Printed version for reference only. Refer to Requirements Management Tool for Official Version.

Contents

1   Introduction

1.1 Purpose and Scope

This is the functional specification for "Scenario Based Data Logging".

Scenario Based Data Logging is an added function to Object Detection System (ODS) which activates in the event of a near-miss or collision, and record all pertinent information from the camera, sensors, and the host machine which will be used and reviewed as part of an incident investigation. Functional requirements of ODS are covered in its respective document.

1.2 Overview

Operators of mining vehicles have a strong need for situational awareness. Operators on board certain mining vehicles have extremely large blind spots in which people, smaller machinery, large rocks, and other obstacles may be present but unseen. This can pose serious risk of injury/damage to the operator, mining vehicle, and any other people or machinery in the vicinity.

The need is to provide a record of the information from the sensors, cameras, and the host machine. Constant logging of this information will cause a large demand for on-machine storage, management, and access to these rich datasets. The objective is to only archive this information during specific scenarios that are deemed to be either high risk, or meeting of a customer condition that necessitates the data be captured for evaluation. The ODS will provide some of the risk scenarios along with the ability for the machine operator to trigger the archiving of this information.

1.3 References

NA

1.4 Definitions

Attachment – The combination of the handle and dipper.

Boom – A structural member typically installed at a 45° angle on the front end of the shovel. This structural member houses the crowd pinion and boom point sheaves.

Centurion – A supervisory control system developed by Komatsu Mining Corp.

Counterweight – A large enclosed structure mounted on the revolving frame of a shovel at the opposite end away from the attachment to help equalize the total suspended load on the front end.

Crowd – The combination of the crowd motor, gearbox, and crowd pinion linked together with a belt. The belt linkage is used to rotate the crowd pinion contacting the rack installed on the handle.

Dipper – A box shaped structure attached at the end of the handle used to dig material.

Handle – A long structural member that is attached to the crowd pinion using a set of saddle blocks that act as clamps. The dipper is attached to the end of the handle at a specific angle.

HMI – Human-Machine Interface.

Hoist – The combination of hoist motors, gearbox, hoist drum, and ropes connecting to the dipper. The hoist motor and the hoist drum are connected through the gearbox, and the dipper is connected to the hoist drum with the use of ropes. This linkage is what allows the dipper to move up and down with the movement of the hoist motors.

Interactive Objects – Interactive Objects are defined as vehicles that interact directly with the host machine (e.g. Komatsu Haul Truck 930E)

LINCS – A supervisory control system for front end loaders developed by Komatsu Mining Corp. Longview.

Non-Interactive Objects – Non-Interactive Objects are defined as vehicles or objects which operate nearby the host machine and don't interact directly with the host machine (e.g. light duty vehicles, drills, dozers)

ODS – Object Detection System. A combination of perception sensors (ex. LiDAR, RADAR, Cameras, etc.) along with the processing of that information to determine the type of object (ex. Human, Vehicle, Ground, etc.)

OOIs – Object of Interest. OOIs are defined as vehicles, material, and other bodies that can interfere with the operation of the host machine by acting as obstructions, or safety risks during normal operation.

PM – Preventative Maintenance.

Resolution – The horizontal and vertical pixel count of the HMI monitor.

SBD – Scenario Based Datalogger.

Shovel – Electric rope shovel (e.g. P&H 4100XPC DC)

Voice of the Customer (VOC) – Customer survey visits completed to discover current and future needs with their mining machinery. During these visits, representatives from management, maintenance, operations and procurement were present to provide the different viewpoints.

Zones – Polygon sections identifying set area around the host machine, defined by the machine type.

1.5 Limitations

NA

1.6 Assumptions and Dependencies

Assumptions:

- NA

Dependencies

- NA

1.7 User Characteristics

Operator: The machine operator is the primary user of ODS. Typically, operators are assigned to operate a mining machine during a 12-hour shift.

Mine Maintenance Personnel: The Mine Maintenance personnel are responsible for routine maintenance of the ODS.

Field Service Personnel: Komatsu Mining Corp. Field Service personnel who can interface directly to the ODS system to perform commissioning and diagnostic functions.

2   Functional Requirements
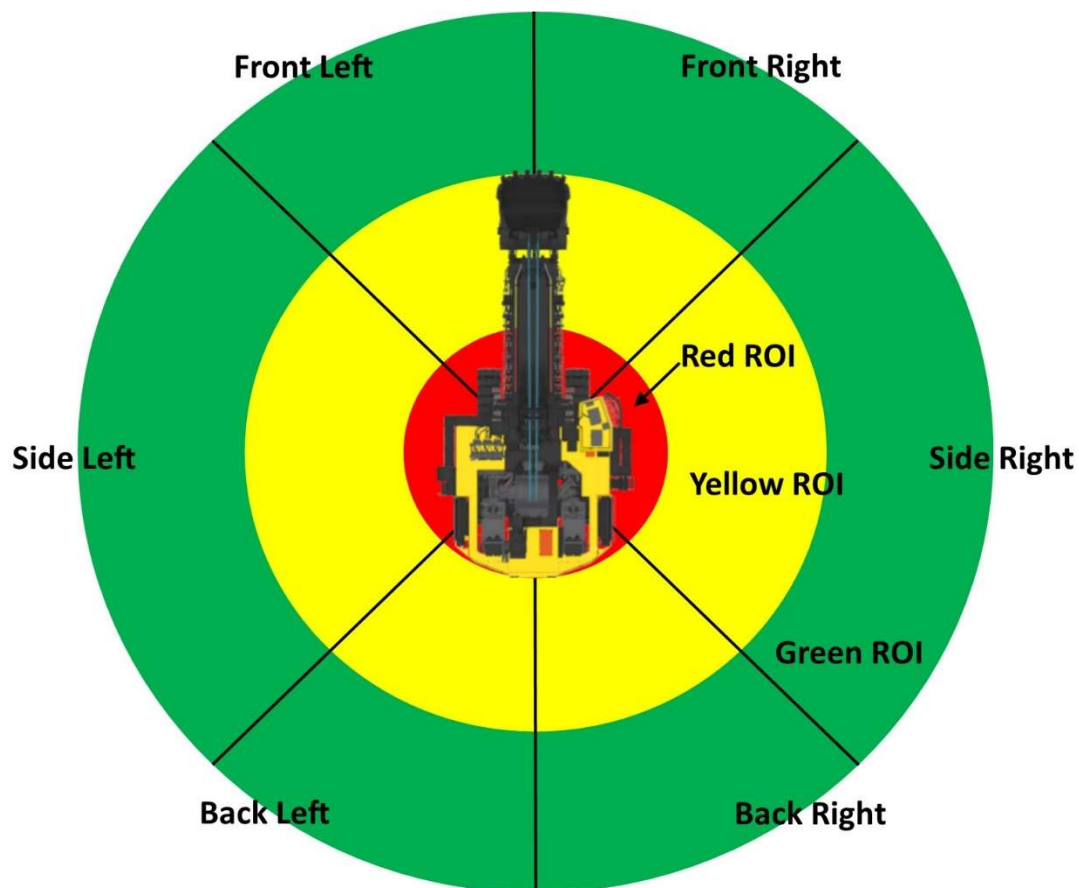
2.1 ODS Requirements

SBD shall meet all functional requirements for ODS as outlined in the ODS Functional Spec.

2.1.1 ODS Zones

The following regional descriptions must be utilized by SBD and provided by ODS.

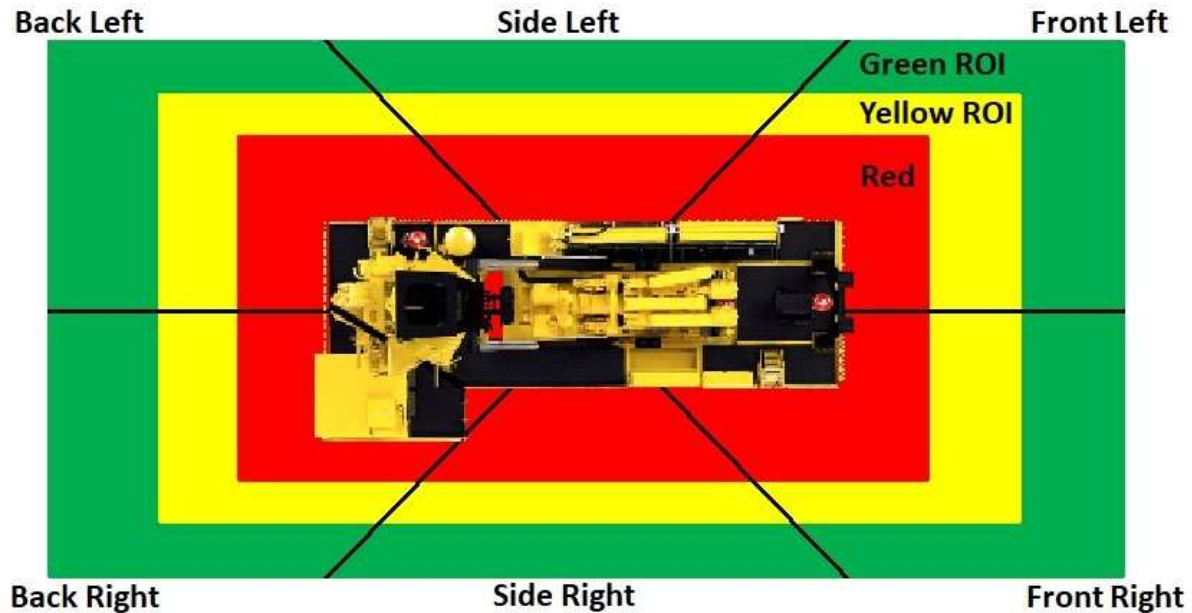*Figure 1 Angular Regions of Interest and Sections for a Shovel*

Figure 2 Rectangular Regions of Interest and Sections for a Drill

2.1.2 ODS Classifiers

SBD must utilize the Object classifiers: Interactive Object and Non-Interactive Object.

2.2 Host Machine Communication

NA

2.3 Defined Scenarios

SBD must automatically activate in the event of following scenarios:

1. Either Non-Interactive or Interactive Objects detected in red zone. Data Logging must stop when objects leave red zone.

2. Non-Interactive Objects detected in yellow zone and the host machine is moving. Data Logging must stop when Non-Interactive Objects leave yellow zone.

	Red Zone	Yellow Zone
Interactive Objects	Activate Date Logging	Stop Date Logging
Non-Interactive	Activate Date Logging	Activate Date Logging

2.3.1 Defined Scenario Exception

SBD should make exception to any logging scenarios that have reached a size where the logging cannot continue without compromising on-machine storage.

2.4 Operator Triggered Logging

SBD must activate in the event of a user command requesting sensor data to be logged. This event should utilize a static timer to end the recorded dataset.

2.5 Logging Requirements

SBD must log the following information if the Defined Scenario is met:

- Timestamp Start
- Timestamp End
- Triggering Condition (Scenario vs. User)
- All Perception sensors (ex. LiDAR, RADAR, Camera)

2.6 Replay Requirements

TBD

3 Constraint Requirements

3.1 Documentation

The following documents shall be provided:

3. Functional Specification
4. Technical Specification
5. Product Manual
   o Installation Guide

- o Troubleshooting Guide
- o Maintenance Guide
6. Export Compliance Documentation

3.2 Operating Environment

ODS shall operate in the normal expected conditions of the host machine. The following is a list of commonly used operating conditions for the host machines targeted:

- Temperature: -40 °C to 70 °C
- Humidity: 90% relative humidity, non-condensing
- Altitude: 5,000 m
- Enclosure ratings: IP67

3.3 Robust Components Selection

ODS shall prioritize selection of robust and rugged hardware components where available. The components selected should be designed for outdoor, mining use.

3.4 Components Life Expectancy

ODS shall provide datasheets and a general component life expectancy from the manufacturer for each of the primary components utilized by the system. This information should be constructed into a maintenance schedule for the ODS system.

3.5 Cost Constraints

3.5.1 Kit Cost

ODS kit cost to Komatsu Mining Corp., not including labor, shall not exceed XXXX

3.5.2 Annual Maintenance Cost

ODS' annual maintenance, not including labor, shall not exceed XXXX% of the kit cost to Komatsu Mining Corp.

3.6 Safety

ODS shall provide all applicable datasheets, MSDS, safety requirements for the components and installation of the kit. Maintenance practices must outline the proper procedures for working on the ODS system and provided to the customer via product documentation and HMI.

3.7 Serviceability

ODS installation and routine maintenance tasks shall not take longer than a single PM to complete with one mechanical and one electrical service personnel. Routine maintenance tasks are defined as:

- Inspection of sensors, cameras, and cabling
- Cleaning sensors and cameras
- Replacement of sensor, camera, and cable
- Updating ODS software
- Retrieval of ODS data logs