

**INSPECTION OF NONWOVEN WEBS  
USING SMART CAMERAS**  
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**Abstract**

A typical, host-centric nonwoven materials inspection system consists of CCD line-scan cameras, frame grabbers, dedicated image processors and a host computer.

These systems can provide 100% inspection but are expensive to acquire and install, hard to configure and use, difficult to scale and have a large footprint.

As an alternative we propose a *distributed* web inspection system comprised of multiple smart cameras linked to a host computer via Ethernet. Each smart camera incorporates image acquisition, hardware pre-processing, data analysis and communications into one compact package. This distributed processing approach leaves the host computer free to perform GUI and database management tasks

The potential advantages of such a smart camera-based system include enhanced ease-of-integration to factory environment, ease-of-install, ease-of-replacement, reduced system size, powerful system resolution scalability, simplified and robust single package solution, seamless multi-camera integration and ability to handle high defect rates without degradation of system performance.

**Inspection of Non-Woven Webs Using Smart Cameras**

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**Web Inspection**

**What is a Web?**

- Flat material produced in large quantities, continuously at very high rates.
- E.g. fabric, sheet metal, paper, non-woven, plastics etc.

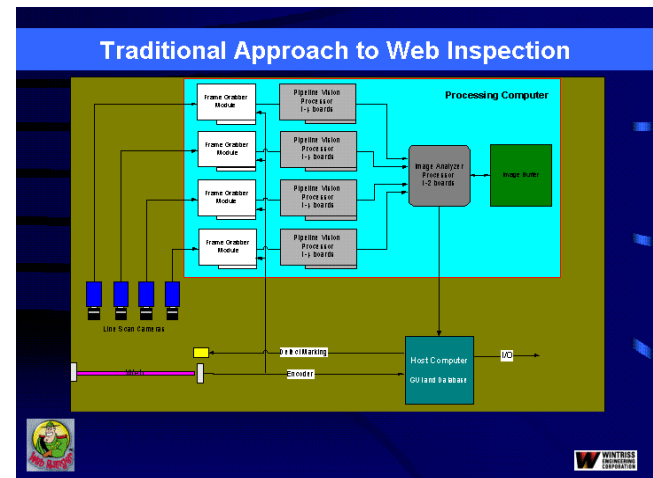
**What is Line Scan Camera based Web Inspection?**

- Inspection of surface flaws and defects
- Involves image acquisition, processing and analysis

**Traditional Approach to Web Inspection**

**Components:**

- CCD line scan cameras
- High bandwidth, camera specific data cables to transfer data from cameras to vision processors
- Frame grabber modules to receive data from cameras
- Pipeline vision processing boards for preprocessing the input image
- Dedicated image processing board for data and image analysis
- Image buffer board for data storage
- Large chassis to house all the boards
- Host computer for GUI and database
- I/O board to control marking systems
- Ethernet board to connect to factory net





## Web Inspection Categories

### Non-Patterned Web Inspection

- High Contrast Web Inspection
- Medium Contrast Web Inspection
- Low Contrast Web Inspection

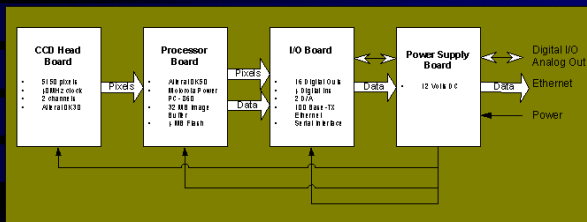
### Print Web Inspection



## OPSIS 5150 High Contrast Web Inspection Camera



## Wintriss Engineering Corp. Hardware Solution



## OPSIS 5150 Camera S/W

### Features:

- VxWorks Real Time Operating System for reliable, deterministic performance
- Ethernet running standard TCP/IP protocols (telnet, FTP, PING, SNMP, SMTP, HTTP)
- RS232 port support included for control of remote devices such as printers, PLC's
- Flash File System for easy updates using industry standard FTP protocol
- Prioritized Ethernet bandwidth allocation (high priority for error & feature data, low priority for image data)
- Elastic data transport for bursting data



## Web Ranger 1000 High Contrast Web Inspection System

### Vision components of the system

1. OPSIS 5150 High Contrast Smart Camera
2. Camera Software
3. Host PC Software
  - Web Analyst - Web Setup Software
  - Web Ranger - Online Web Monitoring Software



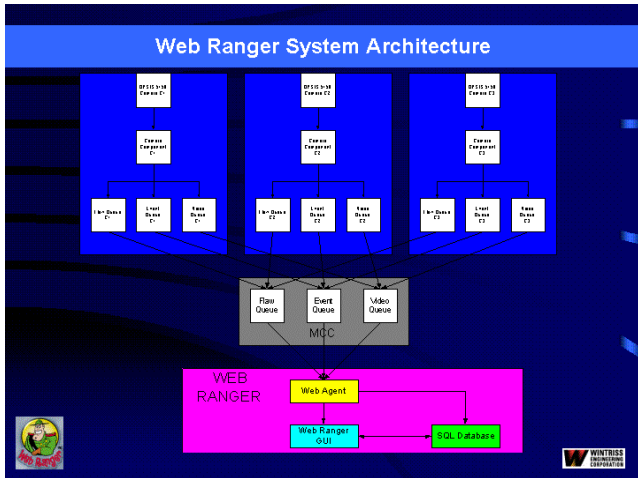
## Web Inspection Host PC S/W

### Features:

- Windows Component Object Model Compliant programs
- One Camera Component represents each camera
- Each Web or 'Virtual Camera' represented by one Multi-Camera Component Object
- Programming of 'Virtual Camera' done using COM interface
- Multiple Webs or 'Virtual Camera' can be defined and accessed by remote hosts
- Remote GUI can be attach or unattached to a Web or 'Virtual Camera'



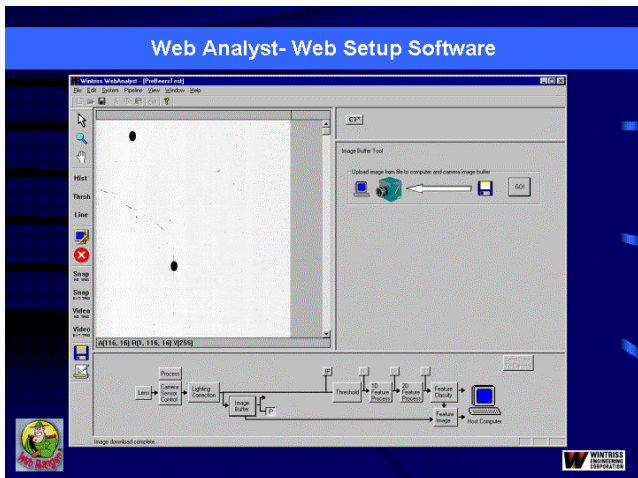




### Low Contrast Web Inspection

#### Introduction

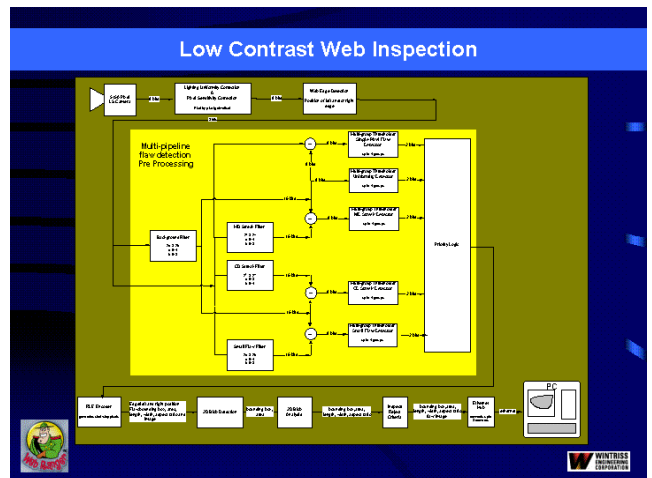
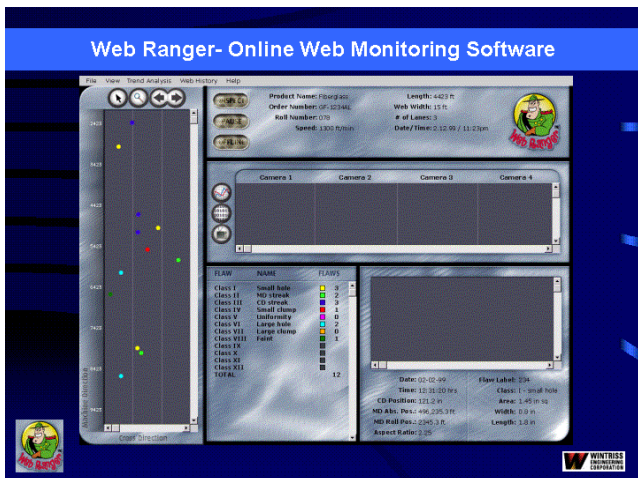
- Contrast between the good material and bad material is very close to noise level.
- 2D filters to enhance and detect flaws
- Filters processing used in conjunction with adaptive background subtraction allow detection of very small changes in the web material.
- Applications are detection of holes, streak, clumps in transparent material, scratches on metallic surfaces etc.



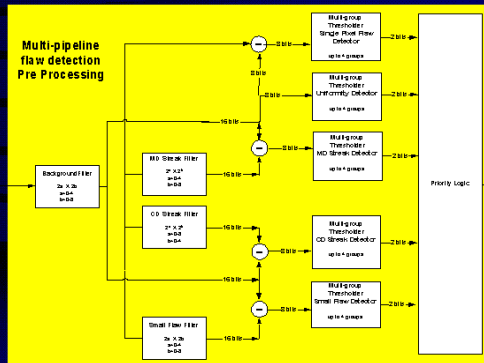
### Low Contrast Web Inspection

#### Requirements

1. lighting and pixel correction on a pixel by pixel basis
2. web edge detect
3. four 2D filters of different sizes, background filter, CD streak filter, MD streak filter, small flaw filter
4. four adaptive background subtraction channels to operate on the output of the filters
5. five channel multi-group thresholding on the averaged data
6. RLE encoding on every channel
7. logic to determine the priority of the type of flaws detected
8. fast 4-8 neighbor blob detection
9. blob analysis
10. inspect/reject flaw analysis
11. flaw classification/statistics
12. flaw dimensions and image data transmission to GUI



## Low Contrast Web Inspection



## Conclusion

### Advantages of the Smart Camera based Web Inspection System

- Balanced architecture
- Standard Ethernet
- Highest Performance
- Digital Camera
- Simplified HW Solution
- Complete Solution

