3D Machine Vision made easy

Industrial Vision Days 2012

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Technical Director
AQSENSE develops and commercializes 3D image acquisition and processing technologies that allow high speed in-line 100% production inspection, for the Machine Vision Industry.

In addition to the 3DExpress and the SAL3D library, AQSENSE also offers consultancy services and special developments related to 3D projects.
Location

Scientific and Technological Park (University of Girona)  Girona (Spain)
Presentation outline

- Background
- Target users / Benefits
- Inputs and Outputs
- Server and client
- Configuration wizard
- Current status
- Summary
Background

✓ Increase on 3D Hardware components
✓ High Interest on the market for 3D tools
✗ Lack of knowledge on 3D
✗ Difficult to combine with existing Machine Vision libraries
✗ Few 3D software tools on the Market
✗ Interest on short development times

“Until now there has been no sensible way of linking 3D tools using a graphical user interface, and all too often the existing display tools are over burdened with 16 bit range maps, which means either additional pre-processing is required or limitations in the functionality are found.” (Mark Williamson - Stemmer Imaging)
Background (AQSENSE)

- SAL3D: Library specialized on laser triangulation scanning (C++)
- CVB 3D libraries (Several programming languages)
- NI LabView – 3DMVL
- Many laser triangulation specific projects
- Experience debugging laser triangulation issues
- Assistance to system integrators requests
Background

Market Needs

AQSENSE background

3DExpress is a 3D pre-processing software for machine vision applications including graphical assistance for the configuration and debugging of 3D acquisition systems.
Target users / Benefits

- System integrators needing laser triangulation
- Easy calibration and measurements
- Flexible hardware inputs
- Flexible outputs
- 2D pictures with 3D information (ZMap)
- C++, .NET, SAL3D objects, Sherlock, LV, Matlab, …
- Easy synchronization
- Fast acquisition
Inputs and outputs

<table>
<thead>
<tr>
<th>Camera</th>
<th>State</th>
<th>FPS</th>
<th>rm/min</th>
<th>Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D camera 0</td>
<td></td>
<td>83</td>
<td>14</td>
<td>0</td>
</tr>
</tbody>
</table>

**Outputs**

<table>
<thead>
<tr>
<th>Type/FG</th>
<th>Frame</th>
<th>State</th>
<th>Counter</th>
<th>In queue</th>
<th>Overflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZMap Plane-Aligned (fg 0)</td>
<td>Available</td>
<td></td>
<td>25</td>
<td>0/5</td>
<td>0</td>
</tr>
</tbody>
</table>

2012-Aug-06 08:16:09: fg0: New rangemap arrived, 201 profiles, lost frames counter: 0
2012-Aug-06 08:16:09: queue0: RangeMap queued. Queue size = 1
2012-Aug-06 08:16:13: fg0: New rangemap arrived, 201 profiles, lost frames counter: 0
2012-Aug-06 08:16:13: queue0: RangeMap queued. Queue size = 1
Inputs

- SAL3D drivers infrastructure
- 2D cameras (CVB GigE Genicam)
- Multicore software peak finder
  - AQSENSE Peak Detector
  - Center-Of-Gravity
  - Position and width detection
- 3D cameras (Automation Technology C4 and Photonfocus 3D03)
- Multiple heterogeneous inputs
Outputs

- RangeMap (2D Picture, pixel units)
- Cloud Of Points (for SAL3D backend)
- Zmap (2D Picture, 3D metric units)
- Zmap plane-aligned
- 3D metric units in 2D picture, with convenient coordinate axes
- Extra Frame (Width, etc.)
- More to come…
Inputs and Outputs

Online visualization of any input and outputs
3D Express

- Accessible through the System Tray
- Standalone program

3D Express Clients

- Dalsa Sherlock camera driver
- Microsoft .NET assembly
- Standalone native C and C++
- Native C++ with SAL3D objects
- Other clients (on demand)
Client: Sherlock

3D Machine Vision made easy
Client: .Net Assembly

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Client: SAL3D C++

```cpp
sal3d::Express::Output out0(0);
sal3d::Express::Output out1(1);
out0.grab();
out1.grab(); // as both are from the same input, this step is
             // not strictly needed

while (condition)
{
    out0.wait(1000);
    const sal3d::RangeMap rm(out0.rangemap());
    out1.wait(1000);
    const sal3d::ZMap zmap(out1.zmap());
    out1.flush(); // we can flush with any output derived from the same
                 // input

    /* ... PROCESS ... */
}

out0.freeze();
out1.freeze();
```

Allow to combine the flexibility of SAL3D with the easiness of 3DExpress
Configuration

Choose the driver

Some cameras may have multiple driver options available.

Silicon Software microEnable II/IV Frame Grabber

Config File:  

- Card: 0
- Port: 0
- Width: 0
- Height: 0
- Buffers: 0
- Format: FG,GRAY

Customize

Previous  Next  Cancel  OK
Configuration

- Selection of the laser detector algorithm
- Configuration of the detector parameters
Configuration

- Definition of the rangemap size and end conditions (time-out, max size)
- Option to use a software presence/absence detection
Configuration

- Metric calibration of the system
- Scalable calibration pattern depending on project requirements
- Calibration ROI
Configuration

- Outputs definition:
  - Rangemaps
  - COPs
  - Zmap
  - Zmap aligned
  - Extra Frame
- 8 bits normalization
Applications

- Raw 16 bit range map provided by camera
- Metric calibration
- Orientation of 3D plane
- Zmap projection
- 8 Bit range map transferred to GUI

without AqSense 3D Express

with AqSense 3D Express

High Z range
- Raw 8 bit range map transferred to GUI

Small Z range
- 8bits
Applications

- Metric measurements using standard 2D tools (also in Z axis)
- Plane fitting (planarity, Braille, etc.)
- Surface inspection
- Assembly verification ...
Current Status

Already implemented
- SAL3D input drivers
- Sherlock acquisition driver
- SAL3D C++ and .Net client

Additional features
- More 3DExpress client modules
- Support for Silicon Software peak detection
- Time Of Flight cameras and fringe projector sensors
- Occlusions minimization (1 camera & 2 lasers)
Summary

- Allows quick acquisition setup
- Easy to use
- Speed up your project developments
- Online visualization of pictures and 3D scans
- Interface thought for acquisition debugging
- Allows 2D MV programmers to stay with the software they like
- Fast algorithms
Thank you for your attention

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AQSENSE SL

VISIT OUR BOOTH 1J11
New special calibration (two lasers+1camera)

Any questions?

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