

Smart Marks Manager :A Smart Tool for Quick Assessments

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Abstract—The Smart Marks Manager presents an innovative solution for automating and streamlining the management of student marks in academic institutions. The traditional process of manual mark entry and management has been time-consuming, error-prone, and inefficient. This project aims to address these challenges by leveraging advanced technologies such as Optical Character Recognition (OCR) and Convolutional Neural Networks (CNN) to automate the extraction of handwritten marks and unique student identification numbers (USN) from uploaded marksheet images.

Index Terms— Smart Marks Management, OCR, CNN, Quick Assessment management, AI.

I. INTRODUCTION

The traditional process of manually grading paper-based exams and recording student marks is time-consuming, error-prone, and inefficient. The faculty members spend significant effort inputting marks into the computer system, especially for classes with large student enrolments. This manual process not only consumes valuable time and resources but also introduces the risk of errors and inconsistencies in marks recording.

Therefore, there is a need for a software solution that automates the mark-entry process, streamlines data management, and provides a user-friendly platform for students and faculty members. This solution should leverage computer vision techniques, such as OCR and CNN, to extract marks and unique student numbers (USN) from scanned answer sheets accurately. The software should integrate with a database system to store and manage the marks data efficiently.

The Smart Marks Manager is a comprehensive system that automates the mark-entry process, facilitates real-time mark recording and management, and enables easy access to assessment data for students and faculty members. By addressing these challenges, the Smart Marks Manager aims to improve the efficiency, accuracy, and accessibility of marks recording and evaluation, ultimately enhancing the overall academic assessment process.

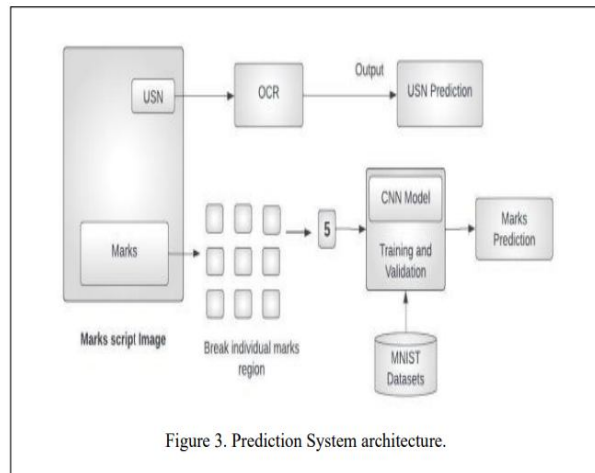
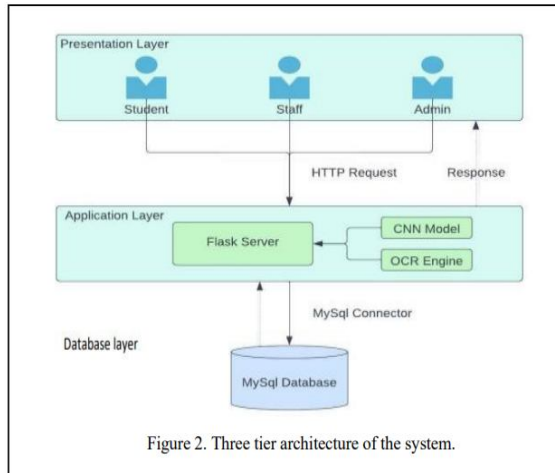
II. HIGH LEVEL DESIGN

Figure 2. is a depiction of the three-tier architecture of the system that briefly describes the presentation layer, application layer, and database layer. The presentation layer of the architecture consists of users of the application who interact with the application. The application consists of a server, i.e., Flask, that is used to implement and handle both the CNN model and the OCR engine. The application layer components are used to interact through the MySQL connector to extract desired data from the database and write the data into the

database. The database layer consists of a MySQL database that is used to store all the user credentials, student data, subject data, staff data, and mark data.

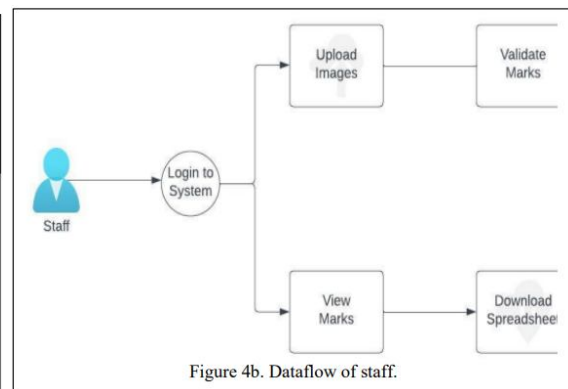
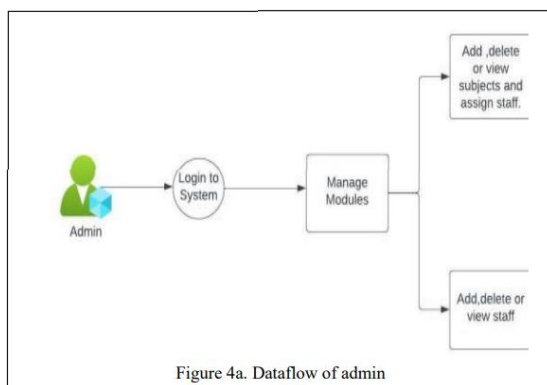
A. Prediction System Architecture

Figure 3. is a depiction of the prediction system architecture that comprises algorithms and models that help in character predictions.



Primarily, after uploading the image, it is aligned to extract the desired data from the MarkScript image. The ORB algorithm helps in the alignment of the image by identifying the keypoints from the template image and storing them in a homography matrix. This matrix is used to match the keypoints with the uploaded image. Further, the required regions, i.e., the USN and Marks regions, are cropped using locations in the aligned image. The cropped USN region is sent to OCR for printed text recognition, which uses the PyTesseract library. The mark region extracted is a table of contents that needs to be extracted. For prediction, the individual cells of the table are cropped out and converted into 28x28 pixel images since the CNN model only takes this resolution of images as input. The converted images are sent to CNN's model. The model uses the MNIST dataset for model training and prediction. This model consists of 1 input layer, 2 convolution layers (5x5 convolution core), and 2 pooling layers (2x2 pool core), 1 fully connected layer, and 1 output layer. The predicted data is used for further processing.

B. Data Flow Design



can assign staff or staff for a subject Figure 4b. is a depiction of staff data flow in the system. The staff can login to the system.

And is authorized to upload images, validate marks, or view marks and download a spreadsheet Smart Marks Manager 2022-23 Department of Computer Science and Engineering 15 that consists of the marks of the students in an individual subject. Figure 4c. is a depiction of student data flow in the system. A student can register by entering his or her details into the system, login, and be authorized to view marks.

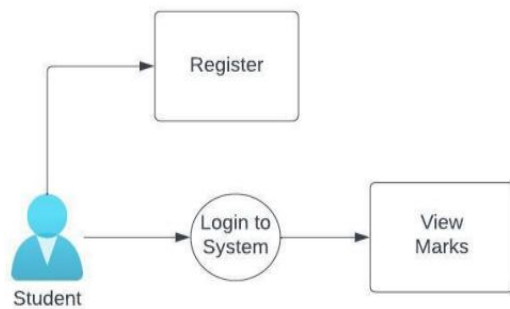


Figure 4c. Dataflow of student

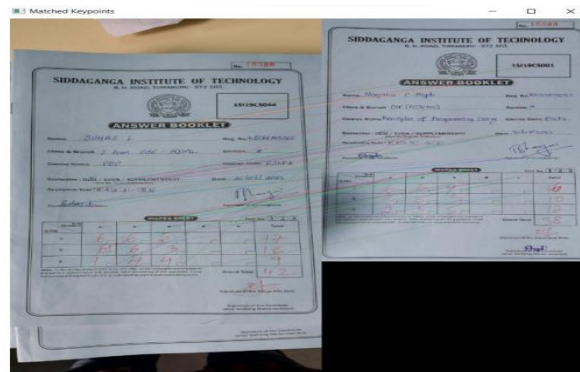


Figure 5a. ORB Matched Keypoints

Figure 4a. is a depiction of admin data flow in the system. The admin can login to the system. And is authorized to manage modules such as adding, deleting, or viewing the staff details and subject details, and can assign staff or staff for a subject Figure4b. is a depiction of staff data flow in the system. The staff can login to the system. And is authorized to upload images, validate marks, or view marks and download a spreadsheet Smart Marks Manager 2022-23 Department of Computer Science and Engineering 15 that consists of the marks of the students in an individual subject. Figure 4c. is a depiction of student data flow in the system. A student can register by entering his or her details into the system, login, and be authorized to view marks.

III. IMPLEMENTATION WORKFLOW

The implementation workflow for the Smart Marks Manager involves the creation of modules for staff, admin, and students, as well as the development of a prediction system. The system architecture is designed to accommodate these modules and ensure seamless communication. The staff module allows staff members to access assigned subjects, input maximum marks, upload marksheet images, and validate predicted marks. The admin module enables administrators to manage user accounts, add subjects, and assign them to staff members. The student module allows students to register, log in, and view their marks and performance evaluations. A server-client architecture is implemented to facilitate interaction between modules, with the server handling requests and data processing. Additionally, a prediction system utilizing OCR and CNN models is integrated, extracting handwritten marks and USN from uploaded marksheet images and providing accurate predictions for staff validation. Rigorous testing is conducted to ensure system functionality and accuracy. Refinements and optimizations are made based on feedback. Overall, the Smart Marks Manager provides a comprehensive solution for automated mark management and prediction, enhancing efficiency and accuracy in academic evaluations.

A. Align Image

The Align Images module plays a crucial role in the marks prediction code implementation. Its primary objective is to align the uploaded marksheet image with a template image using the ORB (Oriented FAST and Rotated BRIEF) algorithm. This alignment is necessary to ensure accurate extraction of the desired regions, such as the USN and marks table, from the *marksheet* image.

In the Align Images module, the ORB algorithm is employed to detect and match keypoints between the template image and the uploaded marksheet image. These keypoints represent distinctive features in the images, such as corners or edges as shown in figure 5a. By matching the keypoints, the algorithm computes the homography matrix, which describes the geometric transformation needed to align the images.

Once the images are aligned based on the computed homography matrix, the desired regions within the marksheet image can be accurately cropped out. The aligned image enables precise extraction of the USN and marks table regions, as their locations remain consistent. By aligning the marksheet image with the template, the Align Images module ensures that subsequent modules can process the relevant regions accurately for further analysis, such as OCR and marks prediction as shown in figure 5a.2. The required code is as given in figure5a.3.

B. Marks Recognition

Gaussian Blur: Apply a Gaussian Blur filter to the cropped marks region. This reduces noise and smooths out the image, making it easier to extract relevant information as shown below in figure 5b.1.

Color Space Conversion: Convert the image from BGR to HSV color space. This transformation helps in isolating specific color ranges, particularly the red color regions that represent marked answers and the outcome as shown below in figure 5b.2.

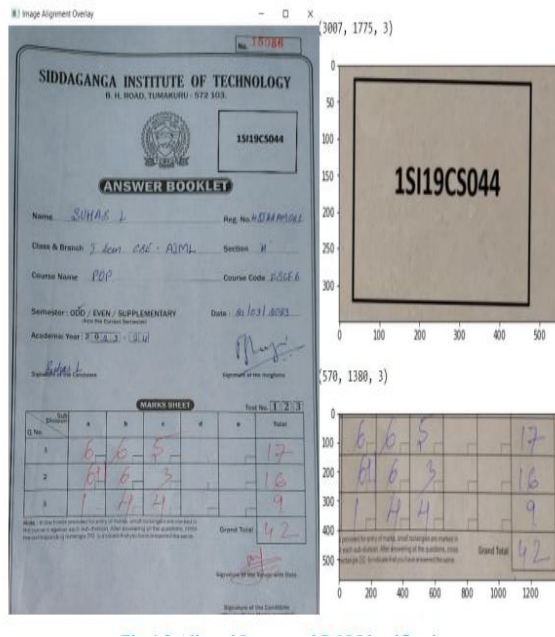


Figure 5a.2. Aligned Image and ROI Identification

```
# use ORB to detect key points and extract (binary) local
#invariant features
orb = cv2.ORB_create(maxFeatures)
(kpsA, descA)=orb.detectAndCompute(imageGray, None)
(kpsB, descB)=orb.detectAndCompute(templateGray,
None)
#Match the features
method=
cv2.DEScriptorMatcher_BRUTEFORCE_HAMMING
matcher = cv2.DescriptorMatcher_create(method)
matches = matcher.match(descA, descB, None)
#Sort the matches by their distance
matches = sorted(matches, key=lambda x: x.distance)
#Compute the homography matrix between the two sets of
#matched points
```

```
(H,mask)=cv2.findHomography(ptsA,ptsB,method=cv2.RANSAC)
#use the homography matrix to align the images
(h,w)=template.shape[:2]
aligned = cv2.warpPerspective(image, H, (w, h))
```

Figure 5a.3. Code Snippet for Aligned Image and ROI Identification

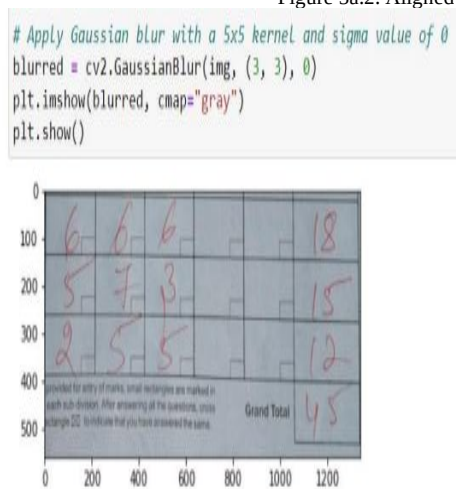


Figure 5b.1. Image Preprocessing: Gaussian Blur

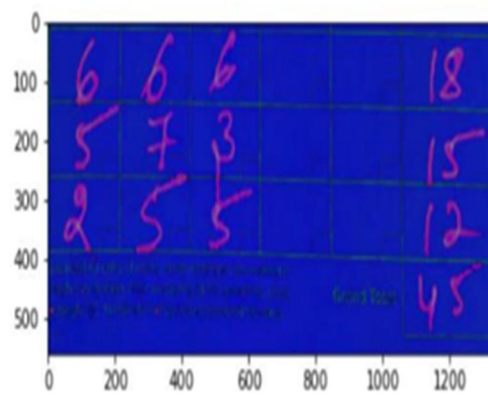


Figure 5b.2. Image Preprocessing: BGR to HSV colorspace

Red Color Extraction: Extract the regions of interest by applying predefined ranges for red Smart Marks Manager 2022-23 Department of Computer Science and Engineering 30 hues in the HSV color space. This process isolates the red color regions, which typically correspond to the marked answers on the marksheet as shown in figure 5b.3.

Morphological Operations: Perform morphological operations, such as erosion and dilation, to refine the extracted red color regions as shown in figure 5b.4. These operations help remove noise, fill gaps, and enhance the features of the marked answers, resulting in clearer and more accurate predictions.

Individual Marks Region Cropping: After preprocessing, the marks regions are cropped individually to separate each marked answer. This step ensures that each answer is processed and predicted separately.

CNN model: The CNN model is trained to recognize handwritten digits. On loading this model into the system, contours will be extracted using bounded rectangle and aspect ratio. For each digit, a few pixels will be padded

and reshaped to standard size. The model will take this resized image as an input and predicts the digits as shown in figure 5b.6. The code snippet is given in figure 5b.5.

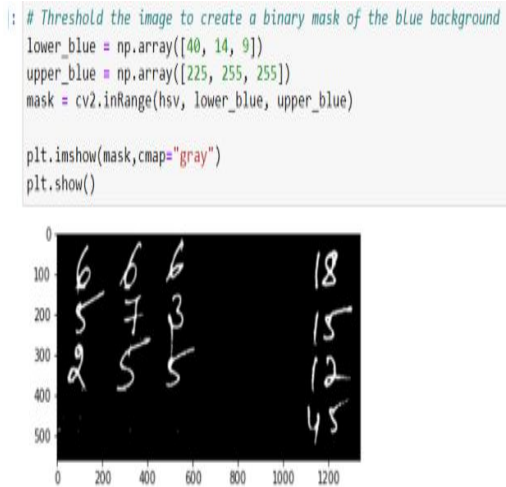


Figure 5b.3. Image Preprocessing: Extracted Red Color Numbers

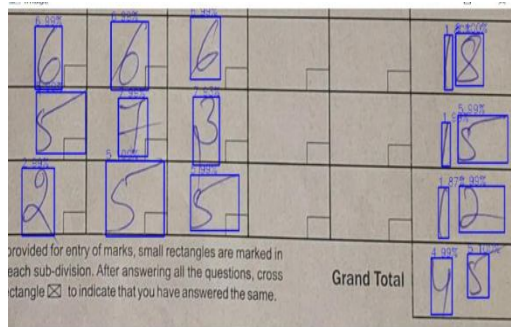


Figure 5b.6 Marks Prediction by CNN Model

```

model = load_model('mnist.h5')

contours, hierarchy = cv2.findContours(dig, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)

contours = sorted(contours, key=lambda contour: cv2.boundingRect(contour)[0])

for contour in contours:

    x, y, w, h = cv2.boundingRect(contour)

    area = cv2.contourArea(contour)

    aspect_ratio = float(w) / h

#filter digit on aspect ratio and resize

padded_digit = np.pad(resized_digit, ((4, 4), (4, 4)), "constant")

digit = padded_digit.reshape(1, 28, 28, 1)

digit = digit / 255.0

#Prediction of the digits

pred = model.predict([digit])[0]

final_pred = np.argmax(pred)

recognized_digits.append(final_pred)

return recognized_digits

```

Figure 5b.5

C. USN Recognition

Image pre-processing, text localization, character segmentation, and character recognition are all parts of the process. To improve the visibility of the text, image processing techniques such as binarization, noise reduction, and edge detection are applied. Following that, text is found and divided into individual letters or words, which are then categorized and recognized using pattern recognition or machine learning techniques. The code and results obtained are as shown in figure 5c.

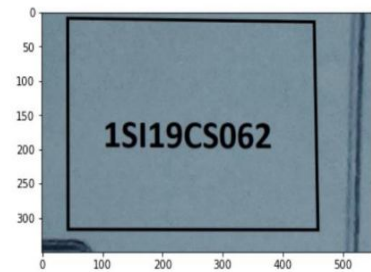
IV. RESULTS

To enhance the presentation and provide visual evidence of the system's performance, screenshots of the output screens have been included. The screenshots in the following figures serve as concrete illustrations of the system's functionality and can provide a better understanding of the results obtained.

```

image = cv2.imread(imagePath)
# Convert the image to grayscale
image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
# Use Pytesseract to extract text from the image and split the extracted text into words
words = pytesseract.image_to_string(image).split()

```



The word extracted from the image is: 1SI19CS062

Figure 5c. USN Prediction by OCR

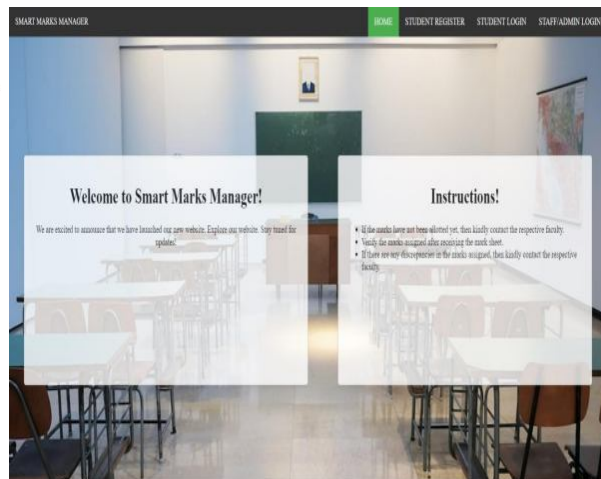


Figure 6a. Home Screen

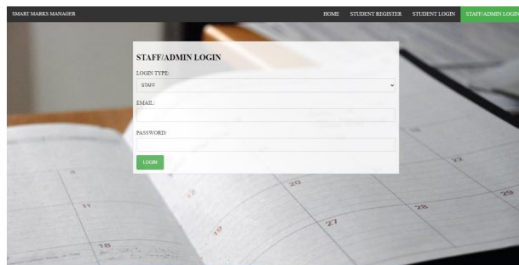
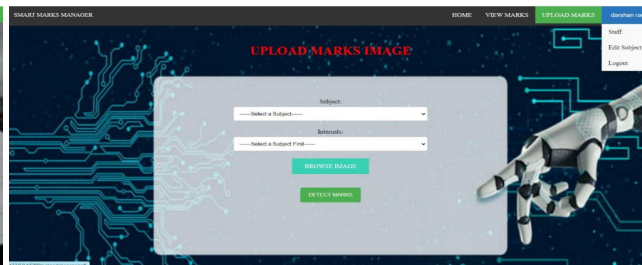
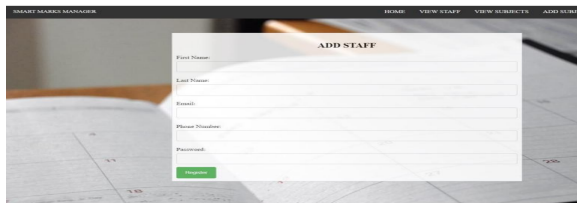


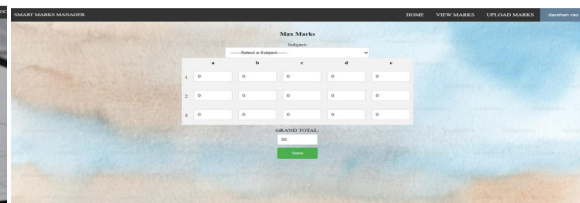
Figure 6b. Staff/ Admin login



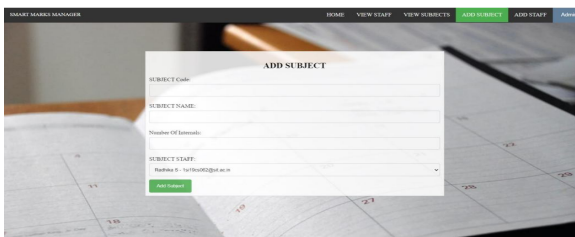
Staff Dashboard



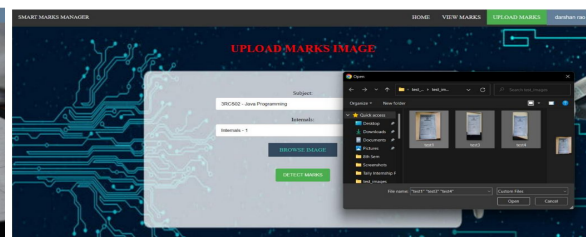
Add Staff



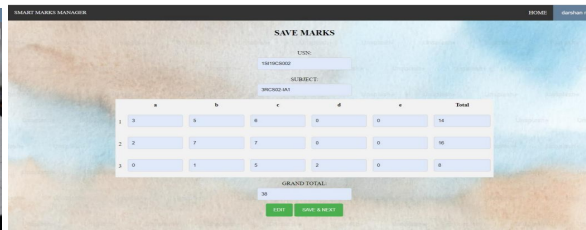
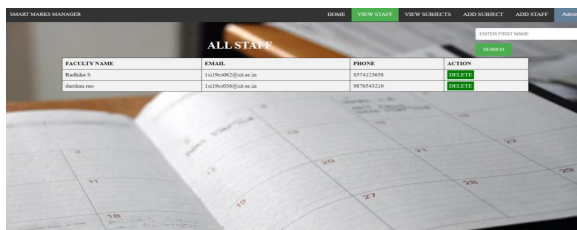
Max Marks Limit Screen

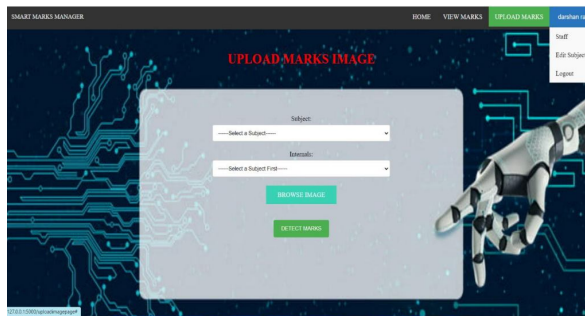


Add Subject

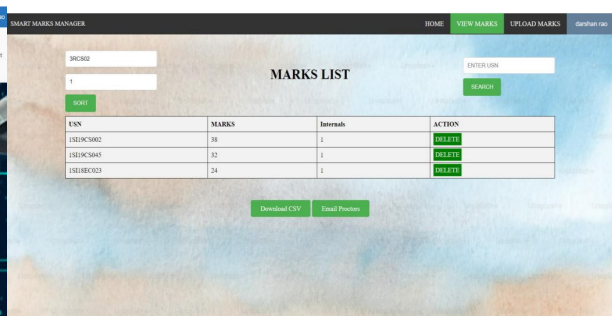


Upload Images

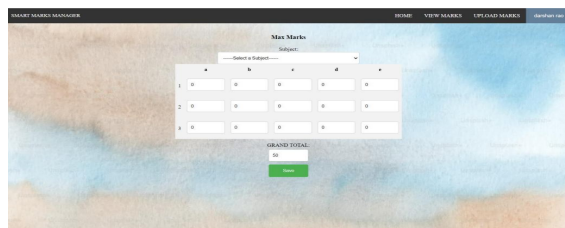




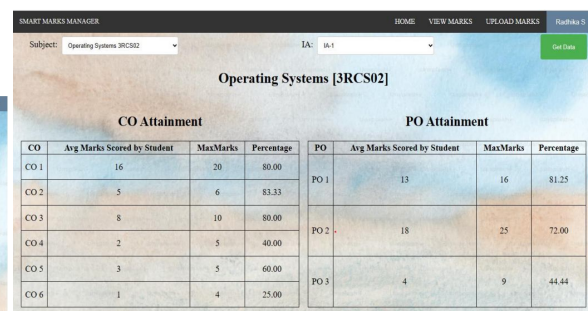
Staff Dashboard



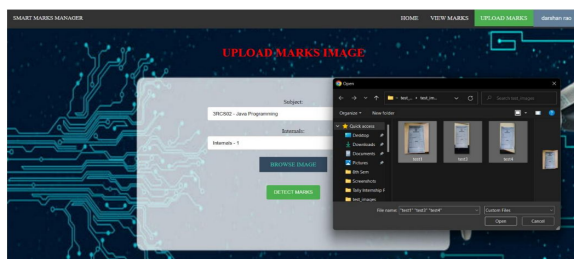
View Marks, Excel Download and Email Proctors



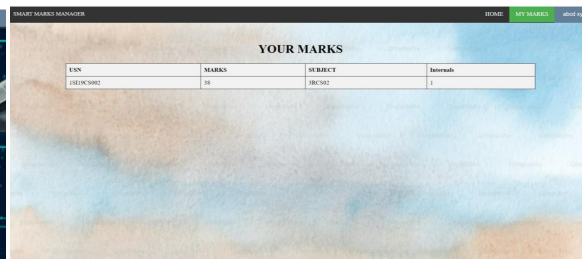
Max Marks Limit Screen



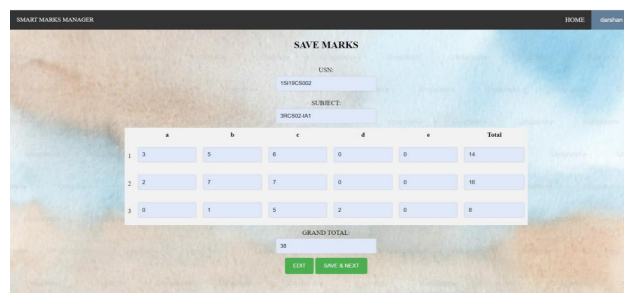
CO Attainment and PO Attainment Figure 6d.2 Staff Functionalities



Upload Images



Student Dashboard to view their marks Figure 6e.2 Student Functionalities



USN and Marks Prediction Output

V. CONCLUSION AND FUTURE SCOPE

Conclusion

The Smart Marks Manager project has successfully addressed the challenges associated with manual mark management in academic institutions. By leveraging OCR and CNN models, the system has automated the extraction of handwritten marks and unique student identification numbers from mark sheet images, eliminating the need for manual data entry and reducing errors. The implementation of the system, along with rigorous testing, has demonstrated its efficiency, accuracy, and user-friendliness.

Through the development of a user-friendly interface, the Smart Marks Manager system has provided administrators, staff members, and students with intuitive access to essential functionalities. Administrators can effectively manage user accounts, subjects, and staff assignments, while staff members can conveniently validate predicted marks and students can access their performance evaluations. The system's integration with a MySQL database ensures data security and integrity, further enhancing its reliability.

Future Scope

The Smart Marks Manager presents various opportunities for future enhancements and expansions. Some potential areas for future development include:

- **Advanced Analytics:** Implementing advanced analytics features to generate insightful reports and visualizations of student performance, allowing administrators and staff members to gain deeper insights into student progress and identify areas for improvement.
- **Integration with Learning Management Systems (LMS):** Integrating the Smart Marks Manager system with existing Learning Management Systems to streamline the process of accessing marks and performance evaluations, providing a seamless experience for students and teachers.
- **Mobile Application:** Developing a mobile application that enables users to access the system on their smartphones or tablets, providing convenient access to marks, notifications, and other relevant information.
- **Automated Email Notifications:** Implementing an automated email notification system that alerts staff members and proctors when students score low marks, enabling timely intervention and support for struggling students.
- **Machine Learning Enhancements:** Continuously refining the OCR and CNN models used for mark extraction, leveraging machine learning techniques to improve accuracy and handle a wider range of handwriting styles.
- **Integration with External Data Sources:** Incorporating data from external sources, such as online exam platforms or digital assessment tools, to automate the import of marks and further streamline the evaluation process.

The future scope of the Smart Marks Manager holds immense potential for enhancing academic evaluation processes, improving efficiency, and providing valuable insights into student performance. With ongoing advancements in technology and machine learning, this project can continue to evolve and adapt to meet the ever-changing needs of educational institutions, ultimately benefiting administrators, staff members, and students alike.

ACKNOWLEDGMENT

I thank first the God, then my parent and then my kids for loving me so much which gives me the energy to do more in life.

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