Biosecurity Automated Threat Detection System (BATDS)





Rain & vaue day

DESIGN I

Department of Agriculture, Fisheries and Forestry

Government Objectives

Automate detections

Pests and contaminants on the external surfaces of sea containers coming into Australia.

Workforce multiplier

Scan more containers with available resources and intervene on containers with identified biosecurity risk.

Simplify screening process

Reduce the time and effort required to scan containers, without adding interruptions to existing processes.



BATDS Development

Proof of concept

1 crane 600 containers scanned 0 compared

During proof-of-concept phase Trellis Data detected threats 25x above expected levels.

Trial Period

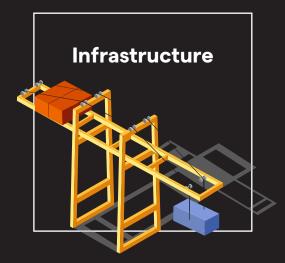
5 cranes 48k containers scanned 1,239 compared

20 weeks scanning - approx. 1,800 containers every week.

Next...

Apply learnings and demonstrate improvements in the system.

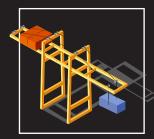
BATDS Development







BATDS Infrastructure



Achievements

Integration with cranes

Connection to PLC data enabled five synchronised camera movements.

Installation

Coordination with stevedore for access, physical connections at the port.

Integration with stevedore

API connection between the BATDS system and work manifest.

Deployment of compute

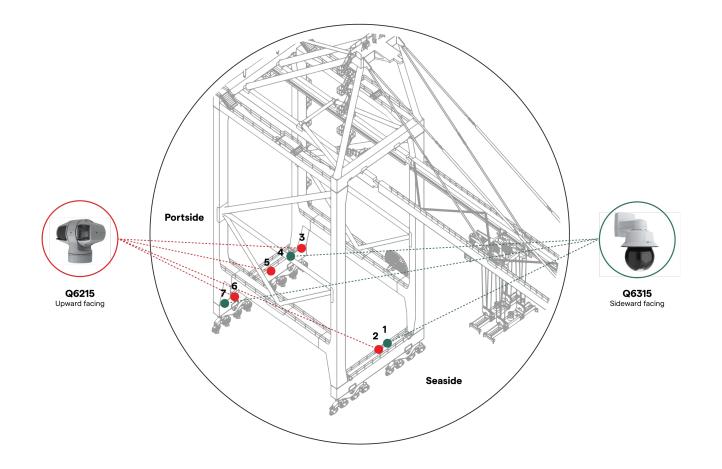
Server setup and connections at DP World headquarters.

Connectivity across port

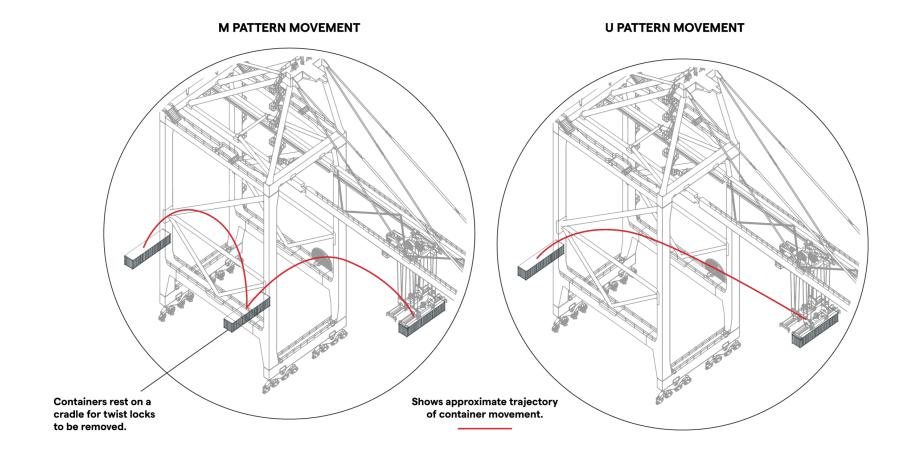
Combination of cables and light towers allows the system to transmit wirelessly.

System stability 48,000 containers scanned autonomously over 5 months.

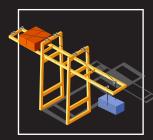
Cameras



Container Movements



BATDS Infrastructure



Challenges & solutions

Environmental conditions

Exposure and temperature changes had some effects on hardware.

Hardware upgrades

Updated housing for some equipment (routers) and improve cable installation.

Data storage and transfer

Reliance on wireless connections, available bandwidth, number of images.

Maintenance of system

Access to equipment in order to service cameras and hardware.

High-speed connection Approved telecommunications

provider, revised data retention policy.

SLA Agreements Resource and support from third party

service providers at the port.

BATDS Machine Learning



Achievements

Cont. improvement process

TIP Teacher technology using department feedback on detections.

Discerning between soils

Model improved to discern between BRM and non-BRM levels of soil.

Database of live images

Examples of detections on shipping containers.

Improved accuracy

More specific and targeted bounding boxes around detections.

Suppressing non-BRM

Discerning damage, paint, reflections, grease etc. from actual detections.

Comparative Results

119 detections from the department **15** 'True Positives' from BATDS (soil)

Better model recall





Object Detection - Model v.7

Better bounding box accuracy





Object Detection - Model v.7

Ignoring rust





Object Detection - Model v.7

Improved Underside detections



Object Detection - Model v.7

Detecting bird droppings







Object Detection - Model v.8

'True Positive' Examples

Detections identified by department and BATDS





'True Positive' Examples

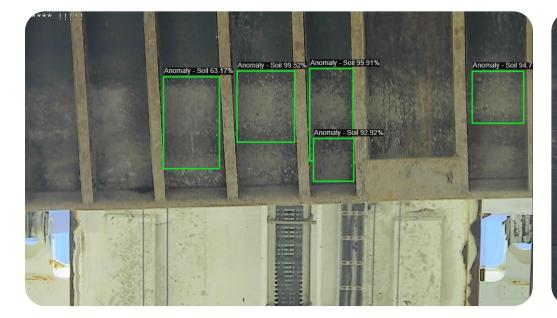
Detections identified by department and BATDS





'True Positive' Examples

Detections identified by department and BATDS





Container ID reading Examples

Examples



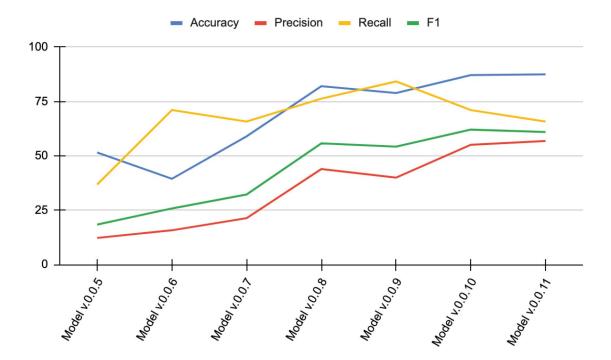


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Model improvements over time

Improving results against the testing data set



BATDS Machine Learning



AI Models

Object detection Anomaly – Level O Category Biosecurity risk material present?

Confidence Level = 57.8%

Object detection Type – Level 1 Category Soil, plant, pest, other-bio, non-bio

Scene text reading Container IDs Vertical and horizontal formats **Confidence Level = 62.8%** (for soil)

Accuracy Level = 86.2%

BATDS Machine Learning



Challenges & solutions

No initial data set

No available dataset of BRM on shipping containers to start training.

Build data set from scratch

Academic (species-level classification), Al-generated, in the field images.

Missed detections

Some objects of biosecurity concern were missed because of lack of data.

Defining BRM detections

To ensure only priority containers are flagged for further inspection.

More time, more examples The model will continue to improve and become accurate at detections.

Clear guidelines for alerts Over time more specific definitions will help to make the system more efficient.

BATDS Imaging



Achievements

Camera calibration

Capture images autonomously 24x7, across daytime & nighttime conditions.

Container Coverage

Cameras are programmed to pan across the surface, while stationary.

Control scripts

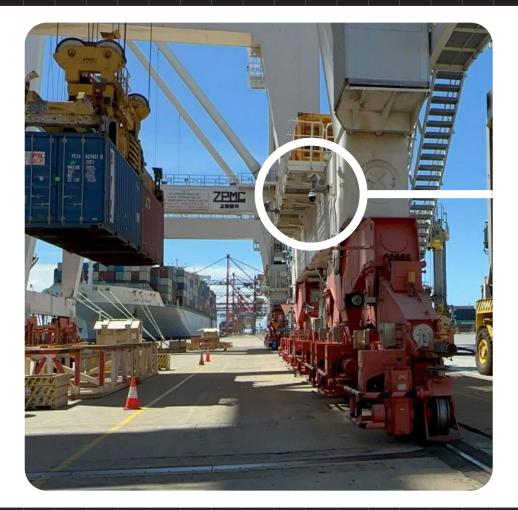
To move the cameras between both M and U patterns.

Real-time alert system

Development of a command center displays detections and alerts users.

Images per container M Pattern = 457 avg. (00:01:06 secs) U Pattern = 132 avg. (00:00:24 secs)

Cameras



Container coverage



Crane 6, Camera 1: Top



Crane 6, Camera 1: Top



Crane 6, Camera 2: Front

Crane 6, Camera 7: Right door



Crane 6, Camera 4: Back - close



Crane 6, Camera 2: Underside



Crane 6, Camera 4: Left door

BATDS Imaging



Challenges & solutions

Consistent image quality

Factors such as lighting and crane vibration could affect clarity.

Hardware upgrades

Additional cameras with faster imaging capability, positioning on the crane.

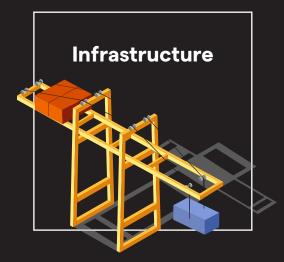


Location and size of objects

Zoom levels set to capture the whole containers, small objects hard to see.

2nd phase inspection stand Containers flagged for further inspection on the ground.

BATDS Development







BATDS Opportunities



Al Opportunities



Biosecurity Automated Threat Detection System (BATDS)

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Australian Governmen

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