LUKK Automation Solution Pte Ltd
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LUKK AUTOMATION – TECHNICAL ASSESSMENT

Role: AI Vision & Robotics Engineer
Submission Deadline: Within 4 days of receiving this email
Submission Format: PDF or Google Doc (include diagrams)

You don't need to write code, if you could **[Bonus]**, but your answer must show **clear engineering thinking, architecture, and understanding of vision + robotics systems**.

[include **diagrams**, **flowcharts**, and **schematics** wherever relevant. Hand-drawn diagrams are acceptable if neat and labelled.]

You may reference standard documentation and AI, but your answers must reflect your own engineering reasoning. AI-generated answers will be considered at your own risk, merit and demerit.

"ALL THE BEST"

PART A

Q1. Lukk Automation is developing a vision-guided inspection station for electronics assembled machine. The station must detect:

- Missing components
- Misaligned components
- Scratches, Cracked or Damaged
- Gas Leak

Check the frame grounding point is labelled correctly per XXXX-XXX-XX	

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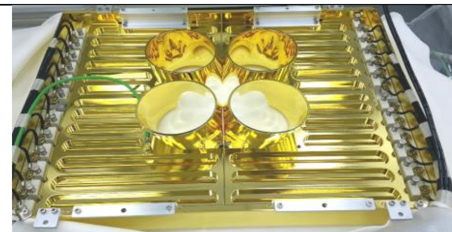
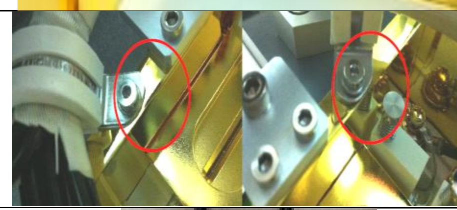
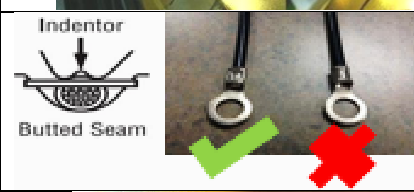
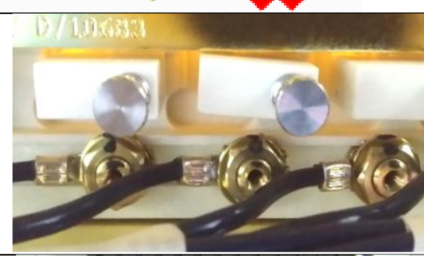
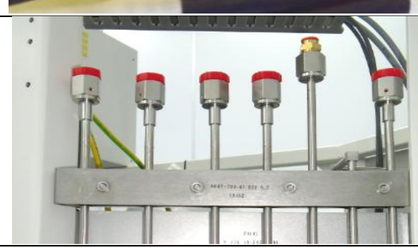
Verify the gold assembly is free from scratches, dents and damages.	
Verify the ceramic insulators are not cracked or damaged.	
Ensure the crimp is trimmed	
Ensure proper crimping/ stripping. The exposed wire must not more than 1mm.	
Ensure the nuts are tight	
Ensure that gas lines are not bent, not stressed and unconnected lines are protected by caps.	
Ensure no screw protrude out.	

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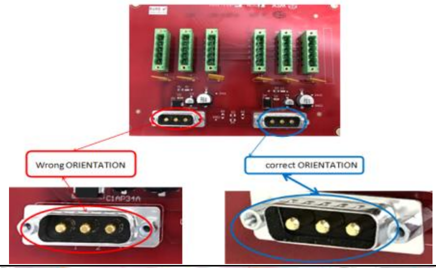
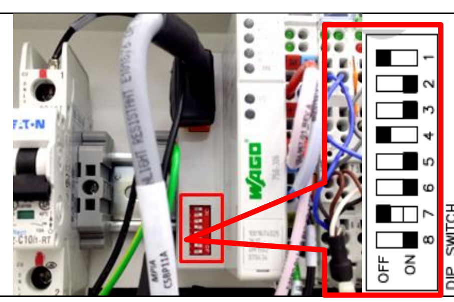
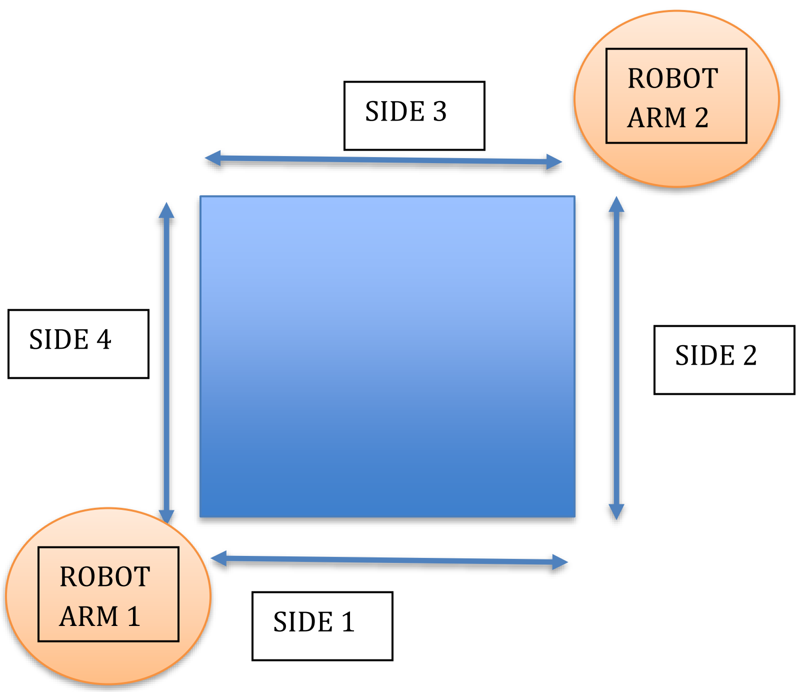
Verify the connector orientation of PCB XXXX-XXX-XX	
Verify the orientation of Valves.	
Ensure the FM-STEC are install according to the drawing and inspect using checklist	
Verify the orientation of 2 pcs Safety Relay are installed correctly.	
Verify the setting of the XXXX-XXX-XX is correct.	

Ensure all 24x SCR-INTREPID MODULE UPGRADE cables connection are per Schematic D096-8666.	

Q1A. Based on these visuals and QA checklist, how do you go about, what is feasible, what is not feasible and whereas what else would you require to make your vision analysis >80 % accurate? Explain your strategy and implementation.

Explain which of these defects CANNOT be reliably detected with vision alone and why.



Q1B. Based on this positioning of 2 Robot Arms and 6 DOF fixed workspace, how do you cover all the QA checklist? what cameras would you go for and placement of these cameras, do you require more than 1?

Describe how you'd design the vision setup:

- Camera type (2D / 3D / RGB-D / machine vision)
- Lens choice
- Lighting type (ring, dome, backlight, etc.)
- Approximate camera placement and angle

Q1C. Explain:

- Which model/framework you'd choose (YOLO / custom CNN / others) and why
- How you would build the dataset (collection, labelling, augmentation)
- How you would evaluate performance (metrics)
- How you would handle false positives / false negatives in production

Q1D. Explain how you would handle:

- Variable lighting and reflections
- Part-to-part variation
- Takt time (e.g., >= 20 FPS detection)

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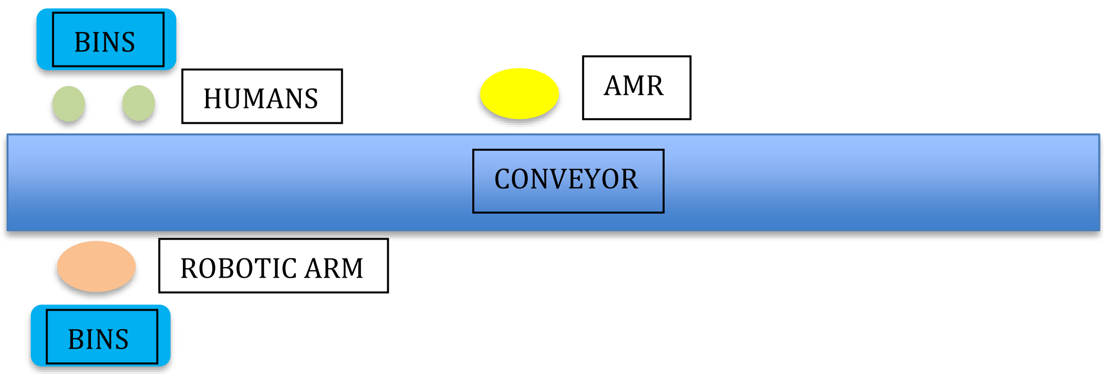
- Keeping calibration and accuracy stable over time

  and highlight what other constraints you might face and please provide explanation for them.

PART B



Q2. The inspection station will be integrated with:

- A robot arm that removes defective parts [Standalone] from conveyor
- Or an AMR that goes across the conveyor line looking for defects and sends information to employees to remove the defective parts. [Cobot]

  [NOTE: Include TF2 Tree otherwise Optional]

Q2A. Which would the customer prefer and why?

Q2B. Design a ROS2 architecture with:

- Camera node(s)
- Vision inference node
- Decision node (OK/NG + actions)

- Robot/AMR interface node
- Logging/DB node
- Optional UI node

Q2C. Assume a robot arm must pick a defective part and drop it in a reject bin.

Explain:

- What information the vision node needs to send (coordinates, class, confidence…)
- How you'd transform coordinates from camera frame → robot base frame
- What calibration steps are required (e.g., hand–eye calibration)
- How you'd handle failure cases (part moved, not found, occluded, etc.)

Q2D. Now assume defects are captured by an AMR.

Explain:

- How the AMR tells the user "Defect arrived"
- How the station reports "inspection in progress / complete"
- What ROS2 messages or actions you'd use for coordination
- How you'd prevent deadlocks or race conditions between AMR and station

PART C

You can choose any AMR or Robotic Arm or Humanoid

Q3. Recommend a compute platform:

- Jetson / IPC model
- RAM, storage
- Expected FPS / latency
- Network setup (LAN, WIFI, DDS configuration)

Justify your choices for a factory environment.

Q4. Explain how the system should behave if:

- The camera disconnects
- Lighting suddenly changes
- The AI model/inference node crashes
- Connection to robot/AMR is lost

What monitoring, retries, or fallback mechanisms would you implement?

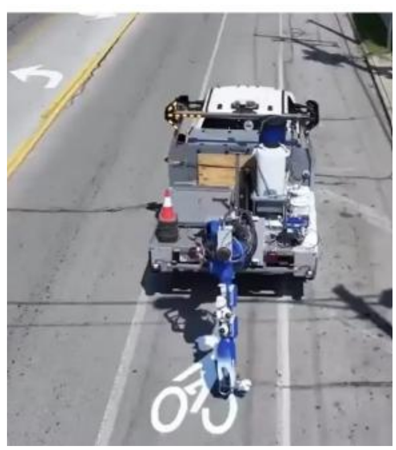
Q5. If the factory wants 5 identical inspection stations:

- How would you structure the ROS2 system?
- Would you use separate ROS domains/namespaces?
- How would you centralise logging/monitoring?

PART D

Q6. Lukk Automation is exploring a road marking robot: A robotic arm mounted on a slow-moving truck that paints lane markings and signs on the road. The system should:

- Follow a pre-planned marking path (e.g., lane lines, arrows, “STOP”)
- Use cameras and/or LiDAR to understand road position
- Compensate for truck motion (vibration, slight drift)
- Ensure safety around traffic and pedestrians



Q6A. Describe how you would:

- Use cameras and/or LiDAR to detect the road surface, lane boundaries, and reference points
- Localize the truck and robot arm relative to the road (e.g., world → truck → arm → tool frame)
- Handle GPS-denied or low-accuracy environments (e.g., urban canyons, under flyovers)

Q6B. Explain:

- How you would ensure the painted line or symbol is placed accurately on the road
- What vision feedback (e.g., downward-facing camera near the nozzle) you would use
- How you would adjust the robot arm trajectory in real time if the truck deviates slightly from the ideal path

Q6C. ROS2 & Motion Coordination on a Moving Platform

The truck is moving slowly (e.g., 0.5–2 km/h) while the arm paints.

Explain:

- How you would design the ROS2 graph so that:
    - Vehicle odometry
    - Robot arm motion

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  - Vision feedback
    are synchronised.

- What you would do if there is a delay in vision data or odometry noise.
- How you'd ensure smooth continuous painting without gaps or overlap.

Q6D. List key safety measures you would implement, such as:

- Emergency stop conditions
- When to pause painting (e.g., pedestrian detected, obstacle ahead)
- How to validate that what was painted matches the intended sign/line (e.g., post-paint camera verification)

This problem statement is confidential and must not be shared publicly, posted online, or used outside the interview process.

Please submit your Submission by using this filename:
LUKK_VAI&R_TechRound_[Your Name].pdf

Evaluation Criteria - Your work will be evaluated based on:

Category	**Weight**
Technical Understanding	40%
Depth of Explanation	25%
Practicality & Constraints	20%
Diagrams / Architecture	10%
Clarity & Structure	5%

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Important Notes [BEFORE YOU SUMBIT]

- There are no trick questions — we want to see your thinking process.
- Partial answers are better than vague or generic answers.
- You may assume any standard robot arm, such as UR5e / Jaka / Yaskawa / KUKA, unless specified.
- Use ROS2 naming conventions (/image_raw, /detected_objects, /tf, /cmd_vel, etc.).
- Use real engineering reasoning.

THANK YOU