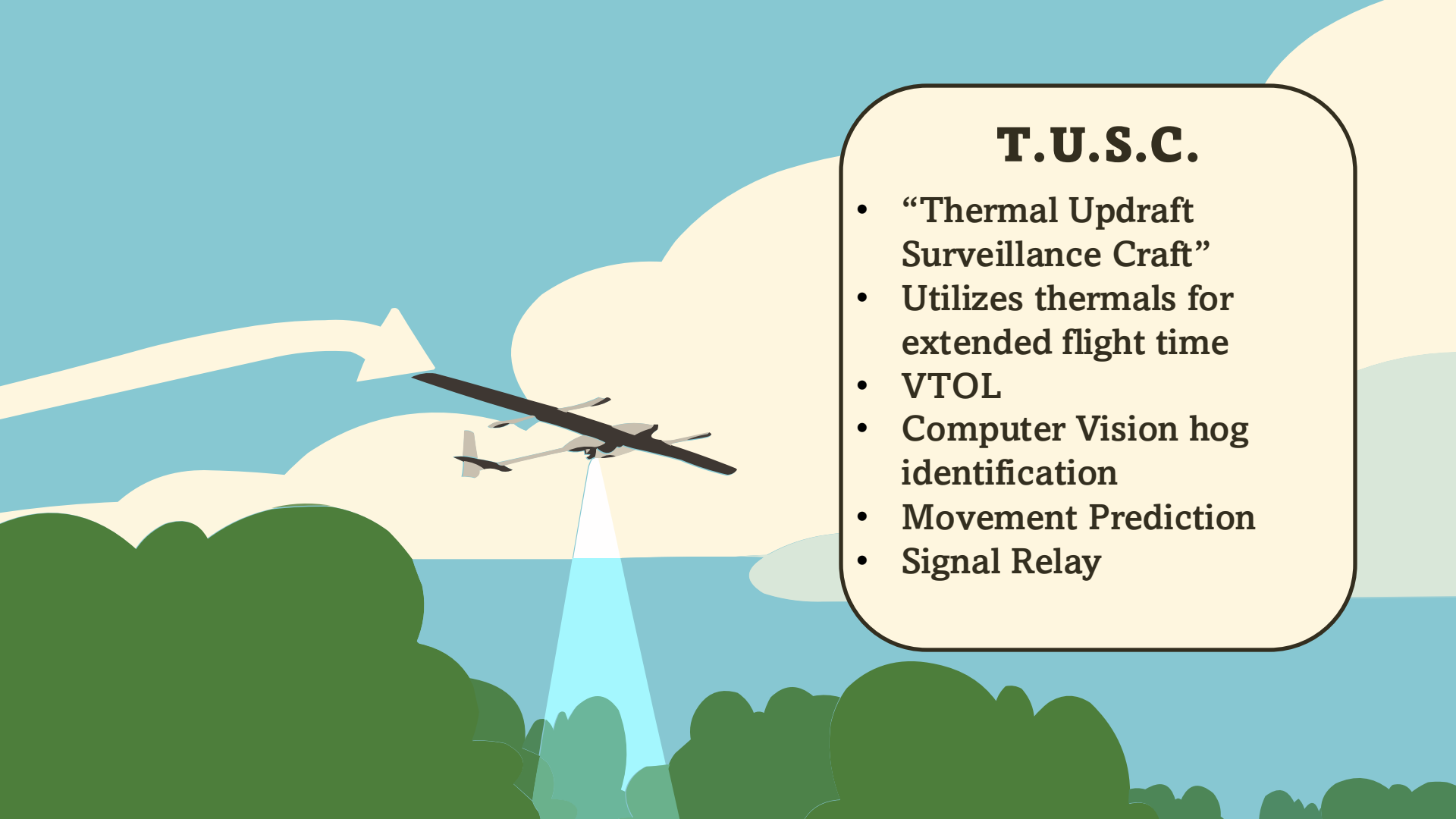


T.U.S.C.

- “Thermal Updraft Surveillance Craft”
- Utilizes thermals for extended flight time
- VTOL
- Computer Vision hog identification
- Movement Prediction
- Signal Relay



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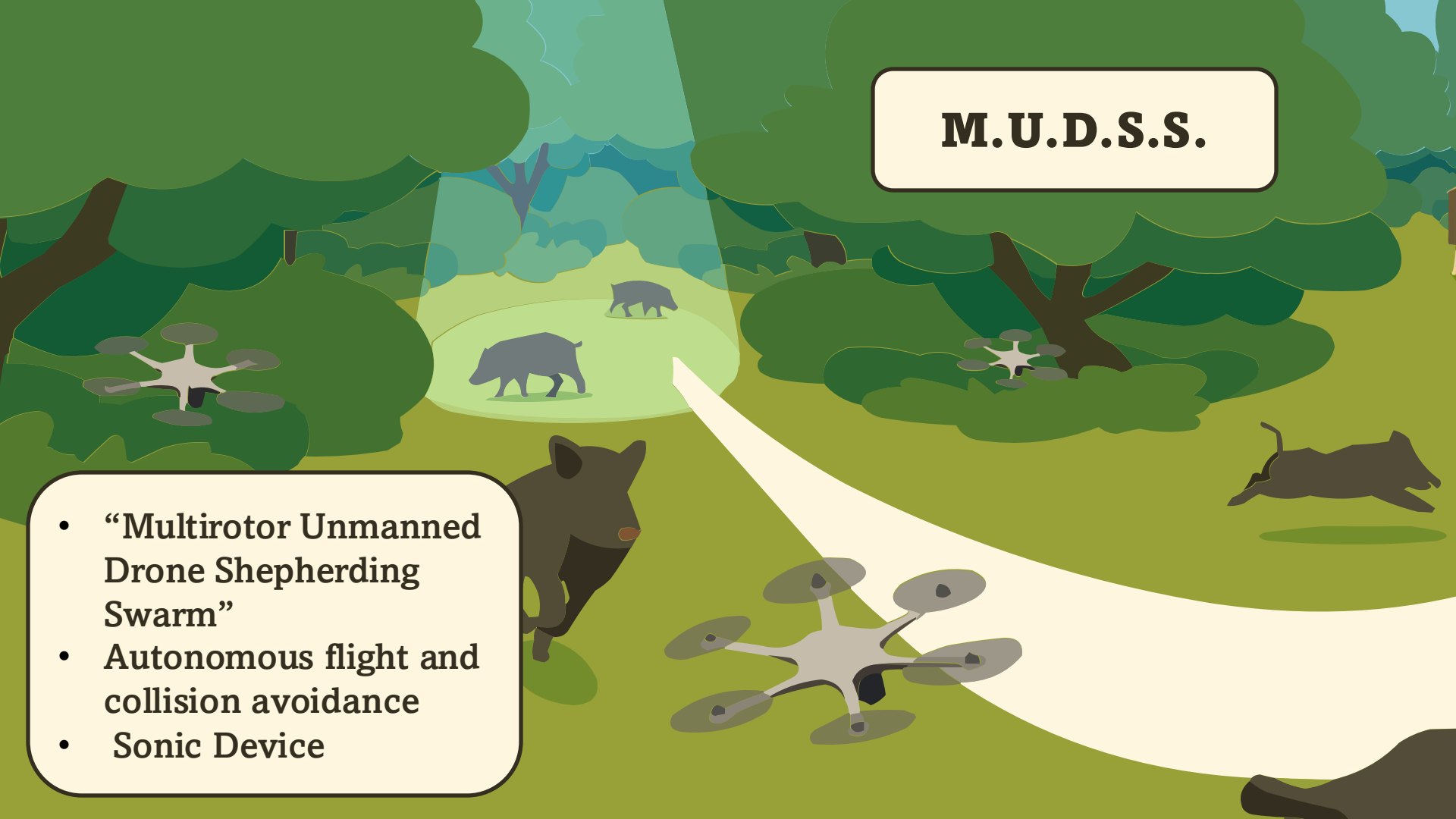
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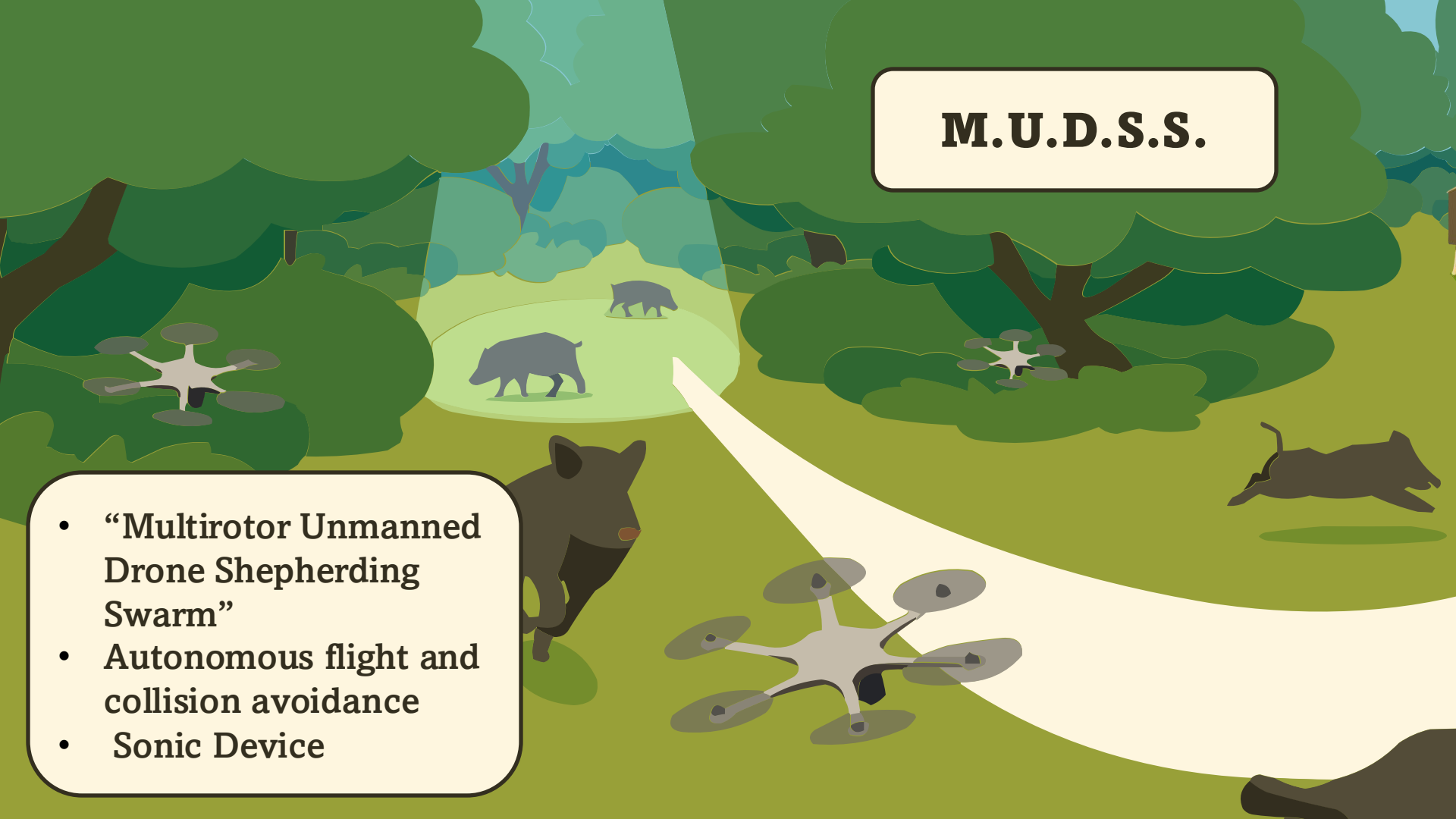
• “Multirotor Unmanned Drone Shepherding Swarm”
• Autonomous flight and collision avoidance
• Sonic Device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Hogs Mitigated

- Hogs move into predetermined area
- Chosen management method employed to greater effect

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H.A.M.S.
Concept of Operations Overview


H.A.M.S.
Concept of Operations Overview

ConOp Overview

- Compact hexacopter design for maximum agility and rotor redundancy
- Autonomous flight and collision avoidance using on-board computing hardware
- Real-time swarm coordination via UWB communication
- Electronic sonic device

Figure 5

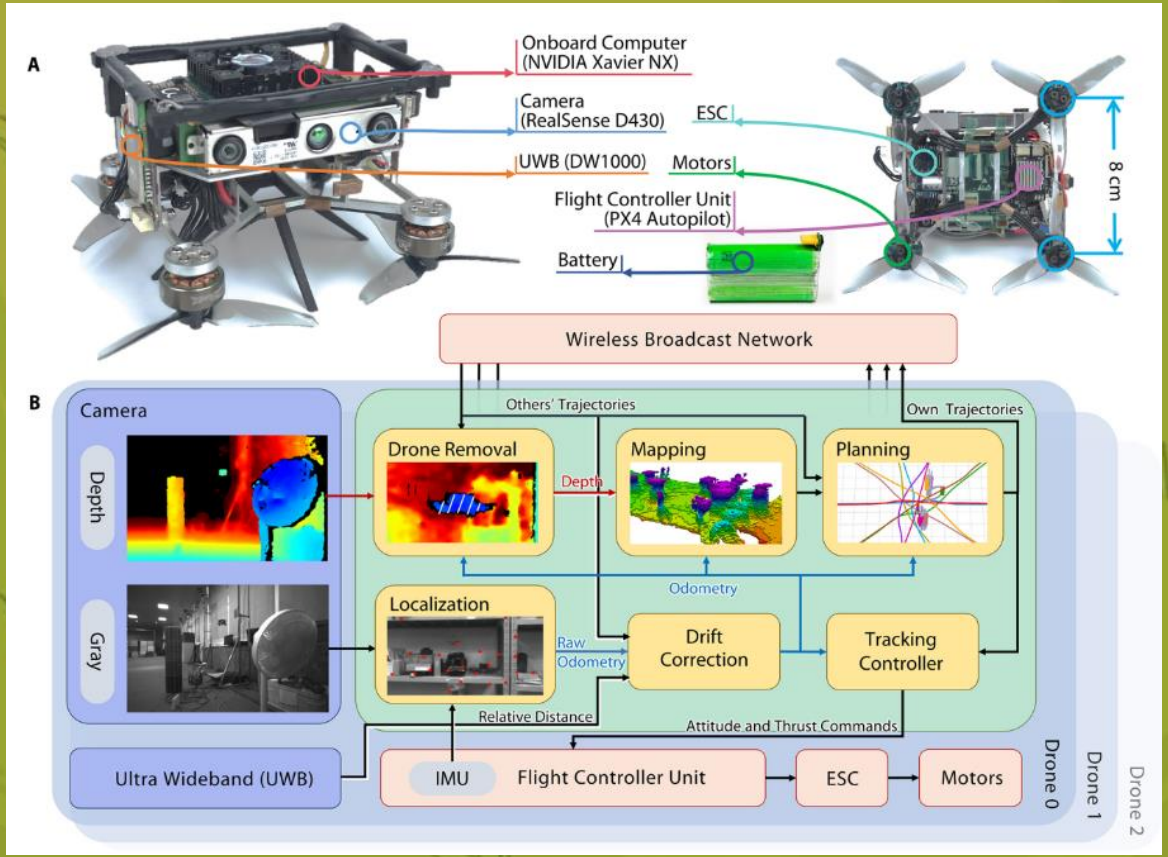

A
Onboard Computer
(NVIDIA Xavier NX)
Camera
(RealSense D430)
UWB (DW1000)
Flight Controller Unit
(PX4 Autopilot)
Battery
ESC
Motors
8 cm
Wireless Broadcast Network
B
Camera
Depth
Gray
Others' Trajectories
Own Trajectories
Drone Removal
Depth
Mapping
Planning
Odometry
Localization
Raw
Odometry
Drift
Correction
Tracking
Controller
Relative Distance
Attitude and Thrust Commands
Ultra Wideband (UWB)
IMU
Flight Controller Unit
ESC
Motors
Drone 0
Drone 1
Drone 2

Figure 6

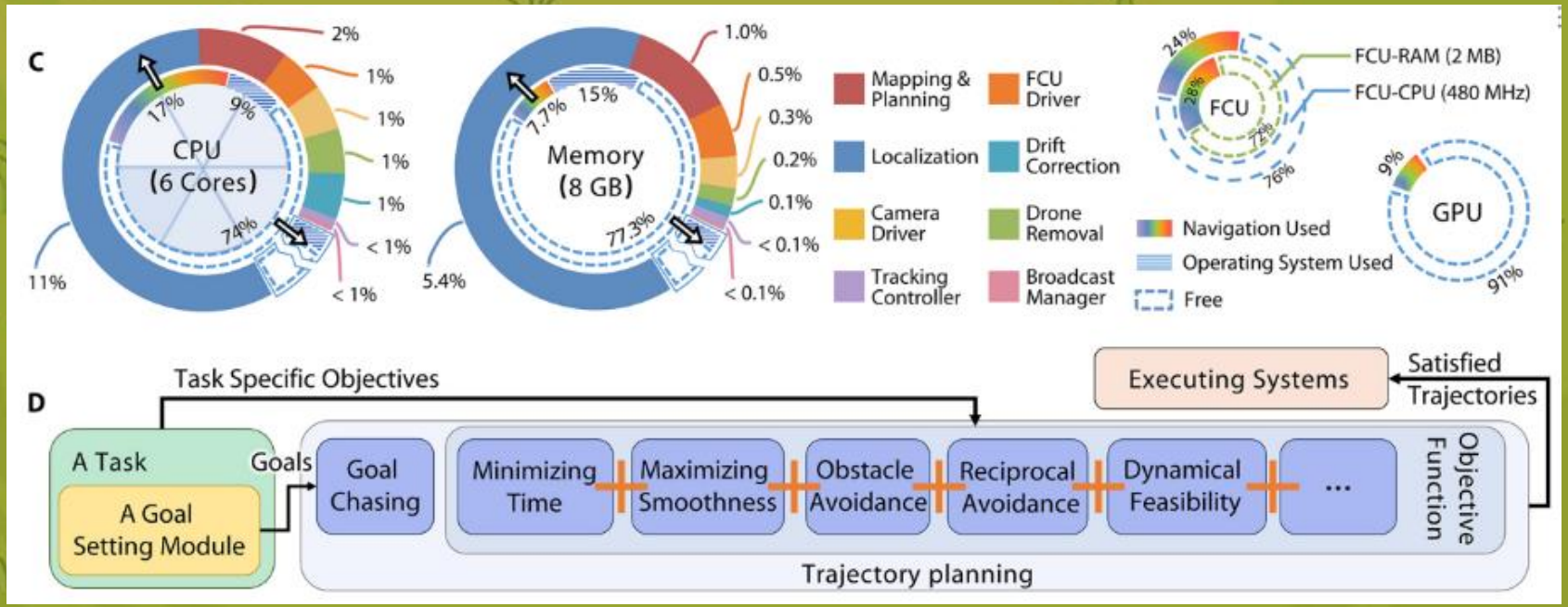

C
CPU
(6 Cores)
17%
9%
74%
2%
1%
1%
1%
1%
< 1%
< 1%
11%
Memory
(8 GB)
15%
7.7%
77.3%
1.0%
0.5%
0.3%
0.2%
0.1%
< 0.1%
< 0.1%
5.4%
Mapping & Planning
FCU Driver
Localization
Drift Correction
Camera Driver
Drone Removal
Tracking Controller
Broadcast Manager
FCU
24%
28%
72%
76%
FCU-RAM (2 MB)
FCU-CPU (480 MHz)
GPU
9%
91%
Navigation Used
Operating System Used
Free
D
Task Specific Objectives
Executing Systems
Satisfied Trajectories
A Task
A Goal Setting Module
Goals
Goal Chasing
Minimizing Time
Maximizing Smoothness
Obstacle Avoidance
Reciprocal Avoidance
Dynamical Feasibility
...
Objective Function
Trajectory planning

Figure 7

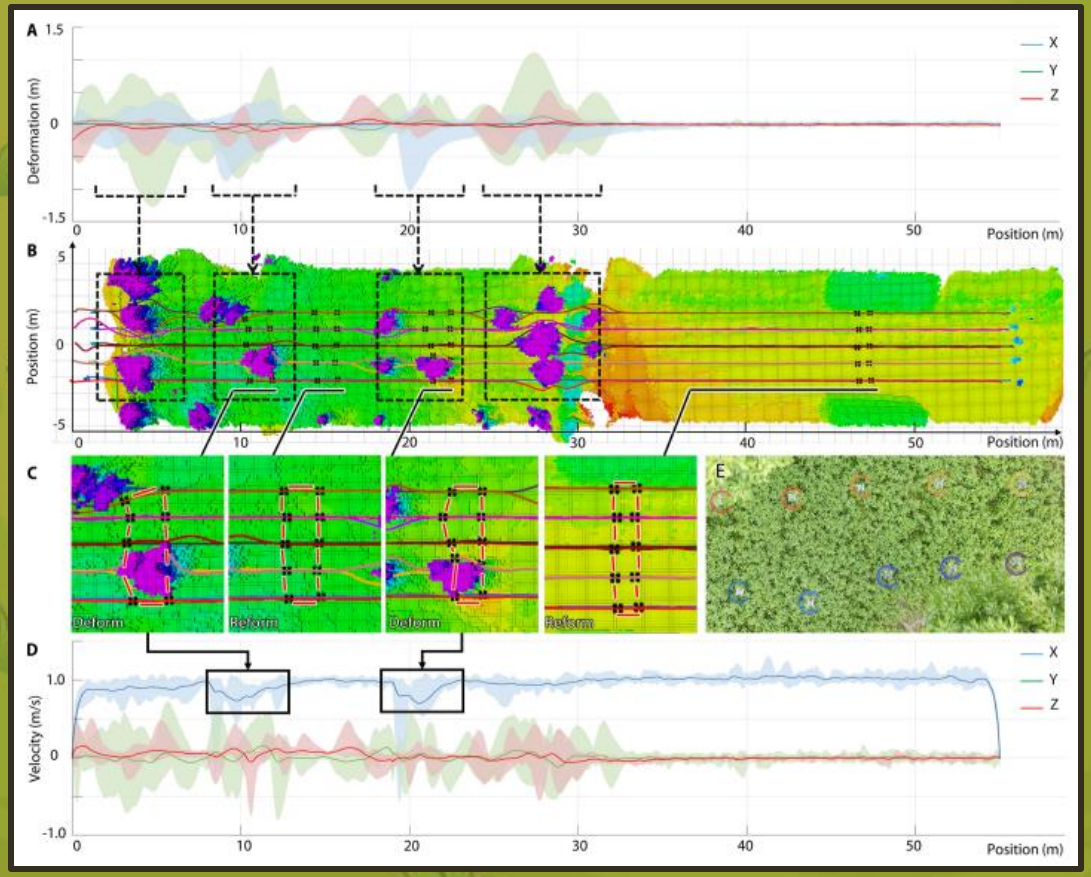
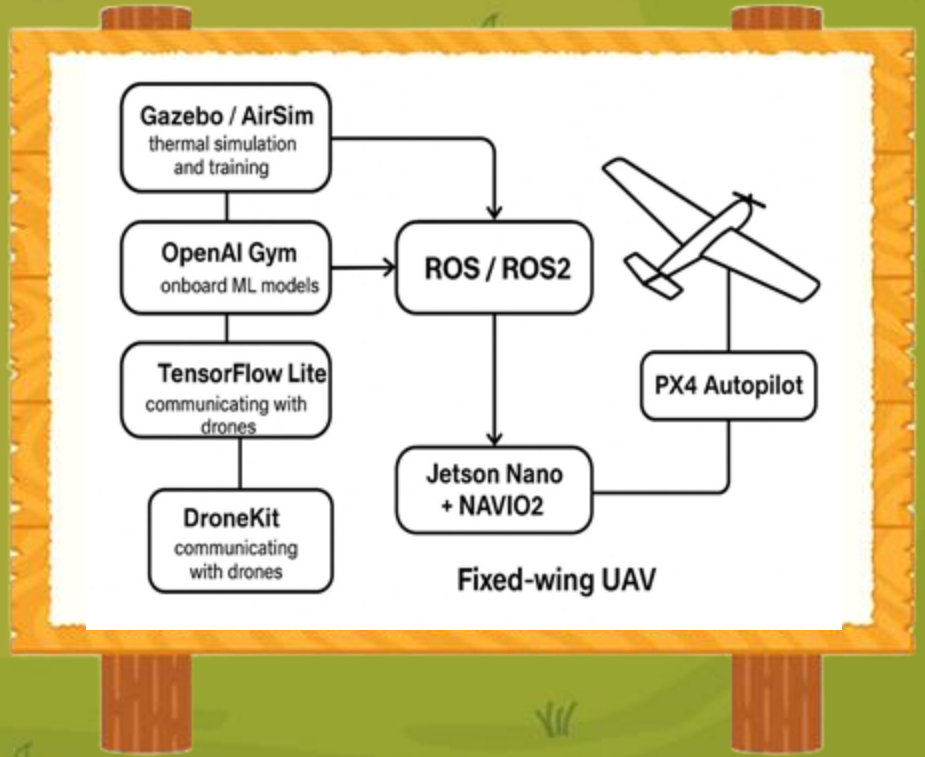

A
Deformation (m)
1.5
0
-1.5
X
Y
Z
0
10
20
30
40
50
Position (m)
B
Position (m)
5
0
-5
Position (m)
C
Deform
Reform
Deform
Reform
E
D
Velocity (m/s)
1.0
0
-1.0
X
Y
Z
Position (m)

Figure 8

- Fixed wing VTOL design for maximum endurance and versatility
- Sensor suite including thermal and visual cameras
- Autonomous flight and thermal utilization
- Multiple communications technologies, including LoRa and video transmission via radio (VTX)
- Can act as signal relay

- ROS2: Middleware for Integration and Decision-Making
- PX4 Autopilot: Open-Source Flight Control
- TensorFlow Lite and Onboard AI with Jetson Xavier NX & NAVIO2



- Serves as a mobile base of operations for H.A.M.S.
- Fulfills energy needs of drones via generator and solar panels
- Utilizes vehicles already used by cooperating government agencies

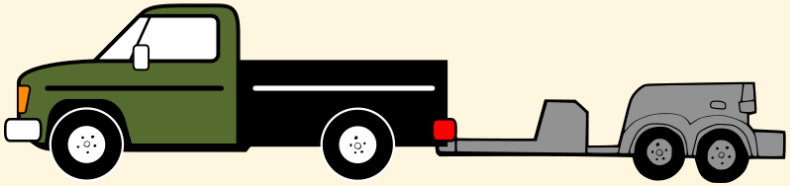


Figure 9

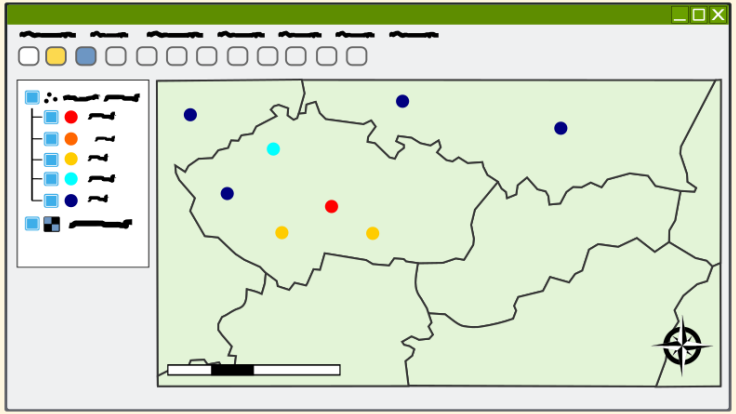


Figure 10

- Fully integrated software environment designed for maximum ease of use
- Used to control all T.U.S.C.s and M.U.D.S.S. drones and to receive imagery
- Lowers barrier for acceptance by reducing required training

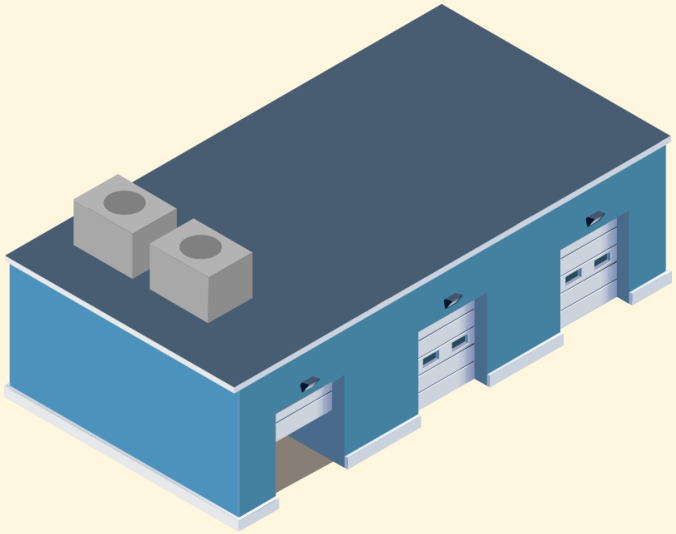


Figure 11

- Combined use building
- Storage
- Maintenance
- Office Space
- May include helipad and helicopter infrastructure if aerial shooting cannot be contracted
- Already existing government facilities may be used

1. Consolidate hog mitigation efforts
2. Enforce hog transportation bans
3. Incentive for landowners

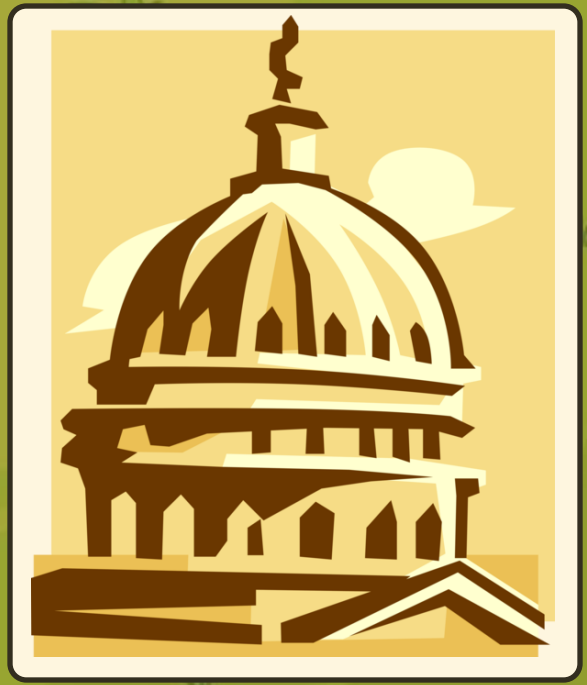


Figure 12

Collaborating Agencies

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M.U.D.S.S. Planning System (TRL 7)

M.U.D.S.S. Swarm System (TRL 5)

T.U.S.C. AI Hog Identification (TRL 5)

T.U.S.C. Thermal Utilization (TRL 7)

B.A.C.O.N. & H.A.W.G. Setup (TRL 8-9)

C.U.R.L.I. Integration (TRL 5)

Full Implementation of H.A.M.S.

2025

2030

2035

Research and Development

Hardware Development

State Government Grants

Production and Testing

Legislation

Governmental Integration

Deployment Timeline

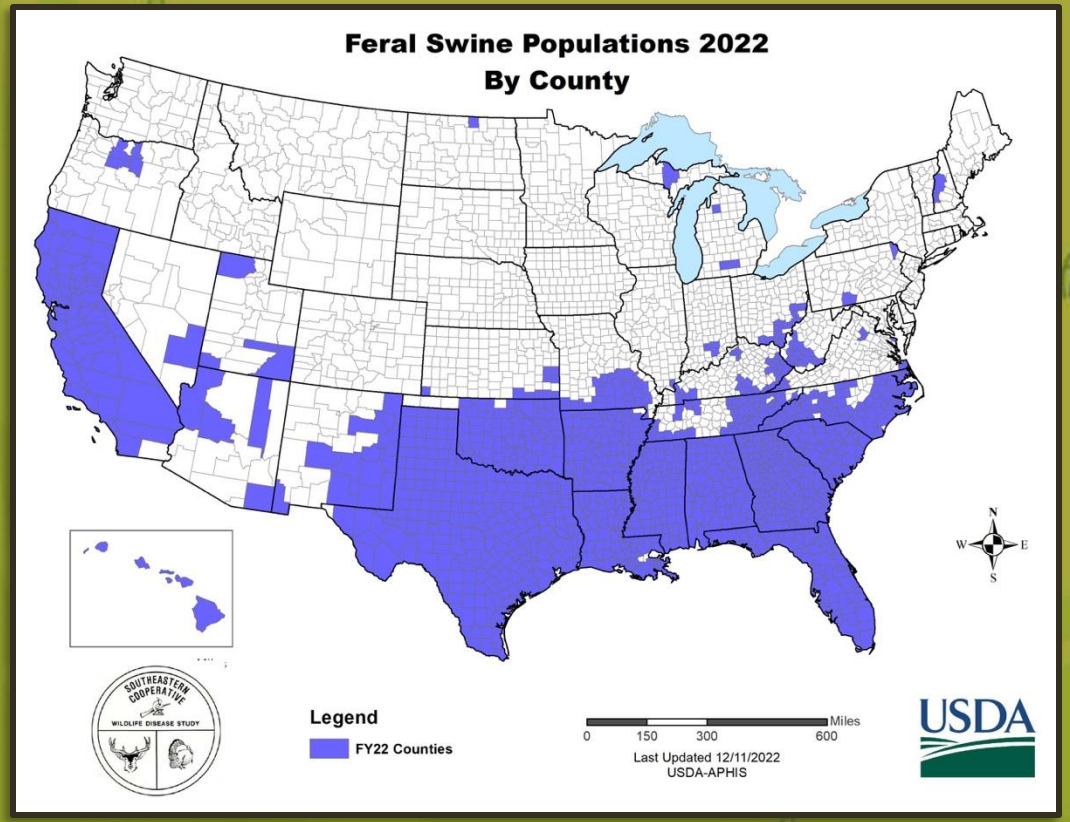

Figure 13

Figure 14

Figure 15

Conclusion

Images Used

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Figure 4: Attribution License. 16 June 2009, flickr, USDA, www.flickr.com/photos/usdagov/8717756792
Figure 5: Attribution License. Campagnoli, Manuel. "Black Hexacopter Drone with propellers stopped, top view perspective." 9 August 2023, Wikimedia, commons.wikimedia.org/wiki/File:Black_Hexacopter_Drone.svg
Figures 6-8: Zhou, Xin, et al. "Swarm of Micro Flying Robots in the Wild." Science Robotics, vol. 7, no. 66, 4 May 2022, https://doi.org/10.1126/scirobotics.abm5954.
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Q&A

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NASA'S GATEWAYS TO BLUESKIES

2025 AgAir: Aviation Solutions for Agriculture Forum

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PRESENTATIONS WILL RESUME AT 1:15 PM PACIFIC TIME