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Micro Components Detection Using Deep Learning

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Abstract: *Industries have to manufacture products in large scale with respect to time in order to compete others but while producing small electronic components goods in bulk where it is automated at some point. Sometimes due to malfunction in automation it produces defects in product which impact negatively in some percentages of production. So, we propose them with our project which will identify the product before getting out of manufacturing unit surveillance camera's with highly trained model to specific task in detection can opt out defects from it. After placing them in required position they detect the products with defects or for particular detection which will make manufacturer hectic & complex work easy especially detecting micro components in it. In can be also cost reduction as we use raspberry pi. Infact all small industrial markets were facing issues to defects detection in small parts of electronic item like semiconductor with mobility devices. Are article is proposing a defect detection algorithm for micro components that are based on a single short detector network (SSD) and deep learning.*

Keywords: Real Time Detection Issue, Deep Learning, Convolution Neural Network (CNN), Machine Learning

I. INTRODUCTION

In today's age Human efforts in only working hard is not enough to achieve required results. Let say there are tiny parts in semiconductor board and goal are to find out any bend or any part of it in unusual shape human eyes has limited range with limited period of time to detect such things when it's moving out of recognising speed. Training computer system with the help of AI technologies which includes machine learning, deep learning will make it reliable in achieving those result. So let us begin with it automatic defects detection technologies have obvious advantage over manual detection but there is a cache the speed (MS) & mAP (mean, average, Precision) of a model decide their value worthiness of it also known as accuracy of model Of Course those things impact to reduce cost, improve efficiency and quality in production.

The dataset should contain proper set of labelled images that should help in devising a proper technique getting used by the system to train various objects [1]. The model we are going to use is lite weight which is purposefully means for working in small environment simple fundamental of all existing model is more time to detect means more accuracy in identifying and the lesser time in detecting means less accuracy in identifying object even though significant efforts have been dedicated to designing and structuring in improving mobile CNNs on all dimensions there are some other technologies also like thermal imaging technologies are widely used in many industrial areas. It was possible to build networks with very deep architectures and increase the layers to more than a hundred [3].

When building object detection networks, we normally use existing network architecture, such as VGG or ResNet, and then use it inside the object detection pipeline. The problem is that these network architectures can be very large in the order of 200-500MB [5]. Focusing on the comparison of results obtained with commercially available non experimental IR methods to provide references for the cameras in the field of non-destructive defect detection. Those things aren't applicable to all due to negative effect on product will detecting it.

Due to object detection's close relationship with video analysis and image understanding, it has attracted much research attention in recent years [2]. Defect detection technology is a trendy topic in the research and development sector. However, they have yet to accomplish product defect types for example steel body covered the main detection techniques,

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summary of applications of defect detection technology, existing equipment for defect detection, and other prospects. This paper is focusing on detecting 2D dimensions electronic pictures with accuracy and not so heavy in used.

II. Literature Review

There are many defect detection methods such as machine vision, YOLO v2, ultrasonic detection. For machine vision detection, the development of components for machine vision system such as vision sensors and underlying vision software requires a huge amount of investment cost. The limitation of early artificial intelligence was also criticized due to the difficulty in handling non-linear problems, such as XOR (or XNOR) classification [14]. For YOLO v2, it struggles to detect and segregate small objects in images that appear in groups, as each grid is constrained to detect only a single object. It is also characterized by not so good accuracy when compared to much slower object detection algorithms like RCNN. For ultrasonic detection, parts that are irregular in shape, rough, very thin or small, or not uniform are not easy to inspect. OddFormations: Rough surfaces, small objects, and curved items will lead to alignment issues. A wheel probe scanner is also best option for curve objects, which has above average accuracy for surface defect detection [15]. The errors increased as the defect depth increased. proposed and applied a damage index that is based on the virtual field method that detect the defects of electronic products. Even so, the index is sensitive to change the properties, such as stiffness. Applying the latest method for defect detection of electronic products, various tasks should be done to extend the current research scope to the defect detection of curved surfaces. The challenge brought by the complexity of trailing pulses to ultrasonic detection, the focusing method of trailing pulse was suggest to improve the accuracy of defect by theoretical deducting the characters of trailing pulses. CNN is composed of different layers, including data input layer, convolution layer, activation layer, pooling layer and fully connected layer [13]. The disruption of defect detection and without defects were taken as the measure of test data obtained at 88.07% accuracy with use of semi supervised machine learning and convolutional neural network (CNN) did achieve automatic aperture detection. The core of SSD is predicting category scores and box offsets for a fixed set of default bounding boxes using small convolutional filters applied to feature maps [10]. Therefore, its proved that deep learning technology was better than the traditional template matching technology.

III. Proposed System

In the Proposed System, we are going to detect objects (microelectronics component) in real time with the help of SSD MobileNet V2 Fpnlite model in fast and efficient way. We will create the Python script in jupyter notebook. Firstly, creating virtual environment which is recommended way to execute those tasks. This will isolate all of our python dependencies and ensure that we have a clean working environment its sophisticated way to work with those things or we can say as per requirement best suitable work flow. It also makes sure that it doesn't conflict with all of the different libraries and dependencies that you have already got installed inside of your system. Now in total there are five steps which includes collections of images, labelling those images, training custom model, testing those images, detecting those images in real time. A] collect numbers of specific images (in our case collection of all microelectronics images) at least four images of single component are required. B] label the collected images in correct manner because (it's very crucial stage to label them in convenient because while detecting in real time it can shows wrong label image). C] training system many times so while detecting image accuracy increases (It will follow the whole pipeline which is design in our model). D] testing it after the model is trained with few images and also in real time. E] finally, it is ready to deploy in any low level computing system performing live image detection. Key points while training After testing the trained model evaluate it through the tensor board in which we will able to recognise how well it is trained with percentage of mAP. The key is longer you trained the model the better it gets. If the model is not precise as you were expecting then load it with more label images with different angle and increase steps of training. Tuning this will increase significant then previous model. The key components to build up this project is also brief below such as Python, SSD MobileNet, OpenCV. Some sample of images with detected defects in them is shown below figures.

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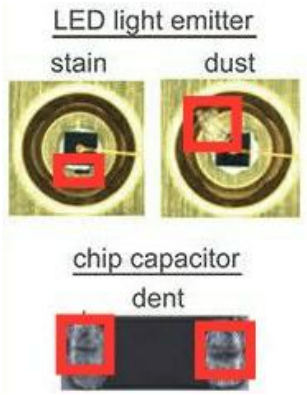

Figure (1): Defects detected in LED light emitter & Chip capacitor

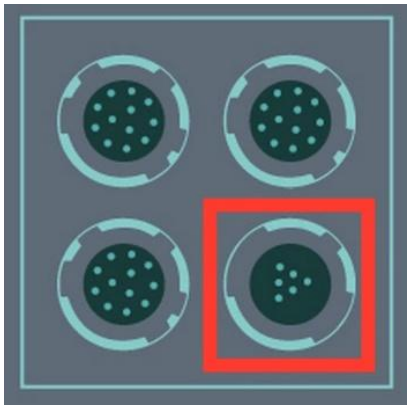

Figure (2): Defect detected in missing connector

Figure (3): Defect detected in open solder joints

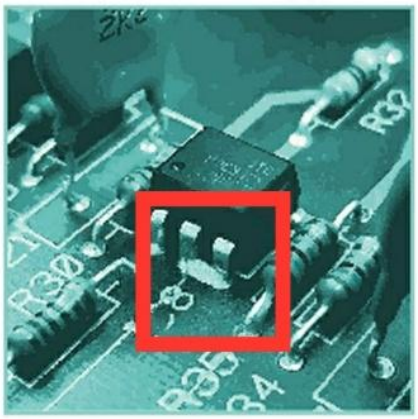

Figure (4): Defect detected in solder bridging

3.1 Python

It is best because of huge numbers of libraries are present and well maintain which makes sophisticated programming for programmer especially in field of ML & DL. Zero confusion remains of errors or conflicting and this leads to more accuracy in such complicated task. Achieving such big goals can definitely enables to unlock your upskills in coding. It simplifies the implementation of different functionalities or branches of program in absolute manner. It is like using better or perfect tool for productivity. Another key feature is that python is also very worthy for collaborative implementation when multiple programmers are concern.

3.2 SsdMobileNet V2 Fpnlite

The model we are using is got a bit of a balanced in terms of speed and precision. These model architecture matrices are based on a popular object detection dataset called COCO. Architecture of SSD is shown below in Fig, (a). So, it is basically going to run each frame in 22 millisecond and also ideally you want this number to be the lower the better and it's to have a mean average precision of 22.2 millisecond so again it's reasonably balanced. It is bit of trade-off here certain model architecture can be fast and can be even more accurate as well and there are many such amazing models. But in order to deploy them in low level computing systems it will have a bunch of different problems.

So, to optimizing speed right because a phone or raspberry pi isn't going without any acceleration or either going to perform fast as it's indicating. Therefore, we wanted to choose the model which is already really lightweight and it's going to be able to run fast and accurate. The backbone of this model is actually going to compress our image from given pixels to 320 by 320 when we actually pass it through. This technique is called pre-processing to compress that down to

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as already told by above pixels and then in post-processing it's going to convert it back to the original resolutions. This is one of the advantages of TensorFlow object detection model another thing is that it uses a bunch of technique called image augmentation.

So, it might darken your image or your image might be shift in it or even might be flip all four side it's also annually boosting the ultimate goal of performance. Well on top of this fpnlite add the fulfillness. Feature Pyramid Network (FPN) is a feature extractor designed for such pyramid concept with accuracy & speed. It replaces the feature extractor of detectors like Faster R-CNN and generates multiple feature map layers (multi-scale feature maps) with better quality information than the regular feature pyramid for object detection. Processing multiple scale image is time consuming and the memory demand is too high to be trained end-to-end simultaneously. Hence, we may only use it in inference to push accuracy as high as possible but with some limits of it due to lite version of it is used over here.

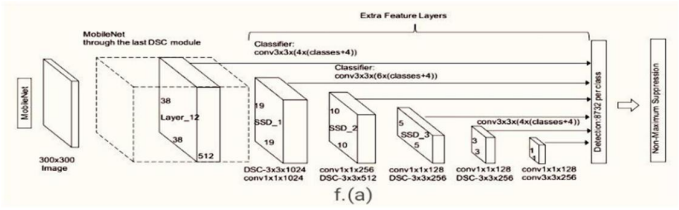

Figure: (a) SSD MobileNet Architecture

3.3 OpenCV

Open source computer vision a common library use for image processing, video analysis, feature detection, machine learning, object detection and much more. It's a tool that supports python, C++, java it is essentially use for above all processes. It is mainly aims at real time computer vision. Its library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and art of computer vision and machine learning algorithms.

IV. CONCLUSION

We proposed a real-time micro part defect detection system for manufacturing using an end-to-end CNN algorithm. We were amazed by how fast it was recognising after tuning the model. While training try to use images capture by camera which is use while detecting it or try to use camera with higher resolutions. This will help a lot to increase the performance of it. The whole process of deep learning is in constant evolving progress in better and great ways in today's world as technologies always do. There are also bunch of different pretrain models. But as per requirements we have to balance it with the technique to fulfil it. And always set first priority to train model in google colab. As training the model on normal computer system will take significantly more time.

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