Label Inspection System Using Machine Learning

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Abstract- A label on any product is important for product detail provided by the manufacturer. Therefore, identification of any defects in the label is one of the important processing stages in the industry, in such as label prints, type error, angle of pasting the label and automatically rejects the product from the packaging line. A software framework that collects camera images, associatesthese images to individual objects and executes inspection modules to actually evaluate the images. A label with the different specification is taken and the images are evaluated using Machine Vision algorithm and the results are found satisfactory. The experiment results are presented and discussed.

Index Terms- Label inspection, Raspberry pi, Convolutional neural network, camera module.

I. INTRODUCTION

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs and take actions or make recommendations based on that information. IfAI enables computers to think, computer vision enables them to see, observe and understand Label inspection systems are used to check print quality, control the production process and verify labels with variable data.

While automatic labeling is fast and efficient, problems may sometimes appear. The labeler is the primary device used for a label application, and it may be automatic or semi-automatic. Product labeling is a special carrier related to product information, corporate culture and image, so its importance is becoming more and more important in people's growing consumer demand. In the past, the standard label comparison method was used to evaluate the appearance of the product label. The method is subjective and compares the label to be tested with the defect-free label by visual measurement under standard lighting conditions. Due to the influence of human factors, it is easy to produce errors by using this method for experiments. It is very difficult to find misaligned labels and stickers in large number manufactured parts and products. Therefore, objective evaluation of label performance, such aslabel scratches and wrinkles, has become essential. The surface of the label with defects such as scratches and wrinkles has a significant curvature change, which can be used as an important feature for detecting label defects. So, using machine learning's different algorithm we are going to make label inspection system.

II. OVERVIEW OF THE EXISTING SYSTEMS

The main purpose of this work is to make cost effective model to detect misaligned label.

[1] In this paper, the product label is taken as the research object, and two kinds of defect labels with scratches and wrinkles are collected. Tag defect detection is implemented using HALCON and C# hybrid programming. Then compared the accuracy of the label wrinkle defect, wherein the accuracy is the ratio of the defect extracted by the three-dimensional reconstruction technique to the total defect image. It can be seen from the figure that the accuracy of the algorithm used in this paper.

[2] This paper proposes a deep learning solution for optical character recognition, specifically tuned to detect expiration dates that are printed on the packaging of food items. and they showed that the proposed method offers a 9.4% accuracy improvement over using real images alone.

[3] This paper presents LabVIEW based label inspection using Machine Vision algorithm. A software framework that collects camera images, associates these images to individual objects and executes inspection modules to actually evaluate the images. In result he found 97% accuracy.

[4] In this paper, a label inspection scheme is proposed using the idea of image hashing. Many algorithms have been proposed to find correspondence between images. These algorithms have been used in a wide a range of applications like object tracking. Convolutional Neural Networks (CNN)s are developed the scheme named Multi-Level Supervised Hashing (MLSH) with deep features. Experimental results show that the proposed technique achieved an accuracy of 90.12%.

[5] This paper, the current development of a high-speed, visual inspection. The current implementation of the label inspection algorithm runs completely on the Bi-i system. During the inspection process the system takes an image from the labelunder test and compares it to the reference data. According to result, the system achieves a very low false alarm rate (i.e. indicating errors incorrectly). This means that there are only a few false stops in an hour, i.e. up to 5 at 144,000,0 samples.

III. SYSTEM OVERVIEW

This design uses a low-cost hardware and open-source software for achieving the goal. Raspberry Pi 3 and a computer are used as the controlling unit. A Computer vision system is designed and implemented for the detection of stickers and their correct position according to the different type of product. System deal with Label and Print Quality, Graphical Identification and Positioning of labels. System uses previously available images for classification. Using Convolutional neural network (CNN) we can classify correct and incorrect labeled products. System detects issues like tearing, wrinkling, flagging, or peeling of labels/stickers. we will speed up the process in real time.

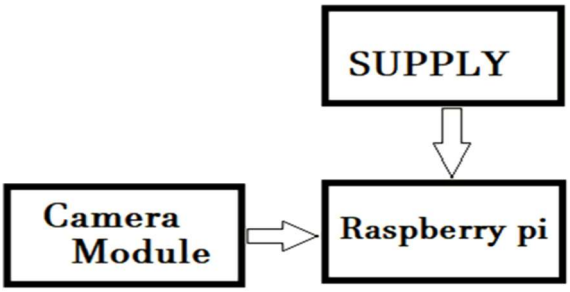

Fig.1 Block Diagram

In this project fist we captured images using camera module. Then by using those images we trained & tested our model, suppose if we have 1000 images we will use 800 images for training purpose and 200 images for testing purpose. After training and testing completed. We validated the result. In that we found that the different between ideal output and actual output. When we trained our model their we got ideal output and when we tested our model their we got actual output and different between them that is error. And we are decreased that error. So this is the block diagram of our project. In our project main components are raspberry pi,camera module , CNN.

We have collected images using camera module and then we have tested it using Raspberry Pi. A software framework that collects camera images, associates these images to individual objects and executes inspection modules to actually evaluate the images. A label with the different specification is taken and the images are evaluated using Machine Vision algorithm and the results are found

Components required:

[1] Raspberry pi4: Raspberry Pi is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towardsthe promotion of teaching basic computer science in schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring, because of its low cost, modularity, andopen design. It is typically used by computer and electronic hobbyists, due to its adoption of the HDMI and USB standards.

automation, robotics and connected objects.

[2] Camera Module: The Raspberry Pi camera module can be used to take high-definition video, as well as stills photographs. It's easy to use for beginners, but has plenty to offer advanced users if you're looking to expand your knowledge. There are lots of examples online of people using it for time-lapse, slow-motion and other video cleverness. You can also use the libraries we bundle with the camera to create effects. If you're interested in the nitty-gritty, you'll want to know that the module has a five-megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA90 video modes, as well as stills capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Pi-camera Python library. The camera module is very popular in home security applications, and in wildlife camera traps. You can also use it to take snapshots.

[3] CNN : Convolutional Neural Network (CNN) is a type of Deep Learning architecture commonly used for image classification and recognition tasks. It consists of multiple layers, including Convolutional layers, Pooling layers, and fully connected layers. The Convolutional layer applies filters to theinput image to extract features, the Pooling layer down samplesthe image to reduce computation, and the fully connected layer makes the final prediction. The network learns the optimal filters through backpropagation and gradient descent. It is assumed that the reader knows the concept of Neural networks. When it comes to Machine Learning, Artificial Neural Networks perform really well. Artificial Neural Networks are used in various classification tasks like image, audio, words. Different types of Neural Networks are used for different purposes, for example for predicting the sequence of words we use Recurrent Neural Networks more precisely an LSTM, similarly for image classification we use Convolution Neural networks. In this blog, we have build a basic building block for CNN. Before diving into the Convolution Neural Network, let us first revisit some concepts of Neural Network. In a regular Neural Network thereare three types of layers: Input layer, hidden layer, output layer.

IV. SOFTWARE/ TOOLS USED

Jupyter Notebook : The Jupyter Notebook is an open sourceweb application that you can use to create and share documentsthat contain live code, equations, visualizations, and text. Jupyter Notebook is maintained by the people at Project Jupyter. Jupyter Notebooks are a spin-off project from the IPython project, which used to have an IPython Notebook project itself. The name, Jupyter, comes from the core supported programming languages that it supports: Julia, Python, and R. Jupyter ships with the IPython kernel, which allows you to write your programs in Python, but there are currently over 100 other kernels that you can also use.

[2] Python3.10: Python is commonly used for developing websites and software, task automation, data analysis, and data visualization. Since it's relatively easy to learn, Python has been adopted by many non-programmers such as accountants and scientists, for a variety of everyday tasks, like organizing finances. Writing programs is a very creative and rewarding activity, says University of Michigan and Coursera instructor Charles R Severance in his book Python for Everybody. "You can write programs for many reasons, ranging from making your living to solving a difficult data analysis problem to having fun to helping someone else solve a problem.

[3] Keras : Keras runs on top of open source machine libraries like TensorFlow, Theano or Cognitive Toolkit (CNTK). Theano isa python library used for fast numerical computation tasks. TensorFlow is the most famous symbolic math library used for creating neural networks and deep learning models. TensorFlow is very flexible and the primary benefit is distributed computing. CNTK is deep learning framework developed by Microsoft. It uses libraries such as Python, C#, C++ or standalone machine learning toolkits. Theano and TensorFlow are very powerful libraries but difficult to understand for creating neural networks. Keras is based on minimal structure that provides a clean and easyway to create deep learning models based on TensorFlow or Theano. Keras is designed to quickly define deep learning models.Well, Keras is an optimal choice for deep learning applications.

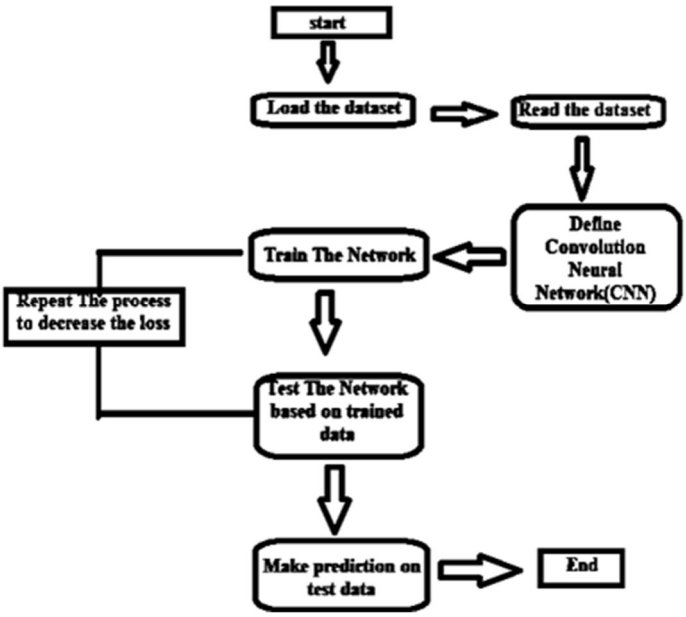

Fig.2 Flow chart of face recognition

[4] OpenCV: It is the huge open-source library for the computer vision, machine learning, and image processing and now it plays a major role in real-time operation which is very important in today's systems. By using it, one can process images and videos to identify objects, faces, or even handwriting of a human. When it integrated with various libraries, such as NumPy, python is capable of processing the OpenCV array structure for analysis. To Identify image pattern and its various features we use vector space and perform mathematical operations on these features.

[5] NumPy: In Python we have lists that serve the purpose of arrays, but they are slow to process. NumPy aims to provide an array object that is up to 50x faster than traditional Python lists. Toidentify facial features, all you need to do is load the image into a NumPy array again using load_image_file() and then pass the array to face_landmarks() This will return a Python list containing the a dictionary of facial features and their coordinates.

[6] Pydrive: The python3-pydrive package provides Google Drive API Python wrapper library for your scripts and apps written in Python version 3. It simplifies OAuth2. 0 into just a few lines with flexible settings. For example, you can wrap Google Drive API into each resource class to make your programmore object-oriented. It allows you to easily upload, download, and delete files in your Google Drive from a Python script.

V. SAMPLE RESULT & DISCUSSION

Our algorithm is capable of clearly classifying the products with defective label as against the products having non-defective label. As a sample example, one of each category is shown in figure below.

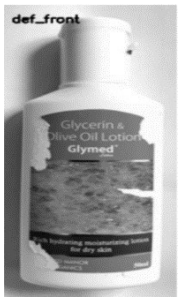

Fig. Defective label

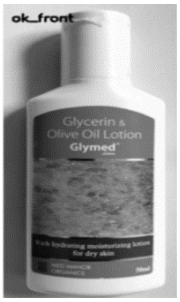

Fig. Perfect label

V. CONCLUSION

By this project work, we have built prototype model of Label inspection system. As we researched, there are very difficult to find misaligned labels and stickers in large number manufactured parts and products. So, we have tried to implement model such that it can find minor misaligned labels i.e. we cannot see it with naked eyes. In the manual placement of the stickers after the injection of the pieces, errors occur due tothe different types of pieces. There are Lack of easy-to-use tool to distinguish between properly aligned and misaligned stickers and labels. We have made cost effective and easy to use model.

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