**IEEE P802.15**

**Wireless Personal Area Networks**

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| Title | **Performance Enhancement of Vehicular Communication using Neural Network** |
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| Re: |  |
| Abstract | This document discusses about the BER reduction technique using neural network in mobile condition. |
| Purpose | In order to reduce the BER during the moving scenarios of vehicle, we have proposed a neural network based feature extraction technique for the reformation of the stripe pattern. |
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1. Training and testing architecture:

An neural network (NN) model is designed to detect the LED and to support mobility during the detection process. When a frame is processed, the LED position in the image frame is compared with the position measured in the previous frames. If the position is changed, then the scenario is defined as mobile. For the LED detection in this scenario, we have trained 70% of total acquired images using darknet\_no\_gpu.exe and OpenCV in Python. In the training process, we used an LED type called coco\_obj.name where yolov3.weights was used as the weight configuration. Another configuration, called yolov3-tiny\_obj.cfg is used for labeling of the detected LED image to find its exact position. In Figure 1-1 the training architecture is shown along with the stripe pattern reformation. After detection in the moving scenario, the LED image can experience two issues,

The image can be deformed by inclining the LED at any angle and

Some vectors of the LED image can be displaced.



Figure 1-1: Training architecture of neural network based stripe pattern reformation.

As a solution, we have used a technique, referred to as feature matching. In this technique, first, each 5×5 kernel matrix in the image patches are checked using NN regression and compared with reference stripes. The angle yielded due to the deformation is updated using the original inverse deformation, and the displaced vector field is partially reconstructed by filtering. Afterward, every point of the stripes is resampled using spatial transformation to produce a warped image. Using backpropagation connected with NN regression, the steps are repeated in a loop until the original stripes are completely reconstructed. The whole testing procedure of feature matching is depicted in Figure 1-2.



Figure 1-2: Testing architecture of stripe pattern reconstruction.

Due to the movement, the stripes can overlap with each other, consequently increasing the BER. To remediate the issue, we have trained 60% of the total transmitted bits. The trained sets of bits are combinations of character, string, integer, and symbol. If any stripe of the testing image experiences an overlap, it is resolved using the trained dataset. For example, if the NN encounters a sequence with an altered bit, it uses probability to predict the sequence is how much similar to the pre-trained sequence. If the probability exceeds a pre-defined threshold, the sequence is recognized as identical to the pre-trained sequence and the altered bit is replaced accordingly. Besides, in terms of decoding numerical data specifically, the symbol defined before the data is utilized to predict the probability. It is worth noting that the higher the probability (defined in percentage), the faster the recovery from the error.

1. Flow diagram of proposed neural network scheme

The neural network mainly operated based on the feature extraction technique of the stripe pattern. However, the given flow diagram shows the training and testing procedure and checking the similarity of each iteration. In every iteration, the relative position of the stripe is change by checking the similarity with the reference pattern. Figure 2-1 illustrates the entire flow diagram of the proposed neural network.



Figure 2-1: Flow diagram of proposed neural network technique.