GPUs making Video Analytics Real time

Malaysian Institute of Microelectronics System (MIMOS Berhad), Malaysia.

Motivation & Introduction:

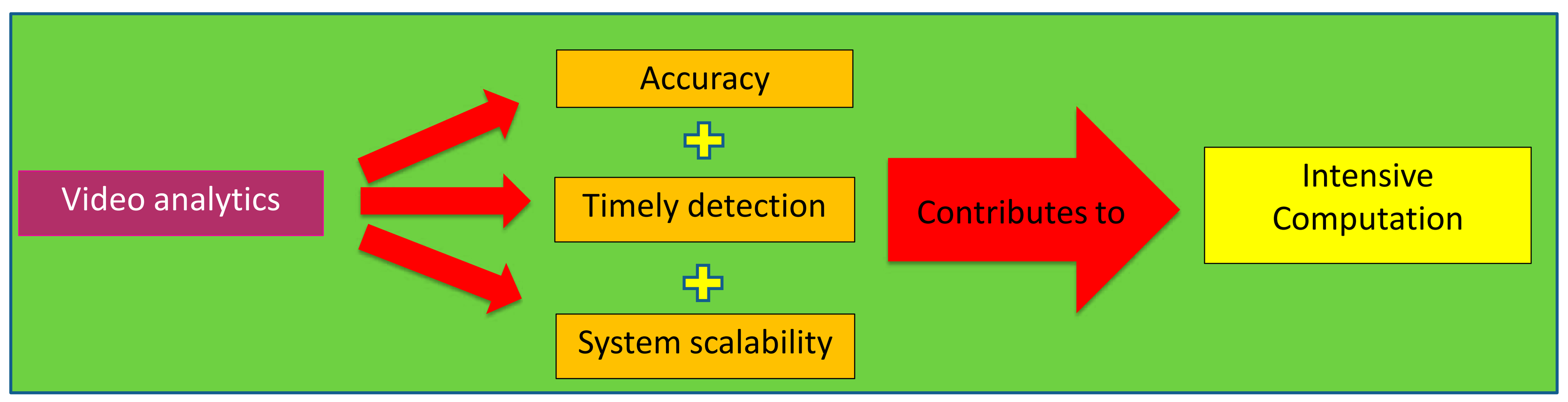
via

A common surveillance activity is to track important people, or people exhibiting suspicious behavior, as they move from one camera surveillance area to another.

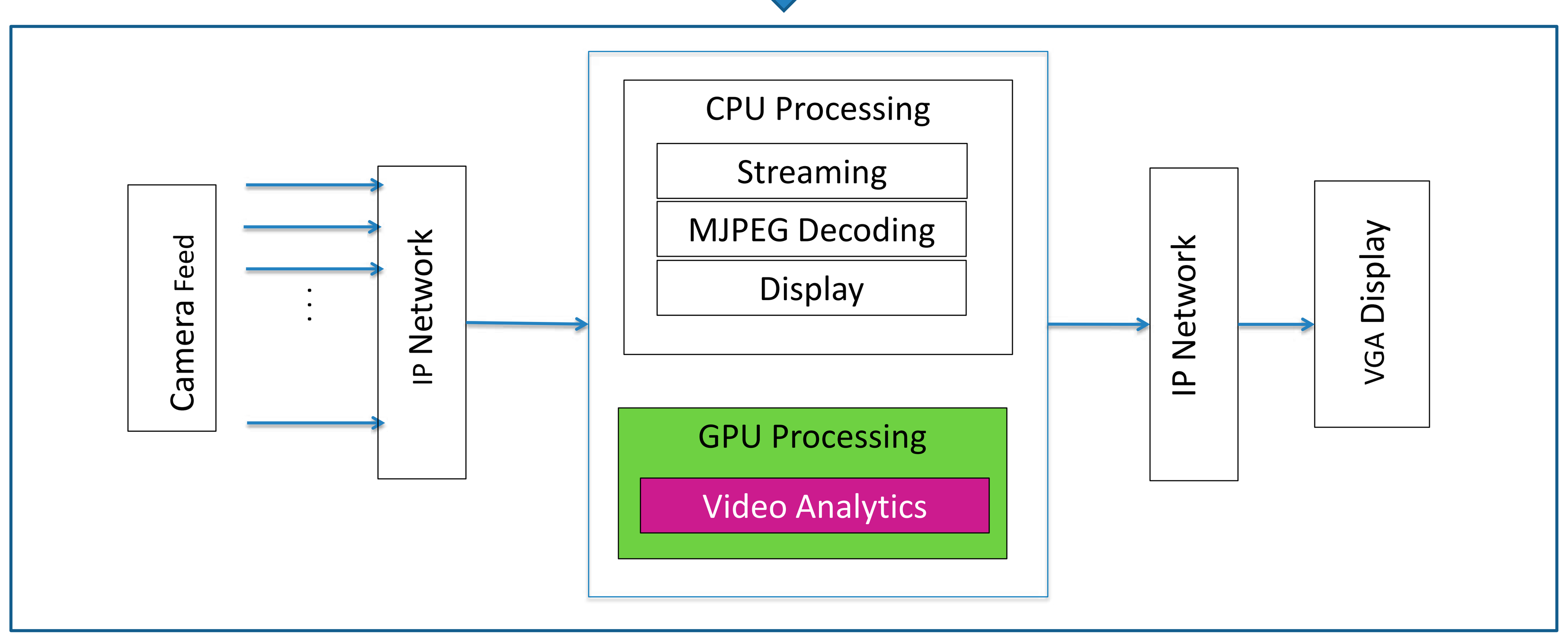
The reduction in video hardware cost has made it more feasible for large scale camera deployment. However, the increased scale of camera deployment creates difficulties for humans to track people through the monitored space and to recognize important events as they happen in timely manner without human intervention

What is Video Analytics & its challenges?

Video analytics is the practice of using computers to automatically identify things of interest without an operator having to view the video. Video analytics enhances video surveillance systems by performing the tasks of real-time event detection as well as post-event analysis. Though the analytics helps ease the operators, the system would have challenges namely timely detection and its detection accuracy. In order to increase accuracy, video analytics algorithm becomes more complex. In addition, with the increase in number of cameras per system, the complex analytics would take up more processing time. Thus, the system scalability and algorithm complexity contributes to its intensive computation which would require more resources in order to keep up its accuracy and timely detection. Therefore, this problem leads to offloading the video analytics to the GPGPU by parallelizing the video analytics modules.



Architecture



Developed Parallelized Video Analytics Components/Features

Parallelized Features	Description
Background Estimation	- Perform moving object detection by conducting background subtraction, shadow removal , background modelling and updating
Morphing Process	- Performing erosion and dilation morphological process on the image.
Connected Component Labeling	- Scan and group the image pixels based on pixel connectivity with its neighbourhood
Region Analyzer	- Compute the blobs properties and relationship between blobs in previous and current image
Filters	- Filter blobs if their properties are not within the specified range - Relabeling the remaining blobs within the object map
Intrusion Detection	- Mapping unfiltered blobs location to the ROI map for detection.

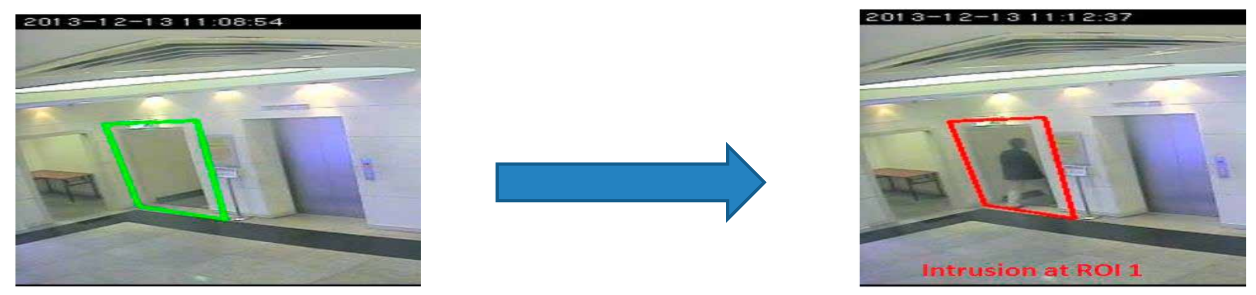
Experiment Setup:

ENVIRONMENT

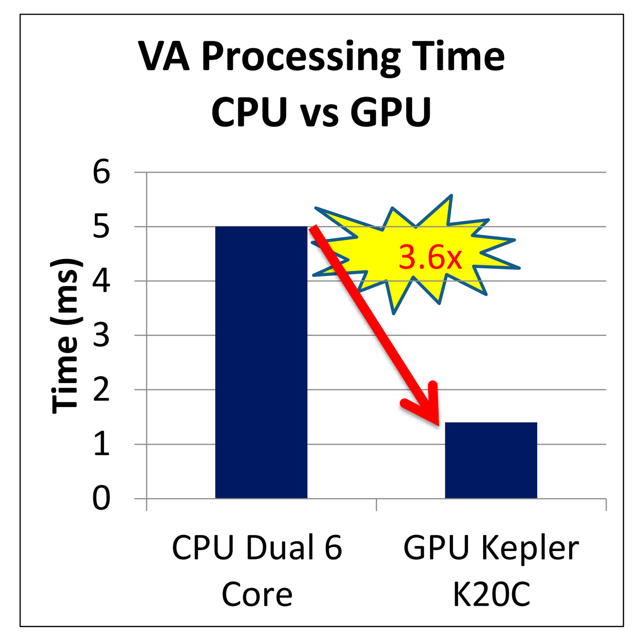
- Intel Xeon E2680 2.7GHz (Dual 8-core)
- 64 GB RAM
- NVIDIA TESLA K20c GPU
- Microsoft Windows 7 (64 Bits)
- **MiAccLib (MIMOS Accelerator Libraries)**

Experiment Results:

Intrusion Detection at real time (single camera)



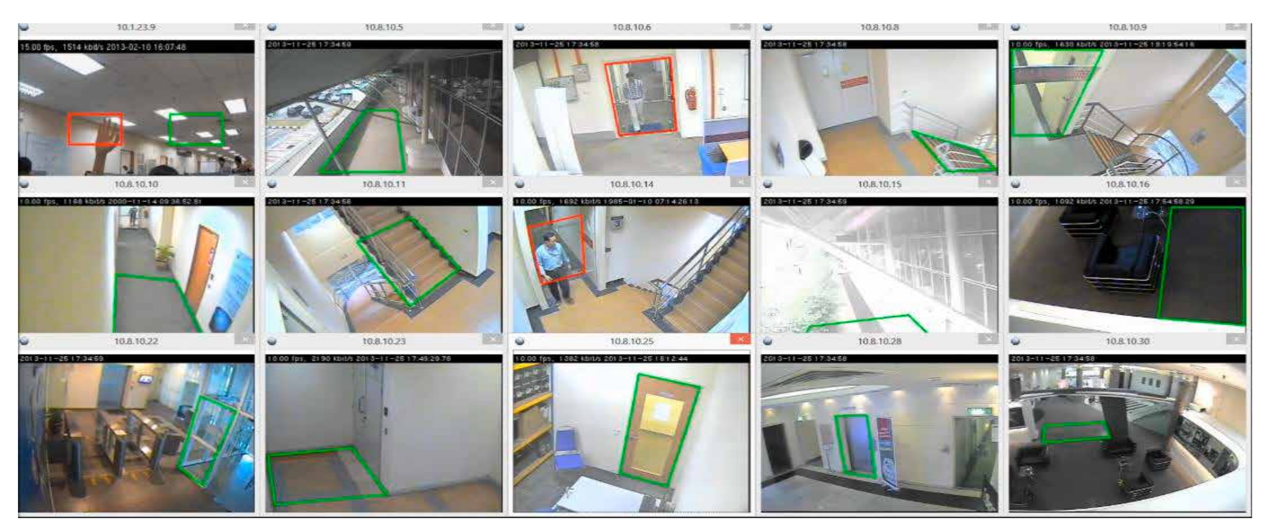
Tasks	CPU + GPU	* CPU % Usage
Network Stream In	CPU	10%
Decompress	CPU	5%
Video Analytics	GPU	35%
Streaming Out & Display	CPU	50%



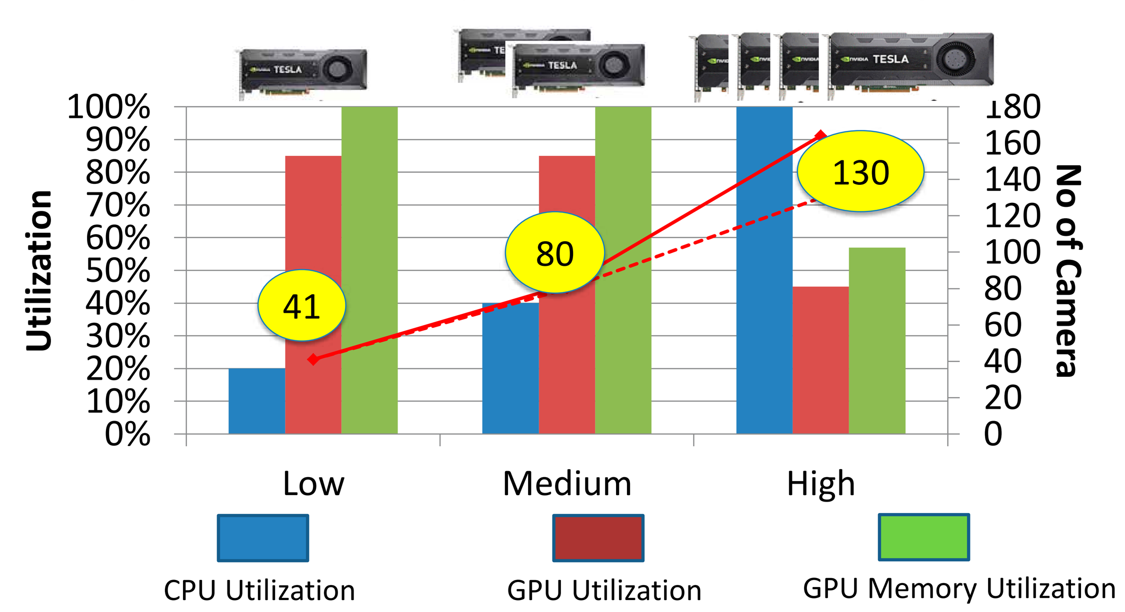
* Reference to 10fps

** Utilizing the GPU, the video analytics processing time **reduced by 3.6 times** as compared to its processing in CPU on 6 cores.

Intrusion Detection at real time (multiple camera)



System Scalability with Different Configuration



Based on the fixed frame rate of 15fps and Dual 8 core CPU, different system configurations indicating the scalability of the number of camera per system however, increment of GPU cards to scalability factor is **non-linear due CPU capability.

Benefits:

- Offloading tasks to GPU can save space & power consumption.
- This translates to **$$ savings** in terms of rental, infrastructure maintenance & utility bills.

Items	Setup Cost (USD)		Annual Maintenance (USD)	
	CPU 50 nodes	CPU + GPU 10 nodes	CPU 50 nodes	CPU + GPU 10 nodes
Space Rental	0	0	45,500	17,650
Infrastructure	83,500	63,500	5,000	4,500
Utilities	0	0	156,500	64,000
IT Equipment	233,500	260,000		
Total Cost	317,000	323,500	207,000	86,150
Savings		-6,500		120,850
% Savings		-2%		58%

Findings:

- Utilizing GPGPU **reduced processing speed** of the **parallelizable component video analytics** by **3.6 times.**
- Tested with **100% accuracy** based on offline data sets from 3 sites namely, TM, MIMOS & KLIA.
- **Allows scalability** in the number of cameras within a single system by increasing the number of GPU cards.
- By offloading the video processing to the GPU, it allows the CPU to have capability to pursue other tasks by the user and **save cost**, moving towards a **green environment.**

Future Work:

- **Algorithm optimization** by **parallelizing** the video analytics algorithm which can **improve** the analytics **processing speed**.
- **System optimization** by **minimizing** the **data transfer** and **optimal GPU memory utilization**.
- Development of **other video analytics functions** for surveillance, health care industry, etc.
- **Support for higher resolution video processing, multiple frame rates**.

CONTACT INFORMATION

Author : Shahirina Mohd Tahir
: Ong Peng Shen
: Lee Chin Yang
: Dr. Ettikan Kandasamy Karuppiah

Email : shahirina.mtahir@mimos.my
Company : Mimos Berhad
Website : gpu.mimos.my

MIMOS Innovation for Life

Acknowledgement:

This research was done under Joint Lab of "NVIDIA - HP - MIMOS GPU R&D and Compute Solution Center". This is the first GPU solution center in South East Asia established in October 2012. Funding for the work came from MOSTI, Malaysia. The authors would like to thank Prof. Simon See and Pradeep Gupta from NVIDIA for their support. The authors would also like to thank MIMOS Video Analytics team for the collaborative effort.