Hako-drone flight in VR city

Background

There are several rules that must be followed in order to fly unmanned aircraft in our country. (DIPS, MLIT)

Areas requiring permission: 150m meters or above, Population concentrated areas ...

Aircraft registration application and approval: Weighing 100g more

Safety of surroundings: Even if registration or permission is not required.

Concept

➤ **Simulation system for realistic drone operation and safe flight in VR space.**

➤ **Inexpensive and easy to start System.**

It is possible to conduct flight simulations even in areas that would normally require registration or approval.

Calculation of drone behavior via hakoniwa-px4sim and gamepad for use in UC-win/Road (C++ API).
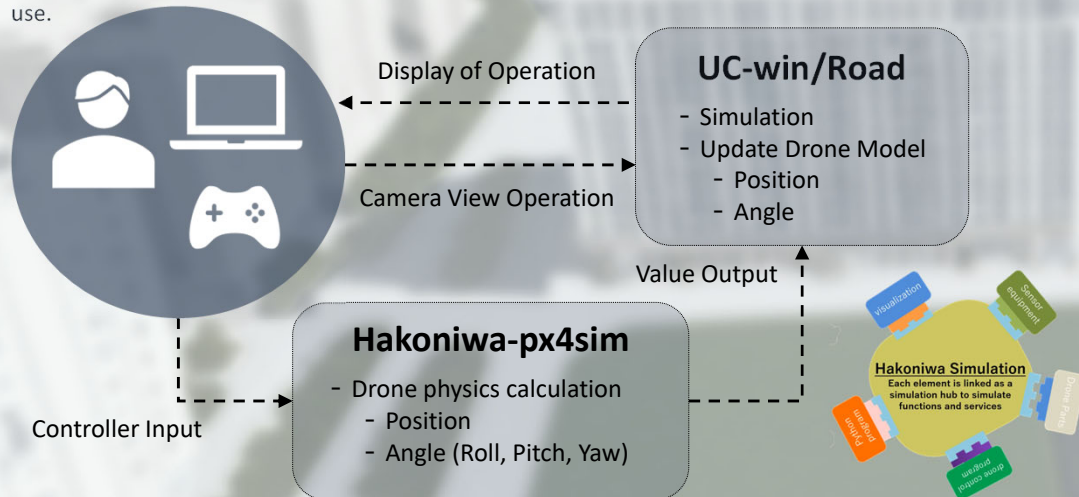
Camera Controls

Objective & Subjective view :
Yaw rotation followed by drone

Tilt angle rotation :
0 to 90 degrees

Pedestrian Detection

30m

System Overview

Hakoniwa is a virtual simulation environment and supporting ecosystem for engineers who develop and provide large-scale and complex IoT systems and automated driving systems, as part of the **TOPPERS** project. TOPPERS license is applied to Hakoniwa, and you can use, copy, modify, and redistribute it by reporting its use.

Display of Operation

UC-win/Road
- Simulation
- Update Drone Model
  - Position
  - Angle

Camera View Operation

Value Output

Hakoniwa-px4sim
- Drone physics calculation
  - Position
  - Angle (Roll, Pitch, Yaw)

Controller Input

Hakoniwa Simulation
Each element is linked as a simulation hub to simulate functions and services

Drone Operation

Use the game controller to control the drone's flight and switch between cameras. The game controller controls are defined as follows.

No	Game Controller	content
1	Left joystick	controls throttle and yaw
2	Right joystick	controls pitch and roll
3	✕ button	Start/Stop propeller rotation.
4	L1 button	Set the camera to a backward view of the drone
5	R1 button	Set the camera to the drone's camera viewpoint
6	L2 button	Swing the drone's camera down.
7	R2 button	Swing the drone's camera up.

L2,R2: Swing the drone's camera down/up.
L1: Set the camera to a backward view of the drone
R1: Set the camera to the drone's camera viewpoint
yaw   roll
Start/Stop propeller rotation.

Camera View from Behind the Drone

View from the drone camera

Tilt angle camera view

Conclusions

Our work provides simulation of drone operations on UC-win/Road using a physical equation-based plant model, hakoniwa-px4sim. By realizing actual drone operations-like interaction in UC-win/Road, it will be possible to conduct flight simulations in various cities.

Future Works

1. **Immersive and experiential systems using VR devices and hand tracking.**
2. **Effects of disturbances**
   Systems that take collision determination and the effects of wind speed changes into account.
3. **Variations in drone airframes**
   Simulation of various types of drone aircraft by changing parameters such as speed and weight.