

# Manufacturing defect detection in ceiling fans by using image processing

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## Abstract

The detection of defects during manufacturing of ceiling fans will help fan industries to identify whether all parts of the fan are present or not, like the proper winding in the armature axle, attachment of capacitor, etc. by using image processing and machine learning. Right now fan industries are using color detection system so that there is no difference between colors of the blades. According to our survey, there is no system to detect defects during manufacturing process of fans.

**Keywords:** Image defect, fan ,manufacturing , detection , recognition

## Introduction

This paper is about the manufacturing defect detection in ceiling fans. Ceiling fans are the mechanical devices that use electricity, suspended from the ceiling of a room and uses hub-mounted rotating blades to circulate air. There are different types of ceiling fans such as:

- Cast-Iron ceiling fans.



- Direct drive ceiling fans.



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- 0 poles induction “Pancake” motor ceiling fans.
- Stack-motor ceiling fans. Friction type ceiling fans.
- Gear drive ceiling fans.
- Internal belt drive ceiling fans.
- DC ceiling fans.
- Hugger ceiling fans.
- Bladeless ceiling fans.
- Synchronous motor mini ceiling fans, etc.

Generally, fan has following parts---

- Electric motor.
- Blades.
- Blade irons which holds the blade and connect them to the motor.
- Flywheel.
- Rotor.
- Following are the mechanism for mounting the fan to the ceiling:

Ball and Socket system,  
J-hook (Claw hook) system,  
U-bolt system,

Some fans are mounted using low ceiling adapter etc. Some other components of fans vary according to model and style include:

- A downrod.
- A decorative encasement for motor.
- Switch housing.
- Blade badges.
- Assorted switches can be used for turning the fan on and off.
- Lamps, etc.

Commercial or industrial ceiling fans are usually used in offices, factories or industries. They are designed to be more cost effective and more energy effective as compared to other cooling alternatives.

A hugger ceiling fans or low profile ceiling fans are usually installed on low ceiling. Outdoor ceiling fans are designed for outdoor purposes. They are water resistant and generally do not get affected by outside temperature, weather or humidity. Mini ceiling fans are mostly used in less developed places such as Philippines and Indonesia. Orbit fans are fans that use mechanism of oscillating at 360 degrees.

So we have seen that there are different types of ceiling fans and there are different parts of it according to the style and model. Also, there are different mechanisms which are used to mount fan to the ceiling.

There can be many types of defects that can occur during manufacturing of fans like poor quality of outer covering, difference in color shades of blades in same fans, improper connections of wires, absence of any important part of fan, etc. Here we are going to discuss about missing defect. In this defect if any part of the fan is missing during the manufacturing process then this will lead to a missing defect. We are designing a system which will give an alert if there is something missing or displaced in the fan [1].

The images of fan armature axle, images of motor, images after connecting capacitor and wires are used for recognition of defect [1] [3].

## II- Methodology

In this paper we will use image recognition technique to identify defects in the product. For image recognition there are various types of algorithms and techniques that are very useful and efficient. One of the techniques used for image recognition is neural networks. This is a widely used technique used for image recognition.

Here we are going to use **Convolution Neural Networks (CNN or ConvNet)** [10] [11] which is used for image recognition. Among various algorithms of **Deep Learning** [7] CNN is one of the most popular algorithm. In this algorithm classification of tasks directly from images, videos, and sounds is done by training a model and this model learns how to perform classification. Basically, CNNs are useful for finding patterns in images for recognition of objects, faces and scenes. CNNs learn directly from image data use patterns to classify images and reduce the need for manual feature extraction [8] [10].

Those applications that demand **object recognition** and **computer vision** such as self **driving vehicles** and **face recognition** applications rely on CNNs.

The need for feature extraction is eliminated by using CNNs. For new recognition task CNNs can be retrained. This algorithm uses state of the art recognition results. For image recognition and pattern recognition CNN provide an optimal architecture. Feature identification and classification of images, video, sounds are performed by CNNs. CNNs are composed of an input layer, an output layer and many more hidden layers between them.

There are three most common layers. They are:

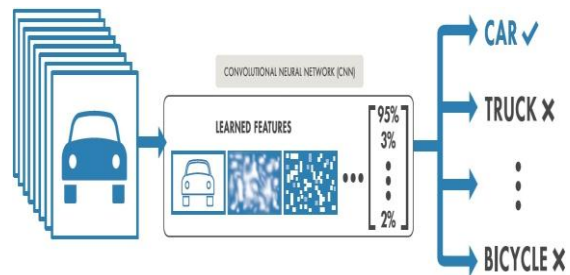
- Convolution.
- Rectified linear unit ( ReLU ).
- Pooling.

After learning features from different layers the architecture of CNN shifts to classification. A CNN is trained on hundreds, or thousands, or millions of images.

## III- Using MATLAB with a CNN-

For our defect detection system we are going to use MATLAB. MATLAB can be used with CNN. Using MATLAB with Deep Learning Toolbox enables us to train our own CNN from **scratch** or use a predefined model for

**transfer learning**. The architect has to define the number of layers, filters and other tunable parameters.



To train a model accurately from scratch massive amount of data, on the order of millions of samples is required which can take an immense amount of time. Without using a huge dataset or long computation and training time, transfer learning is a convenient way to apply deep learning. A network creating from **scratch** means network configurations are determined. This approach can produce impressive results but also requires understandings of structure of neural network.

Transfer learning requires more images for training as the new network needs many examples of the object to understand the feature variations.

## IV- Merits and Demerits-

### Merits-

- No need of skilled labor.
- As this method does not require extensive man power so less expenditure is incurred.
- This is a onetime investment method.
- System usability allows employees to use the system as a tool to complete there job rather than hinder completion of task.
- This system will help in predicting the problem.

### Demerits-

- Taking image from bad quality camera can degrade the quality of image that may not detect the defect with accuracy.

## V- Scope

If this type of image processing system is used for detecting missing defects then it will be very beneficial for industries as they can identify the incomplete part, which will save their product from being defect [4].

There are many **manufacturing challenges** in industries and one of the most common is **Skilled**

**labor** . Due to shortage of labor manufacturers are now need employees with a high tech skill set. And if they heir skilled labor then this will be more expensive for the company because they have to give salary to these employees every month. If this system is installed in the fan industry then there will be only one time investment in the installation of software , after that only one employee is needed to operate this . In this way, this image processing system is beneficial in reducing the cost .

Implementing a **machine learning based image processing tool** will help to manage predictive maintenance and analytics as well as remote monitoring can help manufacturers monitor and analyze there data in real time and predict when maintenance of an asset is required [9] .

As a result, manufacturers can think to move from repair or replace maintenance model to predict and fix model.

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## VI- Conclusion

From this paper we can conclude that by using deep learning/ machine learning with MATLAB for image processing can help fan industries in detecting defect during manufacturing of fans. With the help of this we can check whether there is any missing part or not. Right now fan industries in India are using color matching system for same colors of the whole fan. So this system will be very beneficial for improving productivity of the company.

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