

# Machine Learning Engineer Nanodegree

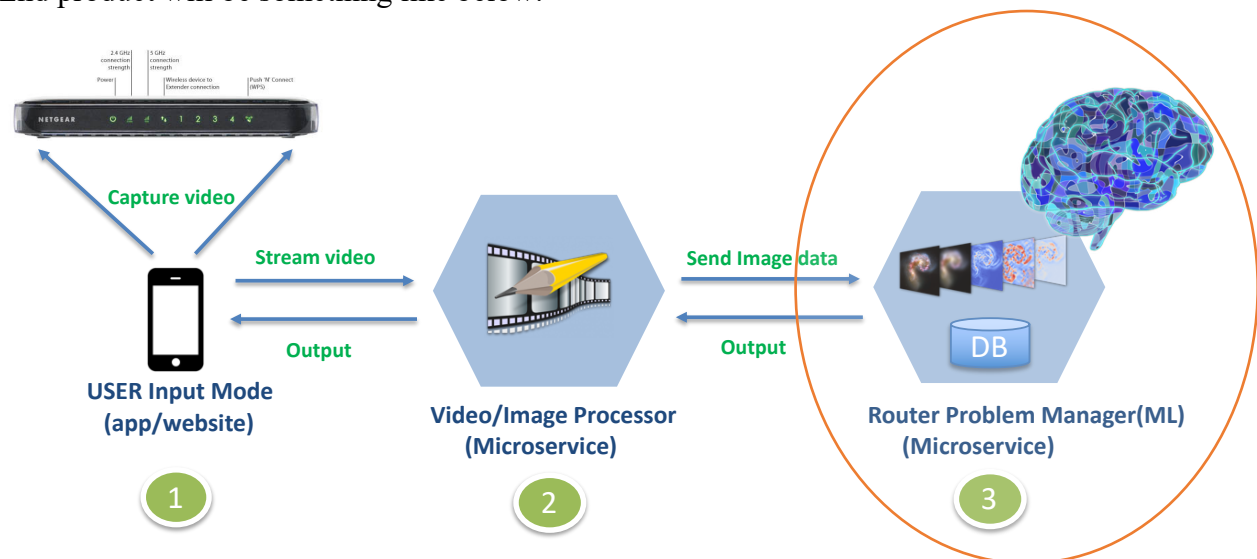
## Capstone Proposal

Ajay Singh  
Dec 17th, 2018

### Proposal

Creating machine learning based application which can capture frames from video and do analysis of that frames picture. So, what is Video about – almost everyone has internet on their home, and we use router/modem/gateways/cable boxes for getting internet connection/wifi/tv services. And we all get sometime these problems with our home devices and call customer care for that. So, my proposal is to create software which will capture a video of device (router/modem/gateways/cable boxes) and identify which lights are on/off and what color they have. Based on that data, we can decide what issue we have with that device like ethernet cable is loose or internet is not available and notify backend system to fix it or call customer care.

End product will be something like below:



I am trying to work on **module -3**, working on architecture solution for identifying network device light patterns and based on that try to resolve issue automatically without customer support.

Something related problem/solution –

[https://link.springer.com/chapter/10.1007/978-3-540-74853-3\\_16](https://link.springer.com/chapter/10.1007/978-3-540-74853-3_16)

<https://pure.qub.ac.uk/portal/files/17844756/machine.pdf>

## Domain Background

Many Telecom and Internet companies provide internet and Tv connections. Generally, devices like Modems, Routers, Gateways and cable boxes, everyone uses, and we all get issues with those. Companies pay lot of money to support customer care and need customer engagement also based on problem issues. So, it addresses those problems which can impact telecom/internet-providers/cable-providers/tv service providers.

## Problem Statement

Home Router issues like ethernet cable loose, no internet connection, wifi off etc. So customers call customer care which takes time and also some customer care support person to look and understand problem. Customers get frustrated most of the time with wait time/explanations and companies have to provide some support person on call even it is very small problem. With Machine learning we can achieve better User experience and save customer time and also save money/time for Company too.

Business Problem :

- ☐ Long wait times
- ☐ Unnecessary expensive dispatches
- ☐ Lack of digital Capabilities
- ☐ Unoptimized resource utilization

## Datasets and Inputs

Dataset :- image of 1066x150 px of device as input.

Classes image – 30x30 px power on led

30x30 px wifi on led

30x30 px internet on led

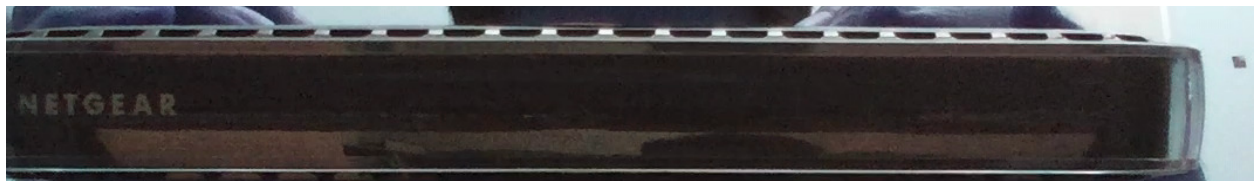
30x30 px 1,2,3,4 on led

(Going to start with 500 Data-points(for each classes imafes) of size 30\*30 and will add more, RGB 0 to 255 for each labels – **power\_on, internet\_on, wifi\_on,2.4 hz channel, 5 hz channel, ethernet port(1,2,3,4)**)

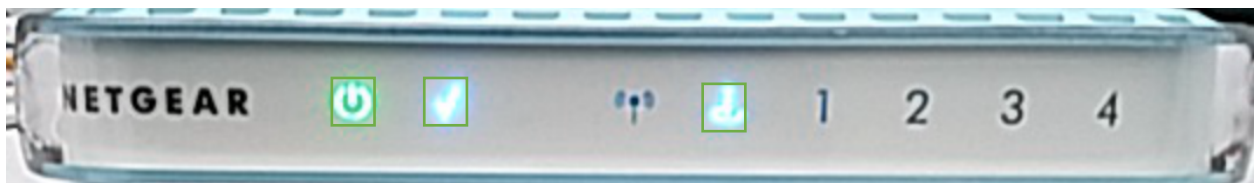
As this idea needs lot of data, I decided to try small scale proof-of-concept with two Netgear routers. Actual solutions will have several routers/gateway/cable-boxes and modems. I took many pictures with guided box as scale of 1066\*150 with different lights on/off. I divided into four categories – **power\_on, internet\_on, wifi\_on,2.4 channel, 5 channel, ethernet port(1,2,3,4)**.

Some examples of images : -

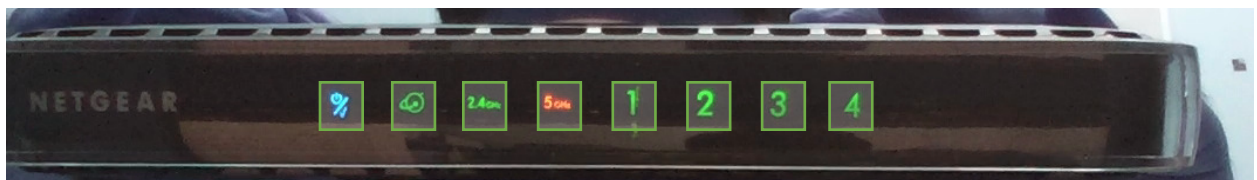
**all\_off**



power\_connect\_internet\_on



power\_connect\_internet\_wifi\_on



power\_internet\_on





## Solution Statement

Gather images as many for different status(lights) of device. Process images and create three sets – train, validate and test. Use CNN with ResNet50 model and train model with train set of images. Validate with validate set and run test cases with test sets. Measure accuracy of prediction and change CNN model designs and if necessary, try other benchmark models. Finalize model and store for future use.

I am going to start with more than 500 images per class and split them as 70%(train), 20%(Validation) and 10%(Test) data. Also, I have guided box as 1066\*150 size to get picture with boundary to avoid as much noise possible from input image, basically matching boundaries while clicking images.

I will categorize images based on which light combinations are ON and put and categorize in different input folders (four categories).

Based on the result, will try to figure out outliers problem and might be try to get more images and resize images and guided box.

## Benchmark Model

I am going to start with ResNet50 as benchmark model and will use others like VGG-16, Inception-V1, based on performance and result will try to choose model.

## Evaluation Metrics

Evaluation metrics explain the performance of a model. An important aspects of evaluation metrics is their capability to discriminate among model results. Test Accuracy and validation Accuracy will be as Evaluation metrics.

## Project Design

Developed web-based interface with guided box to capture image as 1066\*150. Then use ResNet50 model to process input data.

Define CNN model –

```
model = Sequential()

model.add(Conv2D(filters=16, kernel_size=2, padding='same',
activation='relu',
input_shape=(1066, 150, 3)))
model.add(MaxPooling2D(pool_size=2))
```

```

model.add(Conv2D(filters=32, kernel_size=2, padding='same',
activation='relu'))
model.add(MaxPooling2D(pool_size=2))
model.add(Conv2D(filters=64, kernel_size=2, padding='same',
activation='relu'))
model.add(Flatten())
model.add(Dense(256, activation='relu'))
model.add(Dropout(0.7))
model.add(Dense(4, activation='softmax'))

```

use optimizer as rmsprop, loss function as categorical\_crossentropy.

```

# report test accuracy
test_accuracy =
100*np.sum(np.array(predictions)==np.argmax(valid_targets,
axis=1))/len(predictions)
print('Test accuracy: %.4f%%' % test_accuracy)

```

Software – Python, Keras, sklearn etc.

References :- I work with AT&T and we have similar U-Verse devices requirement, project as Smart Agent, so customer can itself resolve issue with using AT&T app which basically send data to backend AI system to resolve U-Verse device issues.