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論　文　要　旨
Thesis Abstract

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主論文題名　（Title）

Study on Reduce of Working Time in Image Data Annotation for Deep Learning through Semi-Automated Active Learning

内容の要旨　（Abstract）

Deep Learning (DL) is an algorithm that is being inspired from the biological brain. One of the variances of DL is called Convolutional Neural Network (CNN). CNN has been used especially in the image domain tasks such as class classification and managed to get a high accuracy compared to all the previous conventional image processing methods.

CNN technology is now being actively used in the development of autonomous active driving system. This technology is commonly being used to detect the presence of objects like other vehicles from the cameras installed onto the autonomous vehicles. Although CNN needs a lot of image data to be trained so that it can be used as a reliable detector model, the current technology and the big data world that we are living right now makes it easy.

However, CNN still needs the image data to be labeled or annotated. For example, an image with several vehicles in it will need to be annotated and tagged such that each vehicle instance will have a bounding box surrounding it with the name "vehicles" attached to it. Annotating these kinds of data can use a lot of time, labor and money resource.

A system called Active Learning (AL) is used to solve this problem. AL is a system that dictates the way CNN model being trained and how the data should be handle. AL system will allow the human annotators to not annotated all the data that they currently have. Instead, the system will select the best data subset from the whole dataset for the model at certain time during the training process and human annotators only need to annotate that subset of data. The idea is that not all data have the same quality and only some of it are useful. This prove to be helpful since the CNN model can now be trained at a lower cost.

However, one problem persists. The human annotators workload is still there and static. It will not get lesser with time. Thus, I proposed solutions for this problem in this thesis. There are two folds of my proposed solutions. First, I have a proposed method where I designed an algorithm called Machine Teachers (MTs). MTs is a set of algorithms made up of DL and conventional image processing methods which in this case, the tracker algorithm called optical flow. Then, I proposed a system called Semi-Automated Active Learning where I plugged in the MTs into the existing AL system to automate some of the image annotation process. MTs is the responsible part of the system to partly automate the image annotation process. I used the video data from the camera installed on vehicles and MTs managed to do this because we designed MTs to use the temporal-spatial information of the video to annotate the images from the video. On top of that, by improving MTs overtime, it is possible to reduce the human annotators workload and other use of resources since a better MTs will automate more of the data annotation process for the CNN training. My experiments show that my proposed SAAL (which is an AL with MTs plugged-in) managed to get similar performance with conventional AL while reducing the workload of the human annotators. This makes my proposed method to be better than the conventional AL system.