Development Model for Surface Mount Technology using CCD and 3D Camera Modeling and Tracking Systems

Yubo Li

Shaanxi Vocational and Technical College, Shaanxi, China

Abstract — In this paper, we analyze the development trend of Surface Mount Technology (SMT), and we sum up the key technologies of charge coupled devices and tracking technology. With the miniaturization development of electronic products, surface mount technology has gained much public attention. On the basis of the industrial product process and basic theory of surface mount technology, we propose a simple and easy manual process program for surface mount technology which uses welding techniques to analyze its process flow and parameters. The principle, process, manual operation and characteristics of surface mount technology are introduced first, and the configuration, design, manufacture and use of hand operated equipment are then provided. At present, electronic products are updating faster with more varieties and small batches, which require SMT production preparation time to be as short as possible. In order to achieve this goal, we need to overcome the disjointed problem. We analyze the common jointing defects and some problems in surface mount technology, such as cleaning, jointing, checking, and so on. Charge coupled devices may be neatly arranged by a number of small photosensitive element array in vast numbers from hundreds of thousands to tens of millions, and have wide applications such as photoreceptor cells to emulate biological retina functions sensitive to light intensity and color.

Keywords — Surface Mount Technology; Charge Coupled Device; 3D Camera Modeling; Tracking Technology

I. INTRODUCTION

SMT production line is the basis of high capacity, high quality, large-scale electronic assembly production, and there are several development trends.

At present, electronic products are updating, faster, with more varieties, and small batches, which require SMT production preparation time to be as short as possible. In order to achieve this goal, we need to overcome the problem that the design link is out of line with the production process. The application of CIMS can solve it completely [1-7].

CIMS is the database as the center, with the help of computer network to the design environment of data transfer to each automatic processing equipment, and can control and supervise these automatic processing equipment, forming an integrated automation system including design manufacturing, testing, production process management, material supply and product marketing management.

CIMS can bring very significant economic benefits for enterprises: improving product's quality, effectiveness, and so on. High production efficiency is an important performance index to measure SMT production line, which is reflected in production efficiency and control efficiency. Productivity efficiency refers to the comprehensive production capacity of various equipment on the SMT production line.

In order to improve the production efficiency, some SMT reflow furnace production line coupled with a line of automatic test instrument, so that in the entire production process can eliminate the interference of human factors, and greatly improve the production speed, thereby improving the production efficiency. Control efficiency includes conversion and process control optimization and management optimization. The control mode has been developed from traditional step-by-step control mode to centralized online optimization control.

At present, many foreign companies are using production management software for the entire SMT production line and monitoring various of the equipment production process parameters. To ensure that each machine is working under normal conditions, and greatly improve the production line's management efficiency and production efficiency.

In order to protect the ecological environment of the earth, the environmental problems of SMT production line are being paid more and more attention. The production line meeting the environmental protection requirements will be the development trend in twenty-first Century [8-11].

The main equipment in the SMT production line including epoxy machine, screen printing machine, SMT machine, reflow soldering machine, cleaning machine and testing machine etc. Glue machine, screen printing machine and testing machine are key equipments, and the chip mounter is the most critical equipment in the SMT production line equipment, because of its highest technical content.

Mounter placement started in the mid-1980s, but in the SMT area, we are basically a blank in marketing. Since 1990s, China began to introduce foreign SM T equipment. However, compared with the developed countries, the research level of SMT in China has a big gap.

Surface mount key equipment is a highly integrated optical mechatronics device, involving optics, machinery, electronics, automation and other interdisciplinary fields.

New placement machine improves the mechanical structure, and system stability, in order to better improve production speed. Another important trend in the development of new mounter is high precision.
II. CHARGE COUPLED DEVICES

A. Characteristics of CCD

Charge coupled devices (CCD) are arrays of small photosensitive elements (usually called pixels) arranged neatly and compactly. Their role is equivalent to the human retina on the photoreceptor cells, to feel the light intensity and color.

CCD has small size, light weight, low voltage and power consumption, high reliability, long life and a series of advantages; CCD has high spatial resolution; CCD has digital scanning ability; CCD has high photoelectric sensitivity and large dynamic range [12-14].

In 1970, the first CCD was developed by Bell Laboratories in America, and CCD technology has been greatly improved in recent years. It involves the application of aerospace, aviation, remote sensing, satellite reconnaissance, astronomical observation, communications, transportation, machinery, electronics, computer, robot vision, news, broadcasting, financial, medical, publishing, printing, textile, medicine, food, photography, education, public security, home appliances, tourism and other fields.

The United States is not only the world's earliest countries to carry out CCD research, but also has maintained a leading position in the current investment in manpower, material and financial resources of the country, and application research field. Baer laboratory is the birthplace of CCD research, and maintain advantages in the CCD image sensor and charge domain signal processing research.

At present, the research papers about CCD devices are gradually decreasing, but they are increasing in production. After entering in 2000, the development of CCD technology suddenly accelerated up, the new structure of CCD continue to enter the market, and CCD's shortcomings are also improved.

B. Full Frame Transfer Type CCD

Planar array CCD is used to collect two-dimensional planar images, and common structural type are full frame transfer type CCD(FFCCD), frame transfer type CCD(FTCCD), and so on.

FFCCD has the simplest structure, which is easy to make and operate. FFCCD consists of parallel CCD transfer register, serial CCD transfer register and photosensitive signal output amplifier. The image is projected onto an imaging plane formed by a parallel array. The column signal of the generated image is transferred in parallel to the serial register, and then transferred from the serial register to the serial data stream. Because parallel registers are used for image sensing and image reading, mechanical shutter or synchronous start signals are required to ensure image integrity.

C. Frame transfer type CCD

Frame transfer CCD is very similar in structure to full frame transfer CCD. The only difference is FTCCD adds an independent parallel register, which is not sensitive. The utility model has the advantages of continuity, that does not need the shutter speed or start signal operation, so there is a faster frame rate. However, this effect is neutral, because in the process of image information transferred to the storage array, optical integration is still in progress, resulting in the image of the "shadow".
D. Interline Transfer Type CCD

ITCCD is designed to overcome the shortcomings of FTCCD, shown in Fig.4. It separates the photosensitive and readout functions by forming an isolated photosensitive region between non photosensitive or shaded parallel readout CCD columns.

The main drawback of ITCCD is that its complexity leads to higher production costs and lower sensitivity. The decrease in sensitivity is due to the decrease in the photosensitive region of each pixel. In addition, the quantization error is also increasing. Some of them use photosensitive diode ITCCD will produce image lag [15-18].

E. Spectral Response Characteristic

CCD has the spectral response characteristics of a typical photodiode, when the wavelength of incident light is greater than the cutoff wavelength, the incident photon energy is not powerful enough to make the electronic transitions on the silicon substrate in the valence band to the conduction band as charge carriers, which has no influence on optical flow.

Because the CCD surface is covered with a transparent electrode composed of multilayer structure, it will produce larger reflection and interference effect, making the low quantum effect of CCD.

F. Photoelectric Conversion Characteristic

The signal charge package stored in the CCD photosensitive unit is absorbed by the incident photon and converted into a minority carrier. Therefore, it has good photoelectric transfer characteristics.

G. CCD Image Sensor and its Driving Module

In this section, we introduce ICX205AL designed by Sony. The diagonal length CCD of 8mm, is an interline transfer CCD, with 1.45M effective pixels, and has the advantages of high resolution, high sensitivity, fast moving speed, low dark current, image distortion etc. An electronic shutter is arranged in the chip, and the flexible exposure time control can be realized without the mechanical shutter.

The chip consists of four main parts: the photosensitive array, the vertical shift register, the horizontal shift register and the output amplifier. In order to make the planar array CCD work properly, 8 coordinated timing signals must be provided. The specific circuit design of the module is as follows:

In order to achieve the requirements of system design, the subject of signal sampling decided to use AD's 12 bit ADC chip AD9225. The chip sampling speed up to 25MSPS, power consumption is only 280mW, using single power supply 5V; differential nonlinear error is 0.4LSB, linearity is very good; signal to noise ratio of up to 71dB.

In addition to the use of internal voltage references, the chip also allows the selection of an external reference level. Chip design not only uses a multi-level differential transmission structure, but also uses digital output error correction system, which ensures the system can still provide accurate resolution of 12 bits in high speed. All internal conversion cycles are controlled by a single clock input, making the conversion process as strict as possible [19-22].
III. TRACKING TECHNIQUE

The target tracking system in multi camera environment also includes the following technologies: target matching and target handover technology, camera calibration technology, etc. Target handover technology is the only target to determine tracking in the field of multiple cameras with overlapping or no overlap. Target handover technology is generally divided into two categories: overlapping target technology with overlapping vision and target handover technology without overlapping vision. Target handover technology with overlapping visual field mainly includes feature fusion, 3D information, queue, vision boundary and target model handover algorithm. In the non overlapping camera environment, target matching, camera calibration and feature fusion are used to accomplish the target handover.

A. Cooperative Scheduling Technology

In recent years, multi camera system has gradually become the focus of research. Now, with the continuous progress of technology and the gradual decline in hardware costs, multi camera system research has not been limited to simple target handover. The camera network based on distributed system and embedded system is becoming the research hotspot. Camera cooperative algorithm plays an important role in improving the resource utilization and robustness of the system.

Because the monitoring system is a complex system based on multi techniques, the following techniques are also introduced in this article.

Machine learning is a very active research field. Some representative algorithms include Adaboost proposed by Freund Y and Support Vector Machine.

B. Gauss Background Modeling

Gauss background modeling is a common background modeling technology. Gauss mixture model is insensitive to light change, but has good adaptability to complex background. Gauss background modeling is based on the observation value of spatial pixels. The probability density function of the point is as follows:

$$\eta(x, \mu, \delta) = \frac{1}{\sqrt{2\pi}\delta} \exp \left( -\frac{(x-\mu)^2}{2\delta^2} \right)$$  \hspace{1cm} (1)

The pixel value and the threshold are used to determine the foreground and background. The probability density function of the pixel is:

$$f(I_i = u) = \sum_{i=1}^{N} w_i \cdot \eta(u, u_i, \delta_i)$$  \hspace{1cm} (2)

where $i$ represents the $i$-th Gaussian model. When a new video frame is received, the following formula is used to update the Gauss parameter:

$$w_i = (1-\alpha)w_{i-1} + \alpha$$  \hspace{1cm} (3)

$$u_i = (1-\rho)u_{i-1} + \rho I_i$$  \hspace{1cm} (4)

$$\delta_i = (1-\rho)\delta_{i-1} + \rho (I_i - \mu_{i-1})^2$$  \hspace{1cm} (5)

$$\alpha \in [0,1]$$  \hspace{1cm} (6)

In general, $\alpha = 0.03$. Figure 7 shows the effect of Gauss background modeling.

Gauss background modeling can effectively separate the background and foreground.

C. Codebook Modeling

Codebook background modeling is also a method to distinguish foreground and background through time series. Codebook algorithm uses quantization technology to set up a codebook for each pixel in the video and cluster these pixels into a codebook set. For each pixel, the number of codebooks is different. The cluster of codebook does not need any Gauss distribution or other distribution correspondence. Compared with Gauss background modeling and inter frame difference, the cost of background modeling is larger.

D. Moving object detection technology

The aim of target detection is to control the area of target detection on the target moving area when the background and foreground are distinguished. Compared
with the background modeling technology, the target detection technology is more concerned with the moving area of the target. Based on the background modeling, the target detection further extracts the information in the image and further reduces the detection range. Due to the increasing demand for detection effect, good detection algorithm should be robust under illumination change, camera shake, environmental interference and so on.

E. Mean Shift Theory

The mean shift algorithm is derived by using the gradient derivation of the probability density function of the pixel feature point, which is a nonparametric probability density estimation method. The mean offset is defined as:

$$M_s(x) = \frac{1}{k} \sum_{i \in S_k} (x_i - x)$$  \hfill (7)

where $S_k$ is a high-dimensional sphere area, shown in Fig. 9.

Some common kernel functions are shown in Table 1.

<table>
<thead>
<tr>
<th>Function</th>
<th>One dimensional expression</th>
<th>Two-dimensional expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit kernel function</td>
<td>$K(x) = 0.5U(-1,1)$</td>
<td>$K(x) = \begin{cases} 1, &amp;</td>
</tr>
<tr>
<td>Gauss kernel function</td>
<td>$N(0,1)$</td>
<td>$K(x) = \frac{\exp(-\frac{</td>
</tr>
<tr>
<td>Epanechnikov</td>
<td>$K(x) = \frac{3}{4}(1-x^2)$</td>
<td>$K(x) = \begin{cases} 1-</td>
</tr>
<tr>
<td>Bi weight</td>
<td>$K(x) = \frac{15}{16} \left( 1-x^2 \right)^2$</td>
<td>$K(x) = \begin{cases} (1-</td>
</tr>
</tbody>
</table>

For the sampling points themselves, it is also possible to set different weights, thus we have:

$$M_s(x) = \frac{\sum_{i=1}^{n} G_{H}(x_i - x)w(x_i)(x_i - x)}{\sum_{i=1}^{n} G_{H}(x_i)w(x_i)}$$  \hfill (8)

Where $G_{H}$ can be calculated as follows:

$$G_{H}(x_i - x) = \frac{1}{h^2} G\left(\frac{H^{-1/2}(x_i - x)}{h}\right)$$  \hfill (9)

Therefore, we have:

$$M_s(x) = \frac{\sum_{i=1}^{n} G_{H}\left(\frac{x_i - x}{h}\right)w(x_i)(x_i - x)}{\sum_{i=1}^{n} G_{H}\left(\frac{x_i}{h}\right)w(x_i)}$$  \hfill (10)

F. Particle Filter Tracking Algorithm

Particle filtering is a typical example of a top-down tracking approach. The benefits of this approach are to maintain multiple states of the target, such as location, size, etc. Particle filter outperforms the mean shift algorithm in many respects. Particle filter can make the tracking algorithm more robust by designing different observation models. The research on particle filter and correlation fusion is one of the hot research directions.

IV. TARGET HANDOVER AND DATA FUSION TECHNOLOGY

Target handover and data fusion technology among multiple cameras is one of the key technologies for multi-camera system tracking. Target handover is often based on target matching. At the same time, data fusion is based on the target matching, so a good target matching method is the basis of handover and fusion.

Target handover technology mainly solves the problem of target matching and confirmation. We divide the target handover techniques into two categories: target handover with overlapping regions and target handover with non-overlapping regions. On the basis of target matching information, data fusion technology further extracts effective information. Data fusion theory includes Bayesian estimation, D-S theory, neural network, etc.
To keep a high quality tracking for a target in a region, the camera cooperative scheduling technology is indispensable. Camera cooperative technology has been developed from target handover and target matching to the overall optimization strategy of camera network. As a hotspot in the past two years, camera network attracts more and more attention. The main structure of the camera network is divided into three types, centralized type, distributed type, and camera clusters.

![Fig. 11. Schematic diagram of camera network structure.](image)

Covariance matrix, as a two order statistical feature, provides a natural representation for any number or arbitrary class of image sets. Since the covariance matrix can handle random and distributed hypotheses, it is not necessary to make any assumptions about the data distribution in the image set. In addition, covariance matrix also has strong ability of anti noise.

Multi camera network is becoming more popular in daily life. These sites have some common features, their tracking targets are persons, and involves a large number of video surveillance cameras. The tracking problem, the single camera tracking algorithm, the target handover algorithm, network communications and data compression algorithms are great challenges. A good multi camera cooperative control algorithm has a great effect on the effective use of cameras and network resources to improve the overall performance of the system. For a multi camera monitoring system, with the increase of system flexibility, the uncertainty of the system is greatly improved. Generally speaking, multi camera system usually value the following aspects of performance.

From the point of view of spatial distribution, there is an obvious difference between the target and the non target object. From the continuity of time, the degree of differentiation between the target and the non target object also has some relevance. As an important part of computer vision, target tracking algorithm has a very important application in video surveillance, human-computer interaction, intelligent navigation, artificial intelligence and other research fields. Although in recent years, the field of visual target tracking technology has made fruitful research results, but there are still some difficulties in the actual tracking scene. This paper proposes an idea based on image set, and provides a new way of thinking for the research of target tracking, and integrates the idea of image set into two frameworks to realize robust visual object tracking.

V. DEVELOPMENT OF SMT PROCESS MATERIALS

Commonly used SMT process materials include: strip solder, paste solder, flux, thinner and cleaning agents, etc. With the increase of the installation density of the circuit, the surface mount component replaced by the traditional hole inserting device has become an inevitable trend. At present, SMD is developing in two opposite directions, namely miniaturization and large-scale. Mounting is to accurately assemble the surface mount elements to the corresponding pad positions on the SMB board. There are two commonly used methods of manual placement: manual method and vacuum suction technique.

At present surface mount technology has become the mainstream installation technology of electronic products, but SMT equipment is pretty expensive due to its complex operation and maintenance. However the cost of SMT is very low, so it has good application and development prospects. The surface mount technology proposed in this paper is simple. We use SMT welding technology to analyze its process flow and process parameters.

VI. CONCLUSION

In this paper, we introduce the principle, manual method and characteristics of surface mount technology, and provide the manufacturing using method of manual operation equipment for surface mount technology. Computer vision is widely used in military, medical, security and many other fields, and video surveillance is one of the hot research directions.

The development of modern technology is not satisfied with the single camera system, therefore, multi camera system and even the camera network are gradually developed. While bringing wider application space, multiple cameras pose greater challenges as well. In addition to a series of algorithms in a single camera, the multi camera system also includes the theory and algorithms of target handover, target matching so on. This paper studies the target tracking algorithm, target matching handover algorithm and multi camera network cooperation framework in the multi camera environment. In a word, multi camera tracking technology is a comprehensive research direction of fusion of various image processing technologies, which has strong application value and theoretical value. This paper introduces the research significance of multi camera tracking, and briefly summarizes the research and development trend in this research field.

Nevertheless, single camera tracking algorithm still needs further research and optimization. There are many problems that need to be optimized and improved for target handover in multi-camera environment. For instance, target transfer algorithm in complex environment need to be improved, and target data fusion method need optimizing as well.

REFERENCES


