

PARTICULAR SPECIFICATION

APPENDIX AW

VIDEO ANALYTICS (VA) REQUIREMENT SPECIFICATIONS

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1 INTRODUCTION

1.1 The function of Video Analytics (VA) is to facilitate better site supervision via automatic anomalies detection. It shall augment and allow better safety supervision, using predefined algorithms and safety rules to ensure safety compliance.

1.2 The focus of video analytics shall target high risk work activities to serve as an additional control measure to mitigate related risks. The customised solution shall be established using machine learning methodology.

1.3 Definitions

“Video Analytics System” or “VA System” includes backend servers with software integration into CCTV system, to be designed, supplied, installed, test, commissioned and maintained by a VA specialist engaged by the Contractor.

“Work Zone” refers to a sectorised work areas with high risk work activities. Work zone areas shall be subject to the Engineer’s acceptance.

“High Risk Work Activities” refers to any of these works but not limited to; demolition works, excavation works, lifting operations, piling works, tunnelling works, work on scaffold where a person could fall more than 2 meters and work involving entry into confined space.

“Construction Vehicular Access” refers to designated vehicular access for construction machinery.

2 VA SYSTEM OVERVIEW

2.1 The Contractor shall propose an overall architecture of the VA system for the Engineer’s review and acceptance. An example of the overall architecture of the VA system is shown in Figure 2.1 for reference.

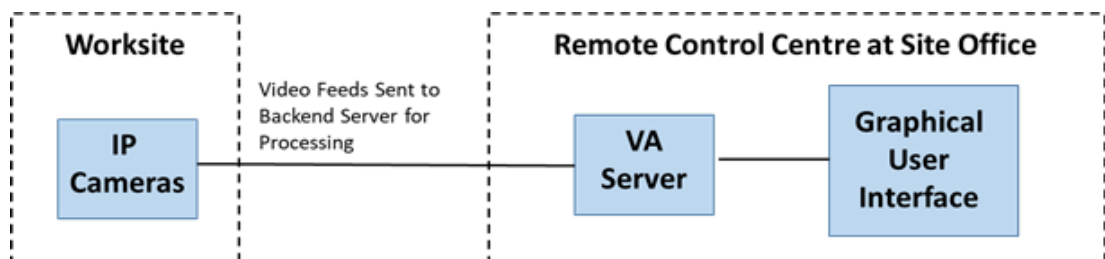


Figure 2.1 Architecture of VA System example

- 2.2 The Contractor shall provide the VA System to be integrated with CCTV system deployed at worksite (refer to Clause 17 of the Particular Specification) and connected to the Remote Control Centre (RCC) (refer to Clause 5 of the Particular Specification) via a Graphical User Interface (GUI).
- 2.3 The Contractor shall design a scalable system architecture that allows adding more cameras while holding the same acceptable performance level. Connectivity for the entire solution shall be hosted on a local private network.

3 SCOPE OF WORK

- 3.1 The Contractor shall engage a VA specialist contractor with qualified and competent personnel with relevant experience and the necessary equipment to design, deploy, calibrate, fine-tune and troubleshoot the VA system.
- 3.2 The Contractor shall complete the implementation (including the design, supply, installation, testing and commissioning all hardware, equipment and software necessary for the VA System including the backend servers installed with VA software subject to the Engineer's acceptance and within fifteen (15) months from the award of the Contract.
- 3.3 The Contractor shall collect datasets upon the commencement of major work activities on Site and use for machine learning to build up the algorithms.
- 3.4 The Authority will provide the Contractor a set of annotated/labelled training datasets for use cases under Clause 4.1(b) and 4.1(c) below. These datasets are to support the machine learning process for object detections. However, It shall not relieve the Contractor from collecting their own datasets to achieve the performance requirements as stipulated in the Contract.
- 3.5 All annotated/labelled datasets created through the images/videos collected from the worksites shall be stored in media storage devices and shared with the Authority. The Contractor shall submit these datasets to the Authority within 2 weeks upon implementation of VA system on Site and progressively until the end of the project.
- 3.6 The Contractor shall develop the GUI for integration with the CCTV system.
- 3.7 The Contractor shall carry out comprehensive maintenance for the VA System.

- 3.8 Upon completion of the Projects, the Contractor decommission, dismantle and remove the system as directed by the Engineer and to archive and transfer the entire existing database to the Authority. The Contractor shall not retain any datasets collected from the project Site.

4 VA SYSTEM REQUIREMENTS

- 4.1 The VA System shall be able to perform the following anomalies detection function:
- a) Facial Recognition;
 - b) Pedestrian Intrusion into Construction Vehicular Access; and
 - c) Additional scope from Clause 4.4 of this document.
- 4.2 For facial recognition, the VA System shall be able to identify personnel at entry and exit points of each work zone and form a trail with timestamped locations to track whereabouts of personnel. The system shall be a walk through, non-intrusive way of detection without deliberate action/ cooperation from personnel.
- 4.3 For pedestrian intrusion detection into construction vehicular access, the VA System shall be able to detect personnel intrude into construction vehicular access at worksite and trigger an alert. The system must be able to differentiate scenarios where personnel is authorised to be on construction vehicular access like travelling on vehicles etc.
- 4.4 The Contractor is also required to conduct studies and include the scope of the following use cases in the test plans, by exploring the feasibility of automatic detection on safety non-compliance with VA technologies or any other applicable technologies subject to the Engineer's acceptance.
- 4.4.1 Effective usage of personal fall arrest system for fall prevention measure. The proposed solution shall be able to detect the usage of body harness for personnel working at height with continuous anchorage;
 - 4.4.2 Usage of safe means of access for working at height. The proposed solution shall be able to detect usage of platform ladders for access instead of A frame ladder;
 - 4.4.3 Installation of physical barricade around heavy machinery to keep personnel away from operation zone. The proposed solution shall be able to detect the continuous presence of effective barricade to demarcate non access zones;

- 4.4.4 Installation of fall prevention measures at edge of structures and excavation. The proposed solution shall be able to detect the continuous presence of effective guardrails to prevent fall; and
- 4.4.5 Presence of competent workforce in the vicinity of high risk work activities. The proposed solution shall be able to detect skillsets and credentials of personnel of the competent workforce and ensure no trespassing into hazardous area by unauthorized workforce.
- 4.5 Graphical User Interface
 - 4.5.1 The Contractor shall provide a customized graphical user interface (GUI) for alerts generated, on the workstation at the RCC. Alerts generated shall trigger a 5 seconds recording and viewable for verification on the GUI. All recordings are to be archived into the server. Detailed design of the GUI shall be confirmed and to the Engineer's acceptance during design review.
 - 4.5.2 A customisable GUI platform that would allow the user to call out any information available within the system required by the Engineer. The proposed illustrations within the GUI shall include but not limited to text, graph and photos. The layout of the GUI shall subject to the Engineer's acceptance.
 - 4.5.3 The proposed platform shall support multiple user access with role-based control and grouping capabilities. Role-based controls shall support at least 2 different roles as follow:
 - a) admin role with edit and read access; and
 - b) normal user role with read only access.
 - 4.5.4 The GUI function for facial recognition shall include the following:
 - a) To identify and display personnel's mugshot linked to his credentials including company name, designation, skillsets/competency, unique identification number, date of registration etc.
 - b) To show work zone sectors with facial recognitions chock points locations reference to site plan at different levels of construction.
 - c) To show live location of last check- in points of all personnel for all work zones for accountability purposes in the event of any emergency evacuation.

- d) To have filtration functions to call out the following:
 - i. Pulling out personnel's' data and provide a summary of clocked in locations with reference to time;
 - ii. Pulling out a set of relevant personnel specific to input criteria such as company name, designation, skillsets/ competency etc.; and
 - iii. Pulling out the list of personnel inside any work zones at any specific time.

4.5.5 The GUI function for pedestrian intrusion into construction vehicular access shall include the following:

- a) To provide monitoring status of construction vehicular access on site and receive prompt in the form of pop out alert when a violation is detected;
- b) The pop out alert to contain screenshot of violation with reference to time and location of incident; and
- c) To provide summary list of alerts with above details.

4.6 The datasets to be collected for machine learning process should contain the following attributes:

4.6.1 Region of Interest (ROI): ID, date and time, region, description, event type, parameters, event name, trigger, schedule, camera id, excluded region.

4.6.2 Camera attributes: ID, name, location, coordinates, resolution, stream URL, ROI x, ROI y, ROI width, ROI height.

4.6.3 Alert attributes: ID, type, name, condition, schedule, trigger.

5 VA PERFORMANCE REQUIREMENTS

5.1 Facial Recognition (FR) Performance Requirements

5.1.1 The Contractor shall develop their own authorised personnel database for FR to be able to track personnel location at entry and exit points of each work zone with detection in both directions.

- 5.1.2 The Contractor shall maintain an updated database with latest black and white list personnel.
- 5.1.3 The Contractor shall provide a FR solution that function in all weather and time of day with necessary provisions to support it to achieve satisfactory accuracy. The proposed locations for facial recognition tracking for specific work zones shall be proposed and submit for comment and acceptance by the Engineer.
- 5.1.4 The Contractor shall perform calibration and fine-tuning of the VA System to aim for an accuracy of at least 90% positive detection rate, and maximum latency of 1s or less using tests within testing parameters which will be agreed during design review.
- 5.1.5 The Contractor shall achieve continuous tracking of all personnel of their location at all time, field of views for FR shall be adjusted and fine- tuned to achieve at least 90% accuracy for positive detection. Set- up of FR chock points at work zones shall attain accurate tracking of not less than 90% of the workforce at all time.
- 5.1.6 The FR solution shall be able to support no less than 10,000 images in the database for recognition purposes:
- a) To identify authorised personnel and link their credentials on their designation and skill sets;
 - b) An end to end capability with both hardware and software facial recognition algorithm;
 - c) To identify unauthorised personnel and trigger alert to remote control centre upon unauthorized access into worksite;
 - d) To identify blacklist or banned personnel and trigger an alert to remote control centre;
 - e) To identify unauthorized personnel at high risk work areas and trigger an alert to remote control centre; and
 - f) To identify multiple subjects and track them at different locations simultaneously.
- 5.2 Pedestrian Intrusion into Construction Vehicular Access Detection Requirements

- 5.2.1 The Contractor shall develop a solution to pick up unauthorised pedestrian intrusion into vehicular access. Stabilize and tune CCTVs to achieve expected results of at least 85% positive detection rate for personnel walking on vehicular access. Personnel transported on vehicles shall be excluded from detection. The proposed locations for tracking of pedestrian intrusion into construction vehicular access shall be proposed and submit for comment and approval by the Engineer.
- 5.2.2 The Contractor shall monitor all construction vehicular access on Site. Cameras for monitoring should be fitted at appropriate height covering a maximum distance of 250m per field of vision with entire width of vehicular access covered.
- 5.2.3 The rate of detection should come with acceptable latency without missing out subsequent alerts.

6 PROJECT SCHEULE AND REQUIREMENTS

6.1 General

6.1.1 The Contractor shall conduct design review within six (6) months from the award of the Contract for the Engineer's acceptance.

6.1.2 The design reviews shall include the following:

- a) Design of VA System including hardware and software specifications, and VA deployment plan;
- b) User Acceptance Test Plan of the VA System; and
- c) Implementation Plan including method statement of installation and risk analysis.

6.2 The project schedule is described below:

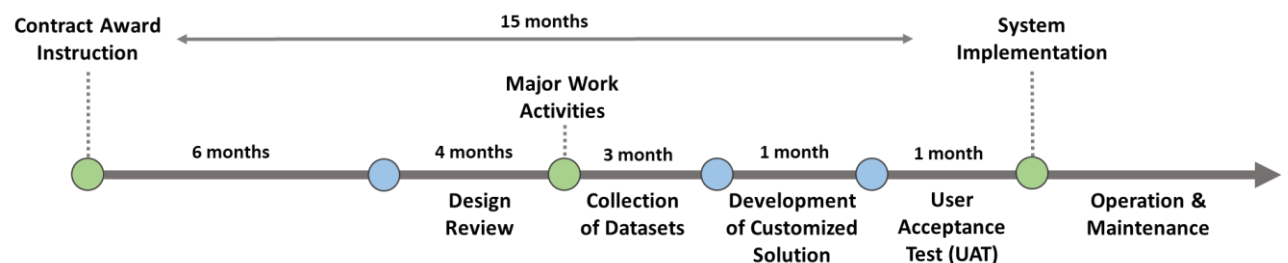


Figure 6.1 Typical Implementation Milestones

- 6.3 User Acceptance Test Plans
 - 6.3.1 The Contractor shall propose testing strategy for each system requirement to ensure the VA System satisfies all the Performance Requirements in respect of coverage, accuracy, precision and recall.
 - 6.3.2 The Contractor shall submit the overall test plan and include the following:
 - a) Objective of testing;
 - b) Scope of testing;
 - c) Test methodology and procedures;
 - d) Environment set up;
 - e) Roles and responsibilities; and
 - f) Test documentation (including test scenarios).
 - 6.3.3 The Contractor shall submit detailed User Acceptance Test Plans to be used for User Acceptance Tests which minimally includes the scope of the testing, the acceptance criteria and detailed test cases of the VA System 2 weeks prior to the actual conduct of the test.
 - 6.3.4 The Contractor shall perform the necessary setup before commencement of User Acceptance Tests.
 - 6.3.5 The Contractor shall provide qualified and competent personnel with relevant experience to conduct the User Acceptance Tests and resolve all problems encountered during the User Acceptance testing period.
- 6.4 User Acceptance Test (UAT)
 - 6.4.1 The Contractor shall ensure the successful completion of system integration prior to commencement of UAT on site.
 - 6.4.2 The Contractor shall allow at least one (1) calendar month for the UAT.
 - 6.4.3 During the UAT period, the Contractor shall rectify all defects including completion of fine-tuning works to meet performance requirements.
 - 6.4.4 The Contractor shall fulfil the exit criteria requirements for the UAT before UAT can be considered completed.

- 6.4.5 Upon the completion of UAT, the Contractor shall submit the necessary documentation, signed off by the Contractor's Project Manager, for the Engineer's acceptance to proceed with system commissioning. This shall include an action plan to resolve any outstanding issues.
- 6.4.6 Upon successful completion of UAT, the Contractor shall obtain a UAT sign-off.
- 6.5 Implementation Plan
- 6.5.1 The Contractor shall propose an implementation plan, specifying the overall project schedule and indicating the roles and responsibilities of support required during the course of the project. The overall project schedule shall include dates for design review, deployments of system, T&C of the system and major milestones for work activities.
- 6.5.2 Submission of test plan, system proposal and confirmation of design requirement should be completed within four (4) months before commencement of major works or six (6) months upon Contract Award, whichever comes first.
- 6.5.3 VA monitoring system should be operational and achieving stipulated performance requirement nine (9) months after the commencement of major works or fifteen (15) months upon Contract Award, whichever comes earlier.
- 6.6 Monthly Video Analytics Monitoring Report
- 6.6.1 The Contractor shall submit the monitoring report as part of an attachment after data logger report in the monthly Safety Health Environment report within 5 days after the month completion.
- 6.6.2 Submission of monthly Video Analytics monitoring report should commence on the first month upon implementation.
- 6.6.3 The report shall be submitted as a section in Safety Health Environment Report after Data logger report. It should be prepared and signed off by the VA specialist and acknowledged by the Contractor.

The report shall follow the guidelines:

- Coverage and intended outcome of the system implemented;
- Executive Summary to give a brief summary of the results with reference to the intended outcomes and recommendations for area for improvement for the reporting month;

- The report shall contain summary of alerts generated with breakdown of alerts (true positive, false positive, false negative) generated and summarized by recall, precision and accuracy rate for each use case; and
- The report shall update the locations of VA cameras and monitoring zones on a site utilization plan with a summary table of percentage coverage complying to Clause 5 performance requirement of this document.

7 SOFTWARE SUPPORT AND HARDWARE MAINTENANCE

7.1 The Contractor shall provide comprehensive maintenance (corrective and preventive maintenance) for the VA System.

7.2 The Contractor shall provide application operation and administration which shall include the following:

- (a) Provide proactive day-to-day administration, system monitoring and system health checks which include but not limited to servers, network and application systems for resource utilisation, faults, intrusions, security incidents, failures and system performance;
- (b) Prepare and perform the deployment process for bug fixes, implementation of application enhancements and development;
- (c) Participate and provide assistance in the user access control review exercise;
- (d) Produce and update technical and user documentation for the application;
- (e) Conduct detection on occurrence of any performance degradation and fault of the services and systems, and provide immediate actions to ensure that the Engineer's defined service levels are met;
- (f) Provide configuration, functional consultancy and technical advice pertaining to problem resolution or queries; and
- (g) Provide technical advice and assistance to ensure the continuity, availability and accessibility of the application;

- 7.3 The Contractor shall conduct biannual thorough health checks on the VA System at the Engineer's site, with replacement of faulty parts or tuning of hardware and software to achieve optimum configurations and system performance if applicable, in consultation with the Engineer.
- 7.4 The Contractor should visit the Site within one working day upon receiving the notification of the system failure. The Contractor shall provide a bypass solution (interim measure) or rectify the system within five (5) working days.
- 7.5 The Contractor shall re-install the components or parts to the VA System once the defective part is repaired and returned to Engineer's premises.
- 7.6 The Contractor may at its option, and with the Engineer's written consent, at no cost to the Engineer, make modifications to the VA System to improve the operation and/or reliability of the VA System.
- 7.7 The Contractor shall advise the Engineer on the improvements to the availability and performance of the applications including middleware.
- 7.8 The Contractor shall analyse and track the performance bottlenecks, unresolved fault and provides rectification efforts to prevent problem from recurring. The Contractor will analyse the progress of the fault resolution and prioritise the rectification effort subject to the Engineer's acceptance.