TATA EIGENVIEW
Vol. XXVI | The Automation Newsletter | October 2011

CAMSYNC- CAMERA LINE-RATE CONTROLLER

For surface inspection at CRM, high speed line-scan camera is used for acquiring images of the moving coil. The efficiency of defect detection algorithm increases with the quality of image. Since the rolling speed of coils at CRM is not constant, the images should also be captured at a variable line rate to reduce blur and distortion in the images and to increase the quality of the images.

But, cameras normally capture images at a constant rate and hence, there is a necessity for a device which would provide the rate at which the images should be captured. Thus, the Camsync device has been developed which takes coil speed as input and generates a synchronization signal which basically provides the variable line rate for the camera at which the images would be captured.

Fig 1 : A model of CAMSYNC used in CRM

The device (shown in Fig 1) is implemented on AVR family of Micro-controllers and has eight separate analog input channels for performing the analog to digital conversion. The voltage signal from the plant containing the speed data is digitalized and the value is used to calculate the current line rate using an established relation. If the current line rate differs from the previous line rate by a pre-decided tolerance margin, the camera is updated with the new line rate. Hence it doesn't overload the camera. This operation is repeated at a rate of 2 KHz. The device also contains a LCD Display which continuously displays the current line rate and exposure time. Manual switches are provided to set the exposure time which is a robust way to enhance the images for different lighting conditions.

The benefits of this device include:

- ✓ Better image quality in terms of less blur/distortion, thereby increasing the efficiency of defect detection
- ✓ Continuous feedback for current line rate and exposure time
- ✓ Independent exposure control for different lighting condition

ONLINE AND OFFLINE IMPLEMENTATION OF FACE RECOGNITION SYSTEM

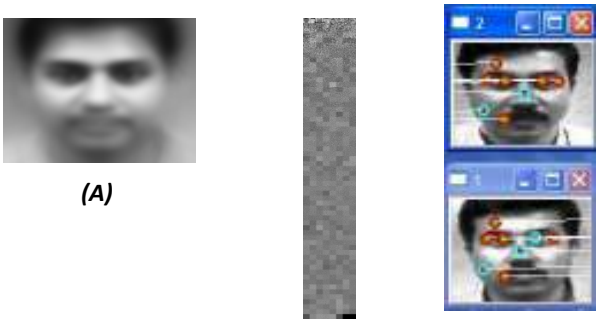
For security applications, one of the most important systems to be implemented is the face recognition system. The system developed by automation would be implemented in the following different scenarios:

- ✓ Online detection where people entering/exiting a building are monitored by cameras and face detection/recognition is carried out in real time.
- ✓ Augmenting the existing Access Control Devices such as RFID reader systems, so that the image of the person carrying the card can be verified against the stored images.
- ✓ Counting the number of persons entering /exiting a building and intruder detection by which unauthorized persons/Humans in prohibited areas can be detected.

This face detection system is much faster than contemporary products available in the market because it employs two different algorithms in which, one finds similar faces and the other searches for a match which has the maximum number of similarities.

The software in the online mode requires all authorized visitors to be trained by the system, wherein the person stands in front of the camera which captures about 10-15 frames of the persons image with different expressions and angles (not greater than 30 degrees off

center). These images are then converted into Eigen vectors and stored in an XML file being used as a database here. For face classification, the visitor's face is captured and projected on the PCA (Principal Component Analysis) subspace which returns images of people in the database with similar features. Using Open surf methodology, 12 Interest Points (pixel locations on both images) are compared for similarity and if there are greater than 5 matches, then the faces are said to be identical.



(A) *(B)* *(C)*

Fig 2: (A) Averaged Image (B) Eigen Face (C) Feature Recognition

The System has also been successfully interfaced with the RFID based gate pass system. In this implementation, as the RFID reader sends the personal number read from the card, the face recognition system detects the face of the person walking through a kiosk or turnstile and compares it with the image stored in the RFID card database to validate the visitor identity.

CAMERA BASED TUYERE MONITORING SYSTEM

With the advent of pulverized coal injection (PCI) in blast furnaces, it has become very important and critical to be able to detect problems in the PCI systems at the tuyeres. As the PCI rates increase, furnace downtime resulting from tuyere, blowpipe and upper assembly failure also increases, often resulting in furnace breakouts and failure of furnace auxiliary equipment.

In this project, a method is developed for the automatic inspection of tuyeres of Blast furnaces using image processing techniques. This system also shows the thermal profile of the tuyeres indicating the temperatures, heat-zones and the blockage of the tuyere, which when over and above a threshold value generates an alarm to the operator to stop the PCI and take immediate action. This application of image processing in the Blast furnaces proves to be very robust in terms of being independent and also in generating auto-alarms, thereby providing greater control and reducing the downtimes of the blast furnace.

The major objectives of this project include:

- ✓ The live images from camera from all the 34 tuyeres should be displayed at a rate of 30 frames per second on the monitors in the control room.
- ✓ Also, as the images are captured, they would also be converted to thermal profiles and these thermal profiles would be stored in the database
- ✓ The live image and thermal profiles should be retrieved in the form of movies and displayed for the selected tuyeres for live as well as historical data.

(A) *(B)*

Fig 3: (A) Mechanical Arrangement for Tuyere Monitoring System (B) The live image of Tuyere through the Peephole

The installation of the cameras is unique for this system since, the arrangement allows for both manual inspection and automatic inspection through cameras. Moreover, the view for the camera is through the peephole of the tuyere.

In this system, CCD cameras are used as the visual sensors for the monitoring of tuyeres. Each tuyere is monitored by a camera and the images from all the tuyeres are simultaneously displayed in the monitor at the control room using image processing. Moreover, using advanced image processing techniques, each of the monitors also shows the thermal profile of the tuyeres indicating the temperatures and heat-zones. Most importantly, the blockage of the tuyere is provided as a percentage based on the intensity of the images of the tuyeres and the blockage over and above a threshold value generates an alarm to the operator so the PCI can be stopped and immediate action is taken.