Automatic Flutter Code Generation using Sketch UI Mockups

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Problem Statement

- In modern software engineering, applications are getting more and more complex. Client demands to build and deploy apps due quickly are increasing tremendously. Yet with this increase of demand in software applications, the development process is stagnate. Development process is usually a two-fold problem: 1. Developing a sketch mockup 2. Implementing that sketch mockup along with its respective logic.
- As this problem is challenging and time consuming, we present Widget Detector which automates the process of converting sketch mockups through object detection to Flutter UI components using deep learning image classification.
- Object detection is a computer vision technique that allows us to identify and locate objects within the image.
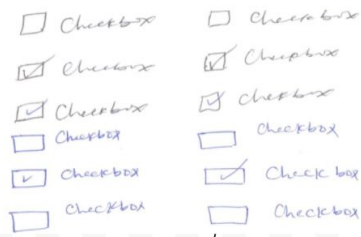
Proposed Solution

Implemented a two branch neural network, one for bounding box regression and one for widget label classification. We utilized transfer learning through the VGG16 pretrained network on ImageNet and added our two branch network on top of it.

Implementation Details

Data Pre-processing:

During this phase, we started converting widget class labels using the LabelBinarizer which assigns a unique value to each label in a categorical feature and the bounding box will be assigned binary value (0,1) since it's easier for the model to be able to predict values in a fixed range for each image.

- Next, we split the csv file into the image_name, label, x1, y1, x2, y2, w and h.
- After which, we would need to normalize the bounding box coordinates (x1,y1,x2,y2) before storing them to the list
- Then we would call keras to load the images and convert each of them to array before storing them to the list.
- Using the VGG16 model preprocess_input() function, this changes the images to the format that is compatible with the model.
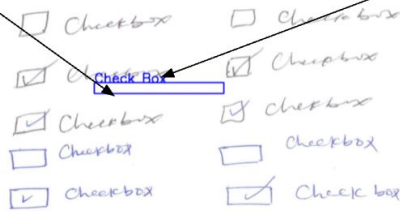- The label binarizer is used to fit and transform the array of labels to binary labels.
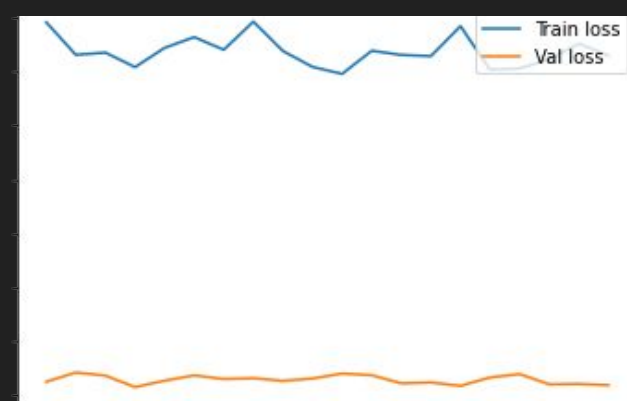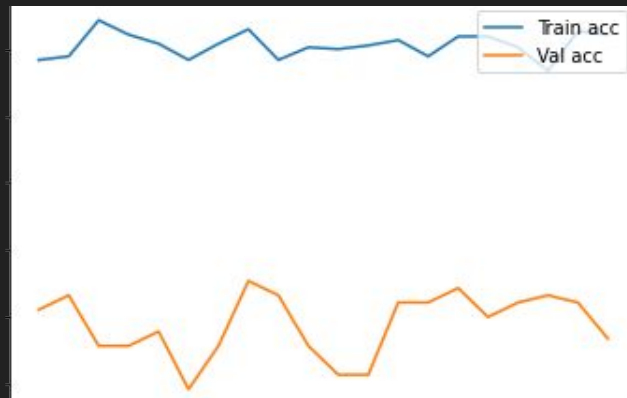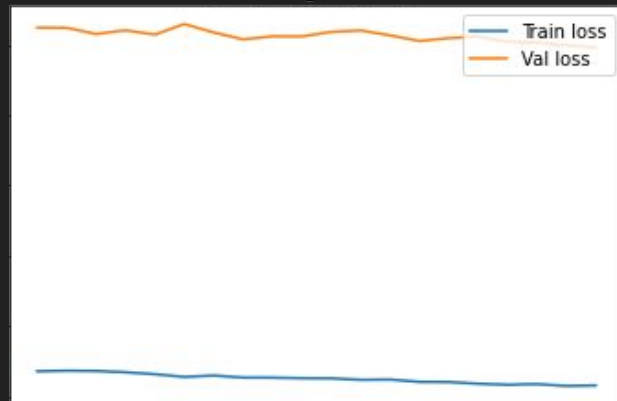
VGG-16

Input

Conv 1-1 | Conv 1-2 | Pooling | Conv 2-1 | Conv 2-2 | Pooling | Conv 3-1 | Conv 3-2 | Conv 3-3 | Pooling | Conv 4-1 | Conv 4-2 | Conv 4-3 | Pooling | Conv 5-1 | Conv 5-2 | Conv 5-3 | Pooling | Dense | Dense | Dense

Output

Bounding Box Layer

Classification Layer

Check Box

Results & Discussion

Total Loss
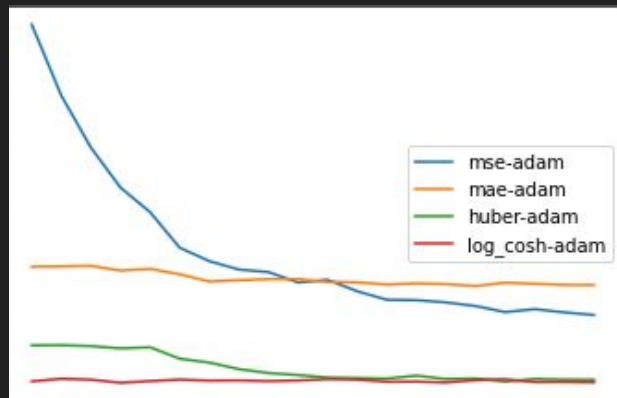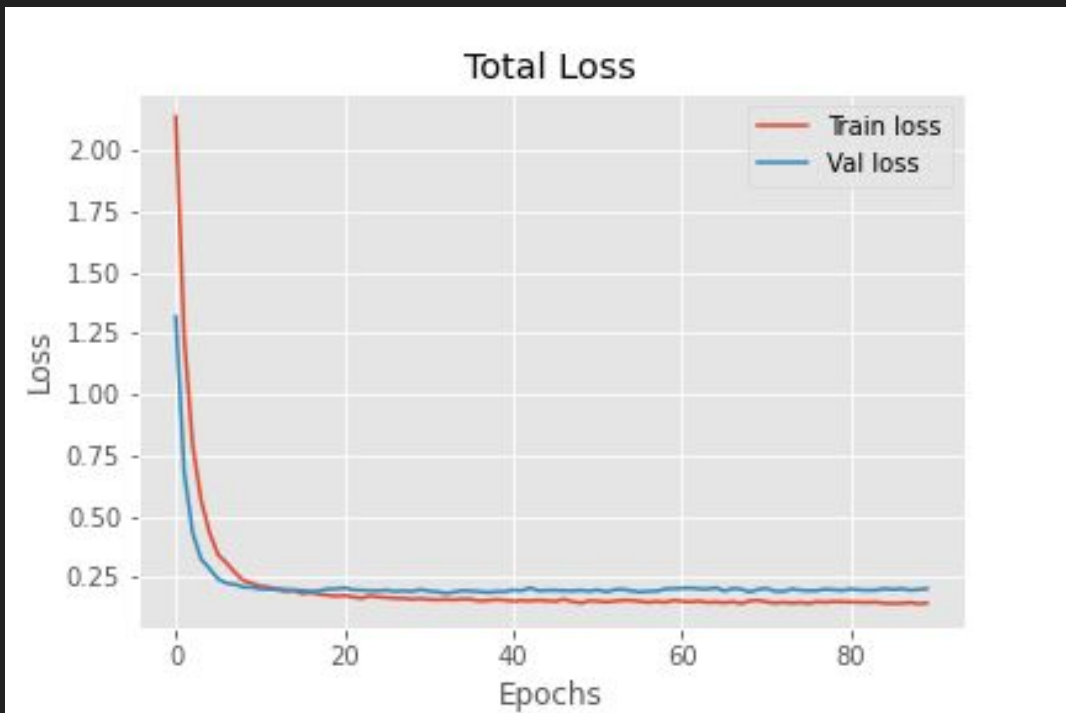
Conclusion

- We have implemented automation of translating hand draw sketches to code with the use of deep learning by classifying and predicting user interface components and generating appropriate code for that component.

- If implemented fully, this can be used to greatly speed up the app development process. It can also be used as a teaching tool. To accomplish our task, we designed a two branch neural network, one for bounding box regression and one for widget label classification.

- We utilized transfer learning through the VGG16 pretrained network on ImageNet and added our two branch network on top of it. Our architecture proved to give promising results for the future with an average widget component classification of 97% and an average bounding box regression of 60%.

References

- Automatic code generation from sketches of mobile applications in end-user development using Deep Learning - Daniel Baulé1 , Christiane Gresse von Wangenheim1 , Aldo von Wangenheim1 , Jean C. R. Hauck1 , Edson C. Vargas Júnior2 https://arxiv.org/pdf/2103.05704v1.pdf
- pix2code: Generating Code from a Graphical User Interface Screenshot - Tony Beltramelli UIzard Technologies Copenhagen, Denmark tony@uizard.io https://arxiv.org/pdf/1705.07962.pdf
- sketch2code: Generating a website from a paper mockup - Alexander Robinson University of Bristol ar15247@bristol.ac.uk
- YOLO v3 Object Detection with Keras - https://towardsdatascience.com/yolo-v3-object-detection-with-keras-461d2cfccef6
- You Only Look Once: Unified, Real-Time Object Detection - https://arxiv.org/pdf/1506.02640.pdf
- Bounding Box - https://d2l.ai/chapter_computer-vision/bounding-box.html
- Going Deeper with Convolutions -https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/43022.pdf
- Sketch2Code: Transformation of Sketches to UI in Real-time Using Deep Neural Network -https://arxiv.org/pdf/1910.08930.pdf
- Sketch2code using Visual Attention & LSTM Decoder - https://vincentk1991.github.io/sketch2code/

- Sketch2code dataset - https://www.kaggle.com/biniamad/sketch2code
- Dataset generator for web sketch-to-code deep learning problems - https://medium.com/@devtarek/dataset-generator-for-sketch-to-code-deep-learning-problems-be9317b7e9b2
- How to Train an Object Detection Model with Keras - https://machinelearningmastery.com/how-to-train-an-object-detection-model-with-keras/
- Build your First Multi-Label Image Classification Model in Python - https://www.analyticsvidhya.com/blog/2019/04/build-first-multi-label-image-classification-model-python/
- https://www.youtube.com/channel/UCkzW5JSFwvKRjXABI-UTAkQ
- Extract annotations from CVAT XML file into mask files in Python - https://towardsdatascience.com/extract-annotations-from-cvat-xml-file-into-mask-files-in-python-bb69749c4dc
- ImageNet: VGGNet, ResNet, Inception, and Xception with Keras - https://www.pyimagesearch.com/2017/03/20/imagenet-vggnet-resnet-inception-xception-keras/
- Classification with Localization: Convert any Keras Classifier to a Detector - https://learnopencv.com/classification-with-localization/