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QinetiQ Proprietary

Cargo Screening Ferret Requirements Capture and Style Guide

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A presentation to: Cargo Screening Network

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1 The Cargo Ferret



What is the Cargo Ferret Project?

Desire to improve methods of contraband detection

Research Project: To develop a robot (the Cargo Ferret) that can move around inside cargo containers / lorries and search for contraband

“To develop a novel approach to cargo screening where we take the sensors to the contraband and provide confident and reliable detection.”

The programme of work is being funded by the Engineering and Physical Sciences Research Council (EPSRC)

Why are we doing it?

The dogs used during a search for contraband are very useful but have drawbacks.

- They cannot gain access to all places
- They fatigue
- They are usually only trained to detect 1 or 2 things
- There is an issue of trust and accuracy

The cargo ferret is intended to be a robotic piece of equipment that could perform a similar role to the current 'sniffer dog'. The robot will not have any of the current difficulties associated with using dogs.

- It will be able to move into small spaces - hovering/crawling
- It will not fatigue*
- A suite of sensors will allow it to detect various contraband

What are we doing?

At present, the robot is in the design stage

To inform design we need to determine:

- User needs
 - What tasks could it be used on
 - What should it detect
 - How does it need to move
- Human Factors Requirements
 - Interface design
 - Usability
- Environmental needs
 - What types of environment does the robot need to operate in
- Training needs



2 User Requirements



2 a

What we did



Locations and Activities

Site visits to UK Borders Agency (UKBA) 'Customs' sites.

- informal interviews;
- focus groups;
- observation of the task; and
- guided tours.



Focus Groups

Now

Define the current task: Task Analysis

Usage Scenarios: Describe typical and atypical days/examinations

Future

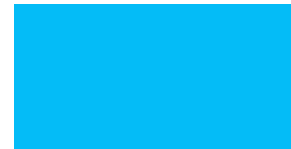
Idea generation for a *trustworthy* and *effective* robotic aid

Past

What makes it useful / not useful

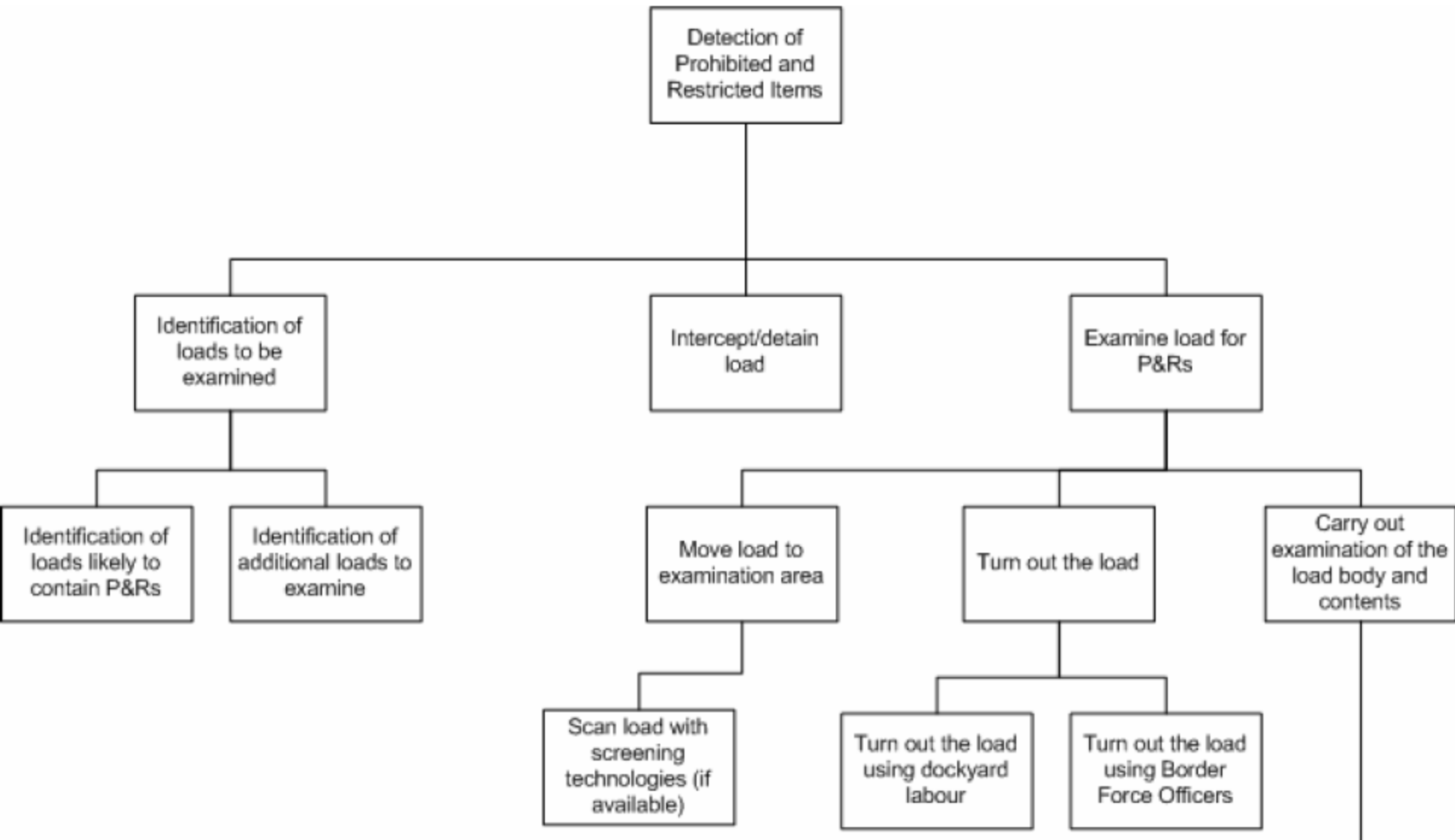
2 b

What we found



The UKBA (Customs) cargo screening process





Key Areas

Key areas where a tool/robot can bring benefit to the cargo screening process:

- improving the targeting process
- reducing the effort required — or the need — to turn out and inspect a load
- improving the chance of detection of the presence of Prohibited & Restricted items (P&Rs) during the examination of the consignment

Targeting Process

Any intervention by the system during the targeting process should be:

- non-invasive
- a very low (less than 1%) False Alarm rate, with a high degree of confidence for positive detections
- have a minimal impact on the time taken for loads to pass through the port

Turning a Load Out

In order to reduce the effort, or need, required to turn a load out the system must:

- navigate the potentially difficult terrain and small spaces within a load
- give a clear indication to the operators to what extent the load has been searched
- detect Prohibited & Restricted items and in particular class A drugs with a high degree of confidence for positive detections
- give a clear indication to the operator that a detection has occurred, and an identification and location of the substance
- save the BFOs time.

Consignment Examination

To improve detection performance system must:

- detect Prohibited and Restricted items, and in particular class A drugs, with a high degree of confidence for positive detections
- give a clear indication to the operator that a detection has occurred and an identification and location of the substance
- save the BFOs time

Completing an Examination

Examining a consignment is an iterative process

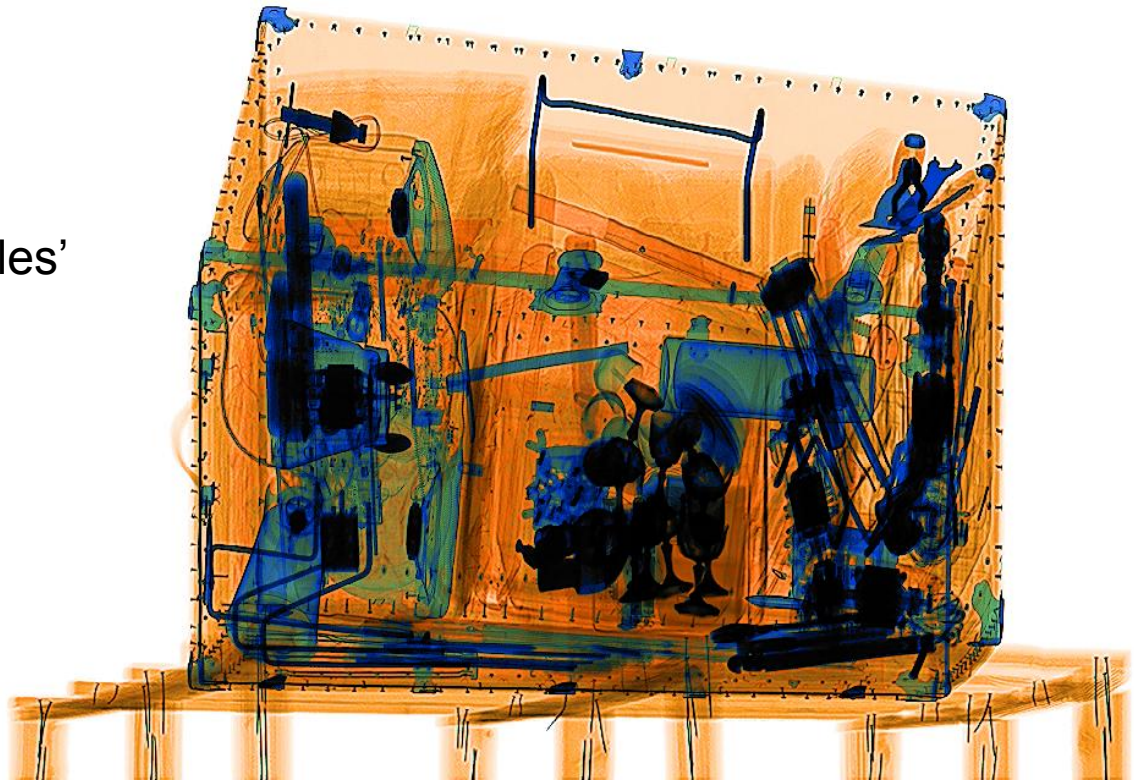
- Rarely has a defined end point
- Based on intelligence about the cargo, the consignment, and ‘gut feel’
- BFOs will continue an examination until they (or their supervisor) are satisfied that the item or load does not warrant further investigation. An examination can be assisted by sniffer dogs, or sensing technologies (and potentially the Ferret) but typically will not be complete until a ‘hands on’ search is conducted.

Tools



Tools

- Saws, drills, screwdrivers, etc
- 'Aviation' cargo X-ray scanners
- 'Lorry' X-ray scanners
- Trace Detectors
- Density probe
- Chemical detection 'ampules'
- Radiation detectors



Sample Requirements



Sample Requirements

R001 The system shall have a degree of autonomy such that it does not require constant direction to operate, this degree of autonomy should be lie within levels 5-7 of the Sheriden-Verplank scale.

R007/8 The system shall be easy and quick to decontaminate. It should take no more than (Mandatory 5 minutes, Desirable 1 minute) to decontaminate the system.

R040 For common maintenance tasks a step-by-step manual should be provided with sufficient detail to allow the users to maintain the system.

R061 The system should invoke feelings of attachment and be perceived in a positive light.

C009 The system shall be usable by the user population [described in the URD] even when they are wearing thick 'winter' gloves.

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“Human-Robot Ferret Interaction” Style Guide



The Interaction Style Guide

1. Interaction Design
2. Autonomy
3. Robot Behaviour
4. Control
5. Information Presentation
6. Anthropomorphism and Zoomorphism

Interaction Principles

- User Centric Design
- Give the Users Control
- Build in Forgiveness and Support
- Minimise Workload

Automation

Automation Level	Automation Description
1	The computer offers no assistance: human must take all decision and actions.
2	The computer offers a complete set of decision/action alternatives, or
3	narrows the selection down to a few, or
4	suggests one alternative, and
5	executes that suggestion if the human approves, or
6	allows the human a restricted time to veto before automatic execution, or
7	executes automatically, then necessarily informs humans, and
8	informs the human only if asked, or
9	informs the human only if it, the computer, decides to
10	The computer decides everything and acts autonomously, ignoring the human.

Levels of Automation of Decision and Action Selection (the Sheridan-Verplank scale)

Automation - Targeting

Automation Level	Automation Description
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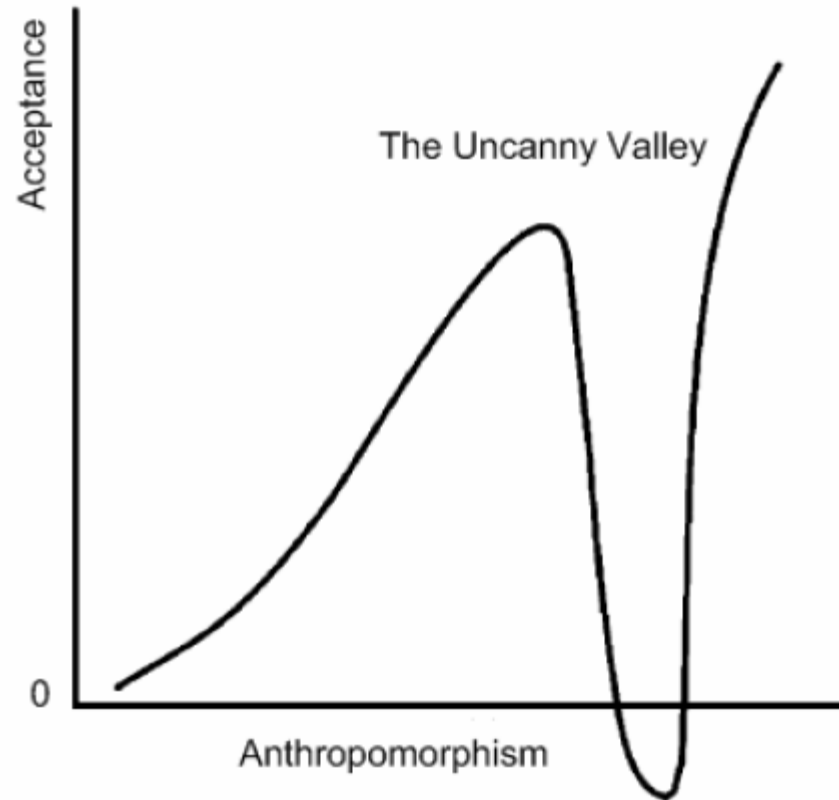
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Automation – Consignment Examination

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Levels of Automation of Decision and Action Selection (the Sheridan-Verplank scale)

Uncanny Valley



Summary

1. User Requirements Document

- Based on site visits
- Provides context
- Common and specific requirements

2. Interaction Style Guide

- Informs the design of the computer interface
- Informs the design of the 'interaction features' of the robot

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