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Stereo Vision Measurement System For Solder Ball Quality Control During Semiconductor Packaging

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Inventors

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Background

In order to interconnect semiconductor devices, micro-scale diameter solder balls are deposited on silicon wafers to fuse electronic components. Inconsistent ball height and ball warping creates defective solder joints that cause connectivity issues. Current ball inspection tools such as laser profiling, fringe projection, and confocal microscopy are expensive, require complicated setup, and are slow, making them difficult to use in a live manufacturing setting. Therefore, a reliable, fast, in-line ball measurement system is needed for inspecting packages undergoing assembly. Stereo vision constructs a 3D object by triangulating matching pixels between 2D images from two cameras located at opposing reference angles. Existing stereo vision measurement techniques rely on the presence of edges, corners, and surface texture for the detection of feature points, and have yet to be directly applied due to the edgeless, smooth surfaces of solder balls.

Invention Description

Researchers at ASU have developed a stereo vision measurement system that uses contour mapping to match groups of similar pixels resembling curves on the solder ball's surface. Ring lighting around each camera lens provides directional light that enhances spatial definition when reflected. Once the images have been captured, software generates a contour map based on the intensity of the reflected light and calculates individual ball height after triangulating points for each ball's apex and base. This method has been tested to be accurate to within four micrometers of the leading conventional solder ball inspection tools. Therefore, this stereo vision measurement system offers reliable quality control at a fraction of the cost.

Intellectual Property Status:

Pending

Potential Applications

- BGA (Ball Grid Array) Soldering
- Flip Chip Manufacturing
- Quality Control for the Manufacturing of
  - Integrated Circuits
  - Microprocessors
  - Random Access Memory
- Semiconductor Packaging

Benefits and Advantages

- **Economical** – Less expensive than laser profiling, fringe projection, and confocal microscopy.
- **Effective** – Accurate within four micrometers of the leading conventional solder ball inspection tools.
- **Practical** – Saves manufacturing time without sacrificing quality.

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