Before the methos used for driver drowsiness detection is explained in detail, some basic terms used in this paper should be first comprehend so that the step used in method’s development can be clearly understood. Two things will be explained, drowsiness and neural network in deep learning as an overview of the component of the proposed method.

**Drowsiness**

In this paper, a method used for drowsiness detection is proposed. Thus, it is important to have clear definition of drowsiness, so that the proper algorithm can be made. Drowsiness in this paper is define when a driver closes their eyer longer than usual which is 2 second. Means that, detecting the driver drowsiness of driver is measuring how long they close their eyes. This implementation will be futher explained in proposed method section

**Neural network in deep learning**

Deep Learning or known as deep structured learning \cite{wiki}, which are modeled after the structure and operation of the brain, are a subfield of machine learning approaches that deal with algorithms that use numerous layers to gradually extract higher-level properties from the raw input. Another frequently mentioned advantage of deep learning models, in addition to scalability, is their capacity for automatic feature extraction from unprocessed data, also known as feature learning \cite{what}.

Neural network is created to make prediction base on given input. That it, neural network is the core of deep learning. Just like human, before it could make any decision, it should learn how to make the right decision. This phase is called training phase after the neural network, or the model is completely built. This phase will be detailed in proposed method section. In this section the basic building block of neural network will be explained to give an idea how neural network works.

Neuron is the basic building block neural network in deep learning. The neuron, depict in ``Fig. \ref{}”, can have several input and output just like human neuron except this neuron is a set of mathematical function \cite{design}. The multiple input can be visualize as shown in ``Fig. \ref{}”.

Diagram, schematic

Description automatically generated Diagram

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Diagram

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Every neuron has their own transfer function or activation function to satisfy some specification of the problem that the neuron is attempting to solve. ``Fig. \ref{}”shows the example of transfer function.

Chart

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Linear transfer function is used when the output should be linearly proportional to its input. Neurons with this transfer function are used in the ADALINE networks \cite{design}.

Diagram

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Another transfer function is log sigmoid, which constricts the output to the range of 0 to 1 from the input that can have any value between plus and minus infinity. Because it is differentiable, the log-sigmoid transfer function is frequently employed in multilayer networks that are trained using the backpropagation process \cite{design}.

Diagram

Description automatically generated

The hard limit transfer function changes the neuron's output from 1 to 0 depending on whether the function parameter is greater than or equal to 0. This process produces neurons that categorize inputs into two different groups. \cite{design}.

As mentioned before, the neuron is basic building block of neural network. This building block can be grouped into the form called layer as depict in ``Fig. \ref{}”. Every layer has their own functionalities and name. For instance, convolutional layer where the neuron acts as a kernel or filter, pooling layer, dropout layer and fully connected layers. These specific layers will be discussed more in proposed method section.

Diagram, engineering drawing

Description automatically generated

The specific layers are then arranged in sequential way to form a neural network or network model. For example, Convolutional neural network (CNN) is widely used in neural network for image recognition that consist at least one layer of convolution layer \cite{practical}.

Aforesaid, neuron in computer science is nothing more than a set of mathematical function that have input and output. That means a layer of neuron have a set of input and output as shown in ``Fig. \ref{}”. These variables are handled in matrix form where input matrix will be multiplied with weight and matrix of activation function and added with bias before supplied to the activation function. The output could be scalar or vector depending on the input matrix and activation matrix. Since the input and output could be vector that have more than two dimensions, they are called tensor of input or output \cite{practical}.