



ICCIT 2020

THE 23rd INTERNATIONAL CONFERENCE ON
COMPUTER AND INFORMATION TECHNOLOGY

Autonomous Deblurring Images and Information Extraction from Documents Using CycleGAN and Mask RCNN

Oishee Bintey Hoque, Maisha Binte Rashid,
K M Tawsik Jawad

Department of CSE,
Ahsanullah University of Science and Technology



Problem Overview

An important document may get blur during scanning or other reasons.

MEMBERSHIP APPLICATION FORM

Name: _____ Member Number: _____
Member Address: _____ Member No.: _____
City: _____ Address/Member No.: _____
State/City: _____ State & Zip: _____
Country: _____ District: _____
Member Number No.: _____ District: _____
Membership Class/Description Class to request: _____
Member's Name & State or State: _____
Country's Name & State or State: _____

Joining Fee Details
I hereby agree to pay the following payment on the date specified. I agree that the agreement is for the membership on one day, but agreed with the 100% (100%) fee of the membership of 100% (100%) for the next five years to support the membership fee of 100% (100%) for the next five years.

Year	Amount	Amount Due	Amount Due
Year 1	1,000,000	1,000,000	1,000,000
Year 2	1,000,000	1,000,000	1,000,000
Year 3	1,000,000	1,000,000	1,000,000
Year 4	1,000,000	1,000,000	1,000,000
Year 5	1,000,000	1,000,000	1,000,000

Payment or Payment Fee with Payment Plan
I agree to pay the membership fee in installments. Credit Card Check Bank Transfer
I agree to pay the membership fee in installments. Credit Card Check Bank Transfer
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I agree to pay the membership fee in installments. Credit Card Check Bank Transfer

Name: _____ Date: _____ Chapter ID: _____

Problem Overview

A proper solution to deblur that system is required.

MEMBERSHIP APPLICATION FORM

Name: _____ Business Telephone No.: _____
Home Address: _____ Mobile No.: _____
City: _____ Alternative Mobile No.: _____
Post/Zip Code: _____ Street & Mail Address: _____
Country: _____ Date of Birth: _____ Nationality: _____
Home Telephone No.: _____
Residence Class/Destination Club to which I belong: _____
Wife/Partner's Name: _____ Date of Birth: _____
Children's Names & Date of Birth: _____

Joining Fee Payment Schedule

Year	Amount	Annual Date	Payment Date
Year 1	7,000 USD	1/2/2015	Date of signing this agreement
Year 2	7,000 USD	+ Annual Date	3rd Year Anniversary of agreement
Year 3	7,000 USD	+ Annual Date	3rd Year Anniversary of agreement
Year 4	7,000 USD	+ Annual Date	3rd Year Anniversary of agreement
Year 5	7,000 USD	+ Annual Date	4th Year Anniversary of agreement

Settlement of Joining Fee and Annual Fee

I wish to pay my membership fees by Credit Card Cheque Draft Bank Transfer

CREDIT CARD DETAILS

CREDIT CARD American Express VISA Mastercard

CARD No. _____ EXPIRY DATE _____ MONTH _____ YEAR _____

CARD SECURITY CODE _____

Name as printed on the card _____
Address of card if different from above _____ Annual Fee as payable by 30th January each year.

MEMBERSHIP APPLICATION FORM

Name: _____ Business Telephone No.: _____
Home Address: _____ Mobile No.: _____
City: _____ Alternative Mobile No.: _____
Post/Zip Code: _____ Street & Mail Address: _____
Country: _____ Date of Birth: _____ Nationality: _____
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CARD SECURITY CODE _____

Name as printed on the card _____
Address of card if different from above _____ Annual Fee as payable by 30th January each year.

SIGNED: _____ DATE: _____ UNIQUE ID: _____

THE EBEN RESIDENCE CLUB
E-mail: membership@ebenresidenceclub.com

Problem Overview

Also, autonomous information extraction is one of the most needed feature in this era.

UNIVERSITY OF SCIENCE AND TECHNOLOGY
(FOR ID CARD PURPOSES)
Department: Architecture

Name: (IN CAPITAL LETTERS)
MAHIA SOLAIMAN

Student No: 1 8 - 0 2 - 0 1 - 0 0 1 Blood Group: O+

Student's Contact Number (Mobile): 2 9 0 0 8 8 0 2 Mahia Solaiman

Emergency Contact Number (Mobile): 0 1 6 1 3 0 8 8 1 0 8 8 Student's Signature



Name(IN CAPITAL LETTERS): MAHIA SOLAIMAN
Student No: 18-02-01-001
Blood Group: O+
Student's Contact Number: 019290...
Emergency Contact Number: 016130880

Paper Overview

Our work focuses on two problems:

- To deblur an image
- To extract information

- To be more specific, we only focus on every type of **ADMISSION FORMS**.

Research Domain



Research Problem

➤ Image Deblurring

- Among, so many options, we chose the most recent CycleGAN Approach.

➤ Information Extraction

- Using **Deep Learning** based object detection method
- Using OCR Library

Related Works

Existing Works

To best of our knowledge -

- **Rasmus Berg Palm et al. 2017**
 - “Cloudscan – A configuration - free invoice analysis system using recurrent neural net-works”
- **Radford et al. 2015**
 - “Unsupervised Representation Learning With Deep Convolutional Generative Adversarial Networks”
- **Sharma et al. 2018**
 - “Learning to clean: A GAN perspective”
- **Sun et al. 2019**
 - “Template matching-based method for intelligent invoice information identification”
- **Zhu et al. 2017**
 - “Unpaired image-to-image translation using cycle-consistent adversarial networks”

Reviews

- Additional device for input
- Dataset
 - Requires increment in volume
 - Variation in document types would allow the model to extract information from all kinds of documents
- Methodology
 - Gaussian, Stack, Motion Blur application with random probabilities in pre-processing
 - Training using Mask R-CNN on cleaned dataset prepared by Cycle GAN
- Output
 - Handwriting recognition not robust enough from Tesseract
 - Performance limited to form type documents.

**For detailed review, please go through our paper*



Contribution

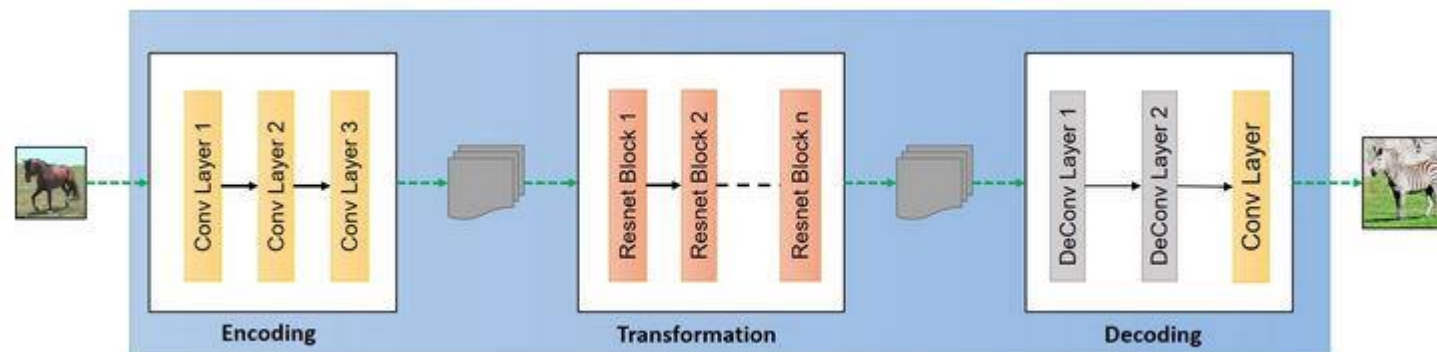
Domain	Our Contribution	
Dataset	Open Source	✓
	Robust	✓
	Proper Variation	✓
Our System	Device Independent	✓
	Real Time	✓

Methodology (Cycle GAN)

Cycle GAN

Basic Concepts

- Unpaired image-to-image Translation
- Generator
 - Encoder (Extract the feature)
 - Transformer (Add the previous result)
 - Decoder (Decode the result)

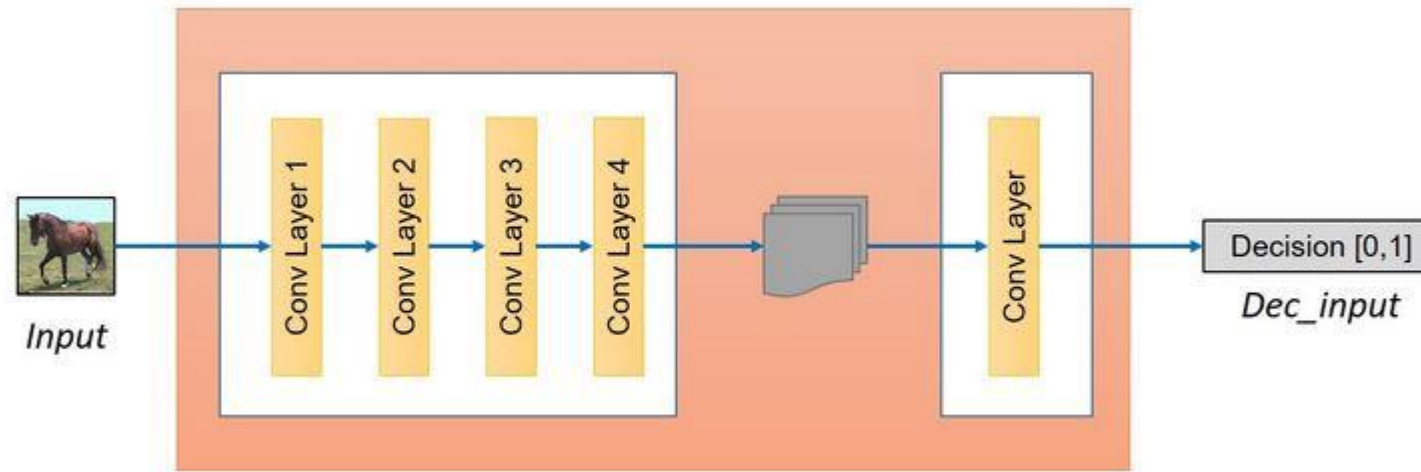


Cycle GAN

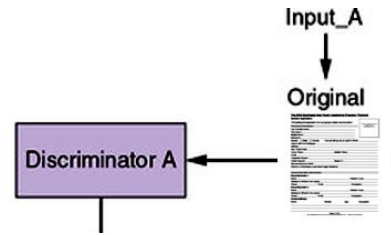
Basic Concepts

Discriminator

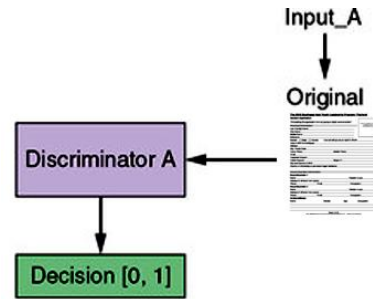
- Take images and try to predict if it's real or fake



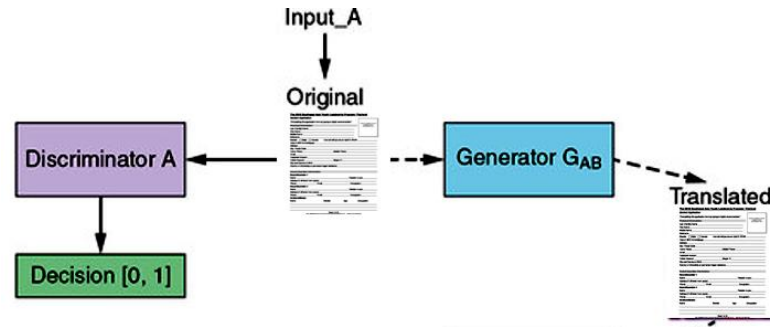
Cycle GAN



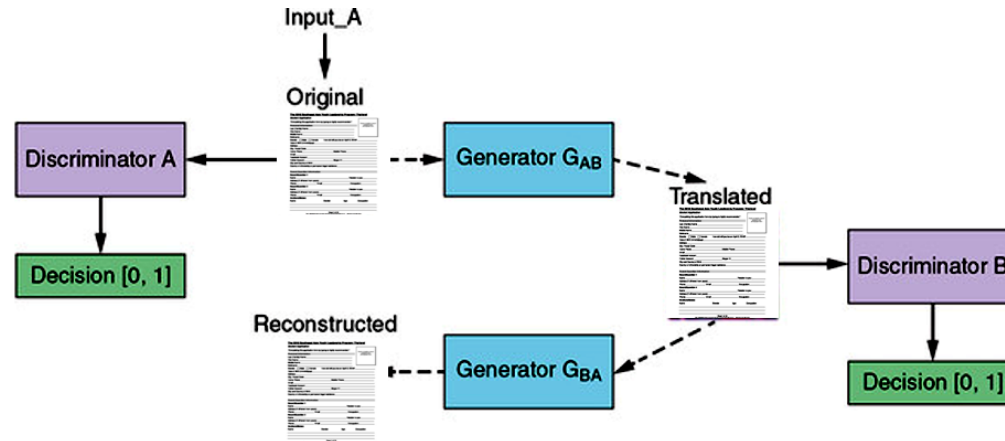
Cycle GAN



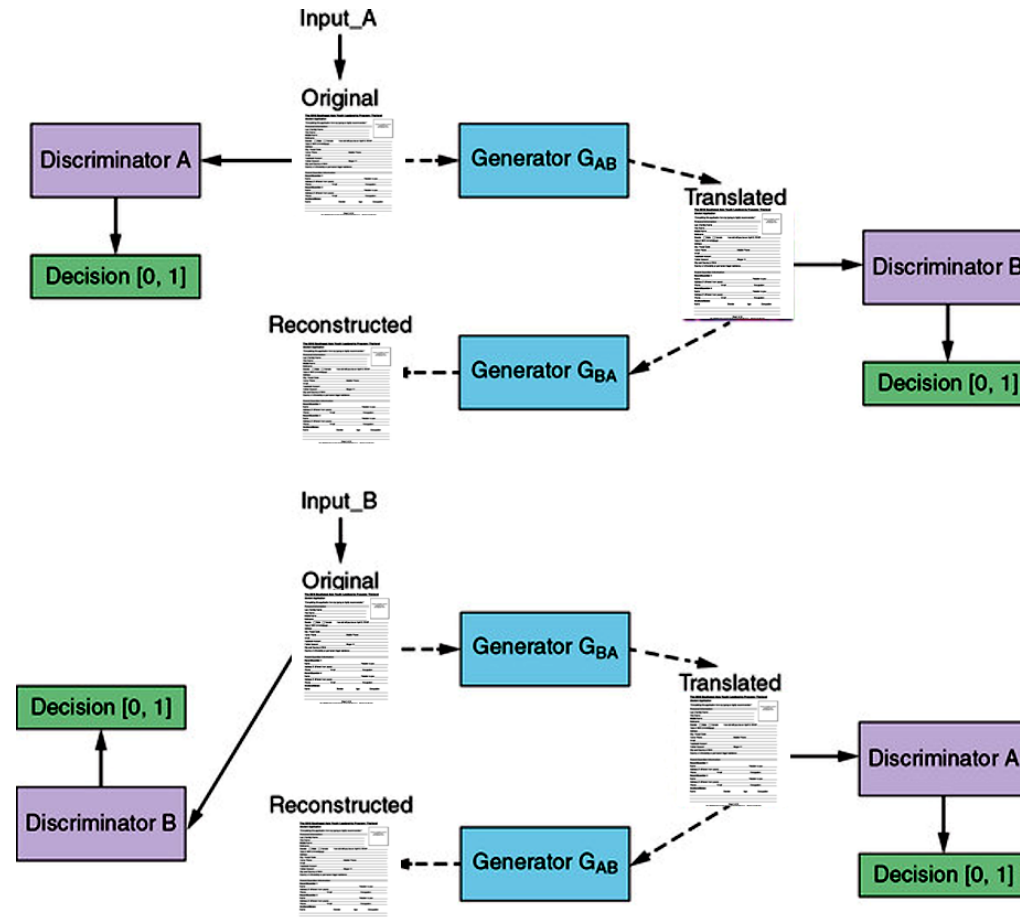
Cycle GAN



Cycle GAN

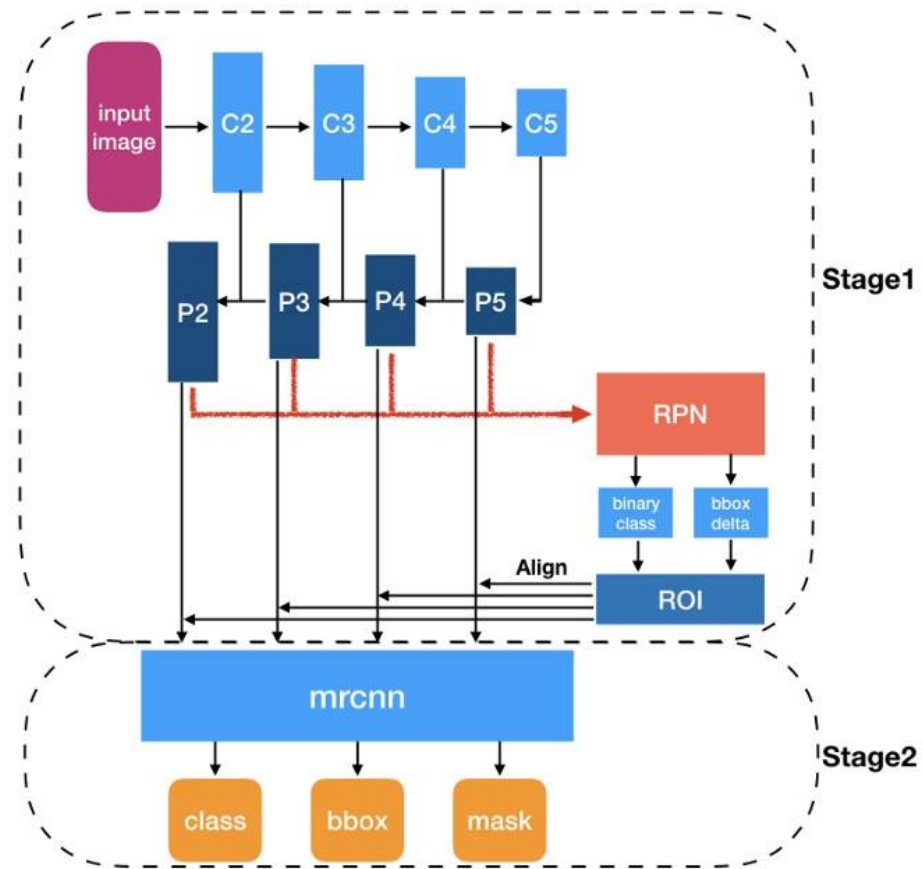


Cycle GAN



Methodology (Mask RCNN)

Mask R-CNN Architecture



Mask R-CNN Architecture



PRIME UNIVERSITY
Application Form For Admission

Department: _____
Program: _____
Year: _____ Spring: _____ Summer: _____ Fall: _____
Name of the Student (Block Letter): _____
Father's Name: _____
Mother's Name: _____
Present Address: _____
Contact No: _____ e-mail: _____
Permanent Address: _____
Contact No: _____ e-mail: _____
Nationality: _____ Date of Birth: / /
Place of Birth: _____ Religion: _____
Sex: _____ IC No: _____

Academic Qualifications:

Year of Graduation	Year	Year	Year	Year	Year	Year	Year

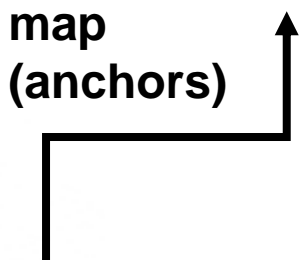
Signature: _____

Input

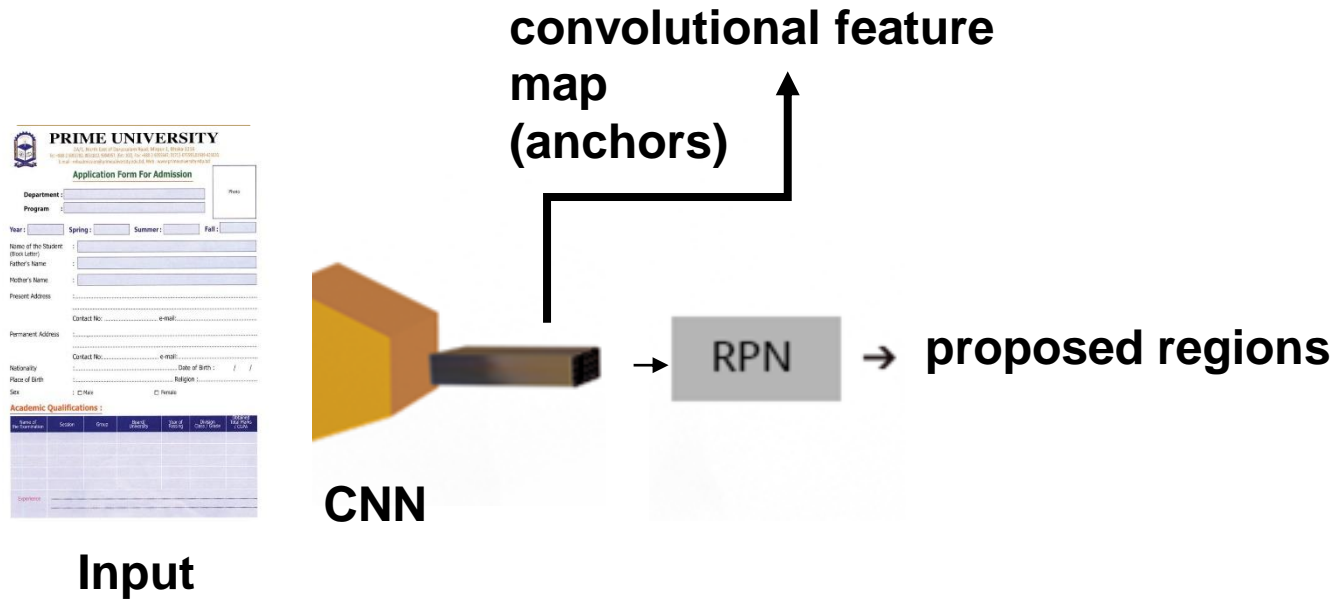


CNN

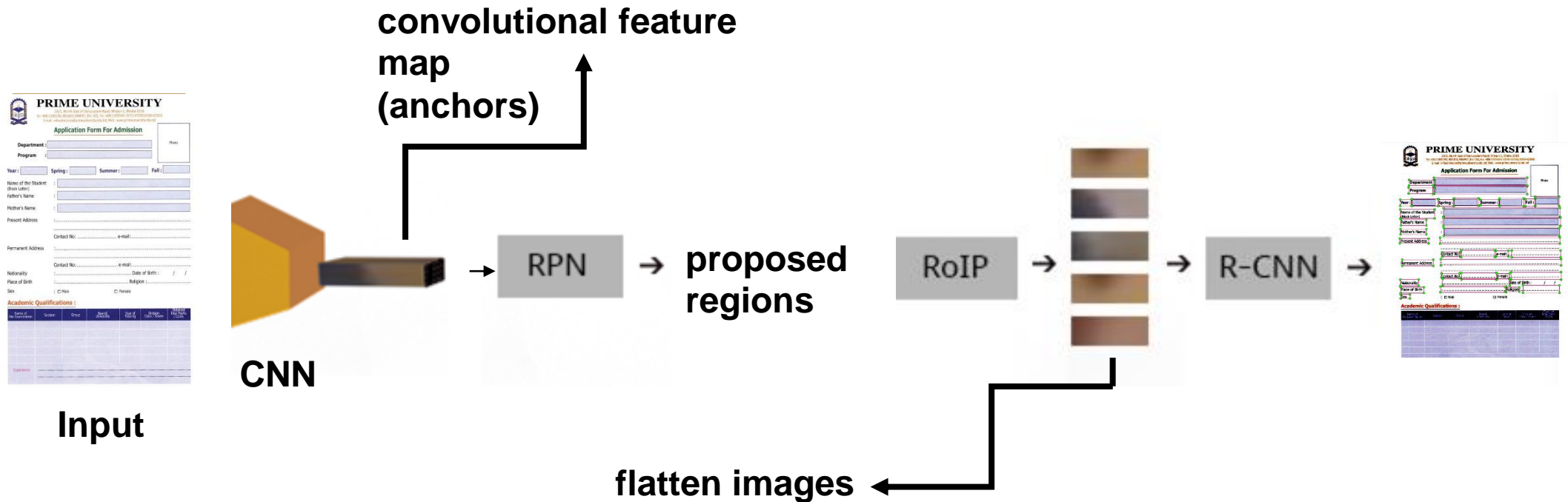
convolutional feature map (anchors)



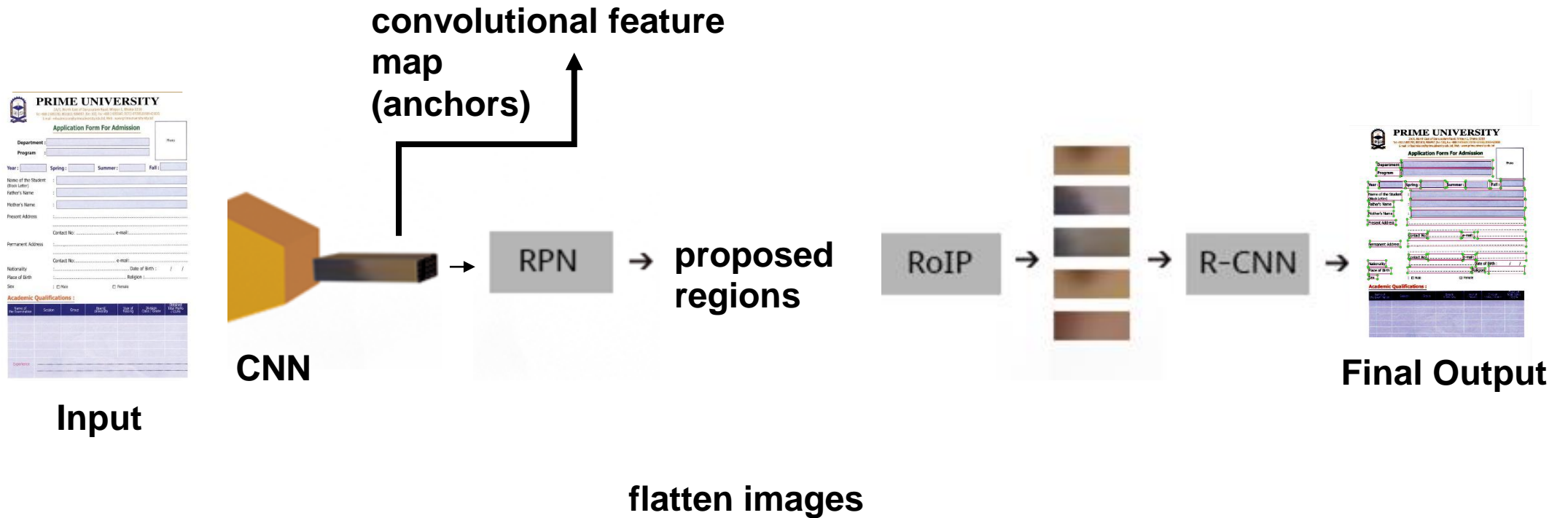
Mask R-CNN Architecture



Mask R-CNN Architecture



Mask R-CNN Architecture



Our Dataset

- ④ We employ two types of document datasets:
 - ④ The first one for background noise removal
 - ④ The other one for information extraction with bounding boxes.

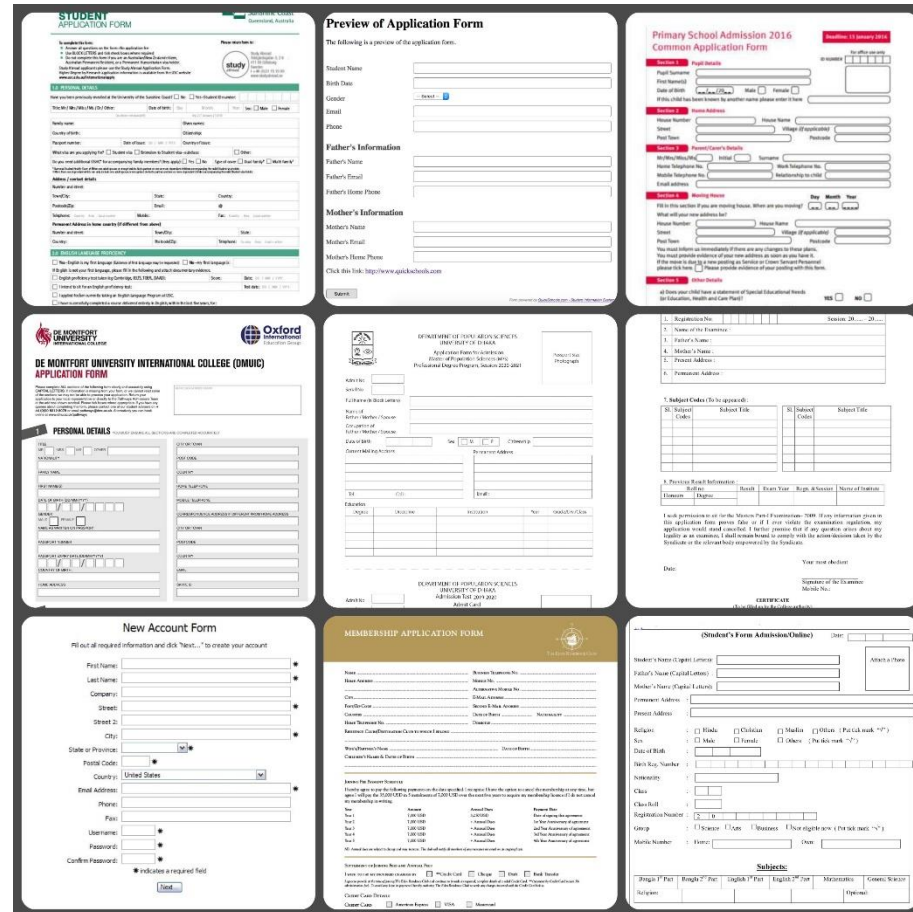
Background Noise Removal Dataset

- ④ We utilize the internet as the primary source to collect several types of documents admission form, NID form, etc. to keep variation in our dataset.
- ④ Initially, we have downloaded 500 images and from those, we separate 100 images for further processing.
- ④ Later, each image goes through three types of blurring, i.e., stack blur, gaussian blur, and motion blur.

Background Noise Removal Dataset

- These procedures are randomly applied to images based on some random probability, radius, kernel size, and standard deviation.
- From each image, we generated additional ten images and manually filtered the dataset.
- Finally, our dataset consisted of 1000 images in total, split into 8:2 ratio as a training and validation set.
- For further evaluation, we collected additional 20 images to check our model's accuracy on the real noisy dataset

Background Noise Removal Dataset



Background Noise Removal Dataset

- ④ Two types of bounding boxes –
 - ④ One for the label field name and
 - ④ Another for corresponding field information.
- ④ One hundred images consist of over 10,000 bounding boxes for each field.
- ④ After labeling the images, we again perform several manual image transformations - rotating, translation, etc. -to make the dataset robust.
- ④ Finally, our dataset consisted of 2000 copies in total, split into 8:2 ratio as a training and validation set.

Background Noise Removal Dataset

PRIME UNIVERSITY
 2A/1, North East of Darussalam Road, Mirpur-1, Dhaka-1216
 Tel: +880-2-8051782, 8031810, 9004957, [Ext: 102], Fax: +880-2-8055647, 01712-675595, 01939-425030
 E-mail : infoadmission@primeubiversity.edu.bd, Web : www.primeuniversity.edu.bd

Application Form For Admission

Department : _____ Photo

Program : _____

Year : _____ Spring : _____ Summer : _____ Fall : _____

Name of the Student (Block Letter) : _____

Father's Name : _____

Mother's Name : _____

Present Address : _____

Permanent Address : _____

Contact No. : _____ e-mail : _____

Contact No. : _____ e-mail : _____

Nationality : _____ Date of Birth : / /

Place of Birth : _____ Religion : _____

Sex : Male Female

Academic Qualifications :

Name of the Examination	Session	Group	Board/University	Year of Passing	Division Class / Grade	Obtained Total Marks / CGPA

Experimental Result

- Peak Signal-to-Noise Ratio(PSNR) of CycleGAN obtains 31.334dB.
- Average Precision with IoU = [.5,.75]. We get 75.8 and 60.1
- Accuracy Rate on Mask RCNN = **98.20%**.

Experimental Result



Blurred Image



After Cycle
GAN Deblurring

Experimental Result

Name: (IN CAPITAL LETTERS)
 MEHNAJ SULTANA

Student No: 1 8 - 0 2 - 0 4 - 0 3 2 Blood Group: B⁺ve

Student's Contact Number (Mobile): 0 1 6 3 5 4 0 8 2 3 5 Mehraj

Emergency Contact Number (Mobile): 0 1 7 6 0 1 0 3 5 9 7 Student's Signature



Name: (IN CAPITAL LETTERS)
 MEHNAJ SULTANA

Student No: 1 8 - 0 2 - 0 4 - 0 3 2 Blood Group: B⁺ve

Student's Contact Number (Mobile): 0 1 6 3 5 4 0 8 2 3 5 Mehraj

Emergency Contact Number (Mobile): 0 1 7 6 0 1 0 3 5 9 7 Student's Signature



Name: (IN CAPITAL LETTERS)
 MAHIA SOLAIMAN

Student No: 1 8 - 0 2 - 0 1 - 0 0 1 Blood Group: O⁺

Student's Contact Number (Mobile): 0 1 6 1 3 0 8 5 1 0 9 9 Mahia Solaiman

Emergency Contact Number (Mobile): 0 1 6 1 3 0 8 5 1 0 9 9 Student's Signature



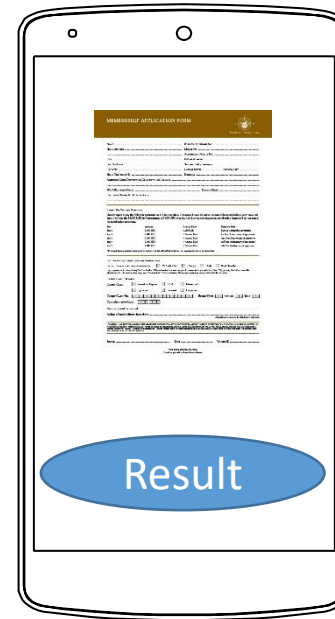
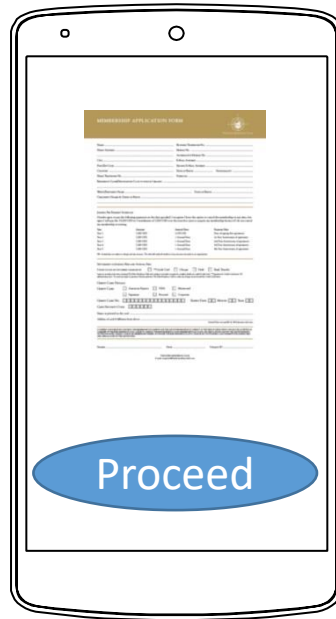
Name(IN CAPITAL LETTERS): MAHIA SOLAIMAN
 Student No: 18-02-01-001
 Blood Group: O+
 Student's Contact Number: 019290...
 Emergency Contact Number: 016130880...

Limitations

➤ Our System is only limited to Admission Forms.

Future Plan

👉 Mobile Version



Future Plan

- ④ User friendly system – Mobile Integration
- ④ Increasing dataset and scope of our work
- ④ Evaluating the performance of our system on all kinds of documents
- ④ Robust handwriting recognition algorithm implementation

Thank You
Any Questions?

