Mohammed VI Polytechnic University (UM6P)
International Artificial Intelligence Center of Morocco (Ai movement)

Multimodal Human-Drone Interaction for Non-Destructive Industrial Inspection

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1 Research Motivation

Industrial sites often require regular, extensive, and emergency inspections of production sites and machinery. The inspection operations aim to assess the state of these infrastructures to detect early signs of possible abnormalities and plan maintenance accordingly, with minimal perturbation to the industrial activity. Conventional nondestructive inspection measures (NDI) result in significant down-time and economic costs as these facilities are often hazardous to human agents. Unmanned aerial systems based NDI is often viewed as a solution to efficiently perform NDI tasks without requiring specific safety measures nor supporting structures to access elevated or confined areas [3]. Indeed, the manoeuvring flexibility and advanced sensing capabilities provided by aerial platforms are particularly interesting for companies, especially for large or confined industrial areas. Moreover, unmanned aerial NDI platforms can significantly decrease the cost of inspection, as well as inspection time, while increasing the reliability and consistency of acquired data.

2 Problem Statement

In an industrial inspection scenario, the UAV system can be fully autonomous or support a human agent in targeted inspection operations. The interaction between the human and the robot (HRI) needs to ensure natural, intuitive communications to control, make requests and express intentions. In literature, many researchers have proposed HRI techniques based on gesture, speech, and multi-modal approahes [1]. However, these techniques are not directly applicable to drone-based NDI platforms [2]. First, drones have different characteristics and constraints compared to unmanned ground robots in terms of movement and security constraints. Second, most of the existing schemes propose mechanisms for HRI for outdoor and indoor domestic settings. Considering the interaction in an industrial facility will introduce a new set of constraints and challenges, including communication range, human safety, and inspection performance.

3 Research Scope

We aim to develop a smart multimodal humain robot interaction system targeted to non destructive maintenance in industrial facilities. Our human-centric platform seeks to provide the inspectors with highly intuitive control tools to execute general and targeted inspection operations.

The research scope can be viewed in two major axes:

- **Multimodal Human-Drone interaction strategies:** We want to enable the drones to use artificial intelligence to respond to the agent's gestures and voice in different scenarios. Computer vision and speech recognition modules will be developed to detect and interpret the agent control.

- **Collaborative strategies for non-destructive industrial inspection:** Our goal is to build an Ai-based system of autonomous and collaborative drones that can inspect a portion of industrial infrastructures in a continuous or targeted operation. The system needs to respond to the multimodal interaction module and collaborate to execute the inspection task.

Extensive simulations, tests and deployment of the robotic platforms on real industrial infrastructures can be conducted. The resulting integrated prototype will allow the deployment of a highly intuitive inspection platform to enable broad and efficient use of drone-based NDI technologies to inspect indoor and outdoor industrial infrastructures

4 Admission Criteria

The PhD position is proposed by the International Center of Artificial Intelligence of Morocco, of the Mohammed VI Polytechnic University. Applicants must be holders of a Master's, an engineering or an equivalent recognized degree in Computer Science, Electrical Engineering or Applied Mathematics. In addition, they should have skills in Programming (Python and C++) and good communication skills in English. Particular attention will be given to the suitability of this research project with the applicant's background.

References

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