Online Captcha Replacement Through Face Recognition and Detection

B.E. Project Report - 'A'

Submitted in partial fulfillment of the requirements

For the degree of

Bachelor of Engineering
in
Computer Engineering

by

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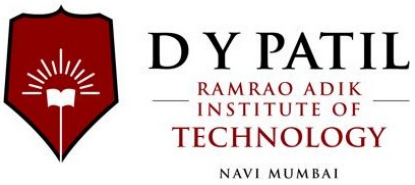

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Ramrao Adik Institute of Technology

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CERTIFICATE

This is to certify that, the project 'A' titled

" Online Captcha Replacement Through Face Recognition and Detection "

is a bonafide work done by

Mr. Aditya Kakad
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Mr. Rutwik Chinchole
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and is submitted in the partial fulfillment of the requirement for the degree of

Bachelor of Engineering
in
Computer Engineering
to the
University of Mumbai

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Project Co-ordinator	Head of Department	Principal
(Mrs. Smita Bharne)	**(Dr. Leena Ragha)**	**(Dr. Ramesh Vasappanavara)**

Declaration

We declare that this written submission represents my ideas in my own words and where other's ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Mr. Aditya Kakad	**15CE8005**	_____
Mr. Sumit Bhirud	**15CE7043**	_____
Mr. Rutwik Chinchole	**15CE7044**	_____
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Project Report Approval for B.E

This is to certify that the project 'A' entitled ***" Online Captcha Replacement Through Face Recognition and Detection "*** is a bonafide work done by ***Mr. Aditya Kakad***, ***Mr. Sumit Bhirud***, ***Mr. Rutwik Chinchole*** and ***Mr. Aakarsh Raghunath*** under the supervision of ***Dr. Bharati Joshi*** and ***Ms. Snehal Mumbaikar***. This dissertation has been approved for the award of ***Bachelor's Degree in Computer Engineering, University of Mumbai***.

Examiners :

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2. .....

Supervisors :

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2. .....

Principal :

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Date : .../.../.....

Place : .....

Acknowledgement

I take this opportunity to express my profound gratitude and deep regards to my supervisor **Dr. Bharati Joshi** & co-supervisor **Ms. Snehal Mumbaikar** for their exemplary guidance, monitoring and constant encouragement throughout the completion of this report. I am truly grateful to his efforts to improve my technical writing skills. The blessing, help and guidance given by him time to time shall carry me a long way in the journey of life on which I am about to embark.

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Last but not the least I would also like to thank all those who have directly or indirectly helped me in completion of this thesis.

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Abstract

Nowadays CAPTCHA technology is widely used for secure authentication allowing the system to distinguish between human user and bots, but this technology is sometimes ambiguous to some extent. But this system is slow and sometimes hard to decipher due to language barriers or other constraints imposed by the system. These issues can be redressed by using face detection as a substitute for CAPTCHA. Our proposed system will eliminate the language barrier and will result in faster and a more secure access to the system. We have studied various proposals in this regard, and have come up with a custom-built algorithm which will overcome the previous system's drawbacks.

Contents

Chapter 1

Introduction

Nowadays CAPTCHA technology is widely used for secure authentication allowing the system to distinguish between human user and bots, but this technology is sometimes ambiguous to some extent. But this system is slow and sometimes hard to decipher due to language barriers or other constraints imposed by te system. These issues can be redressed by using face detection as a substitute for CAPTCHA. Our proposed system will eliminate the language barrier and will result in faster and a more secure access to the system. We have studied various proposals in this regard, and have come up with a custom-built algorithm which will overcome the previous system's drawbacks.

1.1 Overview

The process of identification will be carried out through face recognition and detection, in which features of the face will be mapped and identified through the front facing camera/web-camera and after correct verification, access will be given. A Deep Neural network will learn to detect the face from the image capture, and later authenticate from the face of the user by detecting face features. After correct detection of the facial features, the user will be allowed to access the system.

1.2 Objective

This system will be used as a substitute for CAPTCHA technology. Our proposed system will eliminate the language barrier and slow execution of existing system.

1.3 Motivation

This system is based on face recognition and therefore it will become much easier for the elderly to access the website.

It will also make the lives of disabled much easier as they will be able to solve the captcha just by showing their faces. Moreover, this system will help to overcome the language barrier. uneducated people will now be able to access the site without much trouble.

This system will ensure much efficient completion of the authentication process as it has lesser bugs than the current existing system.

1.4 Problem Definition

We all need better version of every small things these days. Captcha technology used to authenticate users have been used for a long time without any changes in the way it works or without any improvements in current execution.

This project tends not just to make some improvements but replace existing captcha verification with more faster and hassle free solution.

We will use face detection to verify human instead of typing certain unpredictable words or selecting some randomized images.

1.5 Organization of Report

Chapter 1 contains the introduction of the project along with Overview, objective, motivation and Problem Definition. Chapter 2 contains the Literature Survey of the research papers with Research Paper Survey and Analysis. Chapter 3 contains the Proposal of the project along with Problem Statement, Proposed work, Proposed Methodology and Hardware and Software required. Chapter 4 contains the Gantt chart of the project. Chapter 5 contains the Design of the system with System Architecture, Activity Diagram and the Algorithm. Chapter 6 contains the Proposed Results with Proposed Results and Analysis and Project Outcomes. Chapter 7 and 8 contains the Conclusion and future work.

Chapter 2

Literature Survey

2.1 Research Papers Survey

Facial Key Points (FKPs) Detection is an important and challenging problem in the fields of computer vision and machine learning. It involves predicting the co-ordinates of the FKPs, e.g. nose tip, center of eyes, etc, for a given face. In this paper, we propose a LeNet adapted Deep CNN model - NaimishNet, to operate on facial key points data and compare our model's performance against existing state of the art approaches.

Nowadays, facial keypoints detection has become a very popular topic and its applications include Snapchat, How old are you, have attracted a large number of users. The objective of facial keypoints detection is to find the facial keypoints in a given face, which is very challenging due to very different facial features from person to person. The idea of deep learning has been applied to this problem, such as neural network and cascaded neural network. And the results of these structures are significantly better than state- of-the-art methods, like feature extraction and dimension reduction algorithms.

Current face or object detection methods via convolutional neural network (such as OverFeat, R-CNN and DenseNet) explicitly extract multi-scale features based on an image pyramid. However, such a strategy increases the computational burden for face detection. In this paper, we propose a fast face detection method based on discriminative complete features (DCFs) extracted by an elaborately designed convolutional neural network, where face detection is directly performed on the complete feature maps. DCFs have shown the ability of scale invariance, which is beneficial for face detection with high speed and promising performance. Therefore,

extracting multi-scale features on an image pyramid employed in the conventional methods is not required in the proposed method, which can greatly improve its efficiency for face detection. Experimental results on several popular face detection datasets show the efficiency and the effectiveness of the proposed method for face detection.

2.2 Analysis

Paper Title	Proposed Method	Advantages	Challenges
Facial Key Points Detection using Deep Convolutional Neural Network	Convolution Neural Network and Inception Model	Reduces the number of parameters thereby reducing the large computational resource consumption by making ultimate adjustments to the architecture level.	For one hidden model which is the simplest deep architecture, the accuracy is worst. Loss can be decreased by fitting the inception model accurately but it leads to overfitting and starts to share the drawbacks of overfitting.[1]
Facial keypoints detection using Neural Network	CNNs for Face Detection and Recognition	This technique can be used by companies and facilities with security levels: customers could put all personnel's info into the dataset, and then put the camera at the desired position like the office front gate.	CNN's are effective but it has 2 very dangerous flaws Translation invariance and pooling layers, luckily we can reduce the danger with data augmentation but something is coming up (capsule networks) we have to be ready and open to the change[2]
A Fast Face Detection Method via Convolutional Neural Network	A Fast Face Detection via CNN	The ex- tracted DCFs are sparse and insensitive to scale variations for face detection. As a result, direct classification on DCFs significantly improves the efficiency of face de- tection compared with several state-of-the-art face detection methods using CNN.	Abstract Current face or object detection methods via convolutional neural network (such as OverFeat, R-CNN and DenseNet) explicitly extract multi-scale features based on an image pyramid. However, such a strategy increases the computational burden for face detection.[3]

Chapter 3

Proposal

3.1 Problem Statement

We all need better version of every small things these days. Captcha technology used to authenticate users have been used for a long time without any changes in the way it works or without any improvements in current execution.

This project tends not just to make some improvements but replace existing captcha verification with more faster and hassle free solution.[4]

We will use face detection to verify human instead of typing certain unpredictable words or selecting some randomized images.

3.2 Proposed Work

- The front end will first capture the image through the front camera/webcam, after giving a prompt for verification.
- The image will then be bundled in an API and sent to the back-end.
- The neural network at the backend will detect the predefined set of key points in the image to detect face from the image.
- If the features match and are above a certain threshold value for verification, a positive feedback will be sent back to the front end using an API again.
- If the front facing camera is not available, it will fall back to the normal CAPTCHA.
- The feedback from the detection will again be fed to the neural network to make it an optimized Neural network that will learn with every prediction.

3.3 Proposed Methodology

CNNs use a variation of multilayer perceptrons designed to require minimal preprocessing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics.

Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field. The receptive fields of different neurons partially overlap such that they cover the entire visual field.

CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage.

- The front end will first capture the image through the front camera/webcam, after giving a prompt for verification.
- The image will then be bundled in an API and sent to the back-end.
- The neural network at the backend will detect the predefined set of key points in the image to detect face from the image.
- If the features match and are above a certain threshold value for verification, a positive feedback will be sent back to the front end using an API again.The threshold value is the value which will determine whether the face will be detected according to the keypoints.

Each keypoint will have a threshold value and if the Neural network finds the mapped keypoint to be above a certain threshold value, it will detect it as a human feature keypoint. If the front facing camera is not available, it will fall back to the normal CAPTCHA.

- The feedback from the detection will again be fed to the neural network to make it an optimized Neural network that will learn with every prediction.

3.4 Hardware & Software Requirement

3.4.1 Hardware Requirements

• System with Windows 7 and above
• Webcam
• Storage of 2GB
• Minimum RAM of 1GB

3.4.2 Software Requirements

• python 3.6+
• browser capable of running javascript
• jupyter notebook

Chapter 4

Planning & Formulation

4.1 Schedule for Project / Gantt Chart

Figure 4.1 and Figure 4.2 displays schedule of project through gantt chart

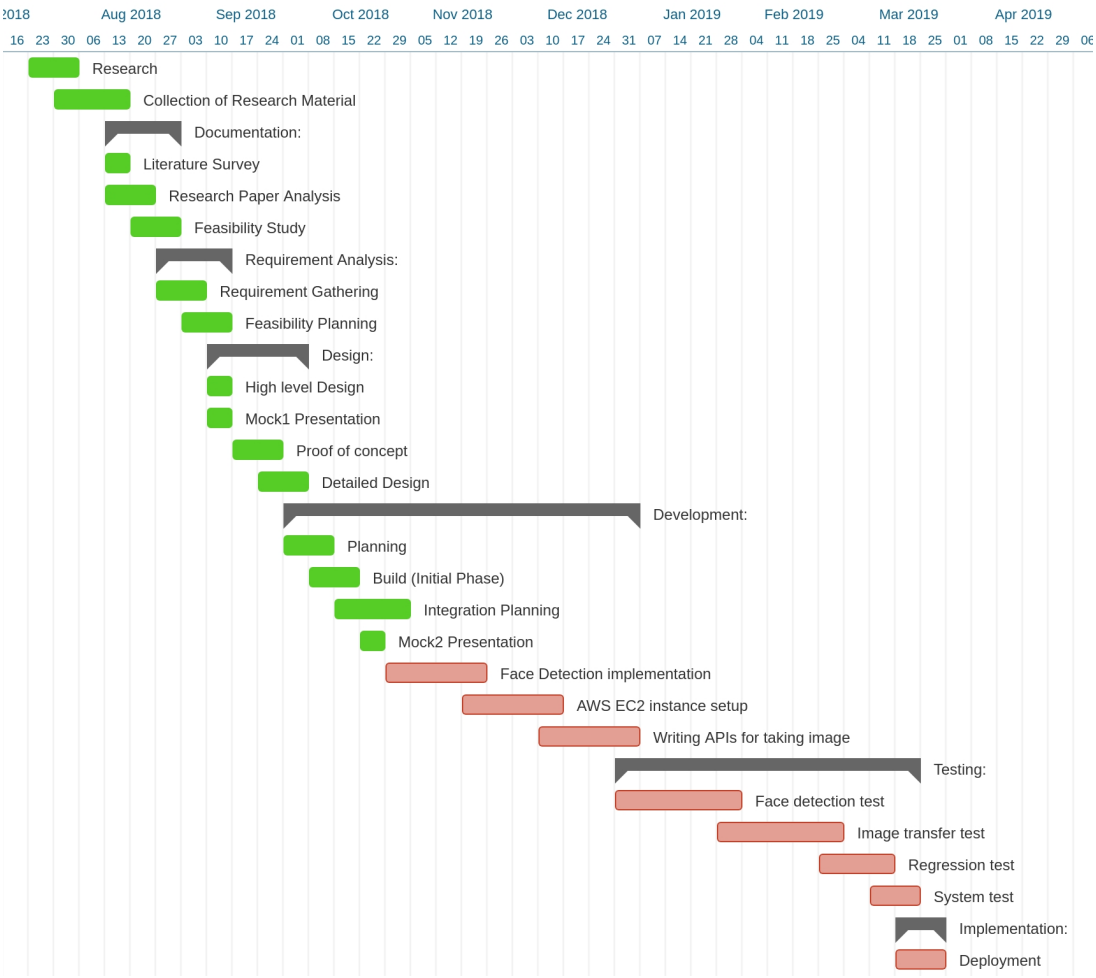

Figure 4.1: Gantt Chart

Chapter 5

Design of System

5.1 System Architecture

Figure 5.1 explains system architecture of this system. It gives the conceptual model that defines the structure, behavior, and more views of a system.

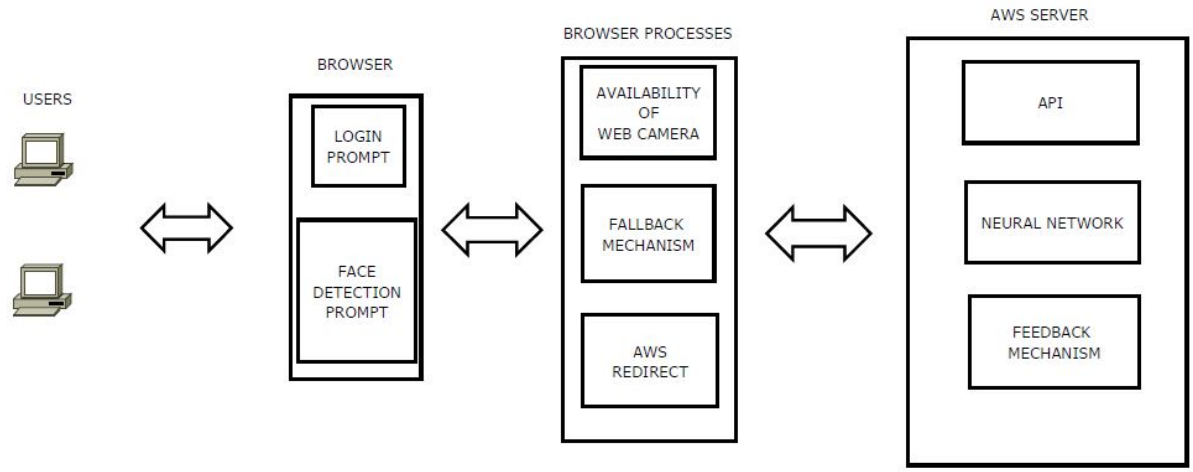

Figure 5.1: System Architecture

5.2 Activity Diagram

Figure 5.2 displays activity diagram of this system. The activity diagram gives the dynamic aspects of the system.

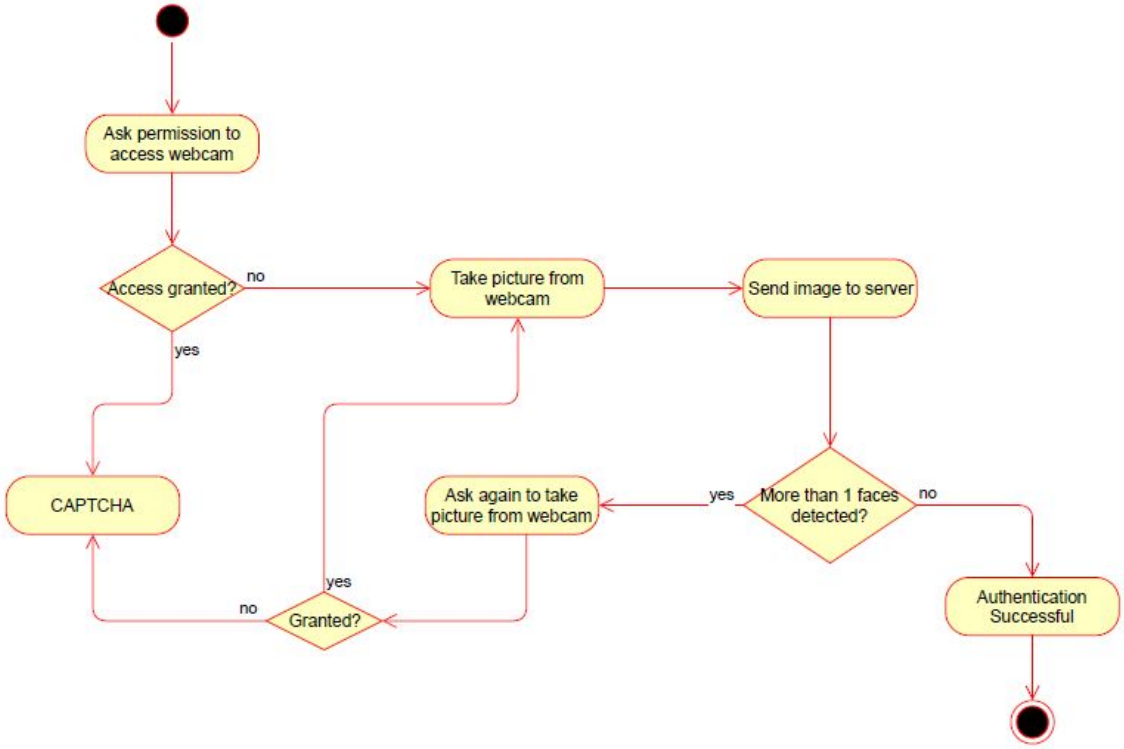

Figure 5.2: Activity Diagram

The following algorithms show the main function and the function for sending an image to server.

Algorithm 1 Online captcha replacement by face detection

```
1:  procedure MAIN
2:      if(webcamAccess != granted)
3:      goto 11
4:      elif(webcamAccess == granted)
5:      captureImage()
6:      sendImageToServer()
7:      if(numFaces > 1 or numFaces == 0)
8:      captureImage()
9:      else
10:     grantAccess()
11:     captcha()
```

```
1:  procedure SENDIMAGETOSERVER
2:      Convert the image to RGB colorspace
3:      Convert the RGB image to grayscale
4:      Detect the faces in image
5:      get number of faces
```

Chapter 6

Proposed Results

6.1 Proposed Results & Analysis

We capture the image from the front camera or the webcam and process the image at the backend to extract the face. After the facial keypoints are detected access to the system is granted.

This system will be used as a substitute for CAPTCHA technology. Our proposed system will eliminate the language barrier and slow execution of existing system.

6.2 Project Outcomes

After successfully completing this project, we will be able to provide this as a plug-in for individual user or organizations to use. They can download install and set the plug-in inside their browser which will override the in place captcha system with face detection. And as a security measure, will fallback to captcha if conditions required for face detection are not met Several benefits and uses are highlighted below.

• For authentication purposes :

This system can be used for any secure authentication purposes with the base of the system being facial keypoint detection.

• Attendance System :

Besides using this online, it can be used as a biometric system for attendance which can be used in : a) Schools b) Offices

• Security System:

Face detection can be used for secure access to buildings/houses to authentic users, and can also be used as traffic camera security system.

Chapter 7

Conclusion

Thus we have implemented a faster and hassle free system for user verification replacing the current captcha technology.

This new system will allow users to get past verification required by majority of the websites by click of a button.

It can be used smoothly even if user suffers from some disability or has hard time figuring out texts or images as put forth by the previous system.

Thus we believe that the correct implementation of the system reduces user effort, enhance user experience, provides a much accurate result and also give access in a much more smoother and faster way to the user.

Chapter 8

Future Work

This system can further be enhanced by using IRIS scanning as a feature. After detecting the face, the system will be able to recognise the features of the iris and give access based on this authentication. Since the features of the iris are unique, it will be a much secure detection feature.

Iris Recognition is one of the important biometric recognition systems that identify people based on their eyes and iris.

Iris recognition is a method of biometric authentication, based on extraction features of the iris of an individual's eyes. Each individual has a unique iris; the variation even exists between identical twins and between the left and right eye of the same person.

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