44 Development of infrastructure inspection system using semi-autonomous multi-copter equipped with flexible electrostatic adhesive device.

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R&D Objectives and Subjects

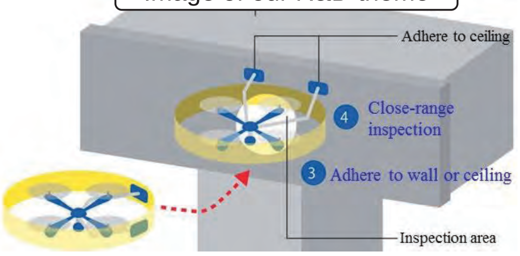
Objectives

Inspection efficiency might be low and a dangerous operation

Low cost, high efficiency, safety inspection is required

Semi-autonomous multi-copters will adhere to the walls of Inspection areas by using electrostatic an absorption device to firmly secure its position. Close-range images are taken by camera to inspect infrastructures.

Image of our R&D theme



Subjects

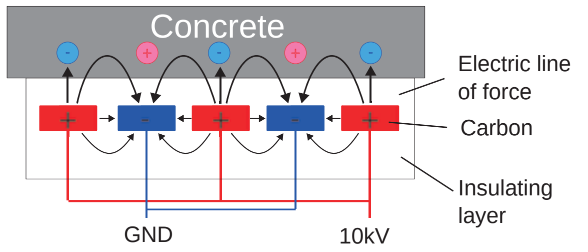
1) Technological development to adhere to a concrete wall by using electrostatic adhesive principle
A flexible electrostatic adhesive device with adhesive force of 1 kgf or more, when applying 10 kV

2) Validity verification of infrastructure inspection, by constructing a demonstration system
① Transport inspection equipment and approach infrastructure wall by small UAV.
Development of semi-autonomous multi-copter with wired power supply cable

② Wall inspection using close-range photographic camera.
Development of crack detecting algorithm for close range visual inspections using camera

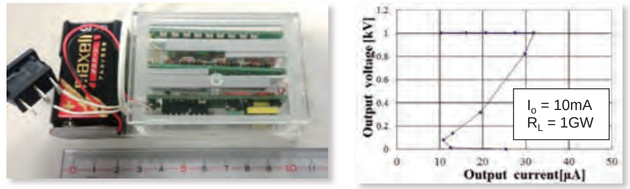
Current Accomplishments (1/2)

Adhesive principle



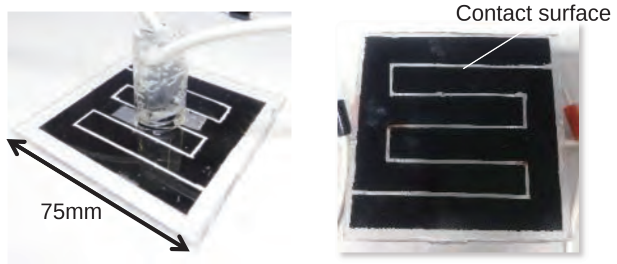
Adhere to concrete walls using an electrostatic force

Compact/Lightweight/10 kV Booster



1) Compact, Lightweight (157 g, 120 x 50 x 30)
2) Output 10 kV stably by using a 9 V dry cell
3) Equipped with current limit circuit of 30 μA

Flexible electrostatic adhesive device



1) Compact, Lightweight (60 g, 75 x 75 mm)
2) Flexibility to fit on a concrete wall
3) Can adhere not only to steel but also to concrete

Experimental verification on concrete

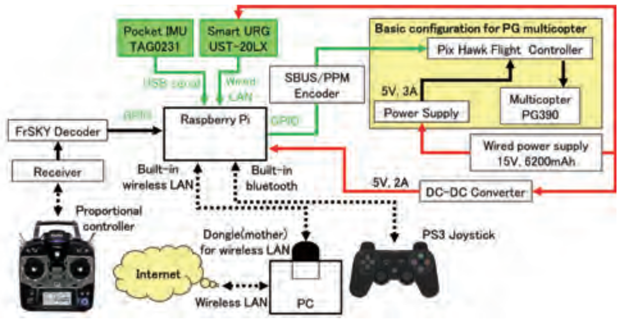
Over adhesive force 1 kgf on concrete wall.

Next Step : Multi-copter with this device

Current Accomplishments (2/2)

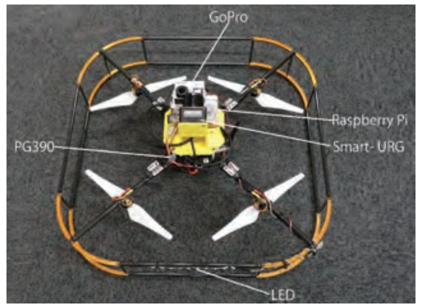
Semi-autonomous multi-copter

Fusion system using both
manual and autonomous operations



Easy to apply to
commercially available multi-copter

Development platform



Experimental verification in bridge

Utilizing several sensor data for autonomous flight, and close-range camera images in bridge girder

Next Step
1) Multi-copter with adhesive device
2) Autonomous flight to approach concrete slab safely for absorption
3) Collision avoidance for operation support
4) Self-localization for bridge girder

Goals

Goals for this R&D theme

1) Flexible electrostatics adhesive device
- Can adhere to a concrete wall, on uneven surfaces of 5 mm or less.
- Adhesive force of 1 kg or more
- Adhere a multi-copter with three adhesive devices on a concrete wall

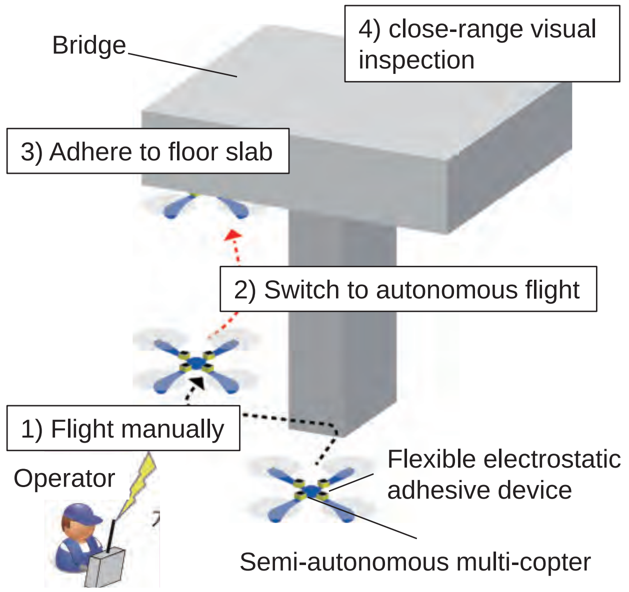
2) Semi-autonomous multi-copter
- Can switch between manual operation and autonomous flight during flight
- Collision avoidance function
- Self-localization accuracy of about 10 cm at bridge girder

3) Realize the flow of our inspection system

Social Implementation Image of this technology

- User : Inspection agency
- Place : bridge
- Application : Close-range visual inspection, crack repairs, fixing an inspection device to a bridge wall

Application image of this technology



By having it adhere to a concrete wall of a bridge, it can be used not only for close-range visual inspection but also for repair work.