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Gesture Recognition Developments

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Abstract - *Man-Machine interface is one of the most highlighted factors in the technology driven world and in the same; Hand Gesture Recognition based interface has become the most advanced technique in the recent years. There are multiple factors affecting the application of this technique such as, complex backgrounds and lightning effects. These parameters put a negative impact on the application of respected technology and force to use it under restricted environment condition. An adaptive skin color model based on face detection is utilized to detect skin color regions like hands. Fast motion history image-based method is developed to classify the dynamic hand gestures. We have 26 alphabets from A to Z so taking all these alphabets as 26 different classes. These letters and so the classes are called as American Sign Language Patterns.*

Key Words: Key Man-Machine interface, Hand Gesture Recognition, complex background, lightening effect, face detection, hand gesture.

1. INTRODUCTION

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.

The Gestural Channel can be integrated in the Human Computer Interaction by promoting an active research in the gesture recognition field. The human gesture recognition concept comes under the general framework of pattern recognition. The system in this framework consists of two processes as Representation and Decision Processes.

The representation process converts the raw numerical data into a form adapted to the decision process which has the capability to further classification of the data. The acquisition process and the interpretation process are two more processes which come under Gesture Recognition System. These processes convert the physical gestures into numerical data and give a meaning of the symbol series respectively.

Any random hand gesture consists of four elements as hand configuration, movement, orientation and location. These gestures are further classified as static gestures and dynamic gestures.

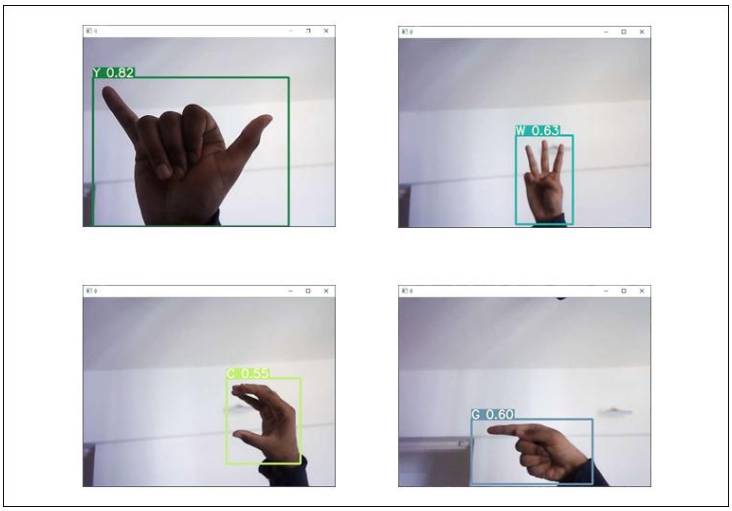

Fig – 1: Recognition Setup A

There are two main families of gesture acquisition systems as device based and vision based. In device-based systems, the acquisition of gestures is made by a physical device that directly measures some characteristics of the gesture, generally the different joint bending angles. In vision-based systems, the gesture is captured by a camera.

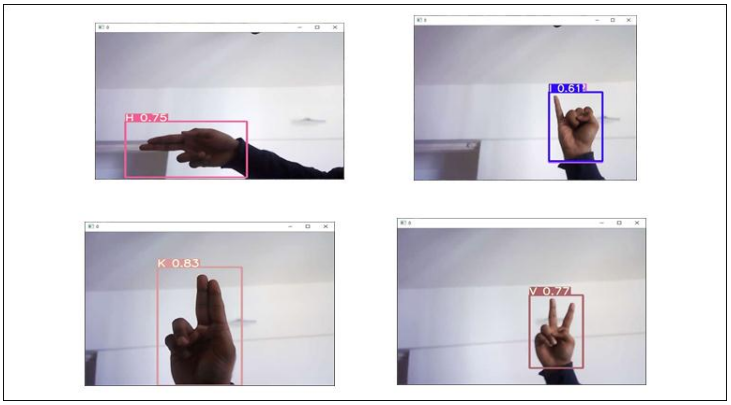

Fig – 2: Recognition Setup B

The vision based approach is little complex but its advantage is its unconstrained nature as it allows a natural execution of a gesture when the user stays in the camera field. Comparatively device based methods are fast and robust.

2. WORKING

Any object in the video can be detected by using Real Time Object Detection Technique. Here we have used YOLOv5m architecture to reach the objective. YOLO stands for "You Only Look Once".

There are multiple variants in YOLO depending on the size and speed of the model. YOLOv5s is the smallest yet fastest variant. YOLOv5m is a medium sized model which is slower than YOLOv5s but faster than other variants.

There are six steps as Preparing Dataset, Environment Setup, Configure/modify files and directory structure, Training, Inference and Result to train YOLOv5 on a Custom Dataset.

"American Sign Language Letters Dataset" is used for the respected objective. In this dataset there were 720 images which were augmented to form a total of 1728 images. It was shared by David Lee on RoboFlow Licensed under the public domain.

PyTorch is needed to be installed to setup the environment. Then we need to clone the repo. Then under the yolov5 directory install all the dependencies from requirement.txt using pip or Conda. Finally setup of the training data near the yoloV5 directory is done.

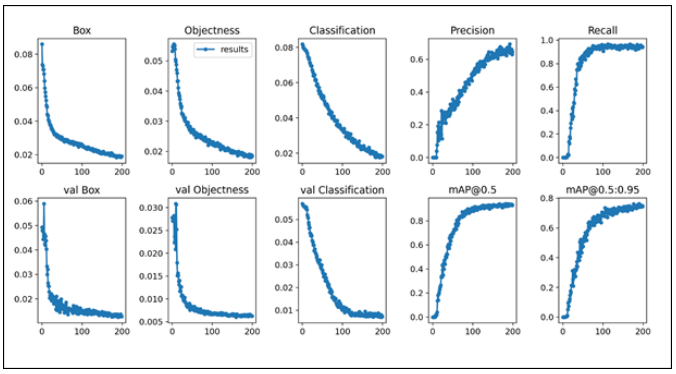

Fig – 3: Result Graphs

Under configuration the dataset file is kept near the yoloV5 directory. Then the model configuration file is modified to set the number of classes' equivalent to classes of the dataset. YoloV5m model is trained for 400 epox for 4 hours on American Sign Language dataset.

After comparing the results the observation was; YoloV5m gave better validation accuracy than YoloV5s, hence selection of medium sized model is done. The model yielded a precision of 65 percentages, recall of 95 percentages. The MAP for training data was 95 percentages and MAP for validation data was 77 percentages.

3. ADVANTAGES

1. It is a simple and active system that has capacity to recognize words and alphabets.
2. It is an excellent performance system with a complex background.
3. Exact shape of the hand obtained led to good feature extraction.
4. Fast and powerful results from the proposed algorithm are obtained.
5. Expected speed achievement and sufficient reliability for recognition system.

4. DISADVANTAGES

1. The recognition is limited to numbers only.
2. Respected system does not reflect the dynamic gesture characteristics.
3. If the object is larger than the hand then a wrong object extraction appears.
4. The irrelevant objects may overlap with the hand.

5. CONCLUSIONS

1. Gesture recognition algorithm using YOLOv5m is relatively robust and accurate with precision 65% and recall of 95%.
2. The MAP for training data was 95 percent and MAP for validation data was 77 percent.
3. Recognition of hand gestures from a live video feed by using webcam to provide an authentication and secured transaction processes and access control is done.

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BIOGRAPHIES

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