TK1-Based Solutions for Intelligent Video Analytic Applications

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Beijing Vion Technology Inc.
The Beijing Vion Technology, Inc. (BVT) was founded in 2005, specialized in computer vision technology. The company currently employs around 200 talented staff members.

The company has developed products in several vertical markets including intelligent transportation systems (ITS), smart video surveillance systems and business intelligence systems. These products are deployed broadly across China and BVT is recognized as one of the leading computer vision companies in China.

VionTech has evolved from a core CV algorithm development company to an IVS software vendor, then to a smart camera/device manufacturer, and recently into a complete system solutions provider.
Demonstration of BVT algorithms

- Demos (3 minutes)
HD TLVD system (smart camera)

System block diagram

- Traffic light recognition
- Vehicle state
- LPR detection
- Tracking
- Image compression
- I/O
- SD
- LAN
- H.264
- Strobe lights
- Storage
- NVR
HD TLVD system (smart camera)

LED strobe light

Camera casing (with polarizer)

6MP CCD Smart ITS camera
Bus lane violation detection system
Bus lane violation detection system
Bus lane violation detection system
Bus lane violation detection system
Highway checkpoint system

- LPR, vehicle brand and model (88%), vehicle color (93%), driver detection, not fastening seat-belt (80%)
People counting system

**DSP Box + Camera**
- High accuracy: ≥97%
- Stable: Linux based, watchdog
- Storage: data for 2 years, support resuming of data transfer
- Low power: 3W per channel
- Concealed camera: diameter less than 5 cm, patented design
- Other functions: real-time video, embedded Web service

**Smart Camera**
- World's smallest people counting camera
- Support POE
- Wide FOV lens with small distortion
- Easy installation
installation comparison

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- concealed camera + DSP
- smart camera (inline mount)
- smart camera (surface mount)
People counting system
Limits of the current IVA systems

- **Insufficient Computing Resources**
  - A 800MHz DSP, with 8-stage pipeline → 6.4 GOPS, with 1 adder and 1 multiplier, 1.6GFLOPS
  - A small ConvNet with 1M weights, require at least 2M FLOPS per evaluation. 100 evaluations per frame, 30 fps, requires $30 \times 100 \times 2M = 6G$ FLOPS
  - Big Gap!

- **High Power Consumption**
  - typical power consumptions of a DSP 5W
  - with prepherals, sensors, and power supply circuit efficiency, around 10W
  - Need to be supported by a 1.5 m² solar panel

- **High Cost**
  - $20–$40
**An Embedded Version of the TK1 Chip**

<table>
<thead>
<tr>
<th>Main elements</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CPU</td>
<td>“4+1” A15 @ 1.9 Ghz</td>
</tr>
<tr>
<td>GPU</td>
<td>192 GPU Cuda cores, 300 GFLOPS</td>
</tr>
<tr>
<td>Memory</td>
<td>2GB RAM, 8GB EMMC</td>
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<tr>
<td>Gstreamer framework</td>
<td>ubuntu-based, Video HW H.264 encoder and decoder &amp; RTSP media transmission</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>5W</td>
</tr>
<tr>
<td>Price</td>
<td>not so cheap</td>
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</tbody>
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TK1-Based IVA Box - VT-B2081A

- Applications: ATM service area protection, perimeter monitoring, gender and age recognition, people counting
- Main features
  - 8 analog video inputs
  - 2 RJ45 1000M ethernet ports
  - Audio: 1 in, 1 out
  - 1 2.5" hard drive
  - Alarm: 4 in, 2 out
  - 1 RS232 and 1 RS485
TK1-Based IVA Box - VT-B2081A
The 1st GPU-based smart camera that can reach 12MP @30 fps

Applications: Face recognition, gender and age recognition, people counting, LPR, fight and chasing detection, perimeter monitoring

Main features
- 12 MP CMOS sensor @ 30 fps
- FPGA+TK1 ISP pipeline
- Full resolution video analytics
- Sensors: gyroscope, accelerometer, digital compass
- GPS & Wifi/3G/4G supported
- Audio: 1 in, 1 out
- Storage: 2 SD cards
- Alarm: 2 in, 1 out, 1 RS232 and 1 RS485
A GPU-based smart camera - VT-E412
Future directions in GPU-based embedded IVA systems

• **Frontend systems (smart cameras)**
  - Sensor friendly
  - Strong and open ISP pipeline
  - 4K H.265 Codec
  - Lower power < 3w?

• **Backend systems (IVA boxes)**
  - H.265 1080P @120fps, decode+encoder solution, can be a chipset

• **Clusters**
THANK YOU

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