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Development of a bridge inspection support robot system that uses proximity-images with Geotag and a two-wheeled flying robot

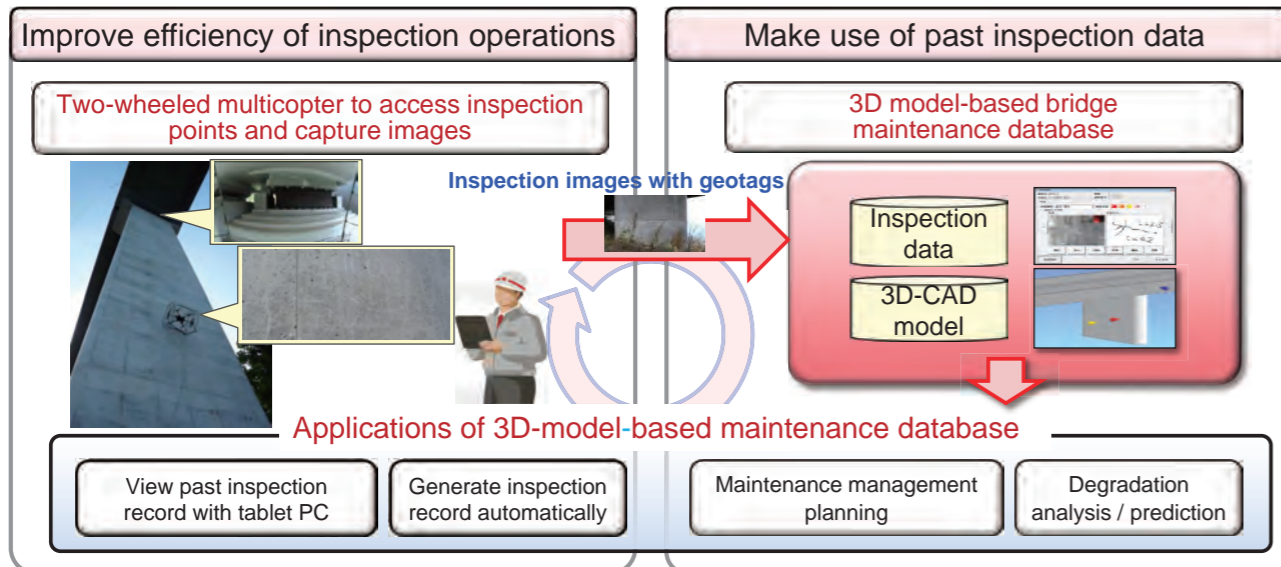


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R&D Objectives and Subjects

We propose a bridge inspection robot system that captures proximity images and a 3D-model-based maintenance database to link inspection data with 3D models. Our system can make on-site bridge inspections more efficient and support bridge maintenance operations.



Current Accomplishments (1/2)

We prototyped two-wheeled multi-copters for bridge inspection.

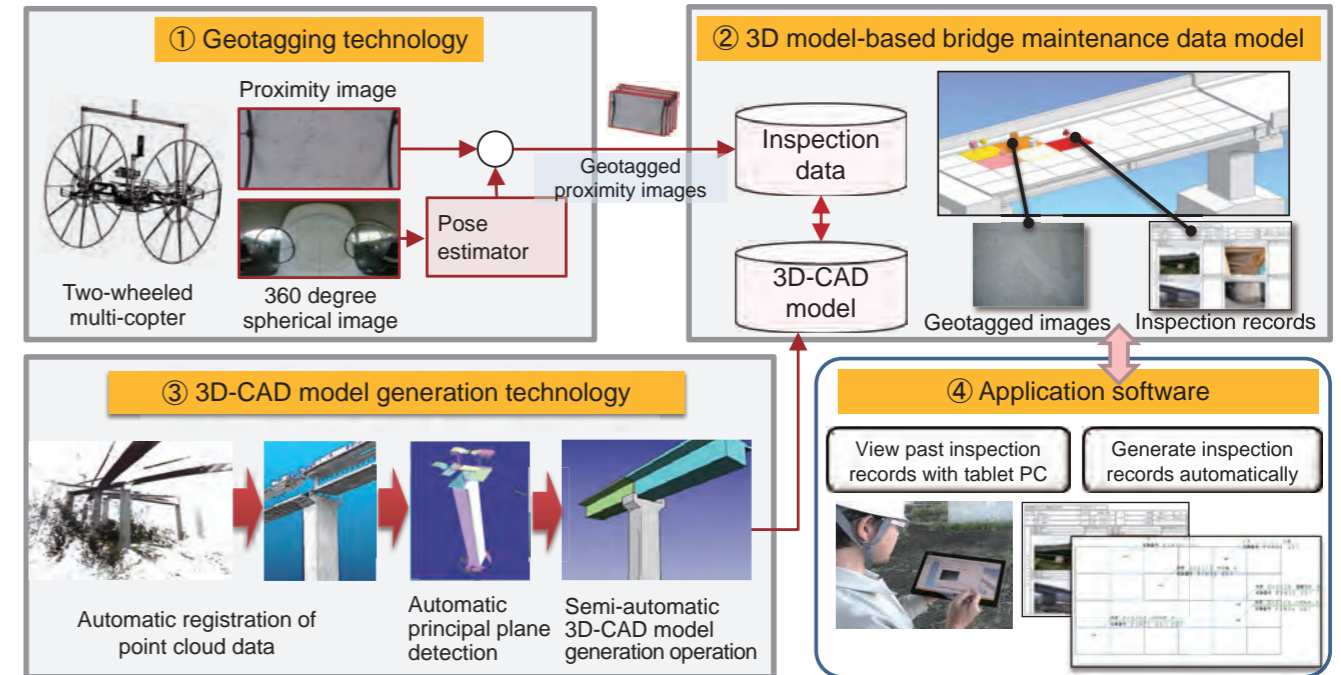
- Features**
- It can take proximity-images with constant distance to bridge surface.
 - It is robust against windy conditions because of skin friction of the wheels.

Type	Specifications
<p>① Large size two-wheeled multi-copter</p> <ul style="list-style-type: none"> • Omni-directional camera • Proximity camera • Wheel diameter: 80 cm • Cable for power supply and image transmission 	<p>[Target] High pier bridge</p> <p>[Features]</p> <ul style="list-style-type: none"> ✓ It can run on a surface of a bridge pier to take proximity images of bridge structure ✓ Inspectors can monitor images in real time
<p>② Small size two-wheeled multi-copter</p> <ul style="list-style-type: none"> • Wheel diameter: 40 cm • Cage for protection 	<p>[Target] Narrow space (shoe, and so on)</p> <p>[Features]</p> <ul style="list-style-type: none"> ✓ It can run on a pier to take a picture of a shoe

Current Accomplishments (2/2)

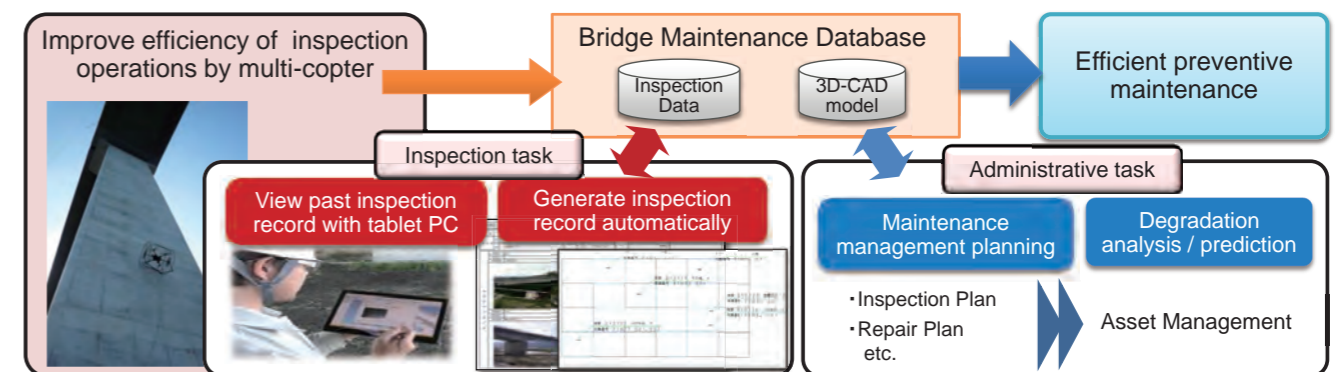
We prototyped a 3D model-based bridge maintenance system for long-term use.

- ① Geotagging technology based on SFM (Structure from Motion) using 360 degree spherical camera
- ② A 3D model-based bridge maintenance data model which is an extension of the ISO standard of the 3D-CAD model
- ③ Semi-automatic 3D-CAD model generation technology
- ④ Application software for viewing past inspection data on 3D-CAD models using tablet PCs



Goals

- Development of multi-copters for taking proximity images of high pier bridges
 - Wind-resistant stability available for practical use, mechanism and a control system for safe remote control
- Utilization of inspection data to make bridge maintenance tasks more efficient
 - Establishment of basic technology for high level utilization of inspection data



	Merits in inspection task	Merits in administrative task
Efficiency	<ul style="list-style-type: none"> ○ Collect inspection images effectively instead of a human ○ Simplify viewing past inspection data at inspection sites ○ Reduce man-hours for inputting inspection data and generating inspection records ○ Utilize past inspection data easily 	<ul style="list-style-type: none"> ○ Simplify planning of inspection and repair ○ Rational reasoning for requiring budgets
Quality	<ul style="list-style-type: none"> ○ Reduce omission of inspection ○ Reduce human errors ○ Level quality of inspection task and generating inspection record 	<ul style="list-style-type: none"> ○ Maximizing cost-effectiveness for maintenance