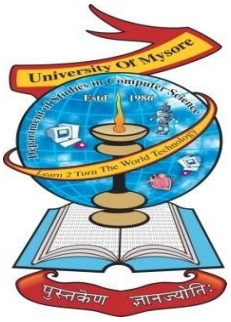
UNIVERSITY OF MYSORE



August 2022

A project report entitled

"COMPARATIVE ANALYSIS ON MACHINE LEARNING APPROACHES FOR SIGNATURE DETECTION FROM DOCUMENTS"

Submitted in partial fulfillment of the requirement for the award of the

Master of Science in Computer Science

Submitted by

NITHIN KUMAR D R
(20MSC27)

VIJAY S N
(20MSC53)

Department of Studies in Computer Science
University of Mysore
Mysore- 570006

UNIVERSITY OF MYSORE

CERTIFICATE

This is to certify that the project entitled **"Comparative Analysis on Machine Learning Approaches for Signature Detection from Documents"** is a bonafide work carried out by **NITHIN KUMAR D R**, and **VIJAY S N** with register no. **20MSC27** and **20MSC53**, students of **Department of Studies in Computer Science, Manasagangotri, University of Mysore**, Mysore at **Department of Studies in Computer Science, Manasagangotri, University of Mysore,** Mysore in partial fulfillment for the award of the degree of **Master of Computer Science (M.Sc(CS)** by the **University of Mysore during the academic year 2020 – 2022.**

The project work is approved as it satisfies the academic requirements in respect of project work prescribed for the aforesaid degree. This project report has not been submitted previously by anybody for the award of any degree or diploma to any other university.

Internal Guide

Thejashwini B L

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DoS in Computer Science

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Chairman

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External Examiners:

1.

2.

UNIVERSITY OF MYSORE

DECLARATION

We**, VIJAY S N** and **NITHIN KUMAR D R,** students of **IV semester MSC, Department of Studies in Computer Science, Manasagangotri, University of Mysore, Mysore,** do hereby declare that the project entitled **"Comparative Analysis on Machine Learning Approaches for Signature Detection from Documents"** has been carried out by us at of **Department of Studies in Computer Science, Manasagangotri, University of Mysore,** Mysore during the period, March - August 2022. This project report is submitted in partial requirement for the award of the degree **Master of Science in Computer Science (M.Sc (CS))** by the **University of Mysore**.

This is a bonafide work and the matter embodied in the report has not been submitted previously by anybody for the award of any degree or diploma to any other university.

Place: Mysore

Date : 26-08-2022

NITHIN KUMAR D R

VIJAY S N

ACKNOWLEDGEMENT

The satisfaction that implies the successful completion of any work would be incomplete without the mention of people who made it possible.

We are indebted to our internal guide **Thejashwini B L, Research Scholar, Department of Studies in Computer Science, Manasagangotri, University of Mysore,** Mysore, who has motivated and guided us throughout this project work. She has made the entire task simple and efficient with her valuable suggestions and meaningful advice.

We wish to place on record our deepest gratitude to our beloved Chairman**, Dr. D. S. Guru, Professor, Department of Studies in Computer Science, Manasagangotri, University of Mysore, Mysore.** We are thankful for his support and guidance throughout the completion of our project.

Our special thanks to our Course Co-ordinator **Smt.L. Hamsaveni, Associate Professor, Department of Studies in Computer Science, Manasagangotri, University of Mysore, Mysore,** for her kind support and guidance in completing this project.

Finally, we would like to thank our friends **Niveditha, Priya** and all those who have contributed directly or indirectly in our effort to complete this project.

NITHIN KUMAR D R
VIJAY S N

ABSTRACT

Signatures are the most widely recognized biometric for a long and also the most practical. Though biometrics play a huge role in verifying a person identity it can be expensive in terms of setting up and using, also not everyone can lug around a biometric detector nowadays. There is also the fact of how exactly this can be accomplished in a timely manner. This can be done with Machine learning approaches. This project is aimed to provide a clear contrast between various machine learning approaches in the field of computer vision to detect signatures of various types from the documents and provide the results to the user.

The primary aim of this project is to detect and extract signatures from various types of signed documents. We have done this with the help of machine learning approaches such as Connected component analysis, Contour Height and width heuristic method, and detecting signature using HSV color space. We made comparative analysis between them and observed that Connected component method gives efficient results. Along with this we also used SIFT feature matching and Template matching technique to locate signature in documents and made a comparative analysis between them, from these two SIFT feature matching provides best results. With further processing we are able to extract a signature from the input and save it for further use. The proposed system uses machine learning approaches of signature detection and extraction types to find different kinds of signature from documents. By analysing these various approaches, we can detect signatures accurately from documents.

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 Background

The modern day technologies and security requirements demand user authentication at every step. The user authentication and verification is performed based on different biometrics like fingerprint, iris, voice, and handwritten signatures. With the advancements in automated user verification and authentication, many methods for the extraction of information and authentication are presented

The handwritten signature is the most accepted and commonly used biometric feature. In forensic science, paper document examination is performed to establish genuineness or non-genuineness, or to expose forgery, or to reveal alterations; additions, or deletions in the document. The type of documents that prominently come under question may be a sheet of paper bearing handwriting or mechanically-produced text or signatures such as invoices, a forged cheque or a business contract. Signature is one of the most essential part generally studied for recognizing the biometric modalities. Nowadays signature detection and verification performs a dynamic part in the organizations somewhere security and confidentiality are the main anxieties. Signatures may be responsible for amusing information about a person as they consist of exclusive belongings of human behavior, therefore they are used for detection/Identification determinations. The signature has been well-thought-out for biometric authentication in organizational documents, legal documents, etc.

To segment documents from two layers; one layer supposed to contain printed text and other layer contain the handwritten parts. Such a segmentation problem has usual an inordinate deal of consideration in the literature for the reason that of the different processing methodologies for printed and handwritten texts. The objective is to apply corresponding techniques on the printed and handwritten parts. Many exploration works are going on for automatic online/offline signature verification and recognition.

1.2 About the Problem

The task of detecting and extracting signatures in the real-time documents poses several challenges. These types of document images have usually very low resolution, which makes them difficult to enhance. So we aimed to detect and extract signature from the documents by applying different methodologies.

Signature detection is a scheme which enables a computer to learn, understand, improvise and interpret the written or printed character in their own language, but present correspondingly as specified by the user. Signature extraction and detection uses the image processing technique to identify any signature features printed or hand written. A lot of work has been done in this field. But a continuous improvisation of this techniques is being done based on the fact that algorithm must have higher accuracy of extraction, higher persistency in number of times of correct prediction and increased execution time.

A handwritten signature is a distinct part of printed documents. Signature detection from the document images and retrieving documents using the signature as a query is a challenging task in the area of image processing. Therefore, treating these images in such a way that only handwritten signatures can be extracted for analysis of their characteristics. In order to solve this problem, we present different traditional approaches for signature detection.

1.3 Platforms used:

Visual Studio

The Visual Studio integrated development environment is a creative launching pad for Python (and other languages) that you can use to edit, debug, and test code, and then publish an app. An integrated development environment (IDE) is a feature-rich program that can be used for many aspects of software development. Over and above the standard editor and debugger that most IDEs provide, Visual Studio includes code completion tools, interactive REPL environments.

1.4 Overview of different types of Signatures

Handwritten signature is a written depiction of the name of a person in most of the cases or otherwise their nickname. Signatures are normally applied on a document to indicate some proof of identity or certify the document making it authentic. Signatures can come in all shapes and sizes, it depends upon what type of documents are used and what type of signature is applicable to them.

For simple documents just a signature or a signature with a date is applied, although many establishments and institutions have their own seal which can also be applied alongside the signature to further ensure its authenticity. Going on with this concept signatures can be classified into 4 major types depending on the situation and the person applying the signature. These types are defined below,

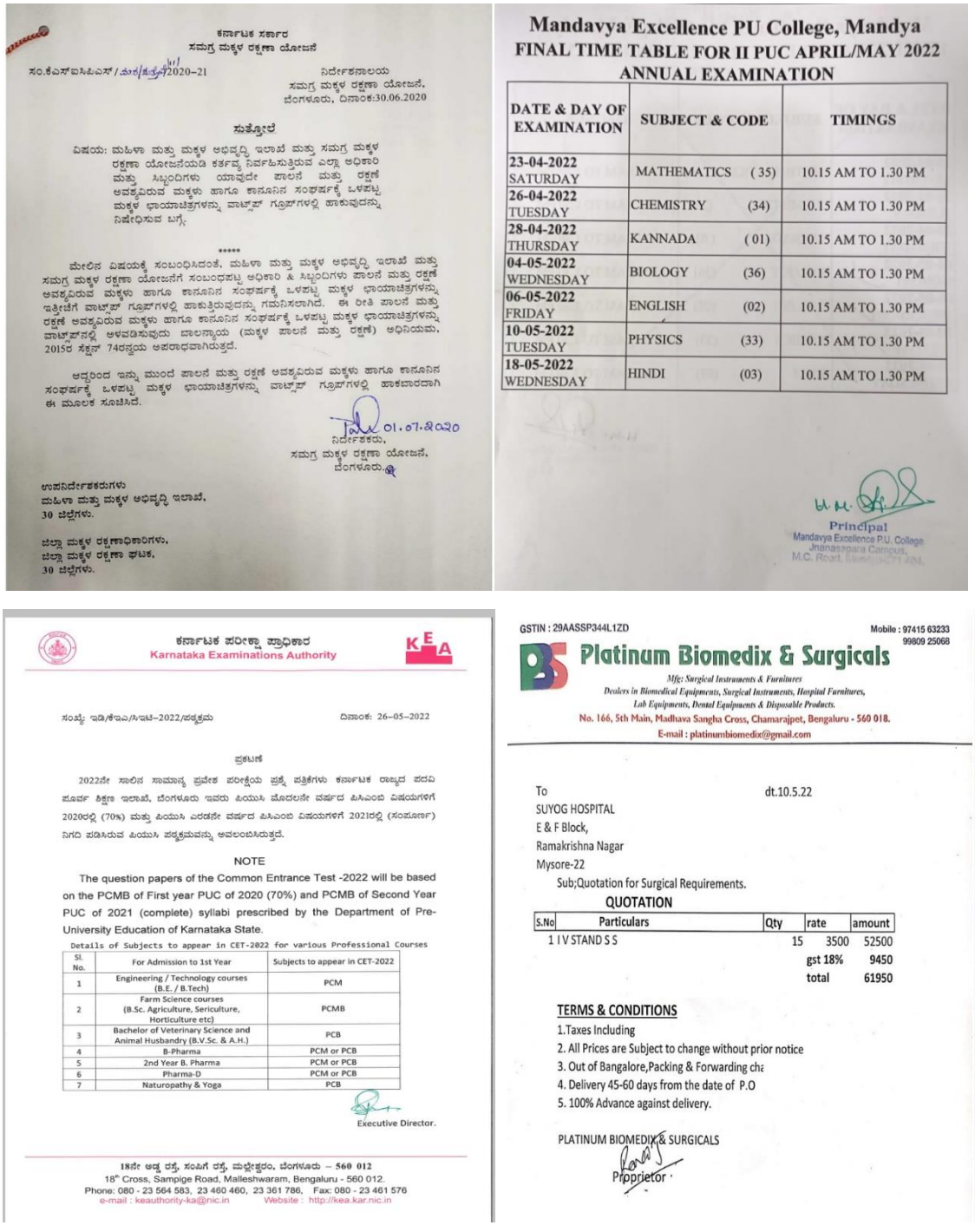
1. Sign: A document which contain only signatures with no other indicators about it.

2. Sign with Date: A document which contains signatures but the signee has also added the date at which it was signed, indicating that it was signed at a particular date.

3. Sign with Seal: A document which contains a signature but there is no date in this case, maybe the document contains a mention of date elsewhere on it or it doesn't matter, although to further validate it a seal of the person or establishment is applied either around it or above or below it.

4. Sign with Date & Seal: A document which contains signatures with dates along with being stamped with seal of the person or establishment applied either around it or above or below it.

In this project the aim is to take a document and have it digitized to an image in any form possible, even on a low end camera of a smartphone, extract features of signatures from it. It isn't that one must use only scanned images from a high end camera or scanner to have the highest quality possible. It is understood that not everyone will have scanners or high quality camera lying around to find signatures on a document considering the current situation in the world, so this system is trained in such a way that any image of document, containing even just legible signature can be processed and have the signature detected. If the signature is even just visible enhancement techniques can be applied to ensure that the signatures are detected by the system.



ಕರ್ನಾಟಕ ಸರ್ಕಾರ
ಸಮಗ್ರ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಯೋಜನೆ

ಸಂ.ಕೆಎಸ್ಐಸಿಪಿಎಸ್/ಮಾರ/ಕುತ್ತಿಗೆ/2020-21 ನಿರ್ದೇಶನಾಲಯ
ಸಮಗ್ರ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಯೋಜನೆ.
ಬೆಂಗಳೂರು, ದಿನಾಂಕ:30.06.2020

ಸುತ್ತೋಲೆ

ವಿಷಯ: ಮಹಿಳಾ ಮತ್ತು ಮಕ್ಕಳ ಅಭಿವೃದ್ಧಿ ಇಲಾಖೆ ಮತ್ತು ಸಮಗ್ರ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಯೋಜನೆಯಡಿ ಕರ್ತವ್ಯ ನಿರ್ವಹಿಸುತ್ತಿರುವ ಎಲ್ಲಾ ಅಧಿಕಾರಿ ಮತ್ತು ಸಿಬ್ಬಂದಿಗಳು ಯಾವುದೇ ಪಾಲನೆ ಮತ್ತು ರಕ್ಷಣೆ ಅವಶ್ಯವಿರುವ ಮಕ್ಕಳು ಹಾಗೂ ಕಾನೂನಿನ ಸಂಘರ್ಷಕ್ಕೆ ಒಳಪಟ್ಟ ಮಕ್ಕಳ ಭಾಯಾಚಿತ್ರಗಳನ್ನು ವಾಟ್ಸ್ ಗ್ರೂಪ್‌ಗಳಲ್ಲಿ ಹಾಕುವುದನ್ನು ನಿಷೇಧಿಸುವ ಬಗ್ಗೆ.

*****

ಮೇಲಿನ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ಮಹಿಳಾ ಮತ್ತು ಮಕ್ಕಳ ಅಭಿವೃದ್ಧಿ ಇಲಾಖೆ ಮತ್ತು ಸಮಗ್ರ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಯೋಜನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ಅಧಿಕಾರಿ & ಸಿಬ್ಬಂದಿಗಳು ಪಾಲನೆ ಮತ್ತು ರಕ್ಷಣೆ ಅವಶ್ಯವಿರುವ ಮಕ್ಕಳು ಹಾಗೂ ಕಾನೂನಿನ ಸಂಘರ್ಷಕ್ಕೆ ಒಳಪಟ್ಟ ಮಕ್ಕಳ ಭಾಯಾಚಿತ್ರಗಳನ್ನು ಇತ್ತೀಚೆಗೆ ವಾಟ್ಸ್ ಗ್ರೂಪ್‌ಗಳಲ್ಲಿ ಹಾಕುತ್ತಿರುವುದನ್ನು ಗಮನಿಸಲಾಗಿದೆ. ಈ ರೀತಿ ಪಾಲನೆ ಮತ್ತು ರಕ್ಷಣೆ ಅವಶ್ಯವಿರುವ ಮಕ್ಕಳು ಹಾಗೂ ಕಾನೂನಿನ ಸಂಘರ್ಷಕ್ಕೆ ಒಳಪಟ್ಟ ಮಕ್ಕಳ ಭಾಯಾಚಿತ್ರಗಳನ್ನು ವಾಟ್ಸ್‌ಪ್‌ನಲ್ಲಿ ಅಳವಡಿಸುವುದು ಬಾಲನ್ಯಾಯ (ಮಕ್ಕಳ ಪಾಲನೆ ಮತ್ತು ರಕ್ಷಣೆ) ಅಧಿನಿಯಮ, 2015ರ ಸೆಕ್ಷನ್ 74ರನ್ವಯ ಅಪರಾಧವಾಗಿರುತ್ತದೆ.

ಆದ್ದರಿಂದ ಇನ್ನು ಮುಂದೆ ಪಾಲನೆ ಮತ್ತು ರಕ್ಷಣೆ ಅವಶ್ಯವಿರುವ ಮಕ್ಕಳು ಹಾಗೂ ಕಾನೂನಿನ ಸಂಘರ್ಷಕ್ಕೆ ಒಳಪಟ್ಟ ಮಕ್ಕಳ ಭಾಯಾಚಿತ್ರಗಳನ್ನು ವಾಟ್ಸ್ ಗ್ರೂಪ್‌ಗಳಲ್ಲಿ ಹಾಕಬಾರದಾಗಿ ಈ ಮೂಲಕ ಸೂಚಿಸಿದೆ.

01.07.2020
ನಿರ್ದೇಶಕರು,
ಸಮಗ್ರ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಯೋಜನೆ,
ಬೆಂಗಳೂರು.

ಉಪನಿರ್ದೇಶಕರುಗಳು
ಮಹಿಳಾ ಮತ್ತು ಮಕ್ಕಳ ಅಭಿವೃದ್ಧಿ ಇಲಾಖೆ,
30 ಜಿಲ್ಲೆಗಳು.

ಜಿಲ್ಲಾ ಮಕ್ಕಳ ರಕ್ಷಣಾಧಿಕಾರಿಗಳು,
ಜಿಲ್ಲಾ ಮಕ್ಕಳ ರಕ್ಷಣಾ ಘಟಕ,
30 ಜಿಲ್ಲೆಗಳು.

Mandavya Excellence PU College, Mandya
FINAL TIME TABLE FOR II PUC APRIL/MAY 2022
ANNUAL EXAMINATION

DATE & DAY OF EXAMINATION	SUBJECT & CODE	TIMINGS
23-04-2022 SATURDAY	MATHEMATICS (35)	10.15 AM TO 1.30 PM
26-04-2022 TUESDAY	CHEMISTRY (34)	10.15 AM TO 1.30 PM
28-04-2022 THURSDAY	KANNADA (01)	10.15 AM TO 1.30 PM
04-05-2022 WEDNESDAY	BIOLOGY (36)	10.15 AM TO 1.30 PM
06-05-2022 FRIDAY	ENGLISH (02)	10.15 AM TO 1.30 PM
10-05-2022 TUESDAY	PHYSICS (33)	10.15 AM TO 1.30 PM
18-05-2022 WEDNESDAY	HINDI (03)	10.15 AM TO 1.30 PM

Principal
Mandavya Excellence P.U. College
Jnanasagara Campus,

ಕರ್ನಾಟಕ ಪರೀಕ್ಷಾ ಪ್ರಾಧಿಕಾರ
Karnataka Examinations Authority
KEA

ಸಂಖ್ಯೆ: ಇಡಿ/ಕೆಇಎ/ಸಿಇಟಿ-2022/ಪಠ್ಯಕ್ರಮ ದಿನಾಂಕ: 26-05-2022

ಪ್ರಕಟಣೆ

2022ನೇ ಸಾಲಿನ ಸಾಮಾನ್ಯ ಪ್ರವೇಶ ಪರೀಕ್ಷೆಯ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು ಕರ್ನಾಟಕ ರಾಜ್ಯದ ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ಬೆಂಗಳೂರು ಇವರು ಪಿಯುಸಿ ಮೊದಲನೇ ವರ್ಷದ ಪಿಸಿಎಂಬಿ ವಿಷಯಗಳಿಗೆ 2020ರಲ್ಲಿ (70%) ಮತ್ತು ಪಿಯುಸಿ ಎರಡನೇ ವರ್ಷದ ಪಿಸಿಎಂಬಿ ವಿಷಯಗಳಿಗೆ 2021ರಲ್ಲಿ (ಸಂಪೂರ್ಣ) ನಿಗದಿ ಪಡಿಸಿರುವ ಪಿಯುಸಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಅವಲಂಬಿಸಿರುತ್ತದೆ.

NOTE

The question papers of the Common Entrance Test -2022 will be based on the PCMB of First year PUC of 2020 (70%) and PCMB of Second Year PUC of 2021 (complete) syllabi prescribed by the Department of Pre-University Education of Karnataka State.

Details of Subjects to appear in CET-2022 for various Professional Courses

Sl. No.	For Admission to 1st Year	Subjects to appear in CET-2022
1	Engineering / Technology courses (B.E. / B.Tech)	PCM
2	Farm Science courses (B.Sc. Agriculture, Sericulture, Horticulture etc)	PCMB
3	Bachelor of Veterinary Science and Animal Husbandry (B.V.Sc. & A.H.)	PCB
4	B-Pharma	PCM or PCB
5	2nd Year B. Pharma	PCM or PCB
6	Pharma-D	PCM or PCB
7	Naturopathy & Yoga	PCB

Executive Director.

18ನೇ ಅಡ್ಡ ರಸ್ತೆ, ಸಂಪಿಗೆ ರಸ್ತೆ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು – 560 012
18th Cross, Sampige Road, Malleshwaram, Bengaluru - 560 012.
Phone: 080 - 23 564 583, 23 460 460, 23 361 786, Fax: 080 - 23 461 576
e-mail : keauthority-ka@nic.in Website : http://kea.kar.nic.in

GSTIN : 29AASSP344L1ZD Mobile : 97415 63233
99809 25068

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No. 166, 5th Main, Madhava Sangha Cross, Chamarajpet, Bengaluru - 560 018.
E-mail : platinumbiomedix@gmail.com

To dt.10.5.22
SUYOG HOSPITAL
E & F Block,
Ramakrishna Nagar
Mysore-22

Sub;Quotation for Surgical Requirements.

QUOTATION

S.No	Particulars	Qty	rate	amount
1	I V STAND S S	15	3500	52500
			gst 18%	9450
			total	61950

TERMS & CONDITIONS

1.Taxes Including
2. All Prices are Subject to change without prior notice
3. Out of Bangalore,Packing & Forwarding cha
4. Delivery 45-60 days from the date of P.O
5. 100% Advance against delivery.

PLATINUM BIOMEDIX & SURGICALS
Proprietor

Figure 1: Various type of documents we used

1.5 Motivation for the Work

Signatures are a unique way to identify an individual apart from various other techniques like the biometric methods and physical ID cards. Usually to identify an individual using a biometric approach requires some special tools and can be expensive to use. On one hand this is good and truly a great method but on the other hand it can also be used in wrong ways such as stealing the ID cards or taking biometric data of individuals without their consent for nefarious purposes.

Handwritten signatures on the need to be written willing and even if forced to sign a document, it could be detected by analysing the handwriting of said person. If done without the consent of the individual a signature is simply a forgery. So to get an inexpensive, as compare to other methods, way to identify an individual, we can use their signature to verify them.

1.6 Challenges of the proposed system

Signature detection from the document images and retrieving documents using the signature as a query is a challenging task in the area of image processing. Therefore, treating these images in such a way that only handwritten signatures can be extracted for analysis of their characteristics.

The issues and challenges for signature extraction are listed below

- Signature with low resolution in documents make difficult to detect and extract.
- The background of document differs from each other.
- The signature may be overlapped with a seal or machine printed text such that after processing that part will be erased.
- The computer vision faces an important problem of Detecting and matching deformable objects such as signature.
- Documents are subjected to restricted processing time due to urgency of applications. Therefore, the detection and retrieval time must be fast.
- The handwritten characters and auxiliary lines contained in the document overlap and resemble signatures.

- Signature present along with date, overlapped with seal or other text will present a challenge to extract only signature.

1.7 Applications for Signature Detection

The proposed system provides a unique opportunity as there aren't many developments in specific to the signatures available to public, applications being one of the things that can readily be adapted to use in a range of applications.

Signature Database: Signature detection would allow us to create a database of signature that can be used to keep track of changes in signature of individuals and for ensuing that it is indeed an authentic signature.

Forgery Detection: In compliance with the above application, a forgery or fraud can be easily identified if there is stock signature to be compared to. This will allow people to check if the signee is indeed a genuine person or a person attempting a fraud.

Signature Analysis: A signature can tell us who or how it was written, understand by analysing the strokes of the signature, its handwriting, the pressure with which it was written and many more things that could define who or how the signature was written.

Mobile Application: A mobile application could allow a person to detect a signature and easily compare it another one instantly and since it would be portable it can be used anywhere and just on a desktop or laptop.

1.8 Objectives of the proposed system

The main aim of this project is to design, test and implement a system using machine leaning that can be able to analyse a document and be able to tell the user where exactly the signature is located on the document. The developing systems should be able to detect a signature anywhere on the document regardless of whether it is dated or even affixed with the individual's seal/stamp. Of course, it goes without saying that the proposed systems should perform the required task in a convenient and speedy manner, and not only that but be as accurate as possible while avoid giving false results or even worse no results.

Chapter 2

LITERATURE REVIEW

2.1 Preamble

A literature survey or a literature study in a project description is the section that displays the different analyses and studies made in the field of curiosity and the results already published. assuming the different parameters of the project and dimensions. It is the most important part of our report as it gives us a direction in our research area. It helps us set a goal for our analysis -thus giving our problem statement.

When we write a literature review concerning our project, we have to write the research made by various analysis- their methodology (abstract) and the conclusions they have arrived at A literature review desires to understand the existing research and debates relevant to a topic or area of study and present that knowledge as a written report. Executing a literature study helps us build knowledge in our domain. We will learn about important ideas, analysis strategies. and experimental techniques used in our research area. We also understand how researchers apply the concepts to seal-world problems. Another great benefit of literature studies in that we will better understand how research findings are presented and discussed in our particular discipline as we read.

2.1 Previous Works

Various researchers have made attempts to build machine models along with other traditional approaches to segment, classify and recognize signatures from general documents, several of the interesting signature detection attempts are discussed here.

[1] Shivakumar G,Ravikumar M,Shivaprasad B J, and D.S.Guru had published a paper on Signature Extraction from Bilingual document images using Blobs method. The experiment is carried out on own dataset containing 150 real-time documents. To extract the signatures the methodologies used are Pre-processing, Otsu method, Connected component analysis, thresholding,. The proposed algorithm extracts signatures from bilingual document with any orientation in real-time scenario even of the most if documents containing more than one signature at different locations. The collected documents are given to the proposed algorithm and performance is evaluated by measuring the Accuracy, Precision, Recall, F1-score, Jaccard similarity, Dice, and Intersection over union as parameters. It is observed that the proposed

method gives good signature detection in terms of all the parameters and also by achieving an accuracy of 84.41%.

[2] Harish Srinivasan,Sagar N.Shrihari and Matthew J.Beal presented Machine learning for Signature Verification in the year 2006. A database of off-line signatures was prepared as a test bed.55 individuals contributed 24 signatures thereby creating 1320 genuine signatures Some were asked to forge three other writers' signatures, eight times per subject, thus creating 1320 forgeries. Feature extraction and Similarity computation, Method of learning, Evaluating a forgery signature, comparison of two strategies and Interactive software implementation are the methodologies used in this work. Two different machine learning approaches, one involving genuineness and forgeries in a general set and another involving only genuineness for a particular case were described. The first approach is analogous to using counter examples with near misses in the learning process. Both approaches involve using a similarity measure to compute a distance between features of two signatures. Special learning outperforms general learning particularly as the number of genuineness increases. General learning is useful when the number of genuineness is very small (less than four). A refined method of extracting features for signatures was also discussed which can further increase verification accuracy. An interactive software implementation of signature verification was described.

[3] M.Muzaffar Hameed, Rodina Ahmad, Miss Laiha Mat kiah and Ghulam Murtaza had published a paper on Machine learning based Offline Signature Verification System in the year 2021. The experiment is carried out using different dataset available like CEDAR, GPDS, MCYT-75, UTsig, BHsig260. Pre-processing techniques, feature extraction methods, machine learning based verification models and performance evaluation metrics are the methodologies used in this work. OfSV system achieved the highest EER of 1.76 on GPDS dataset using the CNN-based feature extraction method. Similarly, OfSV system attained the highest EER of 7.02 on UTSig dataset for 10 skilled forged signatures. OfSV system, which used a CNN-based feature extraction method to achieve EER of 3.91 with 10 skilled forged signatures on MCYT-75 dataset. OfSV system attained an accuracy of 99.91%for 48 skilled forged signatures on CEDAR dataset. All these OfSV systems achieved the highest performance by using CNN as a feature extractor.

[4] Alpana Deka and Lipi B.Mahanata had published a paper on An Ensemble Based Offline Handwritten Signature Verification System in the year 2020. A well-documented and real-time database consisting of genuine and forged samples of three categories like random, sample,

and skilled datasets are used for the experiment. Data Acquisition, Preprocessing, Features Extraction and applied parallel ensemble classifier where Fuzzy C-Means(FCM), Naive Bayes(NB) classifier, and Support Vector Machine(SVM) are the methodologies used in this proposed system. Through measuring criteria like Accuracy, MCC, Sensitivity, Specificity, FRR, FAR, AER to sample of three category datasets by applying four classifier methodologies, the ensemble classified results significant than other three classifiers. It is observed that this proposed system has taken the Ensemble as final classifier and it gives more significant result when compared with other three proposed systems in terms of their AER.Hence this technique may be adopted to resolve the confusing and routine cases of handwritten signature forgery cases faced in real-life situations.

[5] Henali Patel, Shivani Desai, Pooja Desai, Abha Damani had published a paper on Review on Offline Signature Recognition and Verification Techniques in the year 2018. In this paper we have given description about signature recognition methods and have compared all those methods. The modern technique of signature recognition we can achieve a sufficient result. The proposed steps of signature recognition are Pre-Processing, Feature Extraction, Matching, Verification and Output. The methods compared with the proposed system are KNN, NN, SVM, OCR and Template Matching. Signatures are verified based on parameters extracted from the signature using various image processing techniques. Our recognition system exhibited 100% success rate by identifying correctly all the signatures that it was trained for. We did not consider this a "high risk" case because recognition step is always followed by verification step and these kinds of false positives can be easily caught by the verification system. Recognition and verification ability of the system can be increased by using additional features in the input data set. This study intends to reduce to a minimum the cases of forgery in business transactions.

[6] Manjula N1, Navyashree S2 , Nikitha C had published a paper on Signature Localization and Signature Classification in the year 2019. In this project, we have considered around 500 documents. But, can be extended to work with as much as 1000-2000 documents. Various morphological operations such as grey scale conversion, median filter, dilation is applied to the document and all the signatures in the document are localized and extracted. The features of these extracted signatures are collected using the dense SIFT algorithm and stored for classification purposes. The test document is inputted, signatures are localized, features are extracted and the signature is classified using the Support Vector Machine (SVM) classifier. The design of the system is divided into three phases Localization & segmentation, Feature

extraction and Classification. When a set of 100 documents are considered, trained and tested, all the documents are localized and segmented efficiently whereas, only 96 documents are classified. This project helps in extracting all the signatures from the real-time documents and classifying the same. During classification, the features of the signature must not change in order to classify the signature of a person.

[7] Paridhi Swaroop and Neelam Sharma had published a paper on An Overview of Various Template Matching Methodologies in Image Processing in the year 2016. In this paper author has presented an approach to detect an object using Template matching methodology. Template Matching could be a methodology in digital image processing to identify little components of a figure which match a template image. We tend to match a template to an image wherever the template is a sub image which contains the form which we want to find out. This technique is repeated for the whole image, and the point which leads to a best match, the utmost count, is defined to be the point wherever the shape (given by the template) lies inside the image. Template matching approaches are Featured-based approach and Template or Area based approach. The methodology of template matching is explained with the help an algorithm, that is straightforward and simple to execute. The author says that Template matching is the most efficient technique to be used in pattern recognition machines which read numbers and letters that are available in standardized, constrained contexts. This paper defines various effective techniques and has excellent application rate in several fields with their consequences that assist writers in getting a summary of different template matching algorithm and its relevances.

Chapter 3

PROPOSED METHODOLOGY

3.1 Preamble

In this project, we proposed various methods to detect the handwritten signature in document images. By treating document images in such a way that only handwritten signatures can be extracted for analysis of their characteristics. In order to solve this problem, we present different traditional approaches for signature detection.

Document images with signatures are taken as input, and for each document different methodologies have been applied then output is resulted with the images where signatures are detected and extraction done by the proposed methods.

3.2 Methodologies

In this project, to detect and extract signature from the documents, we used three methods they are Connected component analysis, Signature Extraction using Contour Height & Contour width Heuristic, and Detecting signatures through HSV Color Space. Later we do comparative analysis between them.

To locate the signature in a document we applied SIFT feature matching and Template matching methodologies. Also we done comparative analysis between them. Refined method of detecting signatures was discussed here.

3.2.1 Connected components Method:

In image processing, a connected components algorithm finds regions of connected pixels which have the same value. Connected component method is an algorithmic application used to determine the connectivity of “blob”-like regions in a binary image. We often use connected component analysis in the same situations that contours are used; however, connected component method can often give us more granular filtering of the blobs in a binary image. When using contour analysis, we are often restricted by the hierarchy of the outlines (i.e., one contour contained within another). With connected component analysis, we can more easily segment and analyse these structures.

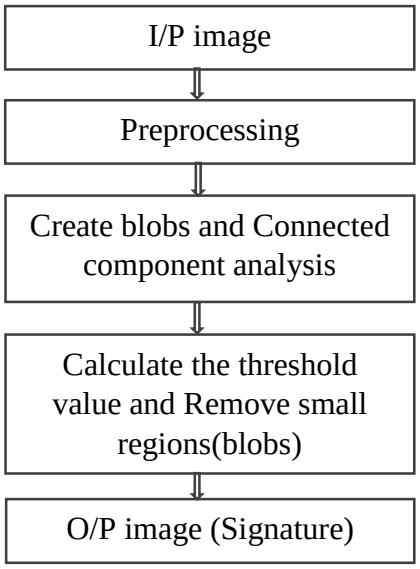


Figure 3.2.1: Block diagram of connected component

Image Acquisition

The proposed system to detect signatures uses documents scanned in image format. Due to very less datasets of normal quality, that is not scanned using a scanner or a high end camera available in public, we have decided to use real documents. These include various types of documents like government circulars, college notices, marks cards, etc. The images come in all shapes and sizes, with at least one signature affixed to them.

Preprocessing

At first we read the image then resize it to 1280 X 1280. Since the documents is real time, which has different background it may contain noises, low resolution, may be blurred. To enhance this image we use Otsu method. If there is any lines or tables in image we remove them by applying morphological open using horizontal and vertical kernel. After this the document is free from noises.

Connected Component Analysis

Normally signatures are irregular in shape containing different features like strokes, curves, edges, etc., to store all these features blob's were created. Since our intension is to extract signature from the document, it is necessary to separate foreground from background.

Sometimes there may be the same size of signature and non-signature information apart from this some small blobs also be created. Using connected component analysis any discontinuity present in the signature is filled. Normally area of the signature is more when compared with all the blobs and these small blobs are removed using region props. In order to eliminate smaller areas called blobs, region props are used which is performed by fixing some threshold values and finally the area i.e, a blob which is left in the documents is considered as a signature. The proposed algorithm extracts signatures from a bilingual document with any orientation in a real-time scenario even if most of the documents containing more than one signature at different locations.

3.2.2 Signature extraction using Contour Height and Contour Width Heuristic method:

Contours are defined as the line joining all the points along the boundary of an image that are having the same intensity. Contours come handy in shape analysis, finding the size of the object of interest, and object detection.

In the same way considering the signature as an object which has height and width in a document, we apply this method to detect and extract the signature in documents.

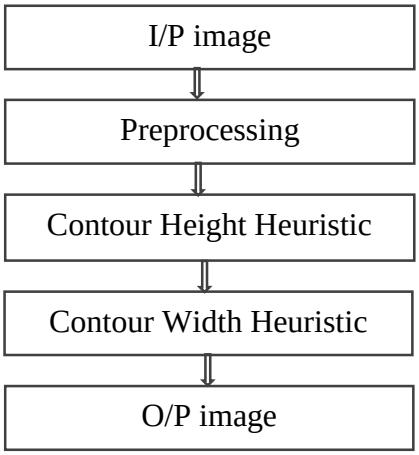


Figure 3.2.2: Block diagram of Contour height and contour width heuristic

Image Acquisition

The proposed system to detect signatures uses documents scanned in image format. Due to very less datasets of normal quality, that is not scanned using a scanner or a high end camera available in public, we have decided to use real documents. These include various types

of documents like government circulars, college notices, marks cards, etc. The images come in all shapes and sizes, with at least one signature affixed to them.

Preprocessing

First we read the image then resize it to 1280X1280. Since the document is real-time which has different background like marginal noise clutter noise, rule noise and other background noise. To reduce that kind of noise in image we use Otsu method then if there is any table or lines we remove them using hough transforms.

Contour Height and Contour Width Heuristic :

In this phase, first we apply Contour height heuristic. Here we Create a blank image of the same dimension of the original image. By finding the average height from all the contour heights we draw those which are above the average on the blank image. We got the signature contours along with noise. Let us apply contour Width to avoid noise with heuristics. After this we apply Contour width heuristic, here also we create a blank image. Find contours and filter contours based on width. Copy the signature to a blank image. Nullify the signature in the original image to get the content part.

3.2.3 Detecting signatures through HSV color space:

HSV stands for Hue Saturation Value, It stores color information in a cylindrical representation of RGB color points. It attempts to depict the colors as perceived by the human eye. Hue value varies from 0-179, Saturation value varies from 0-255 and Value value varies from 0-255. It is mostly used for color segmentation purpose.

Hues are the three primary colors (red, blue, and yellow) and the three secondary colors (orange, green, and violet) that appear in the color wheel or color circle. When you refer to hue, you are referring to pure color, or the visible spectrum of basic colors that can be seen in a rainbow.

Color saturation is the purity and intensity of a color as displayed in an image. The higher the saturation of a color, the more vivid and intense it is. The lower a color's saturation, or chroma, the closer it is to pure gray on the grayscale.

Color value refers to the relative lightness or darkness of a color. We perceive color value based on the quantity of light reflected off of a surface and absorbed by the human eye. We refer to the intensity of the light that reaches the eye as luminance.

The primary goal of this work is to extract only the signature in a document. This technique serves as the foundation for implementing object detection algorithms. The input is a real-time document image and the output will be only signature extracted image.

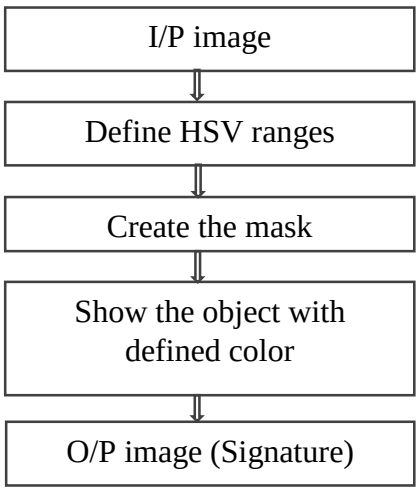


Figure 3.2.3: Block diagram of HSV color space

Image Acquisition

Generally real-time documents have signature with three colors they are blue, green, red. We have collected the documents which has only blue, green, red and the background of the document is of less complex and less color.

Create Mask and Extract Signature:

At first we read images and resize it to 1280 X 1280. Then we create a mask of signature by selecting a possible range of HSV colors that signature can have. After applying HSV ranges we get signature of color to the matched HSV ranges we defined on mask. Then we draw bounded box on original image and crop the signature.

3.2.4 SIFT Feature Matching:

SIFT, or Scale Invariant Feature Transform, is a feature detection algorithm in Computer Vision. SIFT helps locate the local features in an image, commonly known as the 'keyoints' of the image. These keypoints are scale & rotation invariant that can be used for various computer vision applications, like image matching, object detection, scene detection, etc. We can also use the keypoints generated using SIFT as features for the image during model training. The major advantage of SIFT feature is that it is not affected by the size or orientation of the image**.**

FLANN based matcher

FLANN stands for Fast Library for Approximate Nearest Neighbors. It contains a collection of algorithms optimized for fast nearest neighbor search in large datasets and for high dimensional features.

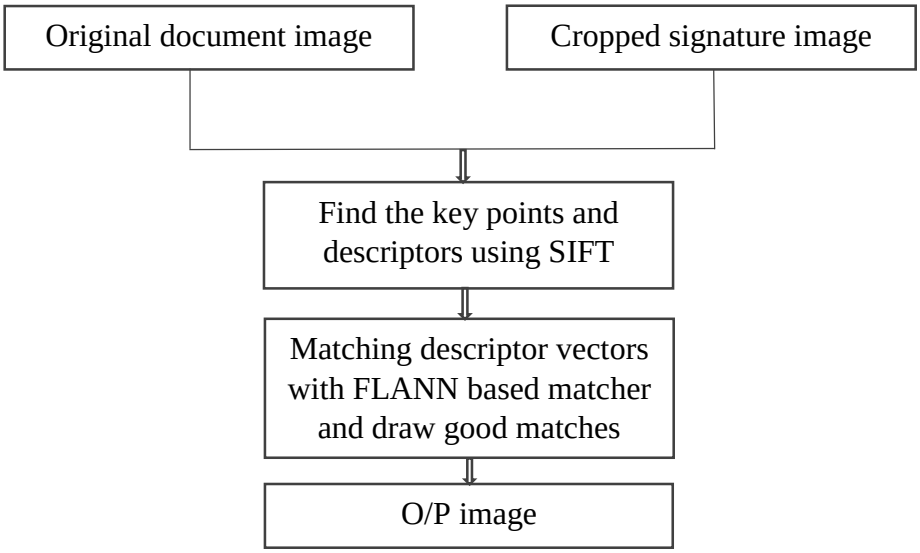


Figure 3.2.4: Block diagram of SIFT feature matching

Image Acquisition

These include various types of documents like government circulars, college notices, marks cards, etc. The images come in all shapes and sizes, with at least one signature affixed to them. Along with this we took cropped signature of that document as input.

Feature Extraction and Matching

We used SIFT feature matching technique to detect the handwritten signature in documents. Taking two images as input one is original image and other is cropped image which consists of only signature. To generate SIFT features to these images first we have to initiate SIFT object then we use then function *detectAndCompute* to get the keypoints and the descriptors.

To match the features from cropped signature image with features from original image we will use FLANN based matcher. To get accurate result we will draw lines between the features that good matches. Then we get predicted image with signature detection.

3.2.5 Template matching:

Template matching is a common computer vision challenge where an algorithm is trying to find similarities be- tween two or more different images.

The recognition and classification of objects in images is an emerging trend within the discipline of computer vision community. A general image processing problem is to decide the vicinity of an object by means of a template once the scale and rotation of the true target are unknown. Template is primarily a sub-part of an object that's to be matched amongst entirely different objects. The techniques of template matching are flexible and generally easy to make use of, that makes it one amongst the most famous strategies of object localization. Template matching is carried out in versatile fields like image processing, signal processing, video compression and pattern recognition. In our work we used template matching technique to detect handwritten signature in a printed document.

Template Matching may be a high-level machine vision method which determines the components of a figure which matches a predefined template. Template Matching could be a methodology in digital image processing to identify little components of a figure which match a template image. We tend to match a template to an image wherever the template is a sub

image which contains the form which we want to find out. This technique is repeated for the whole image, and the point which leads to a best match, the utmost count, is defined to be the point wherever the shape (given by the template) lies inside the image. Templates are usually employed to print characters, identify numbers, and other little, simple objects. It can be used for detection of edges in figures.Template Matching is a strategy for discovering zones of an image which matches (are indistinguishable) a template image (patch). We require 2 crucial segments.

Source image : The picture inside which we are hoping to find out a match to the template image.

Template image : The patch image that can be compared to the template image and our objective is to discover the most effective technique for the best matching region. Matching technique not solely takes the similarity measure however it computes the inaccuracy among images.

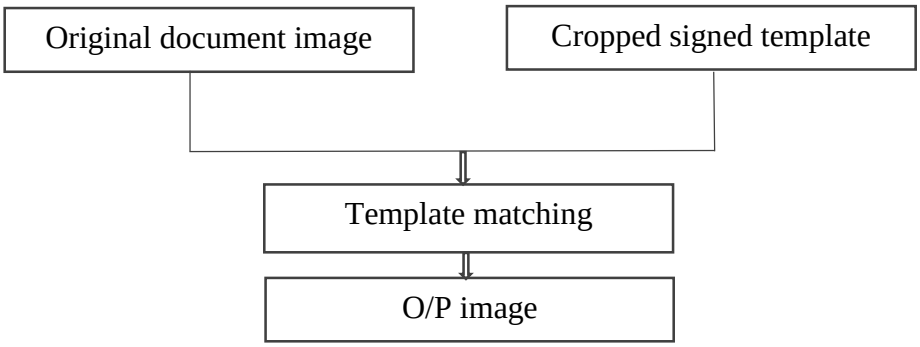


Figure 3.2.5: Block diagram of Template matching

Image Acquisition

These include various types of documents like government circulars, college notices, marks cards, documents with etc. The images come in all shapes and sizes, with at least one signature affixed to them. Along with this we took cropped signature of that document as input.

Template Matching

Basically template matching is a method of searching and finding the location of the template image in an original image. Here we pass two images as input one is original image and other is cropped signature template image. The template and patch input image are compared. The result obtained are compared with threshold. If the result is greater than the threshold, the portion will be marked as detected.

Chapter 4

EXPERIMENTAL RESULTS AND OBSERVATION

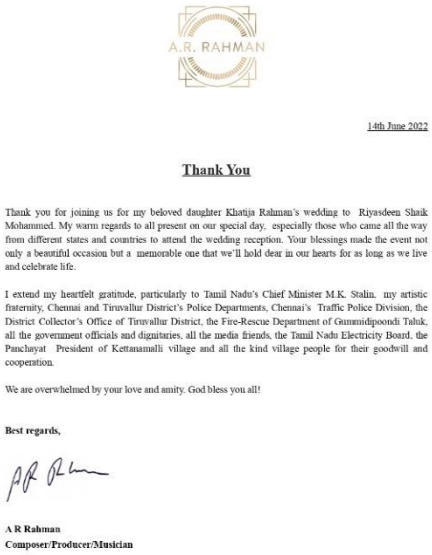
4.1 Preamble

This chapter covers the experiments performed on the proposed framework, the dataset used, the environmental conditions, setup, constraints imposed. Here we present the details of the experimentation conducted to demonstrate the proposed method on our own dataset.

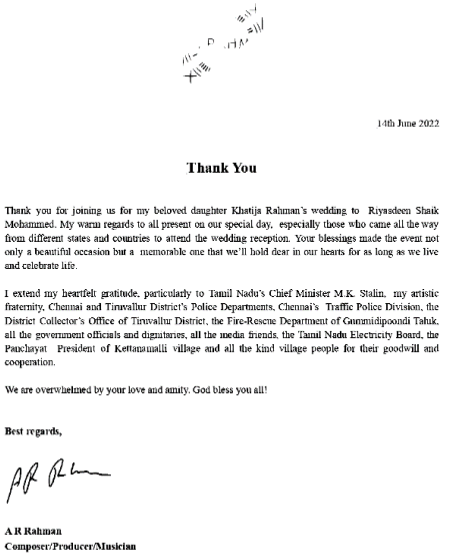
4.2 Dataset Creation

The aim of this project was to ensure that even if we have a low quality image but it had a legible signature we should be able to detect and extract the signature from it. We collected various types of document for this experiment. The dataset includes signed document with different types of signatures, some of which are captured from our mobile camera in college notice boards, and variety of documents which have different backgrounds. Experimentation is carried out on dataset containing real-time documents.

4.3 Experimental Results
[1] Connected Component Method

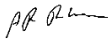


Original Image



Preprocessed Image

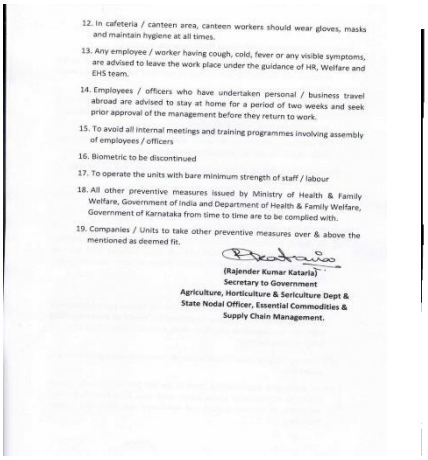
Signature detected image



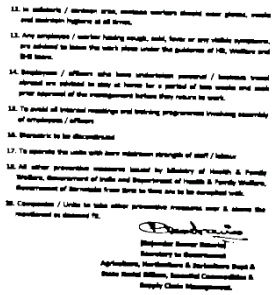
Output image

Figure 4.1: Connected Component method

[2] Signature extraction using Contour Height and Contour Width heuristic method:



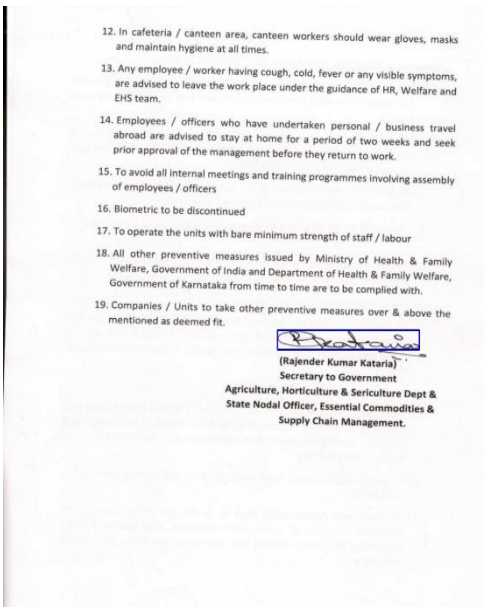
Original Image



Preprocessed

Image after applying Height heuristic

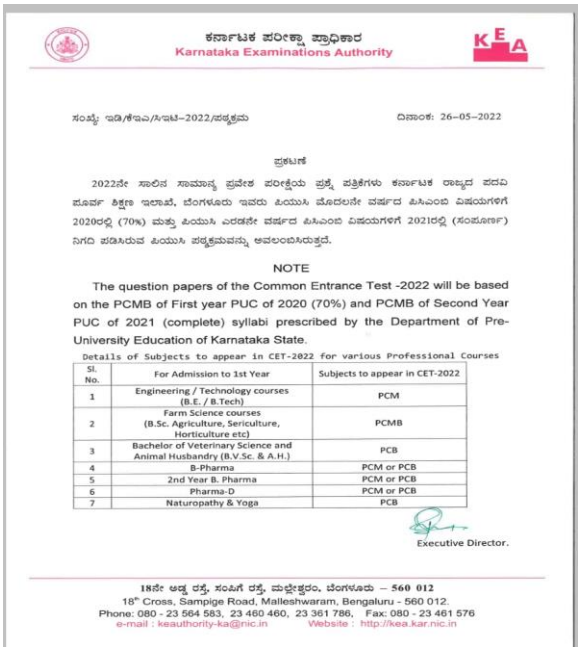
Image after applying width heuristic



Signature detected Image

Figure 4.2: Contour height and width heuristic method

[3] Detecting signatures through HSV color space:



ಕರ್ನಾಟಕ ಪರೀಕ್ಷಾ ಪ್ರಾಧಿಕಾರ
Karnataka Examinations Authority

ಸಂಖ್ಯೆ: ಇಡಿ/ಕೆಇಎ/ಸಿ/ಇಟಿ–2022/ಪಠ್ಯಕ್ರಮ ದಿನಾಂಕ: 26–05–2022

ಪ್ರಕಟಣೆ

2022ನೇ ಸಾಲಿನ ಸಾಮಾನ್ಯ ಪ್ರವೇಶ ಪರೀಕ್ಷೆಯ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು ಕರ್ನಾಟಕ ರಾಜ್ಯದ ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣ ಇಲಾಖೆ, ಬೆಂಗಳೂರು ಇವರು ಪಿಯುಸಿ ಮೊದಲನೇ ವರ್ಷದ ಪಿಸಿಎಂಬಿ ವಿಷಯಗಳಿಗೆ 2020ರಲ್ಲಿ (70%) ಮತ್ತು ಪಿಯುಸಿ ಎರಡನೇ ವರ್ಷದ ಪಿಸಿಎಂಬಿ ವಿಷಯಗಳಿಗೆ 2021ರಲ್ಲಿ (ಸಂಪೂರ್ಣ) ನಿಗದಿ ಪಡಿಸಿರುವ ಪಿಯುಸಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಅವಲಂಬಿಸಿರುತ್ತದೆ.

NOTE

The question papers of the Common Entrance Test -2022 will be based on the PCMB of First year PUC of 2020 (70%) and PCMB of Second Year PUC of 2021 (complete) syllabi prescribed by the Department of Pre-University Education of Karnataka State.

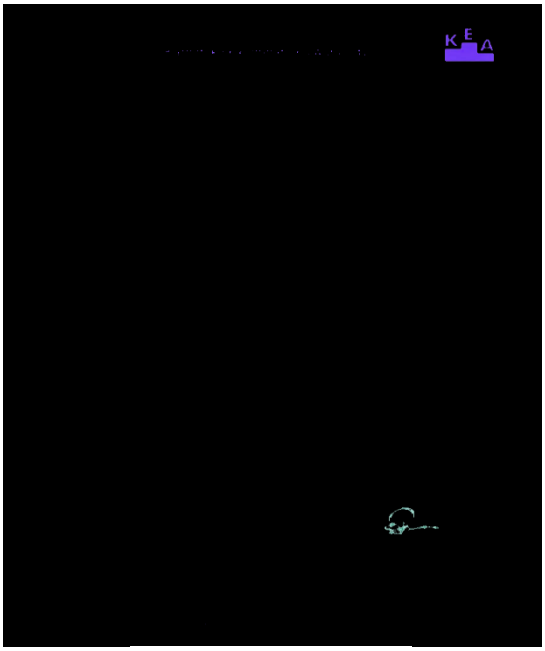
Details of Subjects to appear in CET-2022 for various Professional Courses

Sl. No.	For Admission to 1st Year	Subjects to appear in CET-2022
1	Engineering / Technology courses (B.E. / B.Tech)	PCM
2	Farm Science courses (B.Sc. Agriculture, Sericulture, Horticulture etc)	PCMB
3	Bachelor of Veterinary Science and Animal Husbandry (B.V.Sc. & A.H.)	PCB
4	B-Pharma	PCM or PCB
5	2nd Year B. Pharma	PCM or PCB
6	Pharma-D	PCM or PCB
7	Naturopathy & Yoga	PCB

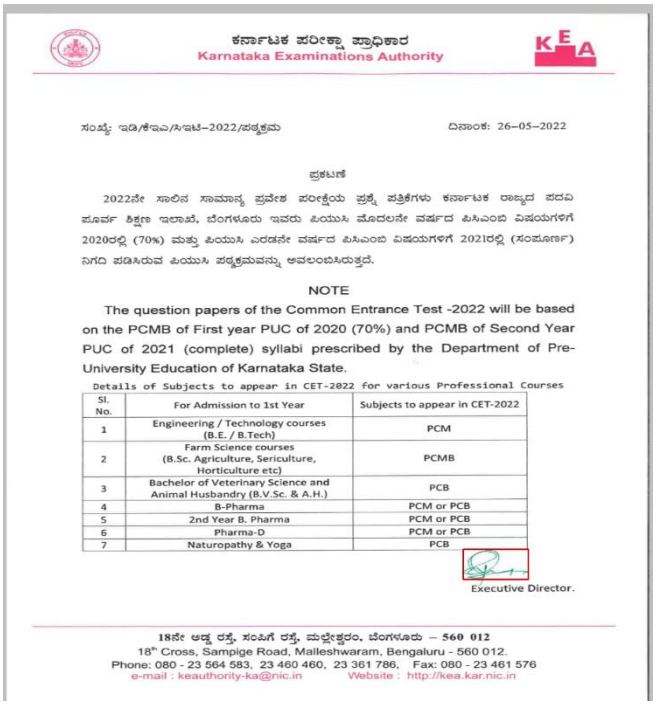
Executive Director.

18ನೇ ಅಡ್ಡ ರಸ್ತೆ, ಸಂಪಿಗೆ ರಸ್ತೆ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು – 560 012
18th Cross, Sampige Road, Malleshwaram, Bengaluru - 560 012.
Phone: 080 - 23 564 583, 23 460 460, 23 361 786, Fax: 080 - 23 461 576
e-mail : keauthority-ka@nic.in Website : http://kea.kar.nic.in

Original image



Mask image



ಕರ್ನಾಟಕ ಪರೀಕ್ಷಾ ಪ್ರಾಧಿಕಾರ
Karnataka Examinations Authority

ಸಂಖ್ಯೆ: ಇಡಿ/ಕೆಇಎ/ಸಿ/ಇಟಿ–2022/ಪಠ್ಯಕ್ರಮ ದಿನಾಂಕ: 26–05–2022

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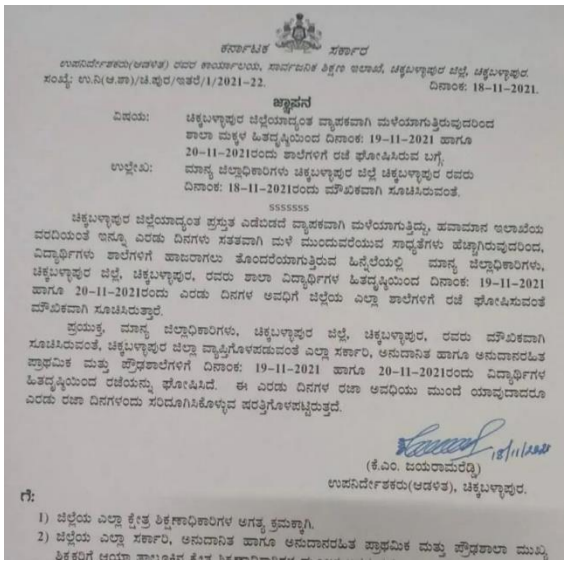
Executive Director.

18ನೇ ಅಡ್ಡ ರಸ್ತೆ, ಸಂಪಿಗೆ ರಸ್ತೆ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು – 560 012
18th Cross, Sampige Road, Malleshwaram, Bengaluru - 560 012.
Phone: 080 - 23 564 583, 23 460 460, 23 361 786, Fax: 080 - 23 461 576
e-mail : keauthority-ka@nic.in Website : http://kea.kar.nic.in

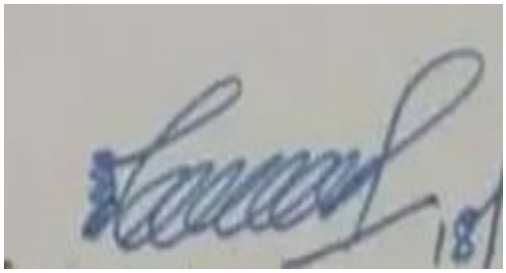
Signature detected image

Figure 4.3: HSV color space method

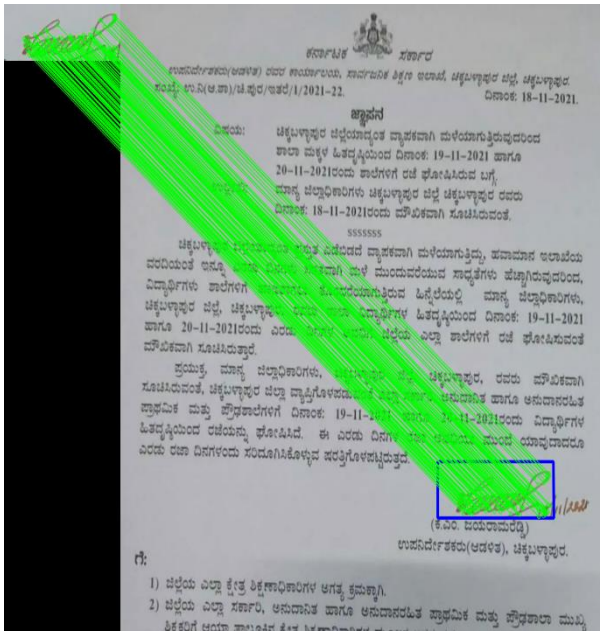
[4] SIFT Feature Matching :



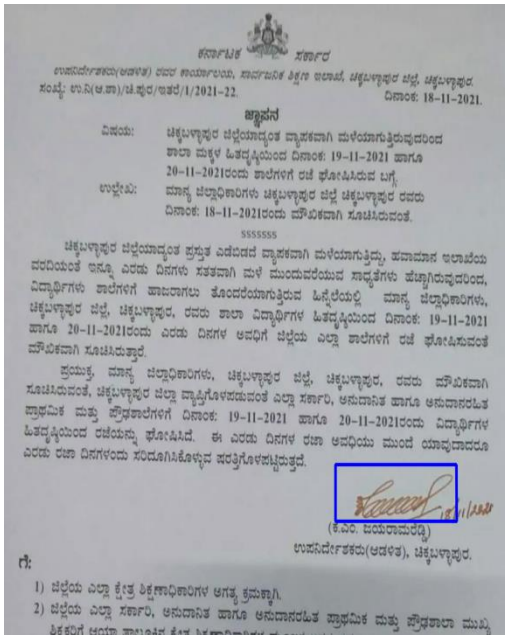
Original image



Template image



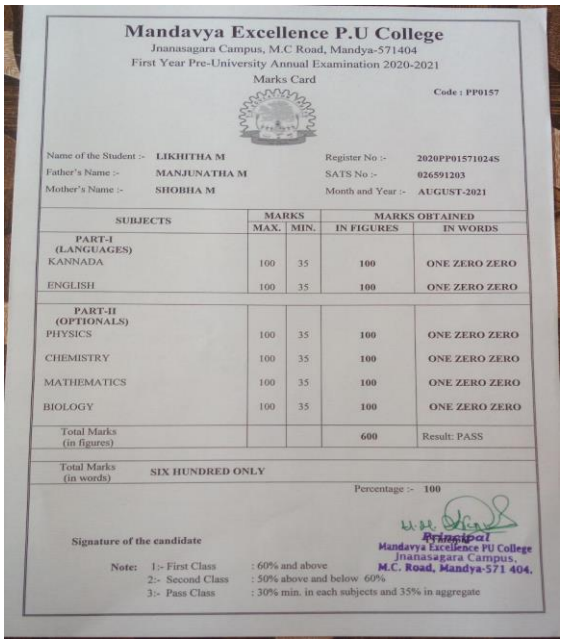
Matching



Signature detected image

Figure 4.4: SIFT feature matching method

[5] Template Matching :



Mandavya Excellence P.U College
Jnanasagara Campus, M.C Road, Mandya-571404
First Year Pre-University Annual Examination 2020-2021
Marks Card
Code : PP0157

Name of the Student :- LIKHITHA M
Father's Name :- MANJUNATHA M
Mother's Name :- SHOBHA M
Register No :- 2020PP01571024S
SATS No :- 026591203
Month and Year :- AUGUST-2021

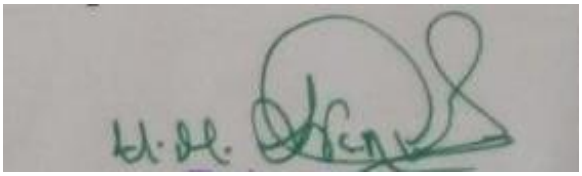
SUBJECTS	MARKS MAX.	MARKS MIN.	MARKS OBTAINED IN FIGURES	MARKS OBTAINED IN WORDS
PART-I (LANGUAGES)				
KANNADA	100	35	100	ONE ZERO ZERO
ENGLISH	100	35	100	ONE ZERO ZERO
PART-II (OPTIONALS)				
PHYSICS	100	35	100	ONE ZERO ZERO
CHEMISTRY	100	35	100	ONE ZERO ZERO
MATHEMATICS	100	35	100	ONE ZERO ZERO
BIOLOGY	100	35	100	ONE ZERO ZERO
Total Marks (in figures)			600	Result: PASS
Total Marks (in words)	SIX HUNDRED ONLY			

Percentage :- 100

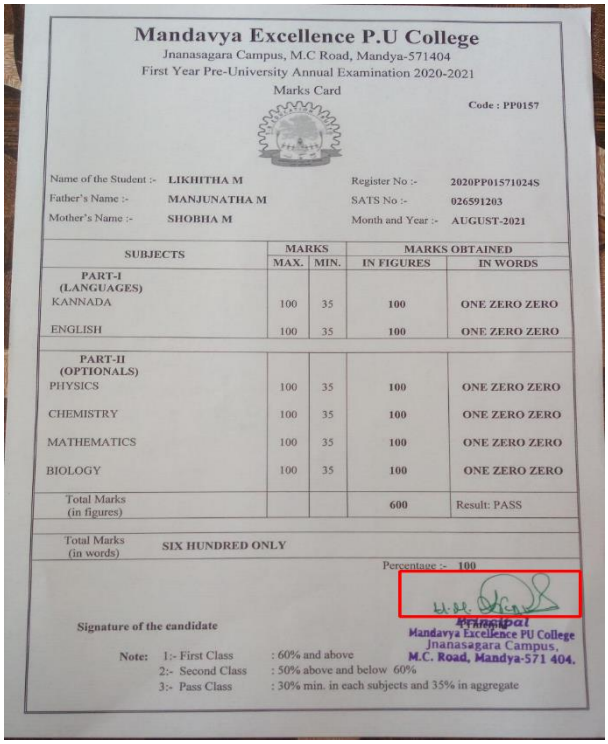
Signature of the candidate

Principal
Mandavya Excellence PU College
Jnanasagara Campus,
M.C. Road, Mandya-571 404.

Note: 1:- First Class : 60% and above
2:- Second Class : 50% above and below 60%
3:- Pass Class : 30% min. in each subjects and 35% in aggregate



Original image **Template image**



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BIOLOGY	100	35	100	ONE ZERO ZERO
Total Marks (in figures)			600	Result: PASS
Total Marks (in words)	SIX HUNDRED ONLY			

Percentage :- 100

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Signature detected image

Figure 4.5: Template feature matching method

4.4 Experimental Observations

In this project, while experimenting all the approaches we observed that:

- In Connected component analysis, signature is detected and extracted with the same accuracy even when the document is given in any orientation.
- Contour Height and Width heuristic detect the signature even when the document image is vertically flipped.
- In HSV color space method, signature is detected and extracted with the same accuracy even when the document is given in any orientation.
- SIFT feature matching results good in locating the signature even when the document image is in any orientation.
- In Template matching method, a slight change in size or orientation variations can cause problems.

For experimentation, we used own real-time document images. The images are given to the proposed algorithm and performance is evaluated by measuring the Accuracy.

Table 1: Results obtained for the methodologies

Method	**No. of images used for the experiment**	**No of output images obtained**	**Accuracy**
CCA	100	94	94 %
Contour Height and Width heuristic	100	85	85 %
HSV color space	100	80	80 %

From the table 1, it is observed that Connected component analysis gives good signature detection.

Table 2: Results obtained for the methodologies

Method	**No. of images used for the experiment**	**No of output images obtained**	**Accuracy**
SIFT feature matching	100	97	97 %
Template matching	100	92	92 %

From the table 2, it is observed that SIFT feature matching locate signature more accurately compared to Template matching.

Chapter 5

EPILOGUE

5.1 Conclusion

In this project, we presented approaches for detecting and extracting the signatures from real-time document images. Our work involves five methodologies for detecting the signature from documents, a comparative analysis was performed between the Connected component, Signature Extraction using Contour Height & Contour width Heuristic, and Detecting signatures through HSV Color Space methods. Along with this we also used SIFT feature matching and Template matching technique to locate signature in documents and made a comparative analysis between them, from these two SIFT feature matching provides best results.

- It is observed that the Connected component method gives more significant results with 94 % of accuracy for the number given set of real-time documents.
- To locate the signature in a document we applied SIFT feature matching and Template matching methodologies. With the highest accuracy of more than 97 %, it is evident that SIFT feature matching is more efficient to locate the signature in a document.
- A refined method of detecting and extracting signatures was discussed which can further increase in accuracy of detecting and extraction.

5.2Future scope

Although our results are encouraging, the future work is to improve upon previous work.

- Analysing the recent work, we noticed to concentrate on obtaining better features to increase the accuracy.
- Augmenting the datasets: Related to the problem of having low number of samples, focusing generating more signature documents, in order to increase the number of samples available for training.

- Processed in real time we will be able to tell whether the given signature is an authentic one or a fake one upon performing signature verification, thereby finding if forgery is committed or not.
- Acquisition of data in such a manner as to ensure the data is not unusable due to lack of quality or having too much noise, instead at least having enough clarity to work with.

BIBLIOGRAPHY

1. D. Hema1 and Dr. S. Kannan: Interactive Color Image Segmentation using HSV Color Space
2. Supriya Das, Purnendu Banerjee, Bhagesh Seraogi Himadri Majumder, Rahul Roy, Srinivas Mukkamala B.B.Chaudhuri: Hand-Written and Machine-Printed Text Classification in Architecture, Engineering & Construction Documents
3. Shivakumar G,Ravikumar M,Shivaprasad B J, and D.S.Guru: had published a paper on Signature Extraction from Bilingual document images using Blobs method.
4. Harish Srinivasan, Sargur N. Srihari, and Matthew J. Bea : Machine Learning for Signature Verification
5. Qing Hong Liu Chew Lim Tan: Newspaper Headlines Extraction from Microfilm Images
6. Hifzan Ahmed Shailja Shukla: Comparative Analysis of Global Feature Extraction Methods for Off-line Signature Recognition
7. Harish Srinivasan, Sargur N. Srihari and Matthew J. Beal: Machine Learning for Signature Verification
8. Pooja Gaikwad, Kashaf Pathan, Purva Patil, Laxmi Pagare, R.P. Dahake: Handwritten Signature Verification System using machine Learning Approach

Websites

- **https://www.analyticsvidhya.com/blog/2019/10/detailed-guide-powerful-sift-technique-image-matching-python/**
- **https://pysource.com/2019/02/15/detecting-colors-hsv-color-space-opencv-with-python/**
- **https://docs.opencv.org/4.x/dc/dc3/tutorial_py_matcher.html#:~:text=FLANN%20based%20Matcher,than%20BFMatcher%20for%20large%20datasets**