## Object Detection

## Heat DetectionA diagram of a model Description automatically generatedA table of information Description automatically generatedA table with text on it Description automatically generatedA math equations on a white background Description automatically generated

15 - coefficient of determination(R2) typically ranging from 0 to 1, serves to gauge the goodness of fit of a model. A higher R2 value approaching 1 implies superior model performance

the mean absolute error, the root mean square error

MAE represents the average of the absolute differences between the predicted and the actual CBT values, whereas RMSE computes the average difference between them. Lower values of MAE and RMSE signify

more accurate predictions

YOLO 5 – PyTorch – OpenCV

The selected classification techniques tested are Support Vector Machine (with Linear, Quadratic, Cubic, and Gaussian kernel) and Ensemble Algorithms (Bagged trees, Boosted trees, and RUSBoosted trees). In the continuing sections, selected machine learning algorithms are described

The SVM algorithm works in the way that the main goal is to find an optimal separating hyperplane with a maximum margin.

Ensemble Algorithms: Ensemble algorithms are aimed to combine “weak” learners into a set of classifiers to construct a higher-performance ensemble model. The main ensemble

techniques are bagging and boosting that construct an ensemble together with the basic learner

RUSBoost trees (RUSBoost, with Decision Tree)

Boosted trees (AdaBoost with Decision tree)

Bagged trees (Random Forest Bag with Decision Tree)

## Odor Detection (electronic sensing)

<https://en.wikipedia.org/wiki/Electronic_nose#:~:text=An%20electronic%20nose%20is%20an,to%20detect%20odors%20or%20flavors>.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC7287618/>

Fecal malodor refers to the unpleasant smell of stool

dog feces - dog stool

## Posture detection

Literature review - <https://pmc.ncbi.nlm.nih.gov/articles/PMC7614502/>

scale-invariant feature transform, histogram of oriented gradients, support vector machine (SVM), Gaussian mixture model, dynamic time warping, hidden Markov model (HMM), lightweight network, convolutional neural network (CNN). We also investigate improved methods of CNN, such as stacked hourglass networks, multi-stage pose estimation networks, convolutional pose machines, and high-resolution nets. The general process and datasets of posture recognition are analyzed and summarized, and several improved CNN methods and three main recognition techniques are compared. In addition, the applications of advanced neural networks in posture recognition, such as transfer learning, ensemble learning, graph neural networks, and explainable deep neural networks, are introduced. It was found that CNN has achieved great success in posture recognition and is favored by researchers. Still, more in-depth research is needed in feature extraction, information fusion, and other aspects. Among classification methods, HMM and SVM are the most widely used, and lightweight network gradually attracts the attention of researchers. In addition, due to the lack of 3D benchmark data sets, data generation is a critical research direction.

<https://github.com/ZheC/Realtime_Multi-Person_Pose_Estimation>

<https://github.com/topics/posture-recognition>

<https://github.com/CMU-Perceptual-Computing-Lab/openpose>

Mediapipe (<https://github.com/google-ai-edge/mediapipe>)

<https://ai.google.dev/edge/mediapipe/solutions/vision/pose_landmarker>

Code sample: <https://colab.research.google.com/github/googlesamples/mediapipe/blob/main/examples/pose_landmarker/python/%5BMediaPipe_Python_Tasks%5D_Pose_Landmarker.ipynb>

OpenCV

MediaPipe excelling in mobile deployments and ease of use, while OpenCV offers broader platform support and finer control over algorithms

PoseNet - PoseNet is trained in MobileNet Architecture (<https://arxiv.org/abs/1704.04861>)

<https://github.com/tensorflow/tfjs-models/tree/master/mobilenet>

<https://github.com/tensorflow/tfjs-models/tree/master/posenet>

<https://github.com/DeepLabCut/DeepLabCut> DeepLabCut is a toolbox for state-of-the-art markerless pose estimation of animals performing various behaviors

<https://www.mdpi.com/2073-431X/11/1/2>

Keras

OpenPose Library C++ - real-time versionA screenshot of a computer

Description automatically generated

(Tensorflow

Pytorch

Caffe2

Chainer

MXnet

MatConvnet

CNTK)

YOLO – Semantic Segmentation

lateral view (side view) of the person is given as input

OpenCV (Open Source Computer Vision Library) is a library of computer vision algorithms. Its primary emphasis is on real-time image processing, and it is freely available for

commercial and academic usage under the terms of the BSD license.

Tensorflow is a mathematical computing framework that provides an easy-to-use high-level API for training and creating machine learning and deep learning models.

Keras is a neural network programming interface. It is a Python library built entirely in Python. Additionally, it integrates with other libraries and packages such as Tensorflow, which simplifies the process of deep learning. Keras was created to facilitate rapid experimentation and prototyping

canine posture

<https://www.youtube.com/watch?v=bO1l4JFMnrQ>

<https://www.youtube.com/watch?v=kRvIcdLhDtU>

## Datasets:

<https://cocodataset.org/keypoints-2020> is not accessible but coco is widely used

<https://cocodataset.org/#explore>

## Notes:

<https://en.wikipedia.org/wiki/Hierarchical_Data_Format>

The .h5 file format, also known as Hierarchical Data Format (HDF5), is a binary file format for storing and organizing large amounts of data:

Data type: HDF5 is a binary format that can store complex, heterogeneous data. It's often used to save machine learning models and their associated weights.

File structure: HDF5 uses a file directory-like structure that allows for many different ways to organize data. The file structure is "self-describing", meaning that the file can be navigated to discover all of its objects.

File size: HDF5 is designed to support large datasets without limit on the number or size of data objects.

File access: HDF5 is more efficient for accessing and compressing data than text formats. It also has integrated performance features to optimize storage space and access time.

File portability: HDF5 is portable and can run on a variety of computational platforms.

File support: HDF5 files are supported in R and Python.

File opening: HDF5 files can be opened using software like myHDF5