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# Simple Real-Time Pattern Recognition for Industrial Automation

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GreyOrange India

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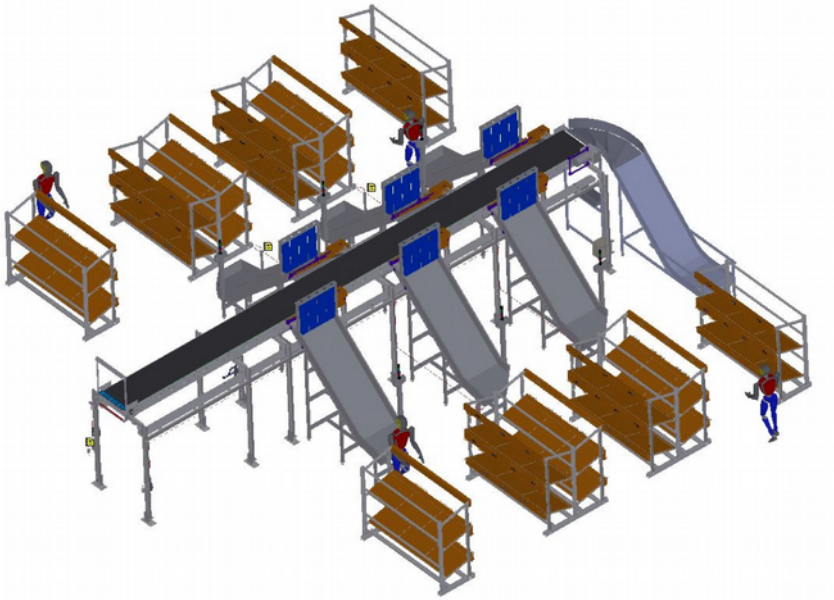
# Context

- Sortation of goods in automated warehouses
- Industry 4.0, multiple distributed nodes
- Sorting requires identification of objects on conveyor at each node





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# Aim of the Research

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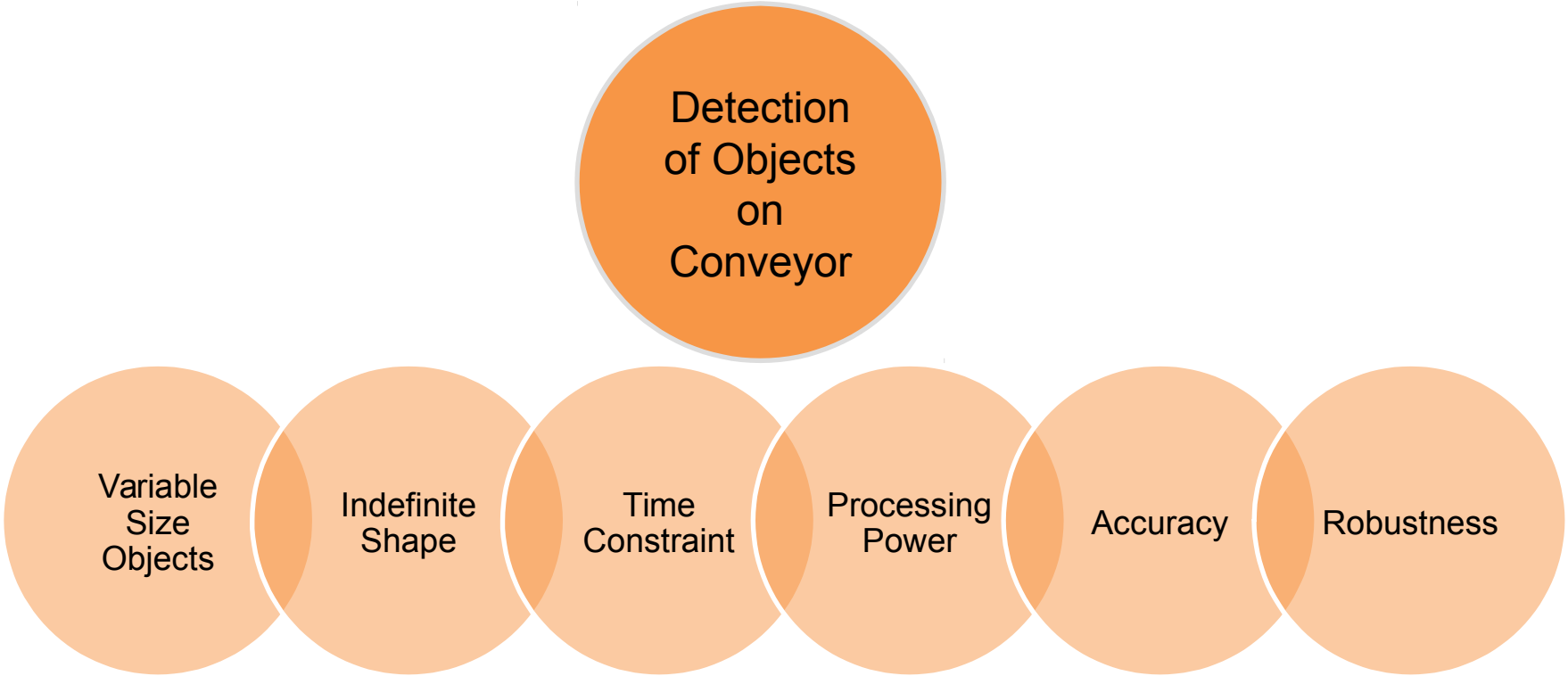




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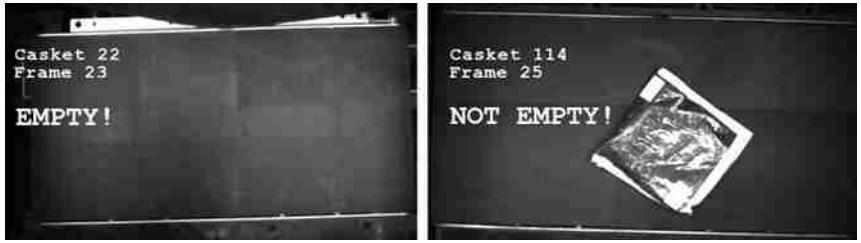
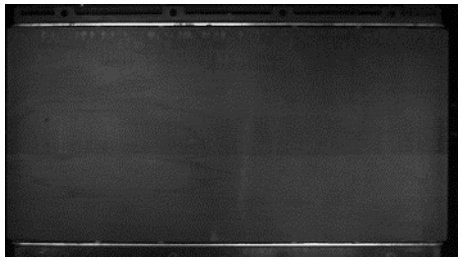
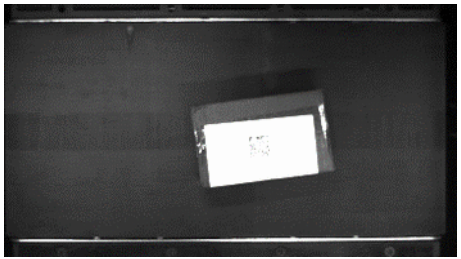
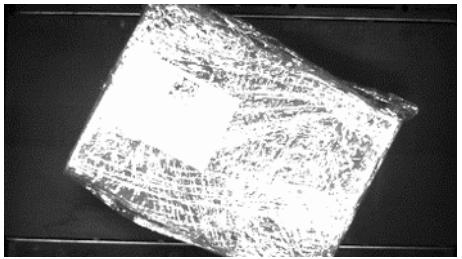
# Aim of the Research




## Example Cases









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# Approaches to Solve the Problem

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- Feature Detecators and Descriptors e.g. HOG, SIFT, Gabor coefficients
- Convolutional Neural Networks
- Depth Camera
- Sensor based approaches
- Boosting of Weak Classifiers

# Our Approach

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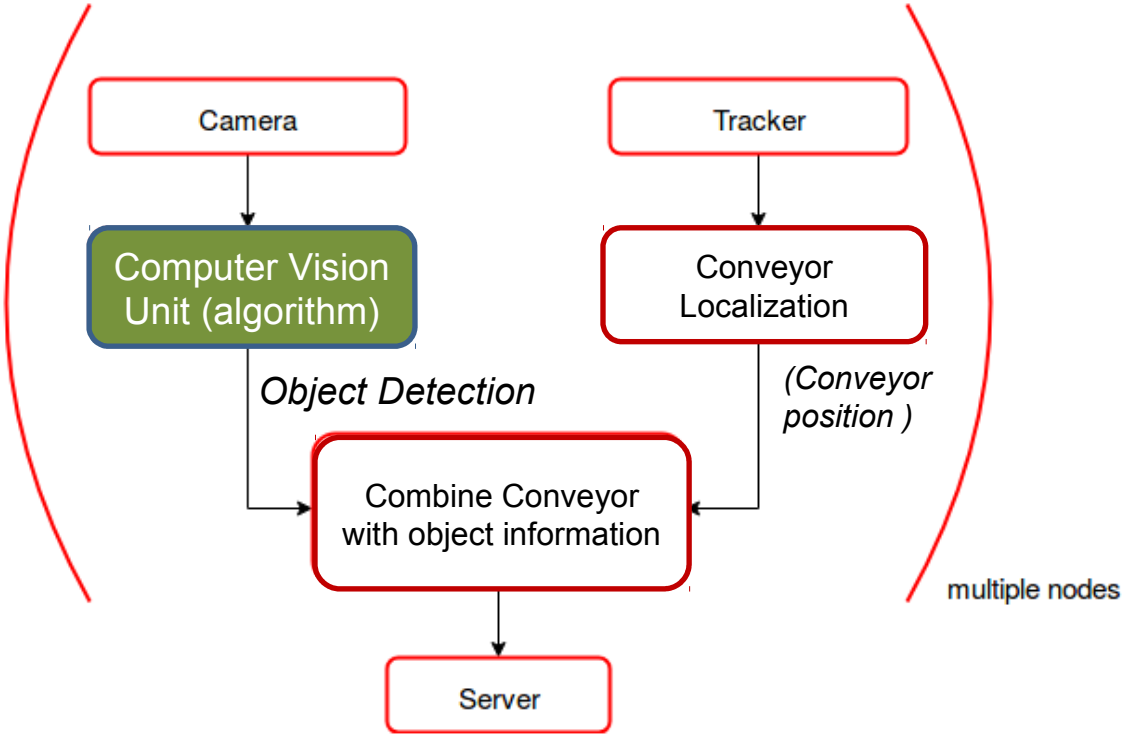




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# Camera Vision Unit – Our Setup

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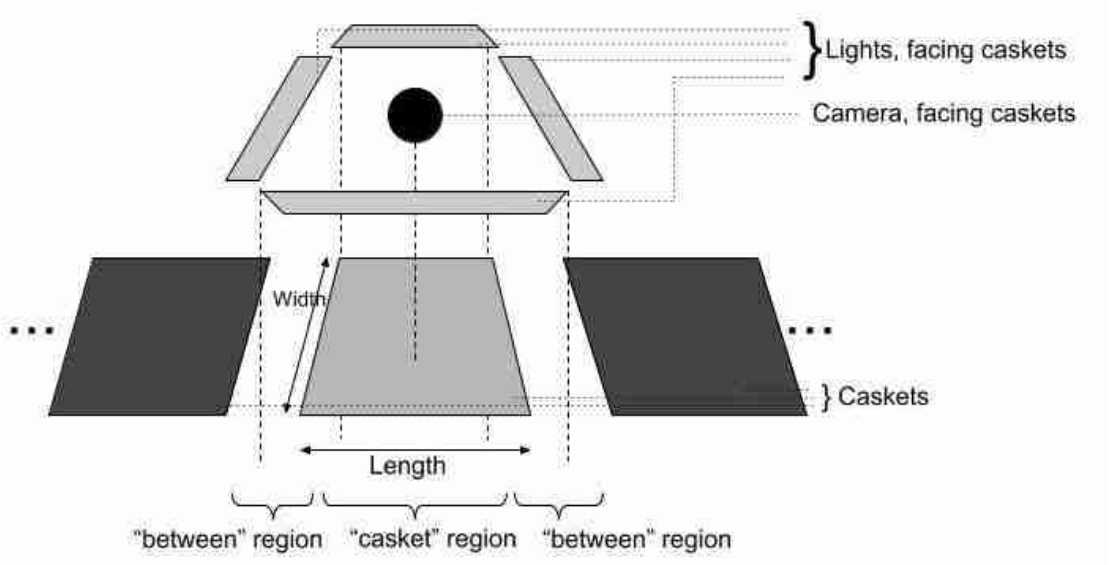
- Camera facing the caskets
- LED lights on the caskets
- Embedded module to compute presence/absence of packets on caskets
- Connection to server and other systems



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# Computer Vision Unit - Algorithm

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**Aim**: To decide whether a casket is empty or not (instead of detecting object)

Record images → Extract features → Compare with model → Aggregate decisions

- Record multiple images of each casket at high fps
- Extract simple features
- Compare features with model to decide if image is of empty casket
- Aggregate decisions on multiple images to ensure robustness



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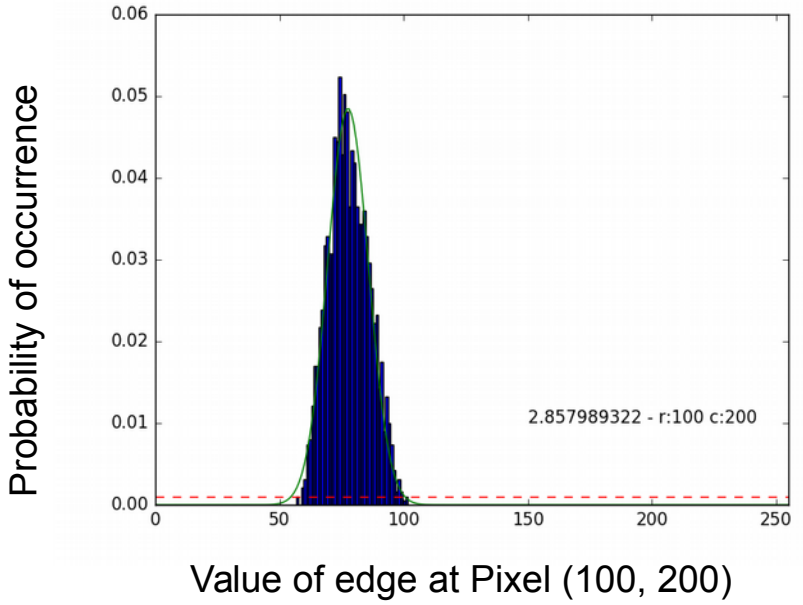
# Empty Casket Model

- **Observe**: Histogram of feature at each pixel across images follows a Gaussian distribution
- **Assume**: Empty Casket image is sampled from a Gaussian Process
- **Train**: Fit the parameters of Gaussian Process (mean, covariance) to empty casket images





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# Results

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| Approach | Mean Time (ms) | Maximum Time (ms) | Accuracy (%) |
|---|---|---|---|
| Entropy | 0.2 | 1 | 70 |
| Power | 0.2 | 1 | 64 |
| Global | 0.8 | 2 | 61 |
| Edges | 0.4 | 2 | ~100 |
| Blobs | 4 | 15 | ~100 |

# Computer Vision Unit – Problems Solved

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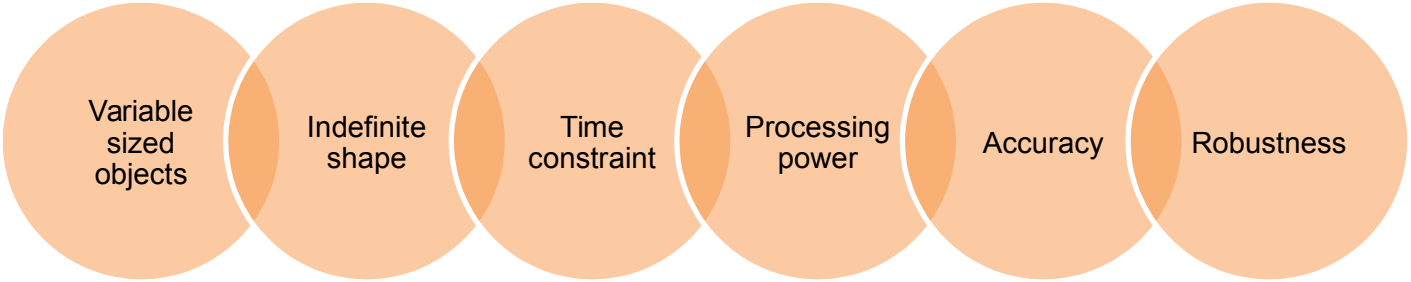


Detect empty casket (instead of object)

Record images at high fps

Extract simple features

Aggregate multiple decisions



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# Conclusion

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Real time

Robust to variation in packet

High accuracy



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# Future Scope

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- Making algorithm resistant to conveyor wear and tear
- Detecting very small size objects
- Incorporating depth information
- Using GPU for computational optimizations to incorporate complex algorithms

# Acknowledgements

## GreyOrange India Pvt. Ltd.

- Srijib Maiti
- Gaurav Kejriwal


# Questions?



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# Thank you



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