Development Team

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Elephant Human Conflict
Crop-Raiding

- Main form of conflict
- Crops destroyed:
  - Wheat 65%
  - Sugarcane 21%
Economic Loss and Casualty

☐ Small plantation
  • 200-600 pounds of food per day
  • A few thousand dollars lost per household per raid

☐ Large plantation
  • Palm oil and timber
  • Riau, the largest palm oil producing province in Indonesia
  • 105 million dollars lost per year

☐ India
  • 100-300 humans and 40-50 elephants are killed during crop-raiding each year

☐ World
  • 500 people are killed by elephant each year according to National Geographic Channel documentary *Elephant Rage*
Solution

The GPS tag is placed on to the elephant

The elephant is within range when the signal from the ground base is strong enough

The GPS tag starts to send real time coordinates

The drone will fly to the coordinate

Since elephants are afraid of drone noises, the drone will be able to chase the elephant away from the base and prevent elephants from damaging crops

On board camera footage is analyzed with AI algorithm loaded on NVIDIA Jetson Nano to identify and track elephants
Solution
Solution
Solution

Waypoint Navigation
Solution
Solution
System Block Diagram
Schematic: Full Block Diagram
PCB Layout

- 4-layer board
- 83.8mm x 83.49mm
- 26.3g
- 198.4 days
Our PCB

- Xbee
- GPS
- ATmega328P
- SD card
Drone

- Tarot 680 Pro Frame
  - Tarot 4108 High-Power Brushless Motor
  - HobbyWing XRotor 40A-OPTO-ESC
- Processor: NVIDIA Jetson Nano
- Flight Controller: DJI N3
- Sensors:
  - IMX219-120 Camera
  - XBee-PRO900HP
- Turnigy 6S LiPo Battery
  - Battery life: 20 Minutes
  - Range: 4 Miles

Battery life: 20 Minutes
Range: 4 Miles
NVIDIA Jetson Nano

- ARM Cortex-A57 (4 cores)
- 128 cores NVIDIA Maxwell GPU
- Clock speed:
  - CPU: 1.5 GHz
  - GPU: 900 MHz
- Power:
  - Requirement: 5V (4A)
  - Consumption: 10 W
- Peripheral Interfaces: CSI, UART, USB, GPIO
- Serves as an onboard processor on drone
DJI N3 Flight Controller

- Stability
- Dual IMU Redundancy
  - 8GB Black Box
- GNSS-Compass
- Onboard GPS
- PMU
- M Pin
  - ESC PWM Port for Motor
- API Port
  - UART
- Onboard SDK
DJI Onboard SDK

- Installed in Jetson Nano
- Interface for DJI N3
- Flight actions
  - Monitored Takeoff & Landing
  - Roll/Yaw/Pitch
- Aircraft state data
  - Direction
  - GPS Coordinate
  - Altitude
- Automate herding process
Software Architecture

- A convolutional neural network model used for elephant detection
- Optical Flow used for real-time tracking
- Localization data is then fed into a PID control algorithm to herd the elephant away
Software Architecture

Optical Flow

\[ frame_{n-1} \quad frame_n \]

\[ \{\text{track}_i\} \]

Kalman Filter

Last State \rightarrow Kalman Filter \rightarrow New State
Software Architecture

\[ f_{r\text{am}_n} \]

\[
\text{CNN Object Detector} \\
\{detection_i\} \\
\text{Association} \\
\{track_i\} \\
\text{Kalman Filter} \\
\text{New State}
\]

Last State
Software Architecture

1280 x 720 Video Frame
Demo
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Questions?