Abnormality Detection Using Neural Network and Image Processing

Niket Tangadpalliwar, Shubham Thapa, Vinit Rege, Kuldeep Singh
Department of Computer Science, Sinhgad Institute of Technology and Science, une.

Abstract: The main aim of the project is to provide a platform/system which can detect anomalies and other events using image analysis system with the help of digital image processing technique and understand the circumstances and if required contact or alert the administrator so that the administrator can relay information to the sub-units present in the area so that some action can be taken. During the last decade, a significant progress in both the theoretical aspects and the applications of neural networks on the image analysis, and processing, has been made. The constant development of computers has led to several major enhancements in terms of data processing. The computational power has sped up, doing millions of calculations per second. Along with the elaboration of computational force, data has also been increasing in size at rapid rate (Big-Data).

Main working modules include feature extraction module which is able to use and then compares different learning techniques, such as Artificial Neural Networks, with old-fashioned engineering tools like SIFT for feature extraction. Then classification module containing models like Support Vector Machines, k-NN, decision trees for classification.

The system is built to utilise most of the computational power. Moreover, it is based on database centric approach in order to decrease computational cost and join different modules. This project aims to present a image/video analysis system using digital image processing techniques with the help of neural networks which will be a part of machine learning and will be used to analyses and distinguish images. We will also be using a big data platform to store and process large amount of data that will be generated during the implementation and execution of the project. An IOT platform will also be used to relay the data generated by the implementation and execution of image analysis system using digital image processing techniques with the help of neural networks. The data will be send via a wireless network (ZigBee).

Keywords: Feature Extraction, Image Classification, SIFT, PCA-SIFT, F-SIFT, SURF, FAST, Artificial Neural Network (ANN), Support Vector Machine (SVM), IOT platform, Big data management, Neural network training.

Introduction:

In the past few decades artificial intelligence and machine learning has advanced significantly. As the computers have grown more powerful day by day, the computation power has sped up, doing millions of calculations per seconds, however to accompany this data has also grown at rapid rate too (Big-Data).

This advancement has opened a huge potential for areas such as Visual-Image processing, and the identification and classification of data. This has enormous usage and benefits with the currently growing data rates and simplifying and solving of big data problems. So with image learning getting increasing popular this has led to a large amount of ongoing research

Image processing is a process of processing of images using mathematical operation using any form of signal processing process for which the input is an image, a series of images, or a video, the output of image processing process may be either an image or a set of characteristics or parameters related to the image. Image analysis is extraction of meaningful information from images mainly from digital images by means of digital image processing techniques. In machine learning artificial neural networks are family of models inspired by biological neural network (the central nervous systems of animals, particularly the brain) which are used to estimate functions that may depend on a large number of inputs though are generally unknown. The utility of artificial neural network models lies in the fact that they can be used to infer a function from many observations.

The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enables these objects to collect and exchange large
amount of data. IOT is one of the emerging and upcoming fields in R&D and has vast applications.

Big data is a term for data sets that are large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, search, sharing, storage, transfer, visualize, querying, update and information privacy. The term often refers simply to the use of predictive analytics or certain other advanced data analytics methods that extract value from data and are seldom to a particular size of data set. Accuracy in big data may lead to more confident decision making, and better decisions can result in greater operational efficiency, cost reduction and reduced risk.

In this project, we will be using mage/video analysis system using digital image processing techniques with the help of neural networks which will store its data in a big data platform and relay information to various sub units using IOT platform.

3) **Basic architecture:**

Various different factors affect the accuracy in manual detection like rolling eyes through various screens may cause less concentration. There is need of a proper platform which will bring the focus directly to the abnormal activity so as to make it possible to act rationally.

Use of neural networks to make use of machine learning so that surveillance cameras can recognize anomaly and bring the administrator to notice. After confirmation from administrator relay information to the various subunits in the vicinity to make sure that proper action is taken with IOT.

As the Pune city is soon going to become a smart city, this would bring lot of efficiency and less reaction time to various such accidents and abnormalities.

4) **System requirement:**

I. **Hardware Required:**
   a) Camera
   b) Arduino
   c) ZigBee/bluetooth
   d) High end Laptop

II. **Software Required:**
   a) Cuda
   b) OpenCV
   c) MATLAB
   d) OpenCL
   e) VIM
   f) Putty
   g) Caltech
   h) Caffe
   i) Decaf
   j) Hadoop

5) **Artificial Neural Networks(ANN):**

ANN is a type of artificial intelligence which is inspired by biological neural networks. They are generally presented as a system of interconnected neurons. An ANN consist of a sequence of layers, each layer consists of a set of neurons which exchange messages between each other. All neurons of every layer is linked by weighted connection to all neurons on the preceding and succeeding layers.

The performance and accuracy depends upon the network structure, number of inputs, the number of hidden layers, and training sample.

v Artificial Neural Nets (ANN) is a type of an artificial intelligence which is inspired by the biological neural networks. They are generally presented as a system of interconnected neurons. This architecture is inspired from the human brain and the way it works. The main driving force of this kind of architecture in our body are called neurons. These neurons have receptors which read inputs with Synaptic Weights from previous neurons and those inputs taken together create a cumulative synaptic (the sum of all inputs). If the cumulative synaptic has got enough weight, this neuron fires, else it does not. This machine learning model is called Perceptron. Through this concept one can classify data into classes as well.
6) Caffe

Caffe provides multimedia scientists and practitioners with a clean and modifiable framework for state-of-the-art deep learning algorithms and a collection of reference models. The framework is BSD-licensed C++ library with the addition of Python and MATLAB bindings for training and deploying general purpose convolutional neural networks and other deep models efficiently on commodity architectures. By separating model representation from actual implementation, Caffe allows experimentation and seamless switching among platforms for ease of development and deployment from prototyping machines to cloud environments. Caffe is maintained and developed by the Berkeley Vision and Learning Center (BVLC) with the help of an active community of contributors on GitHub. It powers various ongoing research projects, large-scale industrial applications, and startup prototypes in vision, speech, and multimedia platforms.

7) MQTT

MQTT (Message Queuing Telemetry Transport) is a lightweight messaging protocol which provides resource-constrained network clients with a simpler way to distribute telemetry information. The protocol which uses a publish/subscribe communication pattern, is mostly used for machine-to-machine (M2M) communication and plays an important role in the Internet of Things (IoT).

How MQTT works

MQTT sessions are divided into 4 stages: connection, authentication, communication and termination. A client starts by creating a TCP/IP connection to the broker by either using a standard port or a custom port defined by the broker's operators. When in the process of establishing a connection, it is important to recognize that these server might continue an old session if provided with a re-used client identity.

The standard ports for non-encrypted communication is 1883 and for encrypted communication is 8883 using SSL/TLS. During these SSL/TLS handshake, the client validates the server certificates to authenticate the server. The client can also provide a client certificate to the broker during the handshake which can used to authenticate the client. While not part of the MQTT specification, it has become customary to support client authentication with SSL/TLS client-side certificates.

As MQTT aims to be a protocol for resource-constrained devices, SSL/TLS may not always be an option and in some cases, might not be desired. In such cases, authentication is presented as a username and password that can be sent by the client to the server as part of the CONNECT/CONNACK packet sequence. Some brokers, especially open ones published on the Internet, will accept anonymous clients. In such cases, the username and password is simply left as blank.

MQTT is called a lightweight protocol because all messages present in it has a small code footprint. Each message consists of a fixed header of size 2 bytes and an optional variable header, a message payload that is limited to size of 256 MB of information and a Quality of Service level. There are three different Quality of Service levels which determine how the content is managed by the MQTT protocol. Although higher levels of QoS are comparatively more reliable, they have more latency and bandwidth requirement so subscribing clients can specify the highest QoS level they would like to receive.

8) Feature Extraction

Zernike moments Statistical-based approaches used for feature extraction such as moment invariants have received considerable attention in recent years for their invariance properties. Moment features are invariant under scaling, translation, rotation and reflection.

The invariant properties of moments are utilized as pattern sensitive features in classification and recognition applications. Zernike moments are the most widely used family of orthogonal moments due to their extra property of being invariant to an arbitrary rotation of the object that they describe.

The Zernike moments are orthogonal set of complex valued polynomials defined over the polar coordinates inside a unit circle.

9) References:

1) "MLP Neural Network Based Face Recognition System Using Constructive Training algorithm ",
2) "Internet of Things for Smart Cities ", Andrea Zanella, Senior Member, IEEE, Nicola Bui, Angelo Castellani, Lorenzo Vangelista, Senior Member, IEEE, and Michele Zorzi, Fellow, 2327-4662 © 2014 IEEE


4) “A parallel computing platform for training large scale neural networks”, Rong Gu, Furao Shen, Yihua Huang, National Key Laboratory for Novel Software Technology Nanjing University, Nanjing, China 210093, 978-1-4799-1293-3/13/$31.00 ©2013 IEEE