Master Thesis Proposal

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Intake: WiSe-19

Study Program: Master of Computer Science,
Big Data & Artificial Intelligence

Master Thesis Topic:

A case study with renewable energy sector data analysis, a special focus on deep learning

Date, Candidate´s Signature :05/12/2022, Venkatesh Gowd Somasamudram

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Date, External/Second/Professorial Supervisor´s Signature

(In case first Supervisor is a scientific worker)

Abstract

Image recognition is the process of detecting the objects, features and classifying them. Image recognition works based on different algorithms like CNN (Convolutional Neural Network), Haar Cascade, MLP (Multilayer Perceptron) & Auto encoders. In this project, we are using Deep Learning approach to detect the objects. Gathering the data from one of the company's databases, where a vast number of images of various system components are available will be used and after initial pre-processing steps the images will be classified depending on their features (size or shape), and to check whether the detected objects' assembly meets the company standards. Later the model will be evaluated using the Recall, Precision, F1 measure and Accuracy.

Introduction

Enpal has embarked on a start-up journey to make sustainable living easier and more affordable for customers in the renewable energy market by offering a new idea of Renting solar panels instead of buying them. The idea caught the attention of the German market and led to significant growth of the organization, leading to expansion across Germany.

The customer journey begins with a sales call after registration in the portal, later many factors are considered like credit score of the client. The journey ends with the installation switching on the Solar panels and integral components of the system. Apart from the Solar panels, Enpal offers additional devices: to store the energy using Battery, Wallbox to charge the electrical cars. Initially the company used to follow the traditional approach using Excel sheets for handling the data, now as the company is expanding, they moved to Salesforce, a customer relationship management software, a common platform for all the employees in the company.

During the installation, the company follows certain protocols starting from installation of hooks on the roofs, connecting inverter, battery, meter box and finally connecting the wall box. The installation process starts from the roof of the house. It is a proven approach to start assembly from the panels. The Panels are positioned in a way to have a maximal exposure to the sun. The craftsmen start with installing hook and arrange horizontal rods parallel to each other with separation of 35cm**,** the arrangement of panels will depend on the size of the roof. Similar procedure is followed for fitting the Inverter, Battery, and Wallbox. The company uses internet connections such as mesh repeater, D-Link adapter or ethernet cable and in recent times 4G devices for the transmission of real-time energy production and consumption date, as well as other readings from the other components of the system.

The company follows a systematic approach for the customer journey. The customer journey ends after being tagged as 'closed-successful' by the Portfolio-Management department. During this stage checking the asset and monitoring if the assembling of the products meets the company standards. This stage the final control of the asset (system) is done to ensure its compliance with the company standards for example one of the pivotal stages is the installation of the system, where the risks for the company are high. To monitor this process, an installation protocol is prepared which includes detailed documentation of key activities. An installation standard was developed by the company to check if all the quality requirements are met. A full overview image data is also incorporated into Installation protocol. The images cover the roof with under structure and hooks, panels.

The manual inspection of images consumes a lot of time. Here deep learning approach is employed to solve the issue by training the model with necessary information to tackle time limitations and allow the Portfolio Management and other teams to meet their daily goals.

Problem Statement

There are minimum number of daily tasks a PM (Portfolio Management) team needs to handle which can be seen in the dashboard of the PM (Portfolio Management) team in Salesforce. The tasks often require, a manual approach that is time consuming and reduces the overall productivity.

Among others, it is the final overview of the installation protocol. The points that must be checked are e.g., if the hooks of the solar panel are arranged without touching the roof and only the edge of the hook needs to be bolted to the roof, the gap can be seen as there will be a ruler between hook and the roof. Another point of inspection could be to check the alignment of the hooks. The Solar panels are installed on the bars, these bars are fixed on the hooks, So, the placement and alignment of these hooks must be in a way that these bars could be fixed parallel to each other.

To reduce manual work and failure rate, the research aims to offer certain solution of using CNN architecture among other existing models to label the objects in the image such as hooks, screws, bolts, and wires, by use of this model to detect the objects will potentially offer a new workflow by cutting the failure rate and reducing the manual effort.

Hereby the research question of the Master Thesis can be formulated as follows:
- Can the CNN deep-learning model be used to identify the hooks on the roof and how high is the success rate.

Literature Review

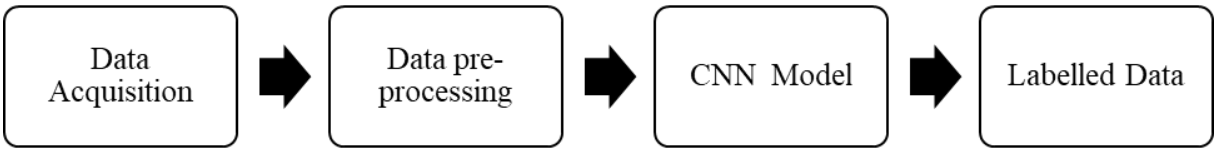
There are many publications related to the field of image recognition. With the advancement of algorithms in deep learning it is amazing how well objects in the images can detected & classified. It becomes challenging however, when it comes to application of conditions over images and when the image needs to be qualified based on given criteria.
Based on literature review there are many states of the art models to classify the objects. The most efficiently used algorithms for the detection are CNN (Convolutional Neural Network), YOLO (You Only Look Once), SSD (Single Shot Multi-Box Detector), Haar Cascade, MLP (multilayer perceptron) & Auto encoders. I have chosen to apply CNN models as it has good applicability to my research and is commonly used in the literature. In addition, I would like to apply the other models as well and compare the final results with the primary CNN model. This will help to evaluate different models.

Methodology

There are many approaches to detect the objects using Machine Learning and Deep learning. In the current scenario we do not have labels to train the models. So, we use Deep Learning approach for solving unstructured and complex issues. The initial step would be to gather the data and perform the necessary pre-processing steps, provide the labels for the Deep Learning model, and train the model to detect the objects. After the model is trained, we provide a sample to detect the objects. Now the model is evaluated using confusion matrix and this will

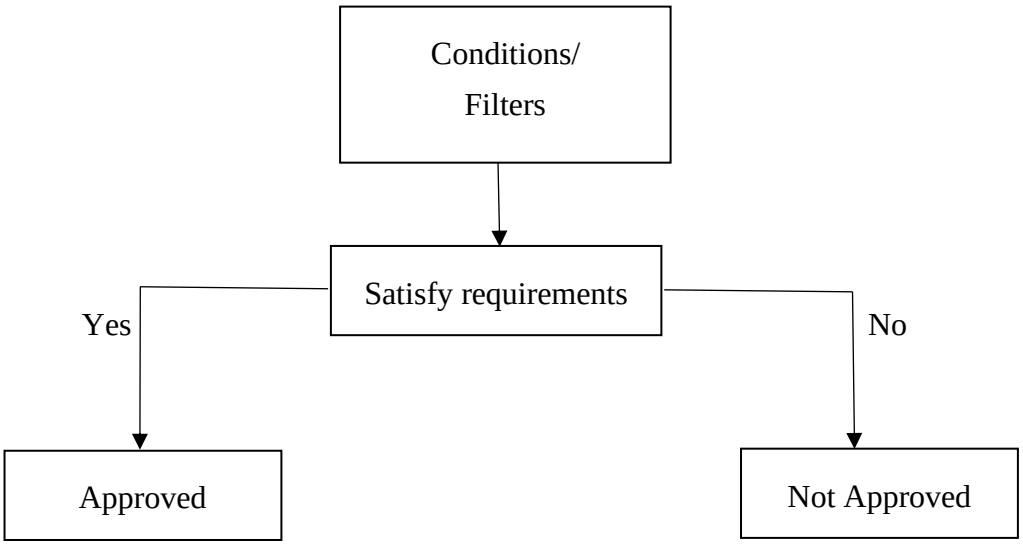
be the prime focus of the research. Later the necessary conditions or filters like alignment of the hooks over the roof, screws fixed on the wood etc., can later be specified.

Step 1: Focus of the topic is to label the data.



Step 2:

After successful completion of the first step the next step would be adding conditions for a picture.



Conclusion

Image recognition in the current generation plays an important role by helping to detect the objects, features and classify the objects in an image. Given the vast ranges of data sources, it is a time-consuming task. It is a time-consuming task to cross check every image with the company standards as approved or not. If not approved by team, it will be informed to the craftsmen which takes efforts physically and economically. Instead, Deep learning approach would save both time and human effort to classify the images into Approved or Not Approved and instantaneously giving an update to the craftsmen about any changes that must be made while they are still at the work site. This method would produce the instant results especially during when there are so many cases needs to be cleared, clarified, and approved

Timetable

Calendar week	51,52	1,2,3	4,5,6	7,8,9	10,11	12,13
Data preprocessing						
Instance segmentation						
CNN Model						
Train & Test model						
Result analysis						
Formatting/Proof reading						

References

[1] Object Detection Using Convolutional Neural Networks by Reagan L. Galvez; Argel A.Bandala; Elmer P. Dadios; Ryan Rhay P. Vicerra; Jose Martin Z. Maningo.

[2] The Real-Time Detection of Traffic Participants Using YOLO Algorithm by Aleksa Ćorović; Velibor Ilić; Siniša Đurić; Mališa Marijan; Bogdan Pavković.

[3] Real-Time Object Detection Using Pre-Trained Deep Learning Models MobileNet-SSD by Ayesha Younis, Li Shixin, Shelembi Jn, Zhang Hai.

[4] Study of object detection based on Faster R-CNN by Bin Liu, Wencang Zhao, Qiaoqiao Sun.