

# SMOKE STACK MONITORING



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Integrated, Intelligent Imaging

*“..any sufficiently advanced technology is indistinguishable from magic.” Arthur C. Clark*

WORLD CLASS,

## Requirement:



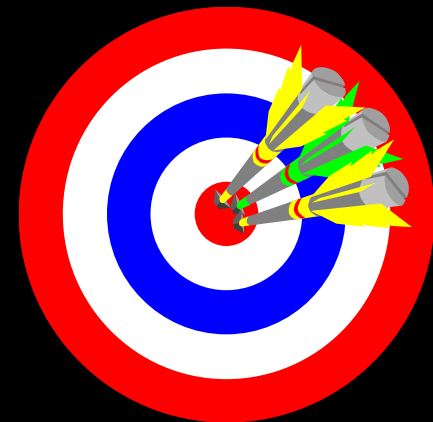
**The requirement is to provide image analysis technology to facilitate smoke stack monitoring.**

**RECORDING and ALARMING when SMOKE exceeds pre-set threshold.**

# Why SMOKE MONITORING?

- ▼ A visual record of all emissions
- ▼ Improved Precision /Accuracy in recording
- ▼ Reproducibility of Results
- ▼ Higher Throughput than Manual Methods (up to 64 cameras per PC)

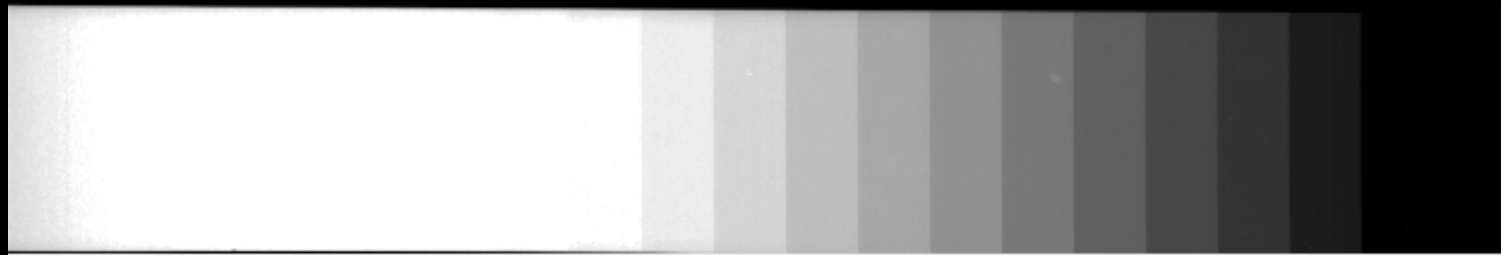
**İLLOVO İGRAND!**



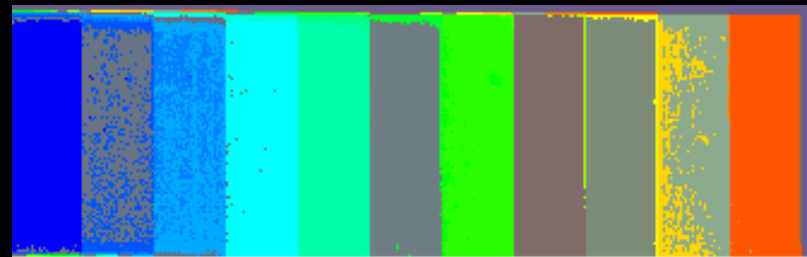
# A Word About Our Eyes

- ▶ 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 (CCTV cameras have 256 levels)
- ▶ Eyes cannot accurately reproduce measurements

NUMBER OF STEPS???



NUMBER OF COLOURS???



# Electronic Imaging Fundamentals

Acquire

Process

Identify

Analyze

Report

Alarm

# Camera Choices

Getting an Image into the computer

VS.



## *Intensity Resolution*

- ▼ Analogue CCTV @ 256 colours (BW)
- ▼ With high resolution colour camera with RGB @ 65 535 levels
- ▼ Digital camera at 16 million levels!
- ▼ To measure smoke with any degree of accuracy min 20 levels required
- ▼ Suggest a colour analogue CCTV DOME camera with presets (calibration & multiple smoke stacks).



## Acquiring the Image

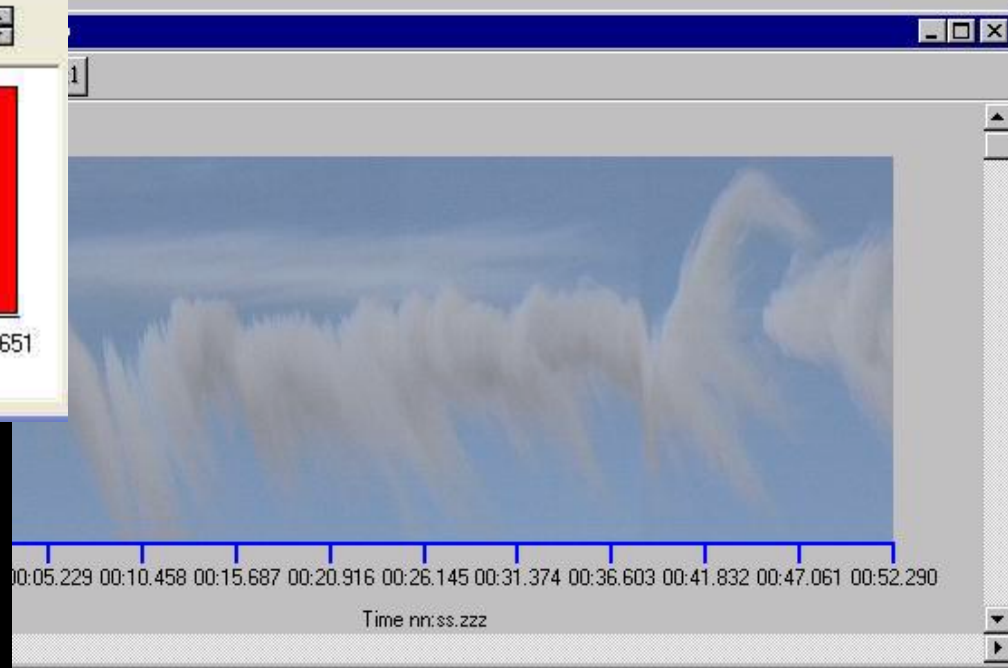
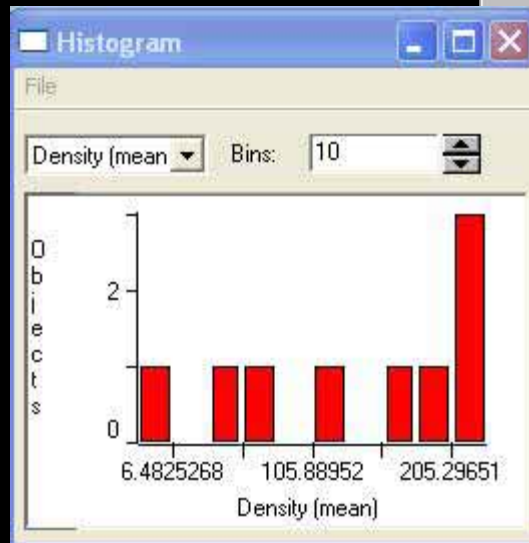
- ▼ Calibrate system via a STANDARD (present 1 on the dome)
- ▼ Obtain an image from smoke stack 1 (Preset 2) and measure intensity compared to standard. Smoke stack X, preset X, etc..
- ▼ If the result is over permitted limits, ALARM
- ▼ Record all images and highlight transgressions

# *Monitoring*



07:57:25  
20/02/2001

# Recording



# Calibration

Intensity Calibration - STEPTAB.TIF:2 ...

Name: SMOKE STACK CAL

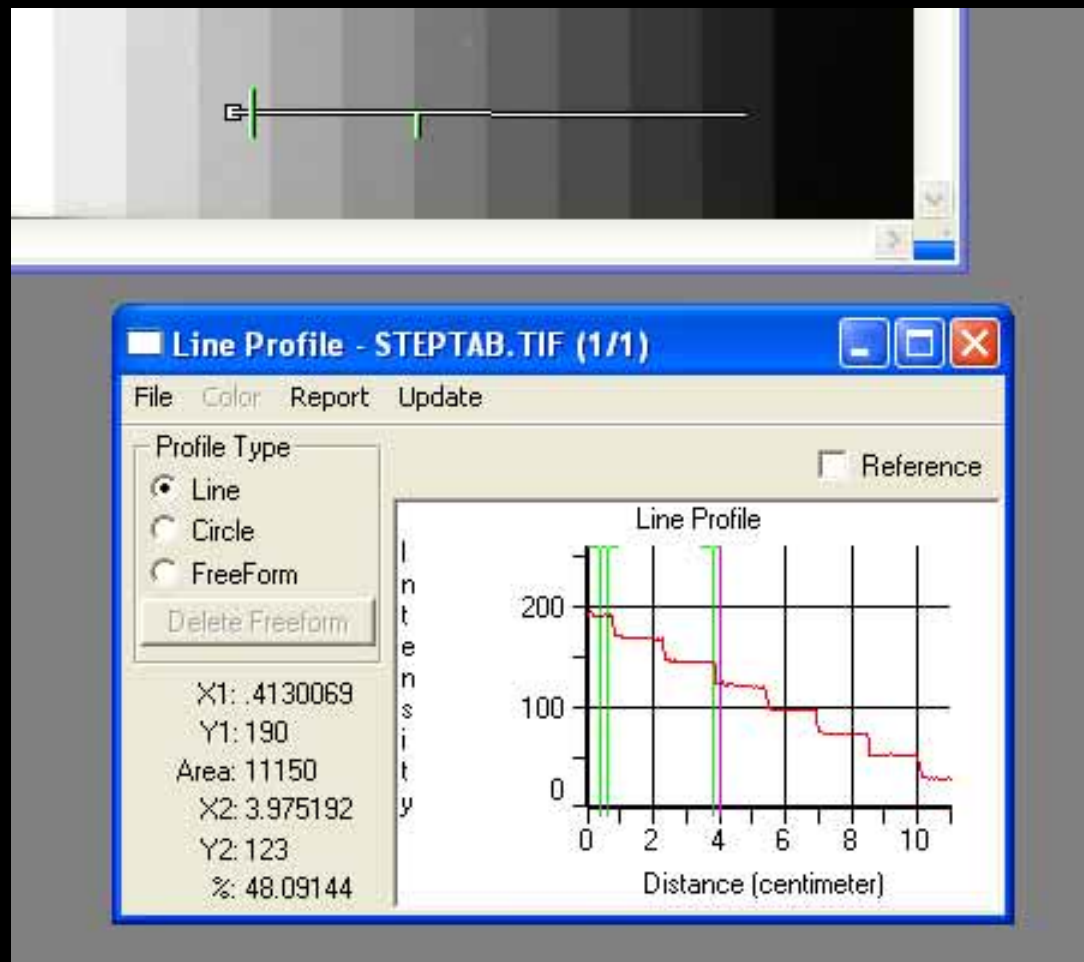
Unit Name: Gray Level

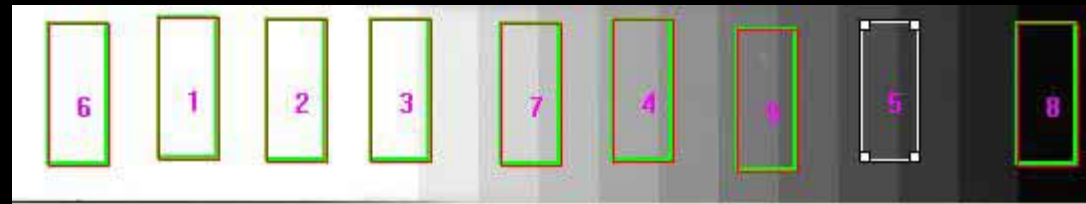
Free Form  Std. Optical Density

Number of Samples: 256

OK  
New  
Delete  
Delete All  
Options...  
Defaults  
Step Tablet...

# Reporting Data





Measurement Data

File

No Sort  Sort Up  Sort Down    On: Density (m) ▼

Locate the object.     Scroll to the object.

Obj.#	Density (mean)	Density (std.dev.)	Density (sum)
1	255	0	569160
2	255	0	569160
3	250.62231	7.9105272	559389
4	161.76837	9.7639074	361067
5	65.093193	10.105195	145288
6	255	0	569160
7	205.09991	11.469039	457783
8	6.4825268	1.8259037	14469
9	112.67473	10.989199	251490

# Summary



- I-CUBE will supply a smoke monitoring system, consisting of:
  - Dome camera
  - HP PC
  - Digital recoding
  - Image frame grabber card
  - Image calibration software
  - Alarm (DDE, TCP/IP and relay output)  
IF smoke exceeds set threshold
  - Ability to connect multiple cameras to PC  
(just add camera, frame grabber & LIC)