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Machine Vision System for Effective Semiconductor Package Sorting

Hyoung-Keun Park[1*]

[1*] Dept. of Electronic Engineering, Nam seoul University,
91 Daehak-ro Seonghwan-eup Sebuk-gu Cheonan-si, Chungcheongnam-do,
South Korea
phk315@nsu.ac.kr

Abstract. Semiconductor-related technologies have recently been developed toward realizing high-density and high-speed motion, reducing production cost to secure price competitiveness at the same time. In addition, as diameter enlargement, which is the main trend of semiconductor process equipment, gets more obvious, efforts are demanded to be made to improve the stagnation of long-term yield and productivity in semiconductor production process. Therefore, the present study developed the machine vision system for effective semiconductor package sorting to apply to semiconductor manufacture process.

Keywords: Sorter, Semiconductor package, Machine vision, Test socket

1 Introduction

Sorter, which works in a high speed in semiconductor production process, has been a main reason for productivity failure, causing equipment failure and process halt due to package double phenomenon as socket full or full status of the semiconductor package is not monitor in loading and unloading work of the semiconductor package of test socket board. Furthermore, it is necessary to promptly control vacuum to load and unload semiconductor package at high speed, but delicate on/off control error and limitation of engineer's bare eye checking are not free form error to package sorting.[1]

Therefore, the present study developed sorter process-focused image (video) processing algorithm and hardware-based MVMS (Machine Vision Monitoring System) to apply to production lines. This system enables to notify a process engineer in remote distance of the status of high-speed sorter without delay and helps him to take a proper action such as prompt correction and readjustment of equipment.

2 Machine vision system structure

The sorter working at high speed in semiconductor production process has been a main reason for productivity failure, causing equipment failure and process halt as socket full or full status of the semiconductor package is not monitor in loading and unloading work of the semiconductor package of test socket board.[2,3] Furthermore,

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it is necessary to promptly control vacuum to load and unload semiconductor package at high speed, but delicate on/off control error and limitation of engineer's bare eye checking are not free form error to package sorting. The system that this study aims for, as seen in Fig. 1, consists of vision camera, image processing, sensor, communication unit, and machine control unit applied with algorithm specialized in controlling MVMS.

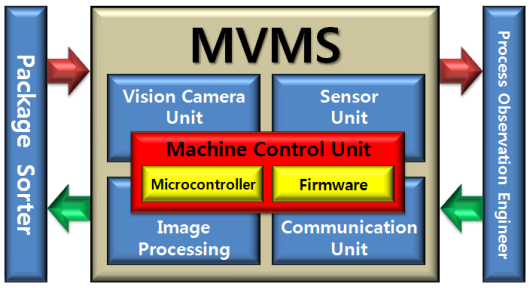

Fig. 1. MVMS(Machine Vision Monitoring System) structure

In the top module, input data format has two paths of 'parallel' and 'LVDS de-serializer' and comprises uniformed data (Vsync, Hsync, Pclk, Data) through. CAN data that are converted to SPI are added to image data through CANController.v module. FrameCounter.v module adds count data to the beginning part of image data coming in real time and delivers them to Dram controller part. Dram controller consists of DramWrite.v module that inputs entered image data in Dram; DramRead.v module that outputs the data of Dram; and DrameInitial.v that initializes Dram. Image data that output from Dram are sent to CY3014 chip, which is USB controller, through SdReadCon.v module.

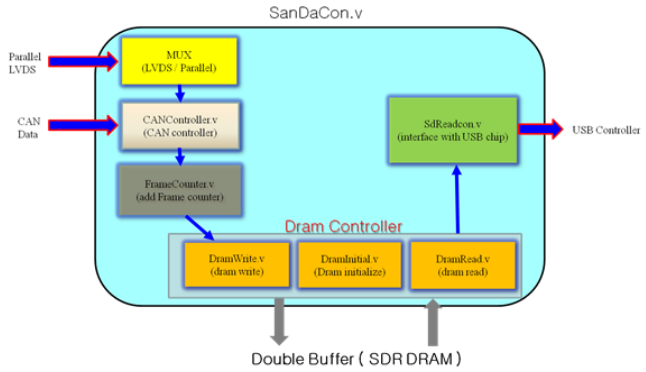

Fig. 2. Top module structure

For the sake of user's convenience, this study developed GUI that consists of Main view, ROI control, S/W control, and Camera condition control window as seen in Fig. 3 ROI can be set and adjusted freely using a mouse after dragging it for changing position. When Set ROI button is clicked, it sets ROI to the defined setting.

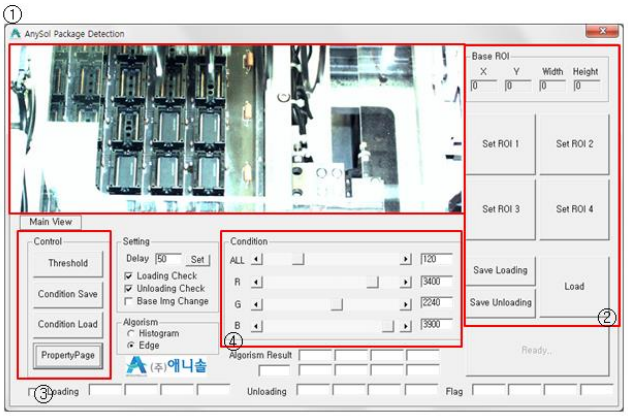

Fig. 3. Graphic User Interface

In case that loading is applied by turning on Save Loading/Unloading with working equipment after setting ROI, pogo-pin image should be saved. As for unloading in this case, package image should be saved.

Table 1. Performance Analysis

Specification	Unit	Values
1. Image gathering speed	ms	Max. 16ms
2. Exposure Time	ms	Max. 34.5ms
3. Calculate speed	ms	< 1ms
4. Alarm Response Delay	ms	Max. 32ms
5. Activity Pixel	HxV	1280x960
6. Interface speed	Bit/Sec	1GB/S
7. I/O scan time	Hz	10KHz
8. Lens FOV	mm	12mm

3 Conclusion

In this study, MVMS was developed by applying machine vision control algorithm specializing in sorter process and remote-monitoring technology for automated semiconductor package testing. Recognition for MVMS was advanced with color space developed through intelligent vision recognition algorithm and reliability was secured through histogram. The developed system is expected to contribute to increasing the yield of semiconductor production process because its image gathering speed turned out to be 16[ms] and alarm response delay is 32[ms].

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