Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Feb 2014

Project Reference Number

NIA_NGET0098

Project Registration

Project Title

Computer Vision For Cable Tunnels

Project Reference Number

NIA_NGET0098

Project Licensee(s)

National Grid Electricity Transmission

Project Start

June 2013

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Mark Farmer

Project Budget

£95,000.00

Summary

Working in collaboration with ARUP and Cambridge University, National Grid will modify a video detection algorithm that has been used to condition monitor bridges to be used in cable tunnels the major technical difficulty to overcome is the repetitive nature of the tunnel structure. This will also be modified to run on an autonomous device that is being designed to run on the I-beam on the roof of the tunnel.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

Cable tunnels have to be monitored for structural integrity. Currently condition monitoring of the cable tunnels are carried out by personnel operating in a confined space using visual inspections which are subjective. In addition enclosed spaces are a potentially hazardous area which National Grid tries to avoid sending personnel into wherever possible. National Grid has to perform this condition assessment, and has no other option but to use people to complete this assessment.

Method(s)

Development

The method proposed is a computer vision based system for the automated mapping of tunnels for inspection and monitoring, building upon experiments conducted during a site visit with Costain and National Grid to the Channel Gate Road site, London, in July 2012. This is a technological transfer with modification from a device that is utilised on condition monitoring of bridges, but will require modifications to make functional in the cable tunnel.

The proposed system receives as input a collection of image data taken by a camera array system moving along the tunnel length (e.g. hung from the existing I-beam). The data is processed automatically and the system provides a number of useful outputs/capabilities:

1. A 3D model of the tunnel, formed using image data from digital cameras

2. Mosaic images for long sections of tunnel, to aid in 2D inspection reporting

3. The ability to image behind occluding objects such as wires or pipes

4. The ability to automatically localise new images precisely within the 3D model. Such images might include a second set of images taken by the rig one week later, or a random assortment of images taken from different viewpoints by inspection engineers

5. The ability to automatically detect and potentially classify anomalous visual changes in these new images versus previous data

6. The ability to collect thermal data using a infra-red camera and register it to the 3D model

Scope

Working in collaboration with ARUP and Cambridge University, National Grid will modify a video detection algorithm that has been used to condition monitor bridges to be used in cable tunnels the major technical difficulty to overcome is the reparative nature of the tunnel structure. This will also be modified to run on an autonomous device that is being designed to run on the I-beam on the roof of the tunnel.

Objective(s)

To produce a system that is able to perform condition monitoring on tunnels, without the need for personnel to be in the tunnel.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be successful if a solution is developed that enables personnel to be removed from the tunnel system whilst condition monitoring is being performed.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is being trialled on 1 tunnel in London as a proof-of-concept.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The project will deliver in London.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

£95,000

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

n/a

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

Currently National Grid has not had a cable tunnel failure or a fatality due to the inspection of the cable tunnels, this is still a risk are which this project aims to reduce.

The abandonment of tunnels can cost millions of pounds, this is a project that aims to detect and identify potential issues before they become issues and allow for early remediation works to take place.

Please provide a calculation of the expected benefits the Solution

Base cost is 3 days at a rate of £500 for personnel time spent inspecting the cable tunnels from a civil perspective across the company as well as the maintenance of specialized equipment. The method cost would be the single cost of the unit plus the license of the software.

Therefore B-M= £1500 - license (to be agreed on successful delivery)

Please provide an estimate of how replicable the Method is across GB

This is replicable on 100% of tunnels with an I beam installed.

Please provide an outline of the costs of rolling out the Method across GB.

For efficient use of resources a few devices should be produced and then utilized by transporting between cable tunnels with a dedicated team. As the cost of the device and the team needed to support it is yet to be established this is not possible to provide at this time.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☑ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☑ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☑ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

n/a

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

This project addresses connections through improved remote system access and Reliability through optimizing asset management.

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

n/a

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

n/a

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

n/a

This project has been approved by a senior member of staff

- [x] Yes