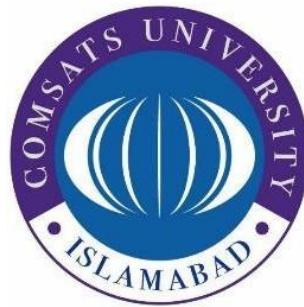


Assessment of Facial Expression In Product Testing

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**DEPARTMENT OF COMPUTER SCIENCES
COMSATS UNIVERSITY ISLAMABAD,
ATTOCK CAMPUS – PAKISTAN**

SESSION 2017-2021

Assessment of Facial Expression In Product Testing

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A DISSERTATION SUBMITTED AS A PARTIAL FULFILLMENT OF THE
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**DEPARTMENT OF COMPUTER SCIENCES
COMSATS UNIVERSITY ISLAMABAD,
ATTOCK CAMPUS – PAKISTAN
SESSION 2017-2021**

UNDERTAKEN

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FINAL APPROVAL

Certified that we have read this project report submitted by Mr. (Areej Jamil, Manahil Sajjad) and it is, in our judgment, of sufficient standard to warrant its acceptance by Department of Computer Science, University of Islamabad, Attock Cantt, for the (BS/MSc degree) in Computer Science.

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(Dean/Director Name)

DEDICATION

To my Loving Parents and Teachers

Acknowledgement

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task. We are greatly indebted to our project supervisor “Dr. Muazzam Maqsood”. Without her personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to them for their encouragement and continual help during this work. And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us the values of honesty & hard work.

Areej Jamil

Manahil Sajjad

PROJECT BRIEF

PROJECT NAME	ASSESSMENT OF FACIAL EXPRESSION IN PRODUCT TESTING
ORGANIZATION NAME	COMSATS UNIVERSITY ISLAMABAD, ATTOCK CAMPUS
OBJECTIVE	OUR WORK HELPS VENDOR TO IMPROVE THE EXISTING PRODUCTS AND PROVIDE ASSISTANCE TO PREDICT THE SUCCESS OF NEW PRODUCT RELEASE
UNDERTAKEN BY	AREEJ JAMIL, MANAHIL SAJJAD
SUPERVISED BY	DR.MUAZZAM MAQSOOD COMPUTER SCIENCE COMSATS UNIVERSITY ISLAMABAD, ATTOCK CAMPUS
STARTED ON	SEPTEMBER ,2020
COMPLETED ON	MAY, 2021
COMPUTER USED	HP

SOURCE LANGUAGE PYTHON, JAVA, XML

OPERATING SYSTEM WINDOW 10

TOOLS USED ANDROID STUDIO 4.0.1, IDLE (PYTHON 3.6)

ABSTRACT

The system aims to detect emotional states from continuous and spontaneous facial expressions. It includes preprocessing, feature extraction, sentiment classification, and sentiment frequency statistical analysis. Emotions are reflected through facial expressions. Therefore, extracting and understanding emotional features is very important for human-computer interaction. This project describes the progress in this field and thus introduces various methods of identifying emotions. The project's primary purpose is to propose a real-time implementation plan of an emotion recognition system to evaluate people's preferences during product testing.

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Chapter 1

INTRODUCTION

1. Introduction

Facial expressions express real feelings or thoughts of a person; it has a significant role in our lives. Facial Expressions are nonverbal scientific gestures that are represented on our Face based on our emotions. Most people are aware of nonverbal communication aspects as it is the channel for communicating by expressing. Most retailers now focus on implementing a new way of enhancing their productivity by gaining customers' belief and satisfaction.

Expressions are mean to provide emotional information in nonverbal communication. The Face has 20 anatomically independent muscles that can perform a variety of facial behaviors. It has been recommended that the fundamental reason for some of these facial muscles is to communicate.

Generally, facial expression can be used to determine whether someone likes the product or not as it gives us clear and rich data based on their expressions. To predict how long our product will retain its value in the market, the best way is to take reviews from different customers before launching it. This can also give us information that the majority likes witch type of products. Handwritten is the old way of taking reviews, and we cannot distinguish between rational or emotional reviews. Usually, people didn't feel comfortable answering different questions in written form.

Our work's objective is to create an application that automatically analyzes customer reviews regarded to our product. By analyzing their facial expression, we capture human emotions by dusting the questioner's session, and by these emotions, we analyze either they are interested in buying the product. Our system takes human facial images from live video and classifies emotions like happy, sad neutral surprise, angry disgust and record result of classification in different intervals, and then this recorded result is calculated and used for the final result that the customer likes either our product or not.

1.1Brief

Despite extensive consumer testing before being put on the market, the quality of the product is still low. This shows that traditional methods cannot fully predict market performance, and these methods alone cannot fully reflect the long-term acceptance of the product by consumers.

With the significant impact on consumer behavior and a deeper understanding of consumer behavior, emotional levels have risen sharply in the past decade. We ask participants to review how much they liked/disliked the product and expressed their preferences with the camera face. The purpose was to investigate whether AEFA could be used to discriminate between samples using a preferred face of interest or not. We have 17 students participating in our program. We wanted to arouse feelings of emotions and, at the same time, record it.

The Face is first captured in a video using a set of marking points called "face-to-face." Find specific regions, points, landmarks, or curves/diagrams in each 2-D image or 3D width image. In this step to remove this feature, the element vector is displayed from the existing image. Common features that can be removed are-

- a. Lips
- b. Eyes
- c. Eyebrows
- d. Nose tip

In the third step, the separation, the algorithm attempts to distinguish a given face that expresses one of the seven basic senses.

Statistically analyzes the structure of the topic using Repetitive Steps Analysis (RM ANOVA) has been used. We decided to use high strength values for facial patterns. RM ANOVA results have shown that AFEA using Face Reader software is an accurate method. On a precise scale, clear discrimination between high, neutral, and low samples is possible based on the facial expressions of "angry," "disgusting," "happy," and "neutral," which led to similar discrimination based on hedonic values.

Significant findings in the case of full measurements were that although most participants indicated changes in facial features, about 25% indicated very little of the changes not found on the Face during the trial period.

The severity of the "anger" and "disgust" was closely related to the liking, and the appearance of the "neutral" Face was well.

1.2 Relevance to Course Modules

1.2.1 Artificial Intelligence

In AI, all machine learning techniques and algorithms are used. We are particularly using neural networks in our project, so artificial intelligence is the core subject for understanding machine learning algorithms, supervised and unsupervised learning, and the understanding of artificially made neurons. For mapping different facial features, comparing different patterns of facial features with the new image, artificial intelligence provides mathematical models. Neural networks comprise technologies like machine learning concepts and deep learning and form a part of Artificial Intelligence.

1.2.2 Human Computer Interaction

HCI is key for designing systems. This course helps us to understand how to make an interactive system that engaged our users. A system that is interactive is easy and comfortable for the user to use the system and understand easily.

1.2.3 Android Studio

Android Studio is the IDE that gives Google to create proficient Android applications. It is used to build up a variety of applications for the Android working framework. It is an IDE and platform to design an easy-to-understand interface by simply drag and drop..

1.2.4 Machine Learning

In this course, we have studied different algorithms which are used to train models to perform task automatically after getting the training data.

1.2.5 Report Writing Skills

This course is about how to compose reports and other proper documentation, analyzing and evaluating data, structure material in a legitimate and intelligent request, and, in our undertaking, we need to compose our documentation, so this course is encouraging us Being ready to impart in this assignment.

1.3 Project Background

Product assessment through facial expression is a significant subject in the fields of computer vision and artificial intelligence. Despite the fact that facial expression reorganization can be directed using numerous sensors, this project focuses on studies that use facial video, images because visual expressions are one of the most important information channels in interpersonal communication.

The level of product appreciation is a significant measure for various retailers, for example, predicting the existence of our product in the market for the long term. Facial expression reveals emotions that help to predict true information about customer reviews. Helping individuals in every such case, we need to understand human emotion to treat humans in a more customized way. Predicting human emotion about a product has been a troublesome issue which is being solved over a decade's time.

1.4 Literature Review

1.4.1 Related Work

Research in the fields of facial expression recognition has been exceptionally dynamic and extensively research area. The scientists have face challenge related to the accessibility of capturing imaged of spontaneous expression, and this is perhaps the greatest challenge in future. Numerous research has been devoted to perceive emotions of facial expression. A researcher namely, (Zhang et al) researched two sorts of highlights: (1). a feature based on geometry, and a feature based on Gabor wavelet technique, used for appearance of face acknowledgment.

According to different writing overviews, shows that for constructing this work, a type of four essential advances needed to be applied namely,

- a) Preprocessing
- b) Registration of face
- c) Extraction of facial feature
- d) classification of emotion.

The detail of above mention types is described below:

1.4.1.1 Preprocessing:

Pre-processing is the initial step in machine learning to clean the data before embedding the data into the machine learning algorithms such as, deep learning among others. A lot of researcher used preprocessing process to clean the images data which can improve the performance of the deep learning model.

There are several ways we can use to apply preprocessing step on the image data set:

1. Noise removal from image
2. Conversion of the Image To different formats such as(Binary / Grayscale).
3. Transformation of Pixel Brightness.
4. Geometric-Transformation of images.

1.4.1.2 Registration Of Face:

A computer-based technique namely, a Face Registration is being utilized in a different sort of applications that used videos and digitized images for the identification of human faces. The registration of face, to use some landmark point human face is located in an image this process is named as "face localization" or "face detection." and then used geometrical normalized step to identify the faces that match with some template-image during a round named "face registration". the face identification strategies, the method based on appearance, feature-invariant method, knowledge-dependent methods are Template-based-methods whereas the detection techniques of expression in the related field are, Emely,

- 1). Local-Binary-Pattern-phase-correlation,
- 2). AdaBoost,
- 3). Haar-classifier
- 4). Gabor- Wavelet.

1.4.1.3 Extraction Of Facial Feature:

The extraction of facial features are main steps in recognition of face and described as the as the way of specific-regions localization, the points, landmarks, or a shape of curves included in 2D-based-image or a range of 3D-image. In the extraction of feature step, a numeric-vector feature is created from the resulting's registered-image. The commonly extracted features are described,namely,a). Lips,b).Eyes ,c).Eyebrows ,d).Nose tips.

For automatic analysis of facial expression recognition Face reader is the premier, and Emotion, Affectiva, Karios, etc are available few of the APIs that are used for recognition of expression. The recognition of Automatic-facial-expression has two forms: a facial feature representation, and classifier's problem. By using these, we extract the expression and by working on them, we can make decision on whether a person is interested in a product or liked or disliked the product.

The representation of facial feature is extracting a suitable group of characteristics from original face images to precise the human faces. The algorithms that are used for facial feature representation are Gabor Fitters and native Binary Pattern (LBP) and lots of others.

Different Algorithms that are being used are:

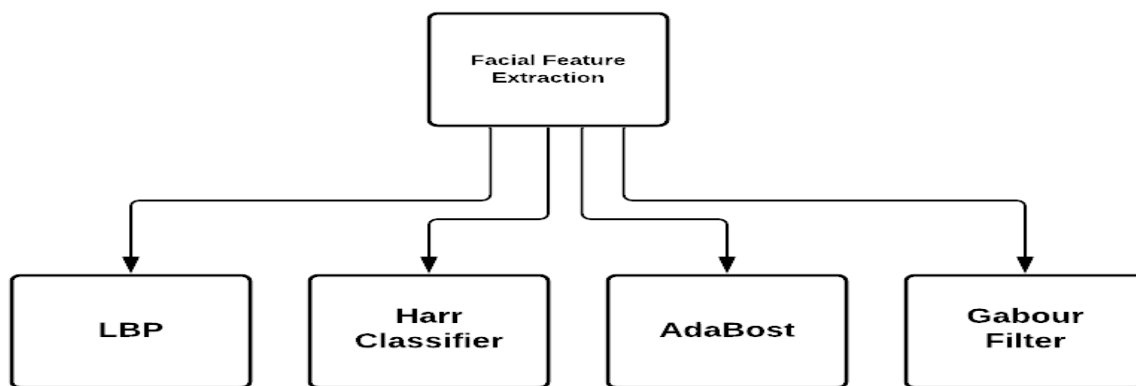


Figure 1 Feature Extraction Algorithms

1.4.1.3.1 Local Binary Pattern (LBP):

LBP is straight forward they divide the frame window into cells and use binary number to compute its values they compare each pixel around it i.e. left, right, top, bottom with some threshold value and consider assign binary result as output. limitation of this method is having small domain of neighborhood that result in capturing feature in small scales. 91% accuracy is achieved by testing LDP feature extraction. Histogram LDP extract both local and global patterns which result in higher accuracy LDP compatibility is good then other classifiers or filters in difference cases.

1.4.1.3.2 Gabor Filter:

Gabor classifier is also feature extraction method used in texture analysis, it is a linear filter. This filter analyses frequency within a specific region of image disadvantage of this filter is that they have bi-orthogonal computation which take too much time. Therefore, filter bank having gabor filters having different scales and rotation is used. Signals then convolved these filters called gabor.

Comparisons between LBP features with Gabor-filter features for facial expression recognition using SVMs.

	6-Class		7-Class		
	LBP (%)	Gabor (%)	LBP (%)	Gabor (%)	Gabor [48] (%)
SVM (linear)	91.5 ± 3.1	89.4 ± 3.0	88.1 ± 3.8	86.6 ± 4.1	84.8
SVM (polynomial)	91.5 ± 3.1	89.4 ± 3.0	88.1 ± 3.8	86.6 ± 4.1	Worse than RBF/linear
SVM (RBF)	92.6 ± 2.9	89.8 ± 3.1	88.9 ± 3.5	86.8 ± 3.6	86.9

Figure 2 Comparison Table

1.4.1.4 Emotion Classification:

Emotion classification is the step after extracting feature these features are then used to classify emotion. Machine learning proposed many classifiers used to detect emotions include Support Vector Machine, Convolutional Neural Network, Recurrent Neural Network, Naïve Bayes and many more The development of histogram by utilizing any of facial component representation will utilize Support Vector Machine (SVM) for expression recognition.

Different approaches are followed for Facial Expression Recognition:

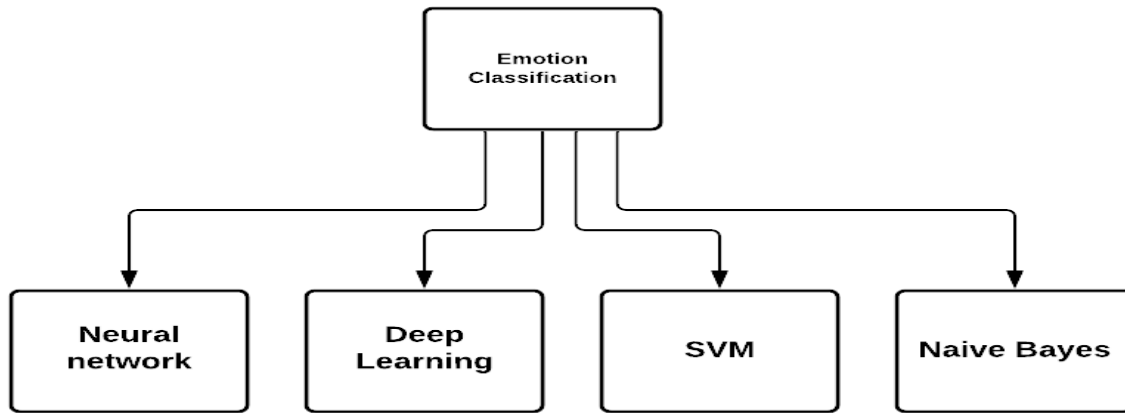


Figure 3 Emotion Classification

1.4.1.4.1 Neural Network Approach:

Neural network is built with the concept of human brain. These networks have neurons connected with each other divided in different layers start layer is input layer which is constant and depends on features and many hidden layers weight factors and output layer. Fer2013 dataset uses CNN model for emotion classification.

1.4.1.4.2 Naïve Bayes:

Naive Bayes Classification is another emotion classification method based on probability. It is straightforward and has low computation time; this is one of the reasons for its popularity. It builds a fast machine learning model. A supervised learning approach uses different classification problems. . . Many new deep learning models for face recognition are being proposed. The practice of deep learning

1.4.1.4.3 Deep Learning:

There are many proposed models of deep learning, deep learning approaches for facial expression reorganization especially CNN have brighten down to great extent, CNN have input layer dense layer output layer. 88% accuracy is achieved on KEFG dataset.

1.5 Analysis from Literature Review

A task is refined with showed goal to achieve an ideal result, it is essential to encounter past research and strategies for evaluating correctness. Different techniques have been used in later quite a while for investigation. These methodologies contrast from each other, uncover the advantages of each and limitations concerning our anxiety. We used the Convolution Neural Network approach to achieve our goal. It has core concepts of machine learning. Artificial Intelligence competence is the space we worked in.

Support Vector machine SVM is a multi-scale machine learning algorithm which is used for classification or analyzing of data, it gives good performance on classifying human facial expressions; it is needed to set controlled environment with no noise or having constant head pose.

On classifying image or video frames in uncontrolled environment SVM show low performance Therefore, deep neural network is better approach for classifying emotions under these circumstances

CNN's kernels, that have matrices which is smaller than size of. New activation matrices is generated by applying kernels to inputs. By applying kernels to the inputs, new activation matrices, sometimes consider as feature maps, is generated and then they pas these as inputs to the next layer of the network.

Machine learning performance depend on data used for training. ,parameters for training, emotion classes , and the requirement of system. For these reasons, experiment with different dataset and

classifiers is good approach in order to get more understanding of different architectures their accuracy and usefulness.

FER models are trained on a set of labeled images in order to classify new input images. We need a large dataset of facial imagery with each displaying discrete emotion for training these applications the more labeled images, the better result.

Greater than 97% accuracy is achieved by LBP features in facial expressions reorganization.

Gabor Fitters and Local Binary Pattern (LBP) are the algorithms used for facial feature representation. The final accuracy is 90% on K-Nearest Neighbor algorithms based on RST-Invariant and Texture features .

Results of Deep Neural Network (DNN) architecture are listed below:

DataSets	Accuracy
MultiPIE dataset	94.8%
CK+ Dataset	92.2%
MMI Dataset	56.0%
DISFA Dataset	56.1%
FERA	77.4%

SFEW Dataset	48.6%
FER 2013	61.1%

Table 1DNN Datasets Accuracy

Emotions have different salient features in facial expression. Patch Matching Operation technique is helpful for extract these salient areas features. Patch Based Gabor features have performed better results based on JAFEE and CK+ dataset and have accuracy 94.93% .

Boosted Neural Network Ensemble (BNNE) classified with a multicultural dataset have better results 81.73% using local binary pattern ,92.79using HOG feature and 90.63% using PCA features.

ML classifier Meta (Random Committee) result 93.1944% classifiers.

we consider CNN model to accomplish our task as (CNN) is currently good for image classification because they extract patterns from small regions in image, such as an eyebrow curve. It processes more deep extraction that is used to classify differentiate between two similar type of emotions.

1.6 Methodology and Software Lifecycle for this Project

The project methodology is a crucial part of any project because it's a key element and set the overall style. For this, we must first understand the system.

1.6.1 Methodology

The objective of the project methodology is to manage the entire process in a controlled environment to allow process go through problem solving and decision making procedure in proper

way while ensuring the success of specific processes, techniques, approaches, technologies, and methods.

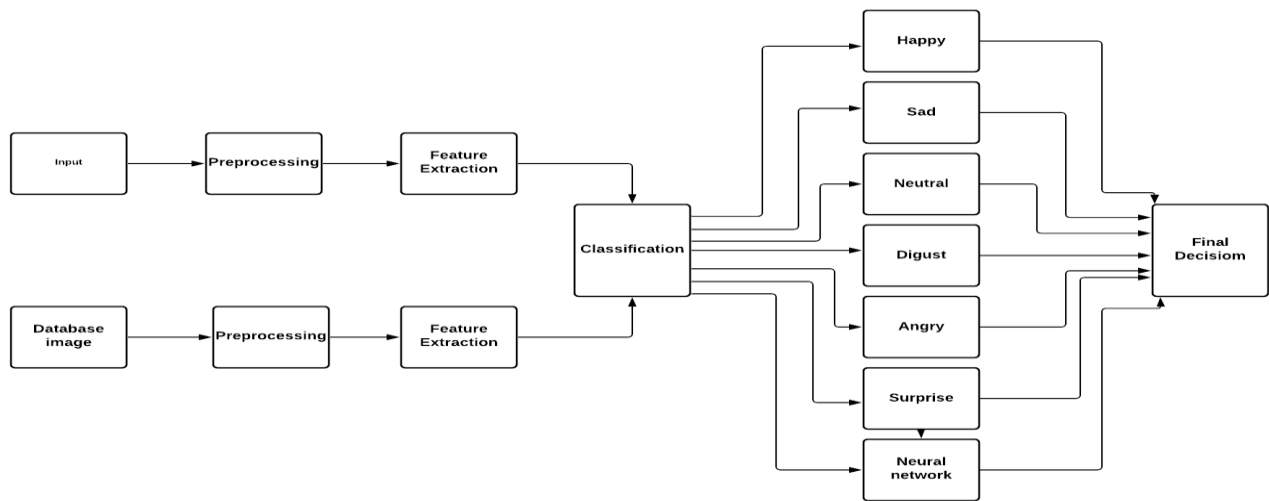


Figure 4Model

Chapter 2

PROBLEM DEFINITION

2. Problem Definition

Our emotions are expressed through our expressions on the face. The expert marketers can identify the customer's behavior through their face expressions. The marketers can estimate whether the customer is satisfied or not through their products.

There are 7 basic emotions associated with human body: happy, sad, surprise, anger, disgust, fear and neutral. Our state of mind is linked with our emotions. When we are mentally distorted then our emotions are sad and same for happiness. Now-a-days normal retailers can also identify the customer's behavior. Judging the customer's behavior and expressions is now a major part of business. Testing the product before launching is a good way to take responses from peoples.

As a human being this characteristic is god gifted. Some people are really expert in this art and some are not. What happened if we design a machine for same task in such a way that it works on behalf of human and give more precise results? Isn't it useful in business? We will design such a neural model which will detect human expressions and predict his opinion about the new product before launching that product. Humans are wrong sometimes, but machines aren't if designed properly.

2.1 Problem Statement

Eyes are called as the "Window to soul" because they gives the image of personality. But our face represents all the hidden emotions of our soul through different gestures. Psychologist might recognize you through your face expressions.

In the whole process, the major part is emotion detection and recognition. In this process many factors involves like: Visual surveillance, teleconference and real-time animation of motion videos because they are far helpful in detection of person's mind through his emotions. Emotions are

expressed by facial expressions and these expressions gives more efficient interaction with peoples. We will take feedback from peoples in order to check the

Face recognition might get difficult in the case of different orientations, location where the face is set or shape of the face might effects the results. So we have to design a system in such a way that in all orientations and dimensions we get possibly accurate results.

2.2 Deliverables and Development Requirements

2.2.1 Software Requirement

Software requirement necessary for our project are:

- a) OpenCV framework
- b) Keras
- c) Tensor Flow

2.2.1.1 OpenCV

OpenCV is a library having almost 2500 algorithms. It contains algorithms related to classic as well as state-of-art- vision of computers and also have machine learning algorithms. Most of the algorithms in OpenCV are used in visual surveillance like detection and recognition of faces, detection of human actions, object identification and also moving objects tracking. These algorithms are also applicable in finding similar images from huge database and also provides high resolution images of whole scene. In short we can say that this library relates to visual and detection features.

OpenCV is natively written in C++ but have interfaces of MATLAB, Python, Java and C++. It supports Windows, Linux, MacOS and Android as well and used by many known companies like Google, Yahoo, Toyota etc. OpenCV is generally used in python because these days most of the development and automation processes are held in python due to its vast libraries and robustness.

2.2.1.2 Keras

Keras is an API of high-level neural networks. It is used for development and evaluation of deep learning models. Keras reduces the cognitive load and offers consistent and simple APIs for python. It is written in Python and also runnable on TensorFlow library or even on Theano and CNTK. Keras includes frequent implementation of basic building blocks of neural networks like layers, activation functions, optimizers, objectives and a lot of tools related to working with data of images. Keras provides the training of deep learning models on iOS, Android, Websites, JVM(Java Virtual Machines) and also distributed training of deep models on Graphical Processing Units (GPU).

2.2.1.3 Tensor Flow:

TensorFlow is a python library developed by Google developers in Google Artificial Intelligence Organization. It deals with the easy implementation of computations in machine learning and in deep learning. It offers python as well as C++ APIs. Normally it held the computations inside Graphical Processing Units (GPU) to maintain the image quality and resolutions.

2.2.2 Hardware Requirement

Following are the hardware requirement that is most important for the project:

- a) Fluently working Laptops
- b) Smart Phone
- c) RAM minimum 4Gb
- d) Web Camera

Chapter 3

REQUIREMENT ANALYSIS

3.Requirement Analysis

Software Requirement Analysis (SRS) is providing a basic understanding of functional as well as non -functional requirements. It measures necessities could determine the procedures that must be followed and limitations that the association must follow. With the help of SRS, users can easily understand the system and its working.

3.1 Use Case Table Elements


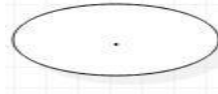

NO	Elements Name	Symbols
1	Use Case	
2	Actor	
3	Association	

Table 2 Use Case Elements

3.2 Use Case Diagram

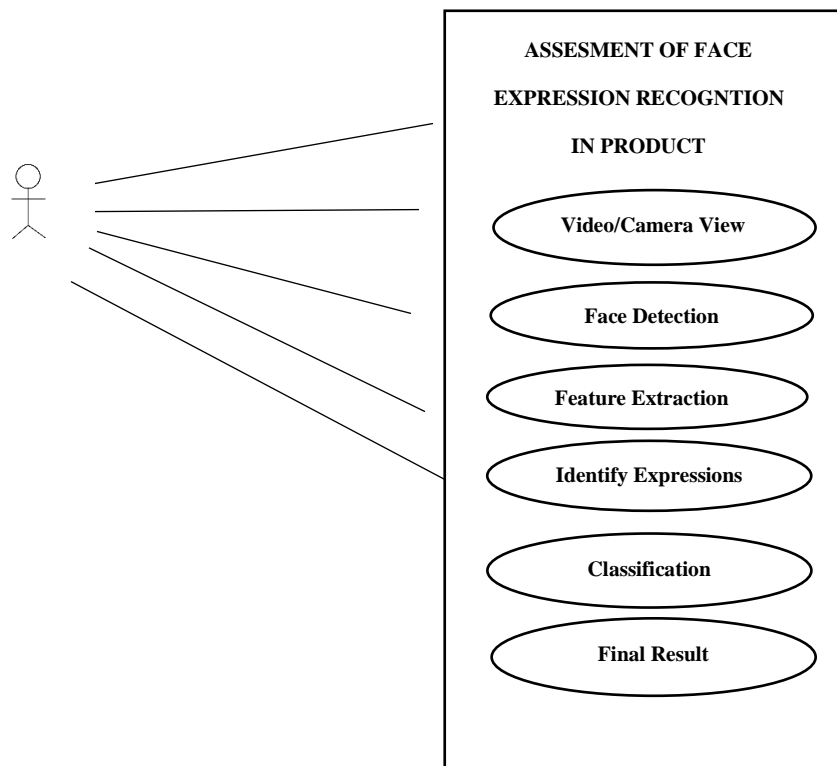


Figure 5 Use Case Diagram

3.1.1 Detailed Use Case Diagram

Use case diagram is one of the UML diagrams which outlines which models dynamic behavior. It is dynamic in nature, comprising of some inside or outside parts for making the connections. It is a set of use cases, actors (primary and secondary actor), and relationships. A use case diagram is used to represent a particular functionality of a system. Many use case diagrams are used to model the entire system. It is a generic way to define that use case diagram captures all dynamic aspects of the whole system.

Use case 1	
Use-case name	Video /Camera View.
Action	User
Description	User will sit in front of a camera and record their reaction to different questions during testing products
Pre-condition	User must show their Face frontal Face.
Post-condition	After giving their review to a system, the result is generated
Use case 2	
Use-case name	Face Detection
Action	Detect Face using Harr classifier
Description	Users Face is detected
Pre-condition	A user must be in front of camera
Post-condition	After detection, a face rectangle is shown over the face

Use case 3	
Use-case name	Preprocessing
Action	Computer Aided System
Description	An input frame is going for preprocessing
Pre-condition	Video must be uploaded
Post-condition	After giving input to a system, image frames are preprocessed, and a user can exit, or it goes.
Use case 4	
Use-case name	Feature Extraction
Action	Computer-aided system
Description	A preprocessed image is sent forward for emotion Feature Extraction
Pre-condition	Input preprocessed images.
Post-condition	After extracting the feature result is used for the classification of emotions

Use case 5	
Use-case name	identify Expressions.
Action	Computer-aided system.
Description	using extracted features, emotions are classified.
Pre-condition	feature must be extracted.
Post-condition	classify results of emotions
Use case 6	
Use-case name	Result
Action	Computer-aided system
Description	classification of emotions result is computed either user like the product or not
Pre-condition	labels must classify correctly, so the system plays it in audio.
Post-condition	Result is displayed on the user screen..

Table 3 Detailed Use Case

3.3 Functional Requirement

The functional requirements for a framework explain what the framework ought to do. Those necessities rely upon the sort of software being created, clients of the product. These are a statement of administrations the framework ought to give, how the framework ought to respond to input, and how the framework ought to carry on in that situation. Functional Requirements of the system are:

- The Systems must possess near real-time performance.
- The system should detect face in a video.
- The system should include a face detection algorithm.
- The system should include techniques of feature extraction.
- The system should include emotion classification algorithm.
- Based on emotion detected system should generate final result.

3.4 Nonfunctional Requirement

Nonfunctional requirements are those that aren't directly related with the required function delivered by the system. They are related to the system properties like Reliability, reaction time, and store occupancy.

Nonfunctional requirements of the project are:

Properties	Measures
Reliability	System should function properly at any given time and respond in the expected way. System should not suffer from frequent down time. The application will meet all the functional requirement without any unexpected behavior and System should be Recoverable and Accurate.

Security	User data integrity should not be at stake. Records should not be compromised and manipulated.
Performance	System will have Fast Response time. Performance will be accurate.
Complexity	Application should be simple, and all modules should avoid unwanted dependencies.
Efficiency	Minimal use of resources. System should work efficiently
Maintainability	This application can maintain easily.
Availability	This application will available all time on the user android device
Integrity	All components well integrated and complement each other.

Table 4 Non-Functional Requirements

Chapter 4

DESIGN AND ARCHITECTURE

4.1 Design and Architecture

After gathering all requirements, the next step is to start planning how we are going to develop our project, how much resources, costs, time, benefits, and other items are required. After planning, we move to the designing and architecture phase that which techniques and methods we can use and how we are going to develop our Project. It is the most challenging phase of project development.

It shows the general flow of the system. In this section we discuss detail of the system:

4.1.1 System Architecture

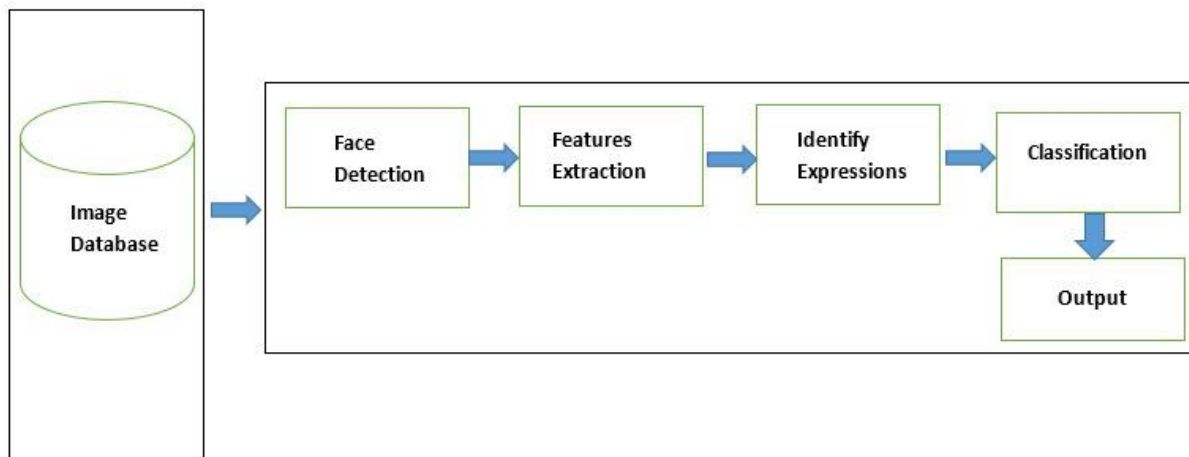


Figure 6 System Architecture

4.2 Data Representation [Diagram + Description]

Data representation is the showing of data through graphs, charts, and diagrams. These methods are used to visualize and understand the flow of the system.

4.2.1 DFD levels and layers

We can understand the system more by going into detail about DFD. Some levels are level 0,1 or 2 and can further go to the next level depending upon the plan.

- DFD level 0 is the basic summary of the overall system, that how the process is designed.
- DFD level 1 gives us more details about the system, and sub-processes .it is the main highlight of the system.
- DFD level 2 is deeper into the parts of DFD level 1.it gives us more detail about system functioning.
-

4.2.1.1 Level 0:

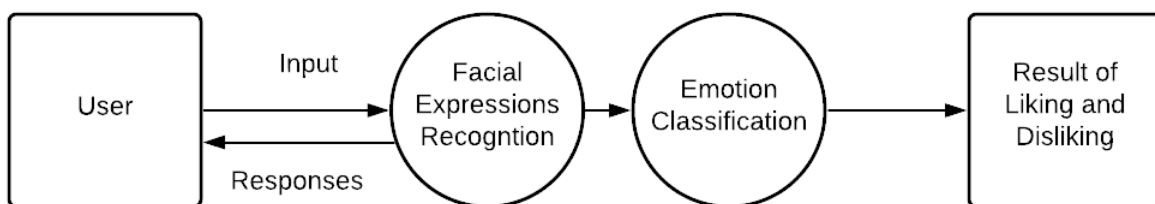


Figure 7 DFD Level 0

4.2.1.2 Level 1:

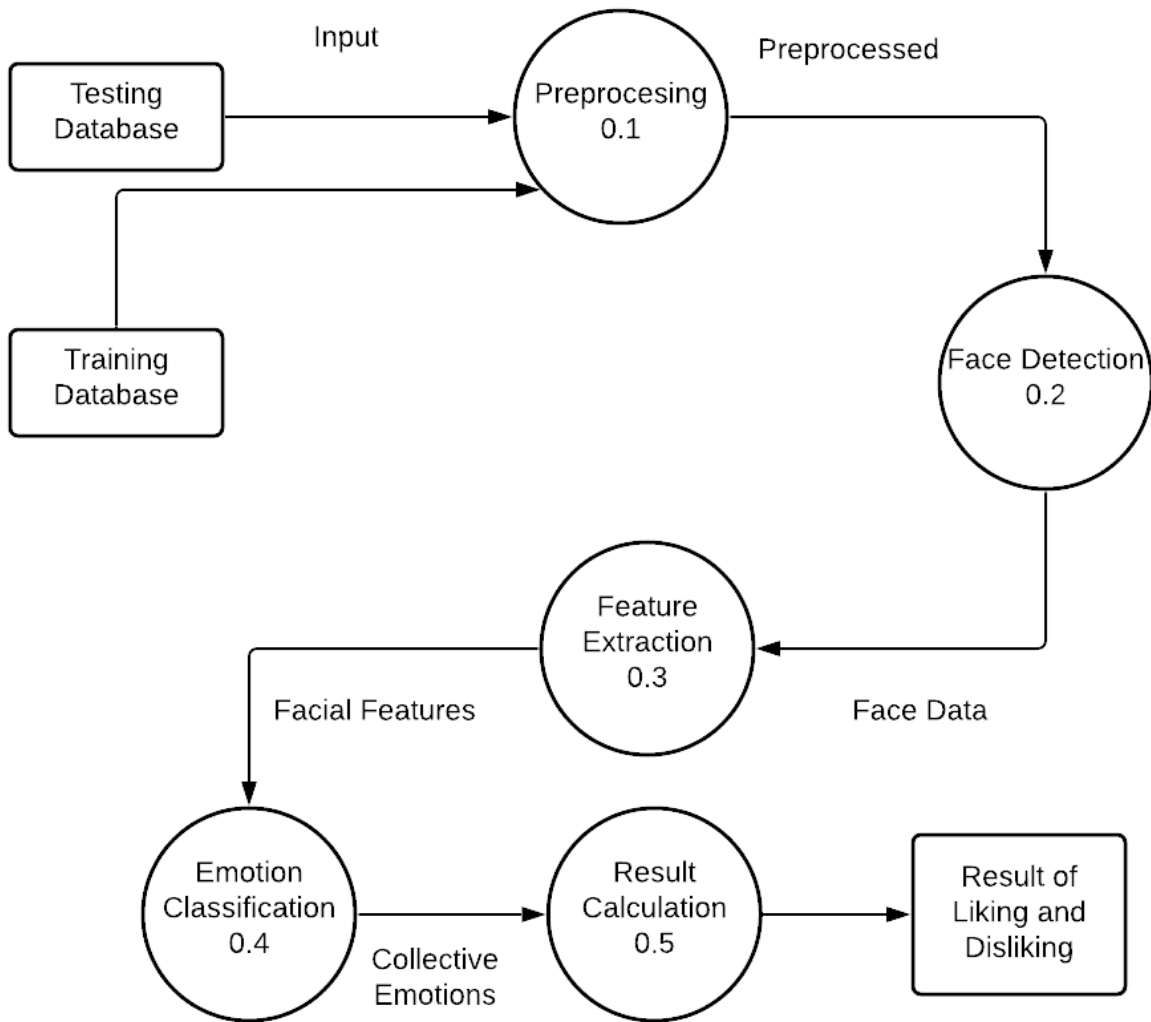


Figure 8DFD Level 1

4.2.1.3 Level 2:

Face Detection

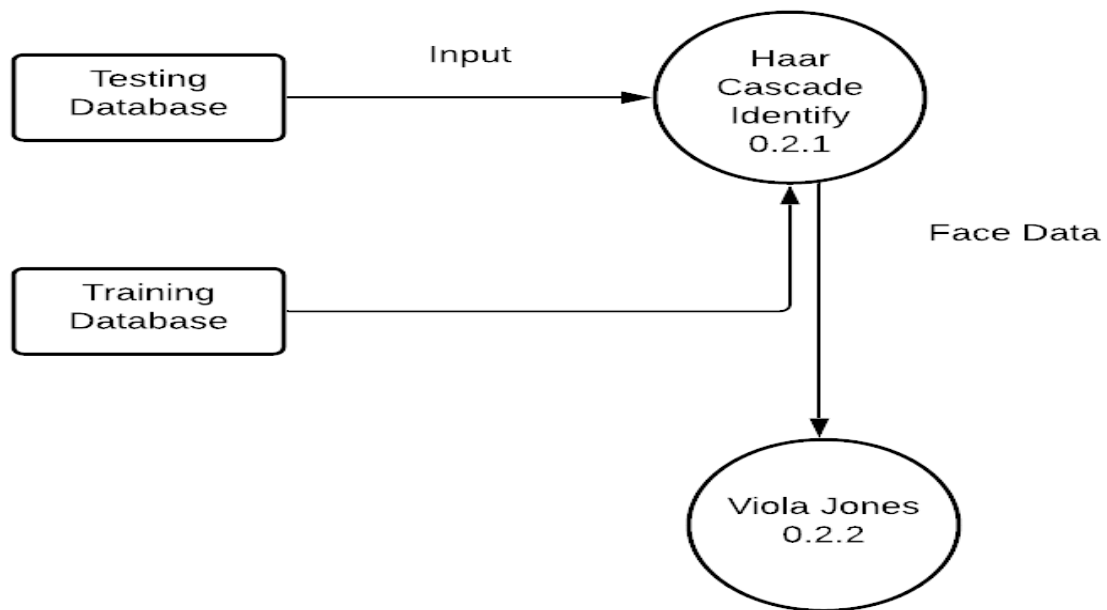


Figure 9 DFD Level 2

Emotion Classification:

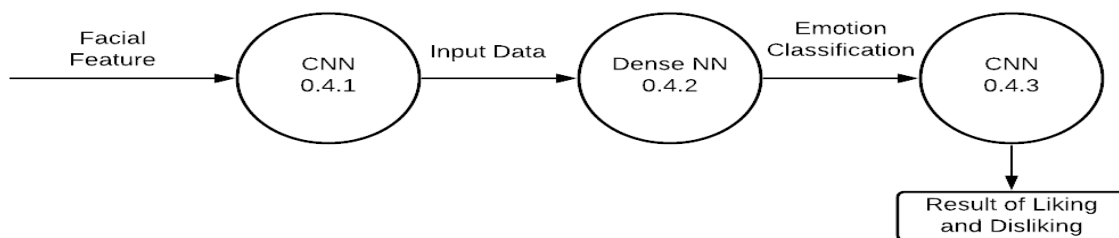


Figure 10 DFD Level 3

4.3 Design Models

4.3.1 Sequence Diagram

A sequence diagram just tells us the order of how the objects are involved in interaction and how the message is delivered from one element to the other in a system. It models the system in a sequence.

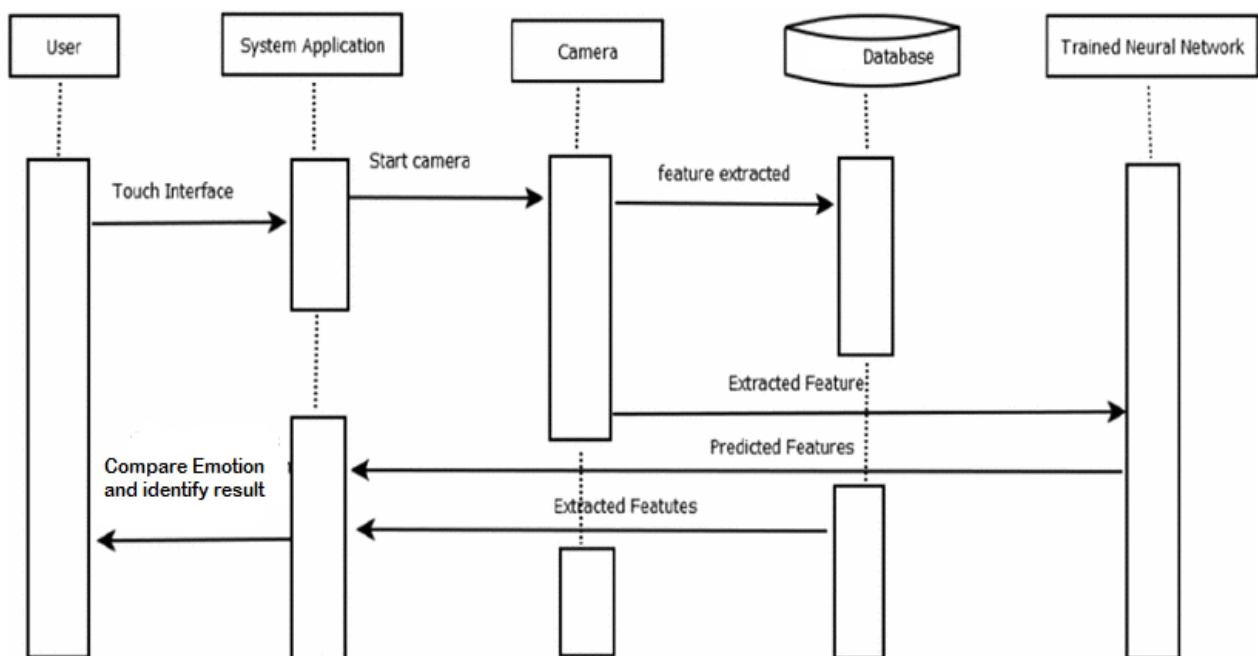


Figure 11 Sequence Diagram

4.4 Process Flow / Representation

4.4.1 Activity Diagram

It shows the workflow between the user and the system. SE elements like methods, operation, and functions are modeled by Activity Diagram.

4.4.1.1 Elements Of Activity Diagram






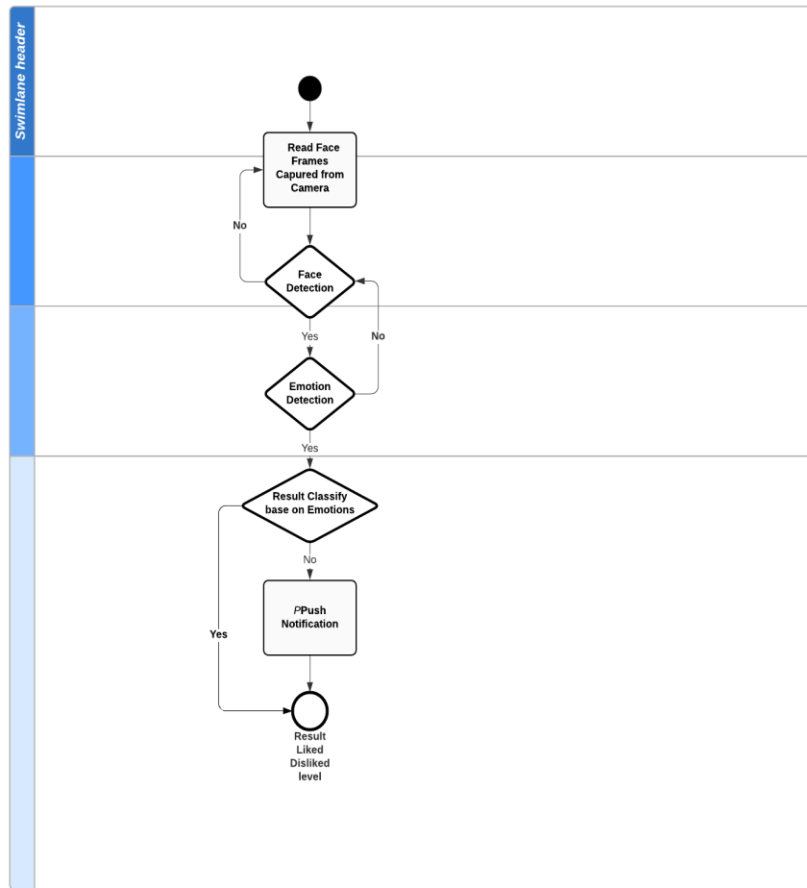




Starting Symbol	
Action State	
Decision	
Data Flow	
Final Node	

Table 5 Activity Diagram Elements

4.4.1.2 Activity Diagram




Learn how to edit this template

1. To **format shapes** as you'd like, click on a shape and then click "Shape Options" , "Fill Color" , and "Line Color"  on the properties bar at the top of the canvas.
2. Hover over a shape and click on any red circle  to **add lines**.
3. **Add text to a line** by double-clicking the text or anywhere on the line and typing.
4. To **format lines**, click on a line and use the properties bar at the top of the canvas.
5. Click on the swimlanes shape, and then use the advanced shape bar at the top of the canvas to:
 - a. Toggle the lane option to **adjust the amount of lanes** in your swimlane.
 - b. **Select the lane and text orientation** you'd like.
 - c. **Select the header and lane color**.

Pro tip: To change the fill color of a specific lane, select the lane you want to change and then click "Header" or "Lane" on the advanced option bar at the top of the canvas.

Tutorials

(Hold Shift +  or Ctrl, then click)

Read how to use swimlanes 

Watch Lucidchart basic tutorials

Figure 12 Use Case Diagram

5. References

- 1 Facial Expression Detection Using FACS. <https://www.ijser.org/researchpaper/Facial-Expression-Detection-Using-FACS.pdf>
- 2 IMAGE PROCESSING FACIAL EXPRESSION RECOGNITION. https://rccit.org/students_projects/projects/it/2018/GR8.pdf
- 3 Going Deeper in Facial Expression Recognition using Deep <https://deepai.org/publication/going-deeper-in-facial-expression-recognition-using-deep-neural-networks>
- 4 Vision Based Hand Gesture Recognition for Indian Sign <http://www.internationaljournalsrsg.org/uploads/specialissuepdf/ICETSST-2017/2017/CSE/1-%20itle%20copy.pdf>
- 5 SRS-sdar - Studylib. <https://studylib.net/doc/25218753/srs-sdar>
- 6 Energy Storage and Microgrid Training and Certification https://www.necanet.org/docs/default-source/NECA2016Presentations/e-21_28-energy-storage-and-micro-grid-training-initiative.pdf?sfvrsn=2
- 7 Naive Bayes Classifier in Machine Learning - Javatpoint. <https://www.javatpoint.com/machine-learning-naive-bayes-classifier>
- 8 Recognizing human facial expressions with machine learning <https://www.thoughtworks.com/insights/articles/recognizing-human-facial-expressions-machine-learning>
- 9 Vithal Vision - Top IT & Marketing company. <https://vithalvision.in/>
- 10 Magnetic-based Door Lock Security System using Face ID w <https://www.inettutor.com/source-code/magnetic-based-door-lock-security-system-using-face-id-w-sms-notification/>
- 11 Feasibility Analysis: Meaning, Importance, Report, Types <https://www.businessmanagementideas.com/feasibility-analysis/feasibility-analysis-meaning-importance-report-types-process-objectives-and-advantages-business/18196>