



Local Detection, Collective Correction: Self-Healing Solution for Camera Sensor Network

RAGE workshop at CPSWeek 2026, Saint Malo, France

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11. May. 2026 | Shadi Attarha, Kanaga Shanmugi, **Anna Förster**



Motivation



Wolf protection fences in North of Germany

System Overview

Multi-camera
monitoring
system

Outdoor
deployment

Challenges

- Environmental factors such as dust, glare
- Misalignment due to the unintentional/intentional contact, vibration, etc.
- Damaged camera or reduced lens quality



A normal image



A blurred image



A rotated image



A blank image

Proposed Solution

Detection

On-device Detection of
Faulty Images
(Blur/Blank/Misaligned)

Correction

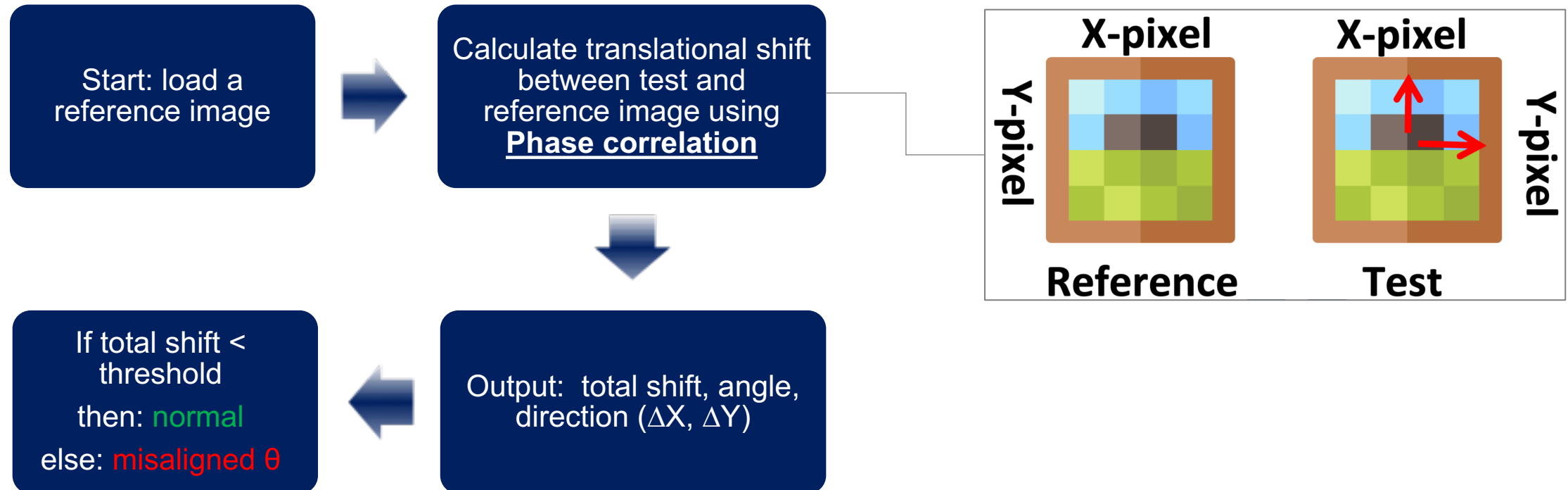
(1) Misaligned

Estimate rotation and
shift for realignment

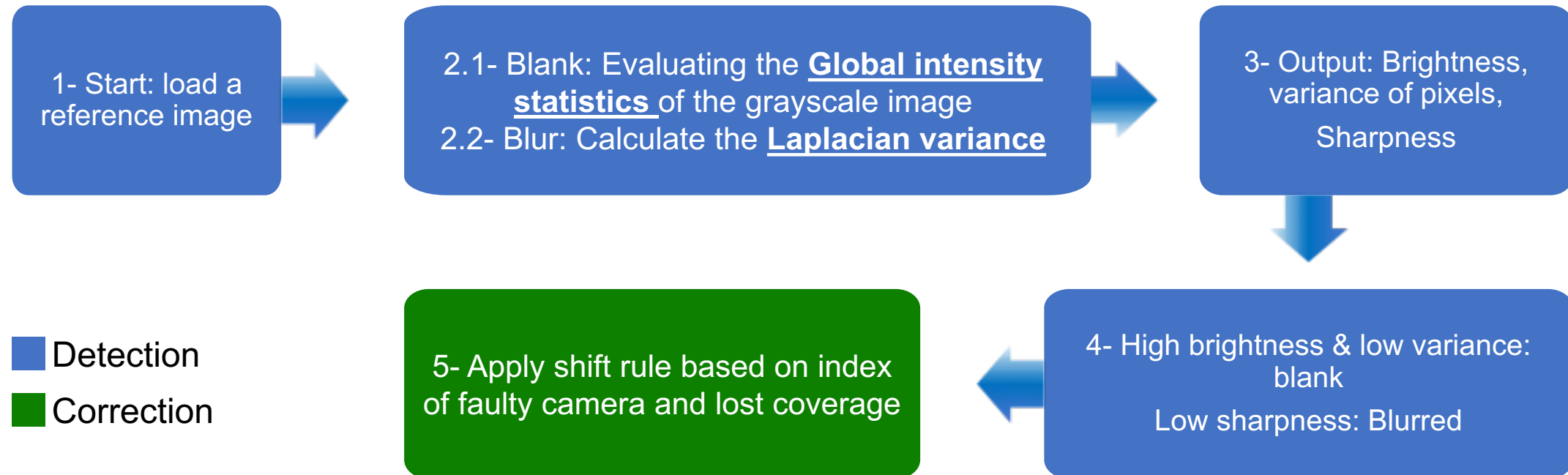
(2) Blurred/ Blank

Redistribute camera coverage to
maximize surveillance while
minimizing camera adjustments

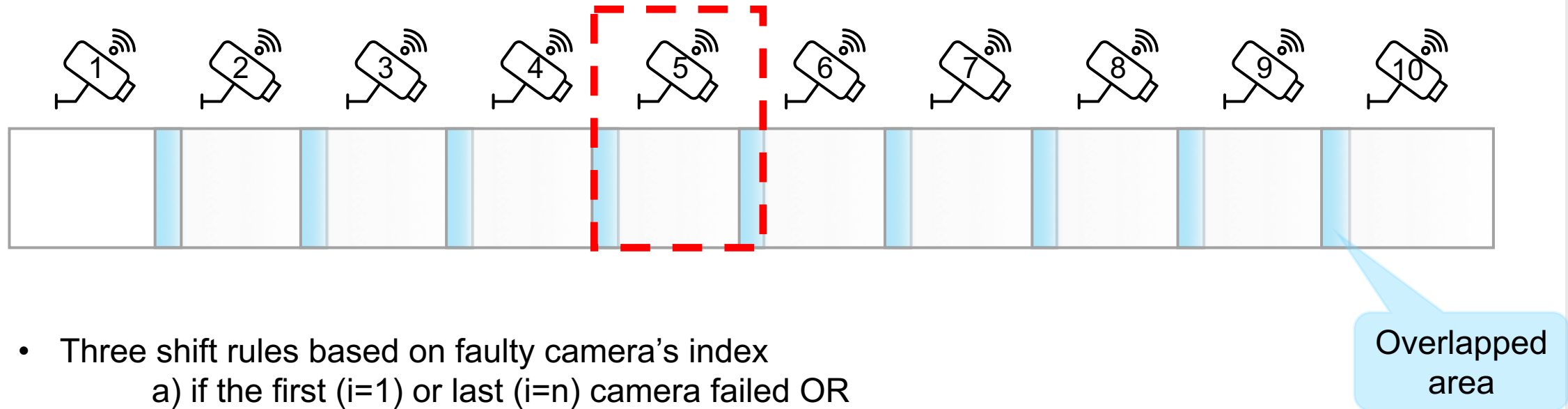
Workflow for Misalignment Detection



Workflow for Blur/Blank Detection and Correction

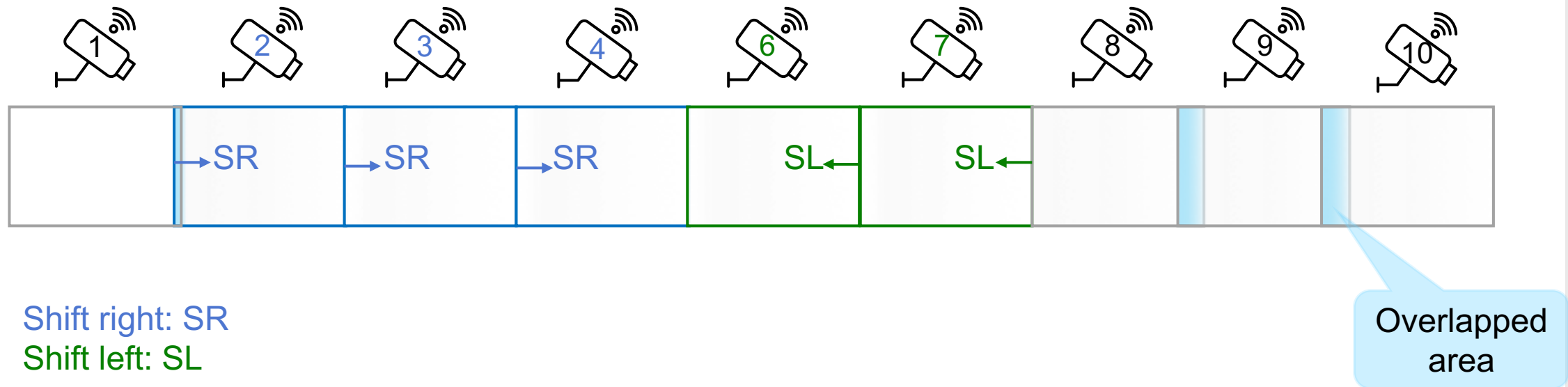


Adaptive coverage redistribution



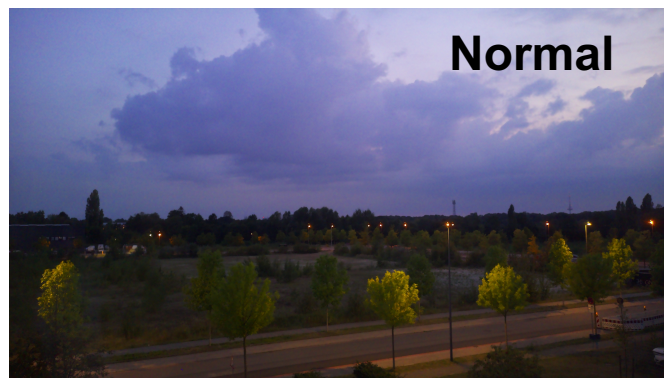
- Three shift rules based on faulty camera's index
 - a) if the first ($i=1$) or last ($i=n$) camera failed OR
 - b) if the second ($i=2$) or penultimate ($i=n-1$) failed OR
 - c) else $2 < i < n-1$

Adaptive coverage redistribution



Performance Evaluation: Dataset preparation

- Collect data from two different locations
- **First location**: north of Germany (Bremen), over period of 10 days, featured by environmental variability, including diverse diurnal cycles (time of day) and fluctuating weather conditions, single camera
- **Second dataset**: south of Germany (Munich), over period of 10 days, featured by environmental variability, including diverse diurnal cycles (time of day) and fluctuating weather conditions, multi cameras

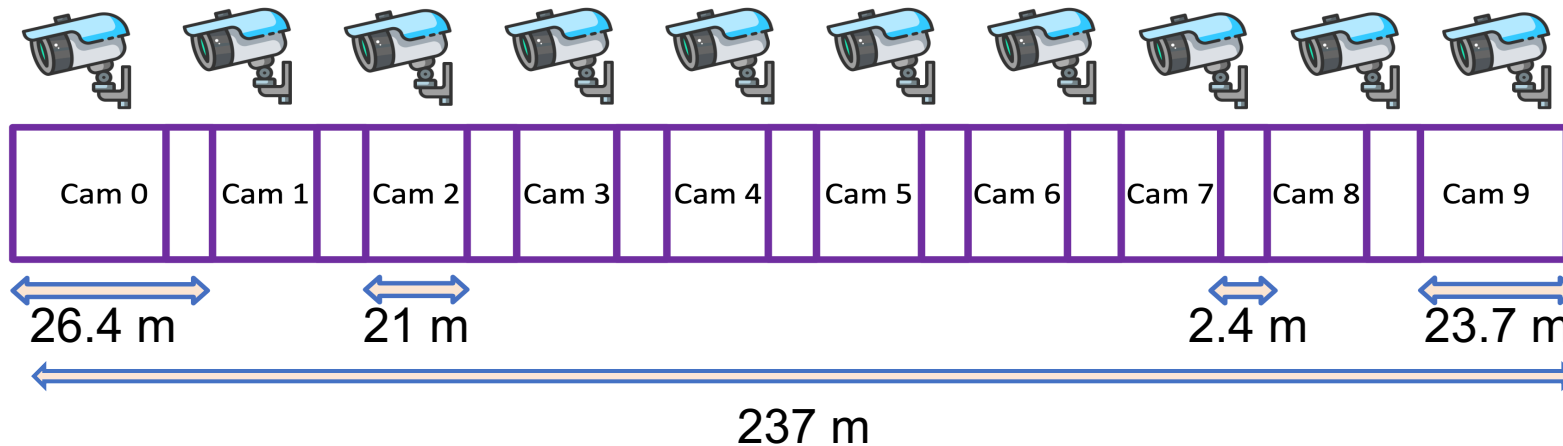


Performance evaluation for detection technique

Metrics	Proposed technique	ResNet	MobileNet
Accuracy	0.9711	0.9700	0.9767
Precision	0.9487	1	0.9545
F1-Score	0.9718	0.9776	0.9767
Recall	0.9961	0.9563	1
Number of training/reference Samples	1	1000	1000
Number of abnormal samples in training set	0	500	500
Size of the model	39 KB	318 MB	14.1 MB

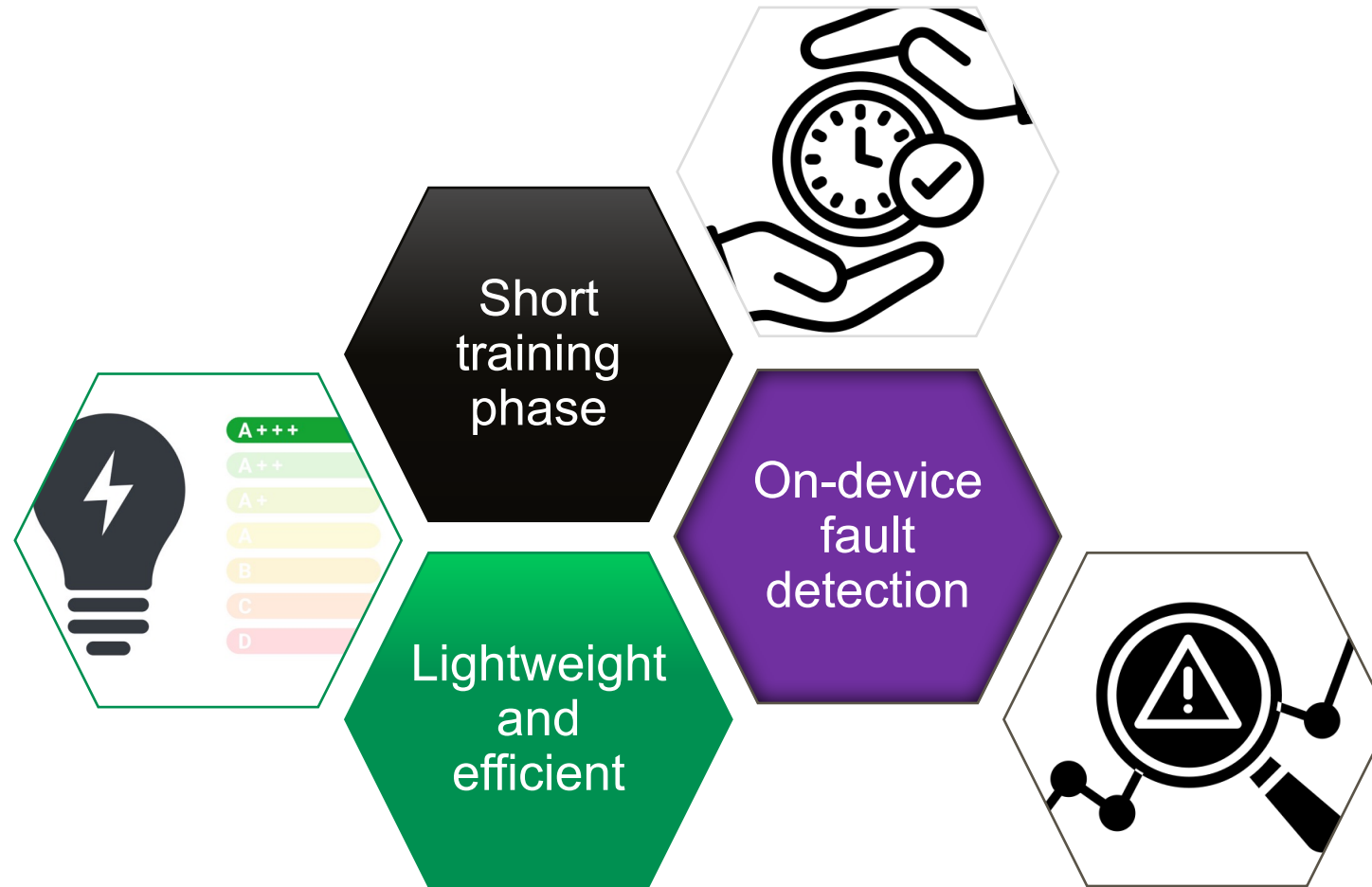
Performance evaluation for correction technique

Metrics	30% Overlap	20% Overlap	10% Overlap
Total cameras	13	12	10
Index of faulty camera	5	2	10
Lost coverage	0	0	11%
Number of shifted cameras	2, $i=4,6$	3, $i=3,4,5$	8, $i=2,3,4,5,6,7,8,9$



Example for 10 cameras

Proposed Solution



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Scan me!

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