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PDP Visual Inspection System in PDP Aging Process

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Abstract: PDP aging inspection process is the first step of inspecting defects in a lighted panel. The causes of appearing defects are particles in a clean room, a failure of a creating electrode. Aging inspection system is designed for contributing optimization of production by detecting these defects. The defects are mainly seen as line, dark or brighten cell and mura. This system has different algorithms according to a characteristic of defects. This system processes a panel in 12 seconds with accuracy in 99%. It consists of high definition camera for shooting a lighted 50 inch panel, PCs for controlling linear systems, communicating with main database system, processing data and image.

1. INTRODUCTION

PDP aging vision inspector is designed for automated facility at full-white lighted PDP panel that is conducted by proper voltage of bus electrode after aging process.

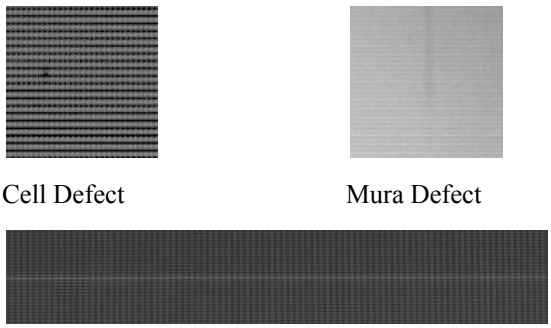
By this system, we can obtain advantage that no person is needed to aging inspecting process and accomplish optimal process condition by reported normalized data.

In this study, we explain the base system that inspect progressive defect automatically that occurred in aging process. This system is consisted of frame part and vision part. Mechanical structure and dimensions are described in frame part and algorithms detecting defects and vision system is done in vision part.

2. ANALYSIS OF PDP AGING PROCESS

PDP panel is assembled in adhering 2 thin glass panels before aging process. After the process that panel is exhausted for impure gas and injects gas like He, Ne, Ar, Xe. To prohibit getting out of the gas, exhausting hole is sealed. When completing tip-off process, aging process plays a role that activated MgO preserves driving a circuit by making stable state in electronic and optical characteristic. In aging process, defects may be whether produced or disappeared. More specifically describing, that is due to changing crystal, morphological changes in surface, removal of adhered thing on fluorescent body by plasma sound.

Aging inspection process inspects defective area of various shape and size that is out of regular pattern. Defects are classified to open, short, cell defect and mura. The cause of producing defect is particle in clean room, contamination of raw material, lack of ability of cleaning facility. It is reported that in accordance with size and location of defect, various defects are appeared. To solve this problem, the technique is needed that inspecting automatically, analyze defect and report causes of defects.



Cell Defect Mura Defect

Line Defect

Fig. 1 Representative defects of PDP Panel

3. DESIGN OF INSPECTION SYSTEM

We researched automated inspecting system for alternating existing man-inspecting process. Furthermore, for applying producing line, we developed system in optimizing conditions in manufacturing. The system mainly consists of frame part and vision part and is designed for low cost and optimized for 50 inch PDP panel. A frame part is applied linear motor system for using 2 cameras to obtain 4 images per 50 inch plasma panel. The frame is designed for robust in vibration and independent from product line, reduced vibration of frame due to the movement of camera fixing unit. The vision part is installed for considering rate of object characteristic and FOV (Field Of View) of optical system. The optical system has 4008 x 2672 resolution for inspecting 50 inch panel. For dealing with job change, camera stage is installed independently between linear stage and camera.

4. INSPECTION ALGORITHMS

Explained in chap. 3, we develop inspection algorithms appropriate for aging vision inspecting. The system has 3 different algorithms for inspecting line defect, cell defect and mura. Specific structure of algorithms is described in Fig. 2.

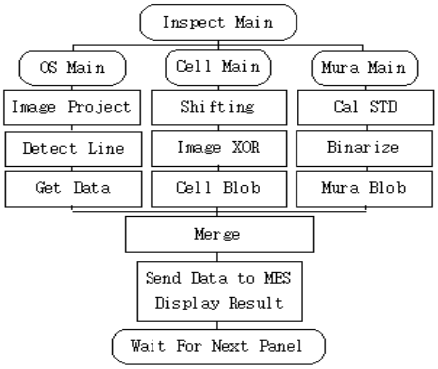


Fig. 2 Detection algorithm for PDP panel defect

4.1 Line Defect

Line defect is mainly appeared for failure of making electrode and seen as line. Line defect is inspected using projection profile. We can obtain every projection value. If any line has defect, the value is higher or lower than the other line. It is needed non-tilted image to acquire reliable result, so we use panel aligning unit and calibration in pre-processing.

4.2. Cell Defect

For inspection of cell defect, we use difference image by shifting and XOR operation. Due to existence of cyclic pattern on PDP panel, it is needed to removal of cell pattern before inspection. An operated image is thresholded by experimentally obtained criteria. That image is blobed and extracted to get data in that order. From extracted candidates, system select final defect.

4.3. Mura Defect

Mura is detected by using image statistics; mean, standard deviation. Using histogram of image, algorithm calculates 2 thresholds for bright and dark mura. Any pixel out of the threshold range is detected as mura. As for cell inspection, mura is selected in candidates finally.

$$\begin{aligned} n &= \#of\ pixels & ht &= m + k\sigma \\ m &= \sum^{u,v} f_{u,v} / n & lt &= m - l\sigma \\ \sigma &= \sqrt{\left\{ \sum^{u,v} \left(f_{u,v} - m \right)^2 \right\} / n} \end{aligned} \qquad (1)$$

The upper and lower threshold is m+kσ and m-lσ each. k and l is the constant value that obtained experimentally. That is calculated equation (1). The thresholds are calculated again and result another 'ht' and 'lt' for candidate pixels using first obtained 'ht' and 'lt' for finding thresholds more accurately.

5. EXAMINATIONS AND ANALYSIS

This system is designed for rapid transaction and reliability.

We analyze result of examination by extracting resulted data reported for 10 days without rest. The result is shown in Fig 3.

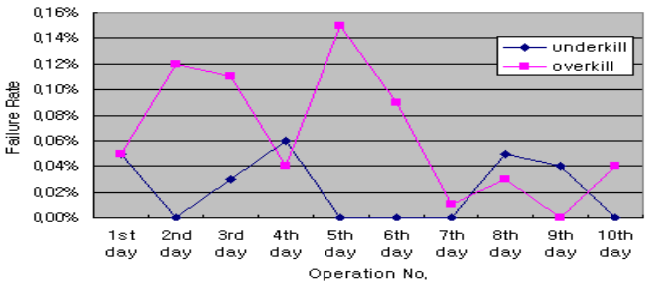
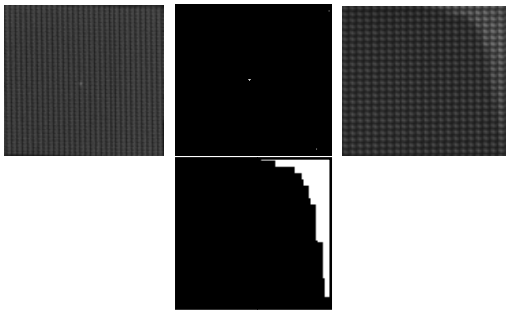


Fig. 3 Result of Aging Vision Inspector

We obtain result of 12 seconds in inspecting a panel including for time of image acquiring 4 seconds and above 99% accuracy. So this system is judged appropriate ability using producing line.

Some binarized image is shown in Fig. 4. These images are blobed and reported at main system by form of text and image data. Line defect algorithm processes data only in texts.



(a) (b) (c) (d)

Fig. 4 Result Image of the Cell and Mura Defect (a) XOR operated cell image (b) Binarized cell image (c) Original mura image (d) Binarized mura image

6. CONCLUSIONS

Now, PDP producing process is needed to concentrate on increasing quality of products by cost-down and lessening errors in inspection. Instead of inspecting defects by human eyes, we develop automated inspection system that is able to detect line, cell, mura defects. We obtain 99% accuracy in bus open and 12 seconds index with 50 inch PDP panel. Hereafter, we plan advanced alignment and optical mechanism for better image acquisition in coping with various defects. We will progress to make advanced algorithm for higher accuracy and lower index. Therefore we hope achieve to increase productivity and quality of producing PDP panel.

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