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Video Summarization for Object Tracking in the Internet of Things

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(no longer in use)

Motivation

Building systems to monitor, trace and track objects is one of the fundamental issues in logistics.

- Video Surveillance
- RFID or GPS

Discovering important features in huge video content.

- Video Summarization

Problem

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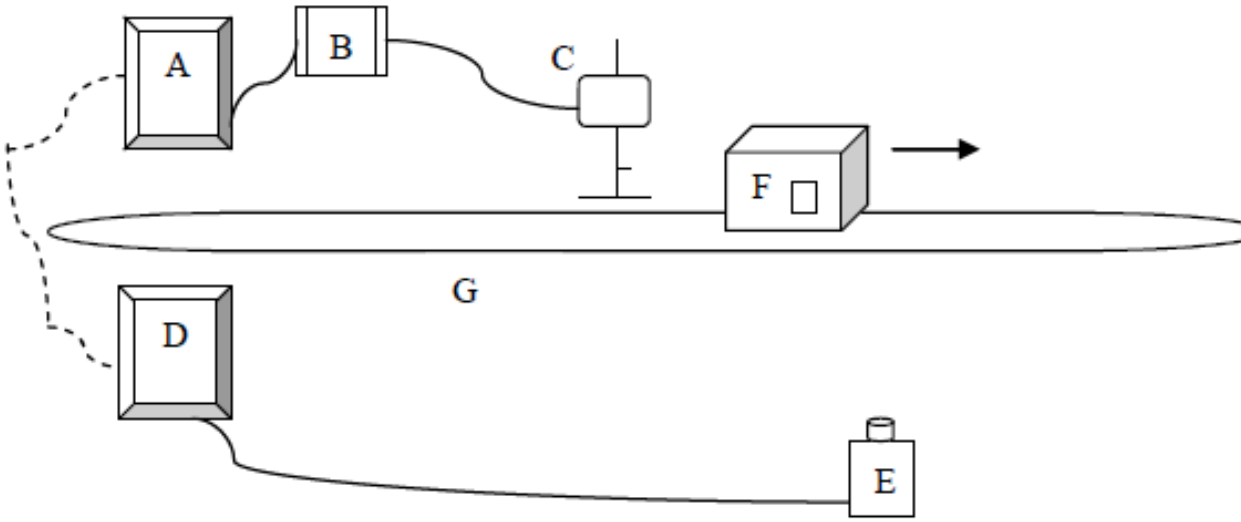
Since visual and RFID-based object tracking are used in IoT, is it possible to summarize the video on the item level?



- A, B & C: RFID-based object tracking system
- D & E: Video surveillance system
- G & F: Conveyor belt and object

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Introduction

- Internet of Things
  - Item-level Object Identification
  - Positioning
  - Environmental Monitoring Applications
  - ……

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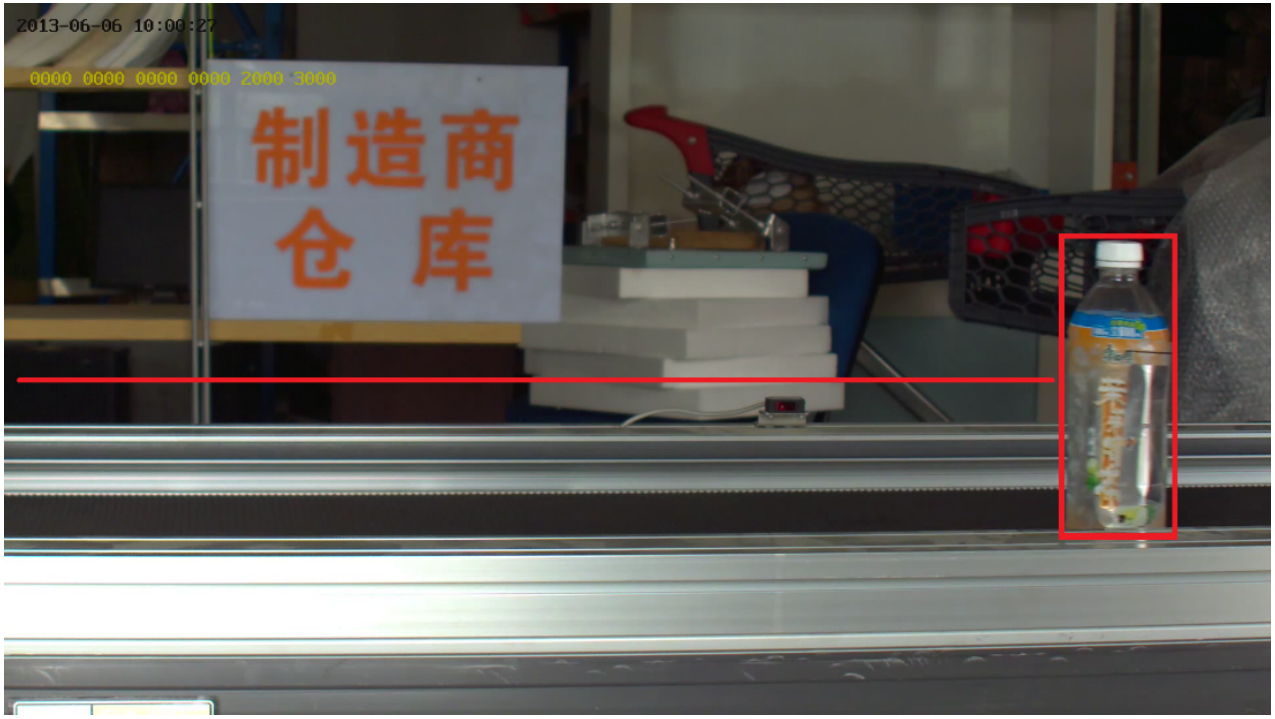
Introduction

- Video Object Tracking
  - Object and Motion Detection



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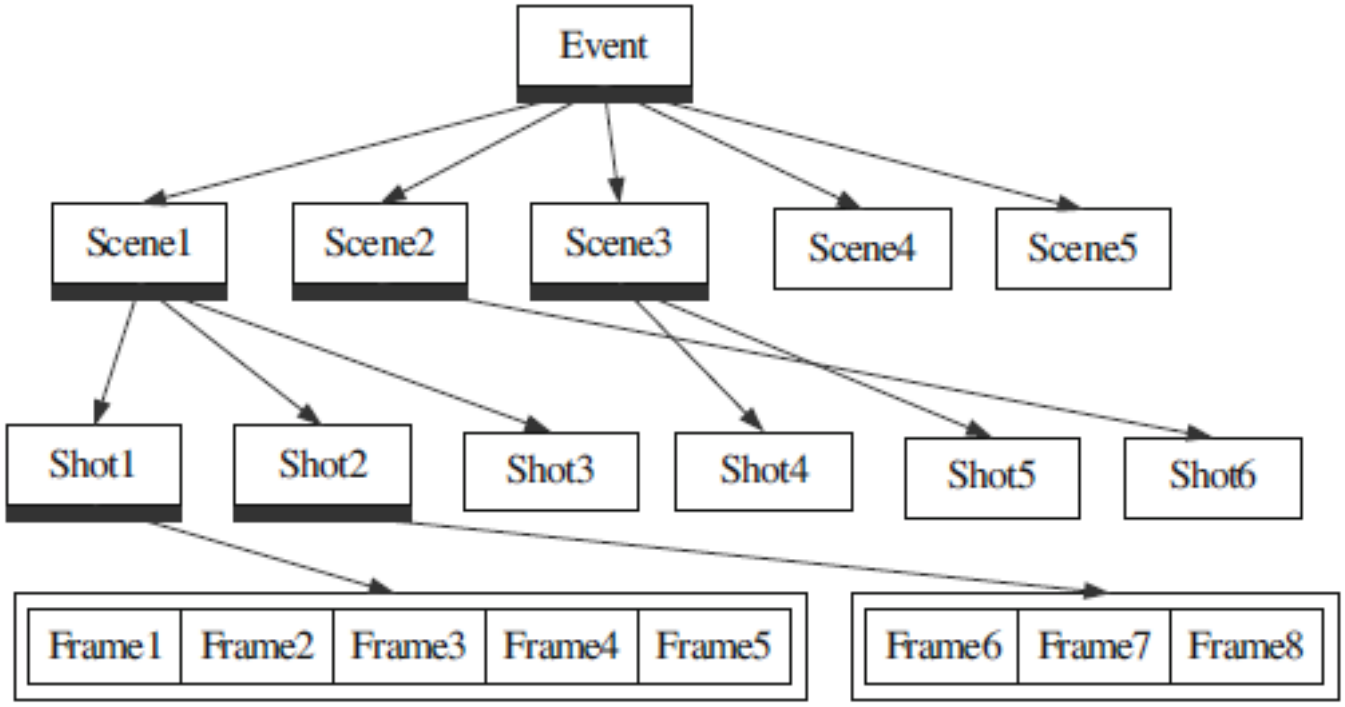
Introduction

- Video Summarization
  - extract an informative summary of video



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Video Summarization for Object Tracking in the Internet of Things

The methodology (algorithmically)

- 1. Build the background with adjacent frames containing no objects in the screen.
- 2. Extract foreground areas (and connected components) from every frame.
- 3. Find valuable foreground areas (objects in the screen) using a clustering algorithm (K-means).
- 4. Stitch segments of frames to create a compact image as the summarization result.

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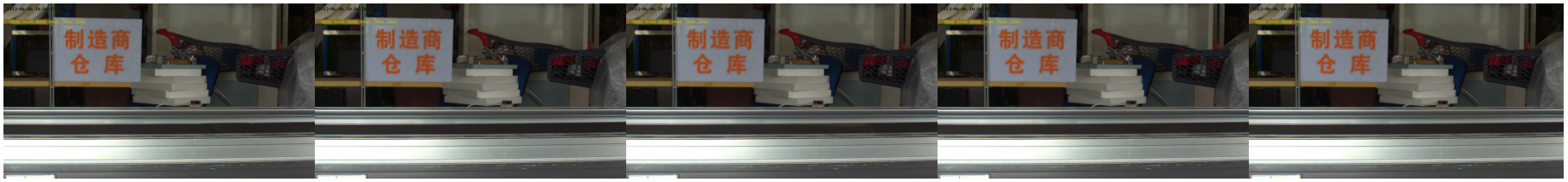
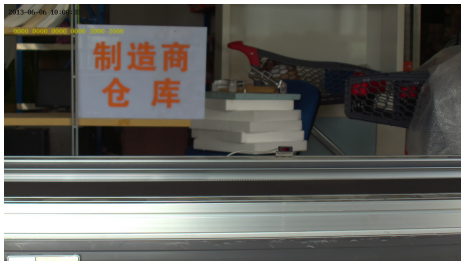
Step 1: Background Estimation

- 1. Pick a group of frames containing no objects in the screen. IoT can easily acquire the time when objects are absent.



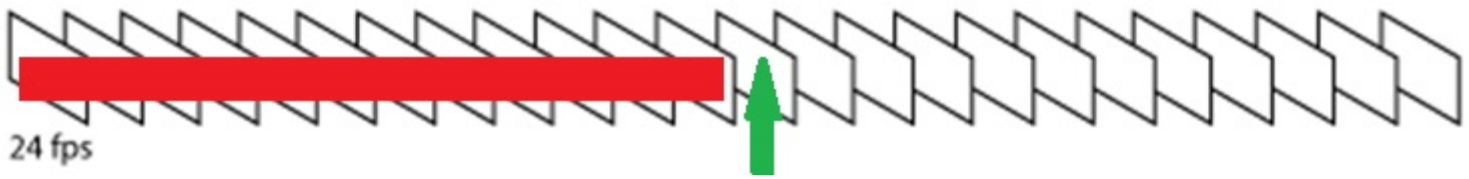
- 2. Build the background

$$P(X_t) = \sum_{i=1}^{K} \omega_{b_t,b_m} \times \eta(X_t, \mu_{b_t,b_m}, \Sigma_{b_t,b_m})$$

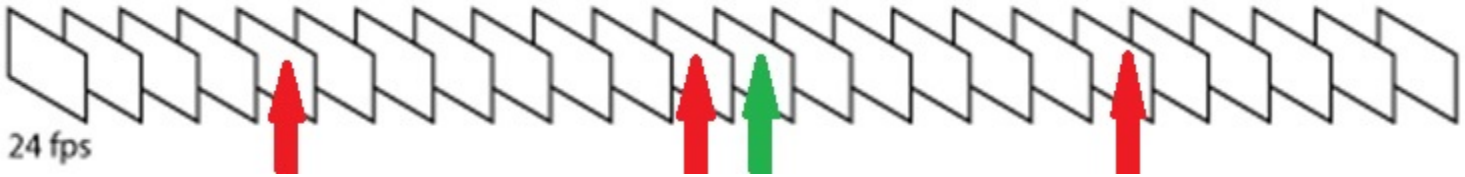


Inside Background Estimation

- The strategy to select frames is critical.
- Conventional GMM causes high computational cost due to the large number of selected frames.



- IoT can reduce this number.



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Step 2: Foreground Extraction

- 1. Given the background, foreground areas can be established with pixels which cannot fit in.
- 2. Find the biggest connected component.

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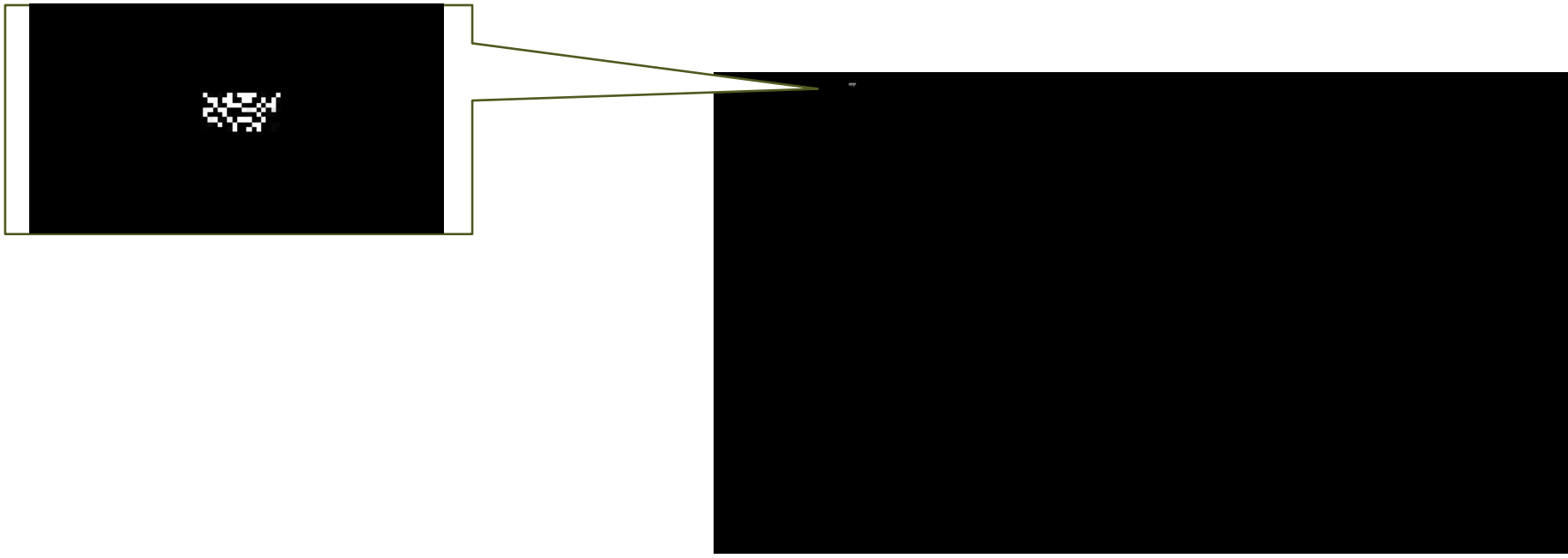
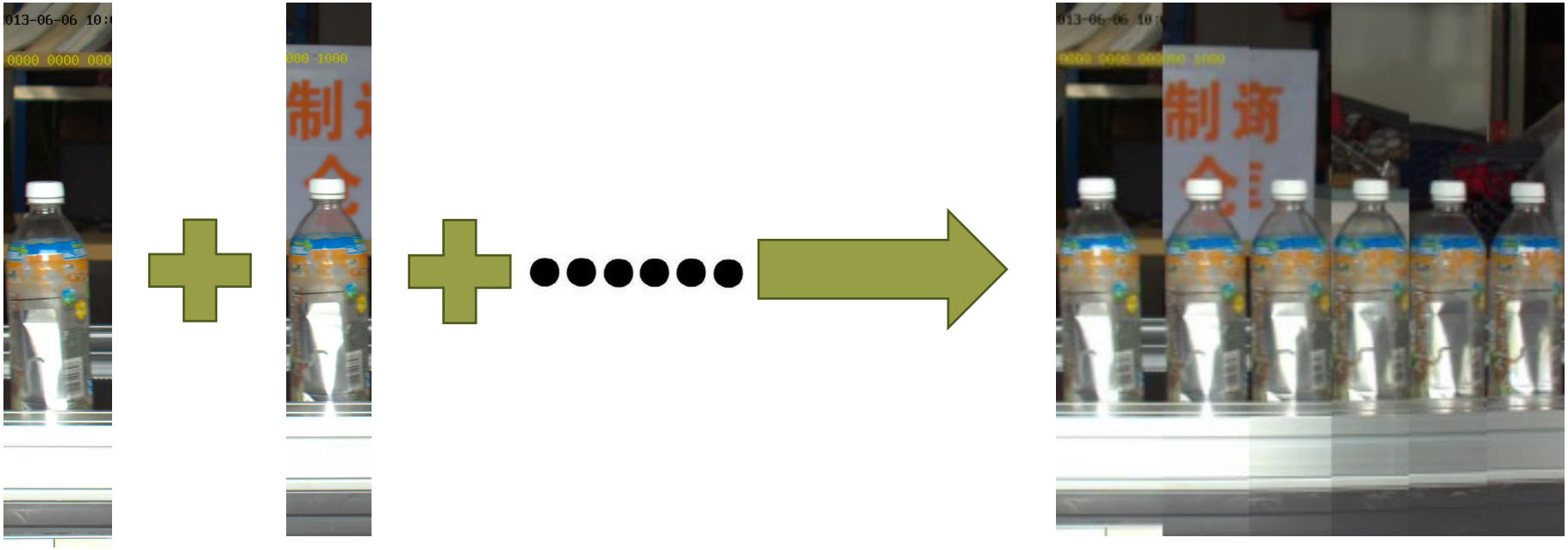
Step 3: Clustering Connected Components

- 1. It is necessary to keep important connected components (as well as to dump useless connected components). Hence, The K-means algorithm is used.

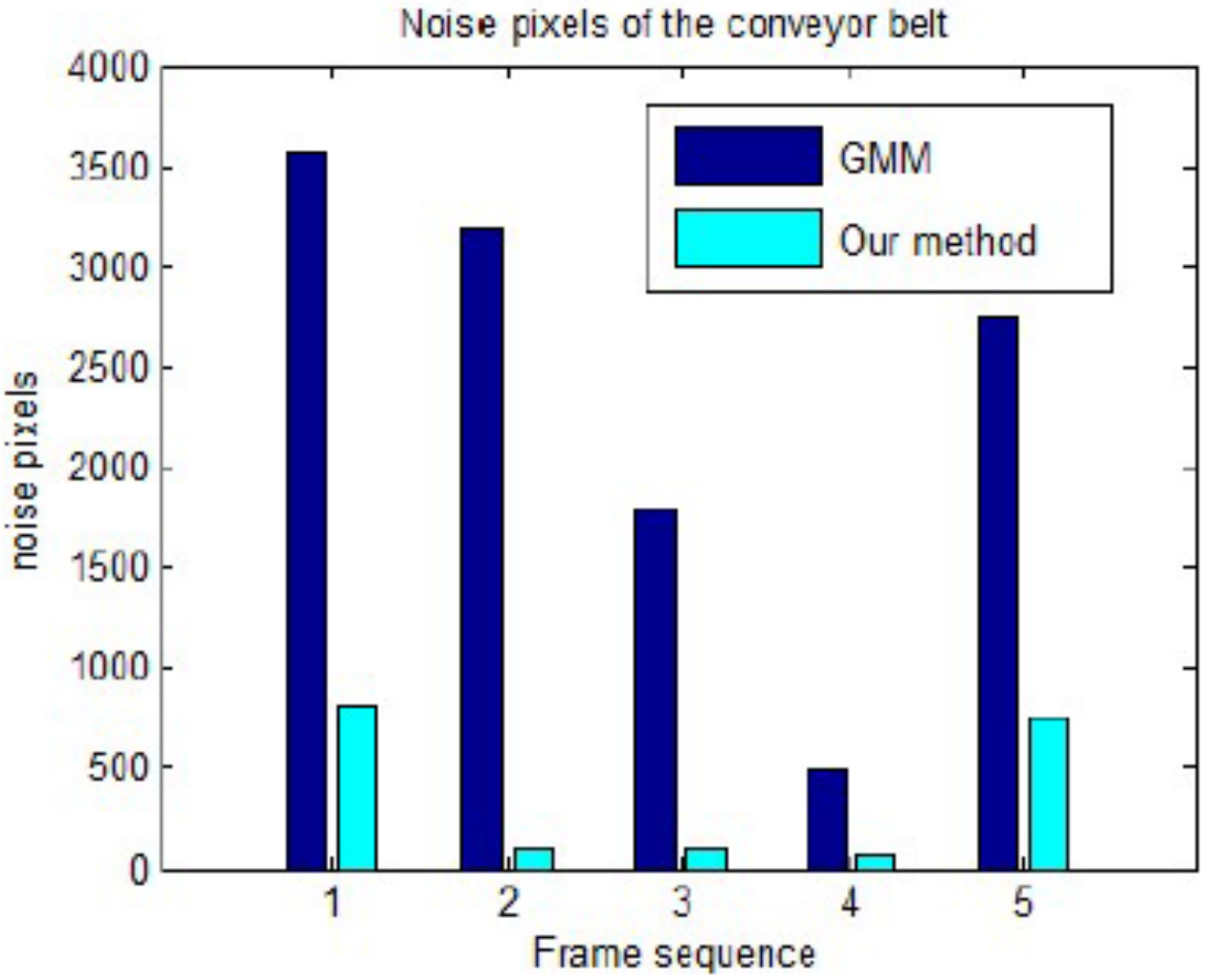


Step 4: Image Segments Stitching

- 1. When useful connected components are identified, the related parts of original frames can be extracted and stitched into a compact image as the summarization result.



Experimental Results



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Conclusion

1. In IoT, it is possible to summarize the video on the item level.

2. Furthermore, IoT can improve the video summarization algorithms.

- Lower computational cost
- Higher summarization quality

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Thank you!