Stockpile Volume Calculation

Supplied by
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Fusion ERP

“any sufficiently advanced technology is indistinguishable from magic.” Arthur C. Clark
FRAME WORK OF PRESENTATION

- INTRODUCTION
- POWER POINT
- DEMOS:
  - Volumetric calculation of a stockpile
  - Inputs (rail trucks and trailers)
  - Outputs (conveyors & containers)
  - Other
- DISCUSSION / QUESTIONS
Digital System, record
Real time monitoring
Layout of stockpiles
PREDICT AND ALARM
Decreased costs, improved performance
Automatic systems, no human involvement
Digital System, record
CCTV / IP
Why do Image Analysis?

- Better Definition of Contrasting Areas
- Improved Precision/Accuracy in Measurements
- Reproducibility of Results
- Higher Throughput than Manual Methods
A Word About Our Eyes

- Eyes are very good contrast adjusters, but not good for distinguishing subtle variations in color.
- Eyes can discern about 30 continuous levels of gray or color in a field of view.
- Eyes are not good judges of distance.
- Eyes cannot accurately reproduce measurements.
Which is BIGGER / LONGER???
Configuration

Fusion ERP

Visual / Audio
SMS / E-Mail
Alarms
Electronic Imaging Fundamentals

Acquire
Process
Identify
Analyze
Report

Section view of stockpile 1 with adjusted base triangulation

Final triangulations with scan data

East Intercourse Island Site 2
Arguably, the most important aspect of all

- Proper setup of imaging apparatus is vital
- Obtain maximum contrast and dynamic range
- Reduce “noise” and other unwanted artifacts
Reporting Data

Primary stockpile at Tom Price

Triangulation of stockpile 2
Export to 3rd Party

- All data available via Fusion ERP
Neural networks

Operate in real time; utilised extensively worldwide. Based on neural networks, I-CUBE software delivers cutting-edge security and split-second processing times. The ability to automatically predict and identify those involved in wrongful unitisation of resources greatly empowers traditional systems.
Worldwide Installations

Over 1000 Sites

U.S.A. Mexico Colombia Brazil Spain U.K. Holland Hungary Litha Italy Israel China Hong Kong Korea Taiwan Thailand Singapore
Camera OPTIONS
• The traditional means of connecting cameras in machine vision (and other similar applications) is through a dedicated frame grabber/image acquisition board installed in a PC.
• Several computer industry based interfaces, such as Ethernet, USB and FireWire have been early candidates for serving as a digital serial camera interface.

• Shortcomings in transmission speed, transmission efficiency and standardization ruled these candidates out for many years, and the industry has continued to use frame grabber based solutions.
## Comparison of different interfaces

<table>
<thead>
<tr>
<th>Technology:</th>
<th>GigE Vision</th>
<th>IIDC IEEE 1394B</th>
<th>USB2</th>
<th>Camera Link</th>
<th>Analogue Coax or Twisted Pair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of standard:</td>
<td>Commercial</td>
<td>Consumer/Computer Network</td>
<td>Consumer/Office</td>
<td>Commercial</td>
<td>Commercial/Broadcast</td>
</tr>
<tr>
<td>Connection Type:</td>
<td>Point to point or LAN link (Cat 5 TP - RJ45)</td>
<td>Peer to peer – shared bus</td>
<td>Master/slave – shared bus</td>
<td>Point to point – link (MDR 26 pin)</td>
<td>Point to point/multiplexed</td>
</tr>
<tr>
<td>Performance:</td>
<td>&lt;1000Mb/s continuous mode, equivalent to 100 Mbytes/sec</td>
<td>&lt;800Mb/s continuous mode, equivalent to 65 Mbytes/sec</td>
<td>&lt;480Mb/s USB2 burst mode</td>
<td>&lt;2380Mb/s (base) &lt;7140Mb/s (full) continuous mode</td>
<td>Depends on digitization in Frame Grabber</td>
</tr>
<tr>
<td>CPU Load</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Distance:</td>
<td>&lt;100m (no switch)</td>
<td>&lt;4.5m</td>
<td>&lt;5m</td>
<td>&lt;10m</td>
<td>100’s of meters</td>
</tr>
<tr>
<td>-max w/switch</td>
<td>No Limit</td>
<td>72m</td>
<td>30m</td>
<td>Repeater is possible 100’s of meters</td>
<td></td>
</tr>
<tr>
<td>-max w/fiber</td>
<td>No Limit</td>
<td>200m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max number of devices:</td>
<td>Unlimited</td>
<td>63</td>
<td>127</td>
<td>1</td>
<td>Depends on MUX</td>
</tr>
<tr>
<td>PC Interface</td>
<td>GigE NIC (on mother board)</td>
<td>PCI card</td>
<td>On mother board</td>
<td>PCI Frame grabber</td>
<td>PCI Frame grabber</td>
</tr>
</tbody>
</table>
Adapting Gigabit Ethernet for Vision

- Gigabit Ethernet in itself provides 10 times higher bandwidth than 100 BaseT ethernet,

- However, the inherent overhead of Ethernet for computer networks using standard TCP/IP Windows stack makes it less attractive for demanding applications due to:
  - Small packets
  - High CPU usage
  - By adopting a modified protocol [based on UDP] with “jumbo” packets and by implementing a high performance driver reducing CPU usage to a few percent, an attractive solution is created.

- This standard is named GigE Vision.
Adapting Gigabit Ethernet for Vision

Standard packet: 1440 Bytes (56 Bytes header)

96.1% efficiency*
(High CPU overhead for sending many small packets)

"Jumbo" packet: Max. 16224 Bytes (one 56 Bytes header)

99.7% efficiency*
(Very low CPU overhead as only one packet)

In combination with a High Performance Driver, based on TCP/IP offload-engine, it provides higher transmission efficiency and drastically reduces CPU usage.

*) Comparison based on sending 16224 bytes of data
Frame Grabber-free solution

Example showing Gigabit Ethernet camera interface, with additional functionality
Possible system configurations

Point-to-point
(One camera, one PC)

Many-to-one
(Multiple cameras, one PC)

One-to-many
(broadcast)
(One or several cameras, with several PCs)
GigE cameras for Vision

- Smaller cameras
- Higher performance
- Cost reduction

- Monochrome and color
- Extensive pre-processing capability
- Higher interface speed (10 GigE)

- Resolution ranging from VGA to megapixel
- Ease of implementation

- **TM(C)-6740GE**
  - 640 x 480 pixels
  - 1/3” format
  - 200 frames/sec.

- **TM(C)-4100GE**
  - 2048 x 2048 pixels
  - 1.2” format
  - 15 frames/sec.

- **TM(C)-1405GE**
  - 1392 x 1040 pixels
  - 1/2” format
  - 30 frames/sec.
Requirement: To provide OPTICAL technology to calculate stockpile volume measurements.

MONITORING & REPORTING of all INPUTS and OUTPUTS, the weight of:

- Trucks, containers
- Trains, Conveyors etc.
Volume Calculation

Conventional methods of surveying are overshadowed when it comes to volume calculations. These following examples show the speed and accuracy of this method, and highlight how safety is an important issue. Volumes of stockpiles can be accurately and rapidly measured.
Volume Calculation Case Studies

**Improving Productivity**

As companies employ total quality management methods to increase their competitive advantage, accurate volume measurement is becoming vital. This method delivers reliable results for reconciliation and contractor payments. An ore stockpile in North America.
Volume Calculation Case Studies

Stockpiles for varying resources have been scanned:
- Ore stockpiles in the Hamersley Iron port facilities
- Mill stockpiles at PT Freeport Grasberg site
- Coal stockpiles at the Wesfarmers Coal site
- Multiple product stockpiles at the Penrice Soda Products chemical grade limestone mine

The results far exceed the speed and accuracy of conventional methods.
Volume Calculation Case Studies

Volume studies on haulage vehicles including trucks, trains, shovels or draglines. Accurate measurements can help resolve reconciliation issues, with minimal interruption to normal production.

Detailed surface model generated for stockpile volume measurements
Volume Calculation Case Studies

Cone stockpiles pose a safety risk to surveyors. Conventional surveying methods are impossible due to the reeling of the stockpile and because the stockpile is often fed from above and extracted from below. Remote access removes the danger, besides providing more accurate volumes. Due to safety reasons Anaconda at Murrin Murrin operations, it has previously proved difficult to obtain good volumes. This approach has saved many hours of work, providing accurate results which are unobtainable by other methods.
Volume Calculation Case Studies

Below is a large 290m long, 15m high coal stockpile, and a smaller reclaimed stockpile. The 3D models provide a realistic representation of the surfaces, giving more accurate volumes compared to more commonly used methods.

Smaller stockpile required 2 scans - as indicated by arrows

290m stockpile required 8 scans
Optical Character Recognition
Wide Range of Applications...

Tracking trains / truck / container from origin to destination:
Reconciling weight & Contents

Tracking and reporting countrywide
System description

- Non-intrusive, computerised method of matching a Vehicle Licence Plate to a database of registration numbers.
- System includes camera/illumination units, hardware and software (application + recognition library)
- Automatically reads License Plate number
- Displays, records and transmits vehicle image and recognition results
- Can compare plate number to database and activate alarm (IP/RS232/DEE)
5 easy steps:

1 - Capture

2 - Find object

3 - OCR

4 - Report

5 - Alarm
SEE TRAIN system

Camera/Illumination Units
(Up to 6 per system)

Frame Grabber

PC Station

Included Hardware
I/O Card + Terminal Block
Power Supply for SCH

SEETRAIN Software + DLL+
Sample Client Program
SEE TRAIN Installation for TWO POINTS

TRAIN approaches trigger zone

Train Sensor (camera zone or loop on the track)

PC Station

/Camera Illumination unit
LPR TRIGGER EVENT

Recognise number

/ Camera Illumination unit

Train Sensor

OCR

61011258

PC Station
Options exist to capture LOAD information and link load to number

Picture of load, possibly compared to load when train departed

Recognition Rate: 0.1 sec
Vehicle logged at both POINT A & B. If weight differs by more than 1%, alarm generated and variance investigated.

Recognition Rate: 0.1-1 s per vehicle (or 1-3 / s)
Data Analysis – OCR success per day
SeeTrain Product Line
Compact Coach Controller (C3)

Revolutionary!  PC-FREE single-lane logging

PC-Free stand-alone unit

Easy 2-Screws Installation

Obtain or update list, *by: Micro-terminal* 
*or GSM or PC*

Low Cost!
Compact Coach Controller (C3) - Unit + Options
SeeContainer Products

- See/Gate
- See/Crane
- See/Train
See/Gate System

Automated Terminal Gate Portal & Pedestal OCR systems
See/Gate System Description

- Automatically reads Container ID and Truck plate + optional Chassis or Wagon ID
- Located/Installed At Port gates *(each system controls one lane)*
- Scans the Containers/Truck in motion
- Displays, records & transmits images and results
- Turn-Key system *(cameras/Illumination, hardware and software)*
See/Gate System Highlights

- Handles all container types (20, 40, 45, 20-20) ISO 6346 ID formats
- Simple configuration
- Fast response *(output in seconds)*
- Fully automatic process
See/Gate Typical Configuration

- 5 Camera/Illumination units installed at Gate Area (*LPR + CCR*)
- 2 Additional Camera/Illumination units for Chassis recognition (for *USA*)
- 3 Container sensors on poles
- 3 Loop Sensors in road
- Solid-state low-energy illumination
See/Gate Application Window
INVESTMENT

We have various financial models which will enable municipalities to optimise revenue and budget opportunities.

Most applications of this technology allows for the enhancement of existing and creation of new revenue models.
DEVELOPMENT
The implementation of this technology will allow for skills transfer to BEE companies and small businesses. These opportunities will create sustainable revenue models for BEE partners which will result in job creation.
NEXT STEP

A meeting with all stakeholders to plan an appropriate way forward. Possibly this includes a LIVE DEMO or a visit to an existing site or a system design around an existing port or a price for a typical solution or some other suitable way to move forward.
Seeing Is Believing

Primary stockpile at Tom Price