

PROJECT REPORT: GESTURE-BASED TEXT CREATION - VIRTUAL NOTEPAD

PROJECT ID: 102

TITLE: GESTURE-BASED TEXT CREATION AKA VIRTUAL NOTEPAD AND RECOGNITION

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INTRODUCTION

THE PROJECT "VIRTUAL NOTEPAD" AIMS TO CREATE A SYSTEM WHERE USERS CAN WRITE AND DRAW IN THE AIR USING THEIR FINGERS, WITH THESE GESTURES BEING CAPTURED AND DISPLAYED ON A COMPUTER SCREEN. THE PROJECT LEVERAGES MACHINE LEARNING (ML), CONVOLUTIONAL NEURAL NETWORKS (CNN), AND OPENCV TO DEVELOP A DIGITAL CANVAS CAPABLE OF RECOGNIZING AND CLASSIFYING HAND-DRAWN INPUTS, SUCH AS DIGITS.

WEEKLY PROGRESS SUMMARY

WEEK 1: FOUNDATIONAL LEARNING

- **OBJECTIVE:** ACQUIRE BASIC PYTHON PROGRAMMING SKILLS AND AN INTRODUCTION TO DATA SCIENCE AND MACHINE LEARNING CONCEPTS.
- **ACTIVITIES:**
 - LEARNED ABOUT PYTHON DATA STRUCTURES: STRINGS, LISTS, TUPLES, SETS, DICTIONARIES, AND ARRAYS.
 - EXPLORED CONDITIONS, LOOPS, CLASSES, AND FUNCTIONS.
 - INTRODUCED TO PYTHON PACKAGES AND MODULE CREATION.
 - STUDIED DATA SCIENCE LIBRARIES LIKE NUMPY, MATPLOTLIB, AND PANDAS.
 - GAINED AN OVERVIEW OF MACHINE LEARNING TYPES: SUPERVISED, UNSUPERVISED, AND REINFORCEMENT LEARNING.
 - UTILIZED INTERACTIVE CODING PLATFORMS SUCH AS JUPYTER NOTEBOOK AND GOOGLE COLAB.

WEEK 2: MODEL TRAINING BASICS

- **OBJECTIVE:** UNDERSTAND THE BASICS OF TRAINING MACHINE LEARNING MODELS USING CNN AND MLP.
- **ACTIVITIES:**
 - TRAINED MODELS USING TENSORFLOW.
 - EXPLORED CONCEPTS OF OVERFITTING AND UNDERFITTING.
 - LEARNED TO SAVE AND LOAD PRE-TRAINED MODELS.
 - IMPLEMENTED ACTIVATION FUNCTIONS (RELU, TANH, SIGMOID) AND LOSS FUNCTIONS IN CODE.
 - COMPLETED ASSIGNMENTS INVOLVING SIMPLE MLP IMPLEMENTATIONS.

WEEK 3: ADVANCED MODEL TRAINING

- **OBJECTIVE:** ENHANCE KNOWLEDGE OF ADVANCED MODEL TRAINING TECHNIQUES.
- **ACTIVITIES:**
 - LEARNED ABOUT DATA AUGMENTATION AND TRANSFER LEARNING.
 - COMPLETED ASSIGNMENTS INVOLVING:
 - TRAINING A CNN MODEL FOR CIFAR100 CLASSIFICATION.
 - FINE-TUNING A PRE-TRAINED MODEL ON CIFAR10.

- CREATING A PNEUMONIA VS. NORMAL CLASSIFIER USING CHEST X-RAYS.
- COMPARING CNN AND MLP MODELS USING THE FASHION-MNIST DATASET.

WEEK 4: HAND TRACKING FUNDAMENTALS

- **OBJECTIVE:** IMPLEMENT A HAND TRACKING MODULE USING OPENCV AND MEDIAPIPE.
- **ACTIVITIES:**
 - DEVELOPED A MODULE TO DETECT AND TRACK HAND POSITIONS IN REAL-TIME.

WEEK 5: PRACTICAL APPLICATIONS OF HAND TRACKING

- **OBJECTIVE:** APPLY THE HAND TRACKING MODULE TO PRACTICAL EXAMPLES.
- **ACTIVITIES:**
 - **DRAG AND DROP:** MOVE SAVED IMAGES USING FINGER MOVEMENTS.
 - **PAUSE SCREEN:** PAUSE AND RESUME THE SCREEN BASED ON HAND GESTURES.
 - **VOLUME CONTROL:** ADJUST DEVICE VOLUME USING HAND GESTURES.

WEEK 6: PROJECT IMPLEMENTATION

- **OBJECTIVE:** FINALIZE AND INTEGRATE VARIOUS FUNCTIONALITIES INTO THE VIRTUAL NOTEPAD PROJECT.
- **ACTIVITIES:**
 - INTEGRATED MULTIPLE MODULES AND PACKAGES INCLUDING OPENCV, MEDIAPIPE, NUMPY, OS, MATH, TENSORFLOW, COMTYPES, AND PYCAW.
 - IMPLEMENTED FEATURES SUCH AS:
 - DIGIT RECOGNITION USING THE MNIST DATASET AND CNN ARCHITECTURE.
 - VOLUME CONTROL USING FINGER GESTURES.
 - DRAWING MODE WITH COLOR SELECTION.
 - IMAGE SAVING FUNCTIONALITY.

CONCLUSION

THE "VIRTUAL NOTEPAD" PROJECT SHOWCASES AN INNOVATIVE APPROACH TO DIGITAL DRAWING AND WRITING USING HAND GESTURES. IT COMBINES ML, CNN, AND COMPUTER VISION TECHNOLOGIES TO CREATE AN INTERACTIVE AND USER-FRIENDLY APPLICATION. THIS PROJECT IS PARTICULARLY BENEFICIAL FOR INDIVIDUALS WHO ENJOY DRAWING AND DOODLING, OFFERING A DIGITAL ALTERNATIVE THAT ELIMINATES THE NEED FOR TRADITIONAL PEN AND PAPER.