Transfer Learning for Scene Text Recognition in Indian Languages

Sanjana Gunna
IIIT Hyderabad

Rohit Saluja
IIIT Hyderabad

C. V. Jawahar
IIIT Hyderabad

https://github.com/firesans/STRforIndicLanguages

Centre for Vision Information Technology (CVIT)
International Institute of Information Technology, Hyderabad (IIIT-H), INDIA

Contents

Introduction

The recent algorithms proposed for Scene Text Recognition (STR) in English perform with an average Word Recognition Rate (WRR) of 92.9% on 4 benchmark datasets.

Model	Year	Train Data	IIIT	SVT	IC03	IC13
GCAM	2019	MJ + ST	93.9	91.3	95.3	**95.7**
GTC [Hu et al.]	2020	MJ + ST + SA + real (5.6M)	**95.8**	**92.9**	95.5	94.4
Luo et al.	2020	MJ + ST	95.4	92.7	**96.3**	94.8
Litman et al.	2020	MJ + ST+ SA	93.7	92.7	**96.3**	93.9

Table 1 - Performance comparison of recognition algorithms on benchmark datasets
(the values correspond to the "No lexicon" results)

- ❑ However, these models have not performed well on non-Latin datasets. The domain of STR in non-Latin languages has not been thoroughly explored as much as English.
- ❑ We set new benchmarks for 6 different Indian Languages (Next Slide).

The correct predictions are in green, and the wrong predictions or missing characters are highlighted in red color.

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কে এম ঘোষ রোড
কে এম ঘোষ রোড
Handwritten Sign Boards
સ્ટેશન સ્વચ્છ મેળવો
આભાર
Printed Sign Boards
સ્ટેશન ૨વ૨છ મોળવો આભાર
అనంతర
ఫైన్ డైనింగ్ | బ్యాంక్వెట్స్
అనంతర బ్యాంక్వెట్స్ డైనింగ్ ఫైన్
అనంతర బ్యాంక్వెట్స్ డైనింగ్ ఫైన్
English on sign boards
உதகமண்டலம்
UDAGAMANDALAM
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എച്ച്.പി.ഓട്ടോ കെയർ
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_ച്ച്_പി_ഓട്ടോ കെയർ കവടിയാർ
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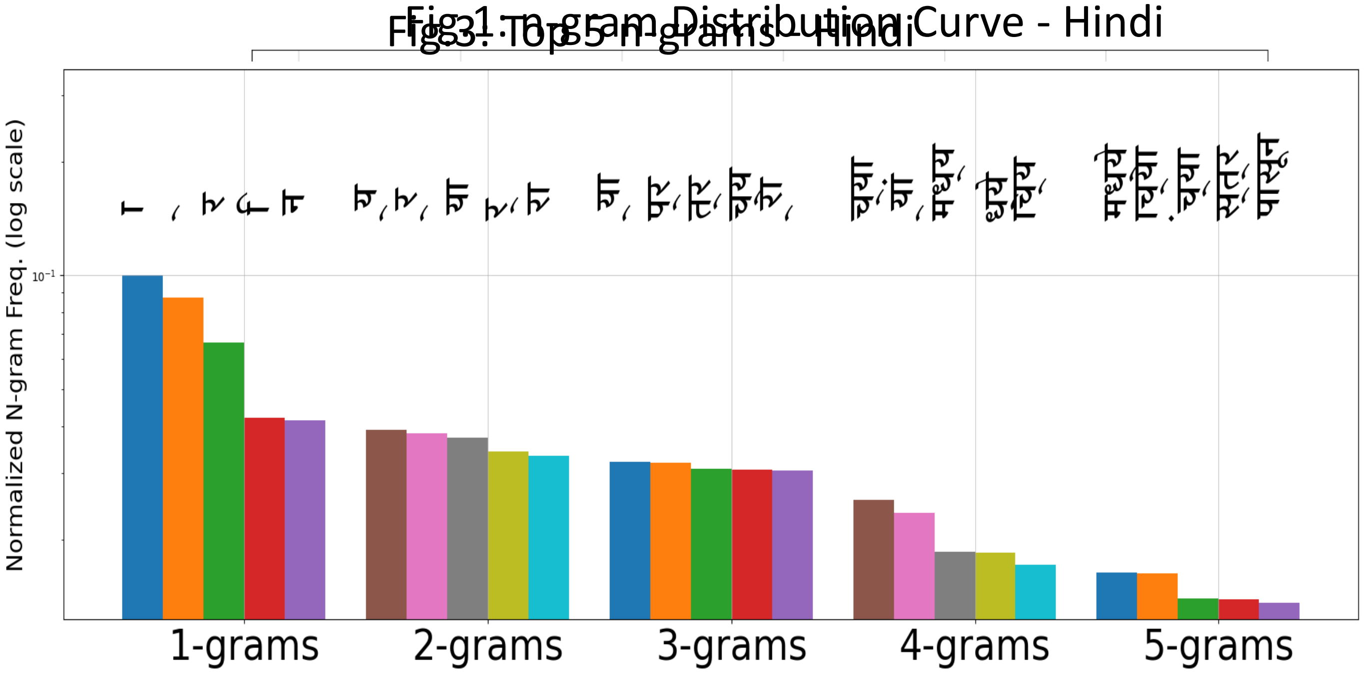
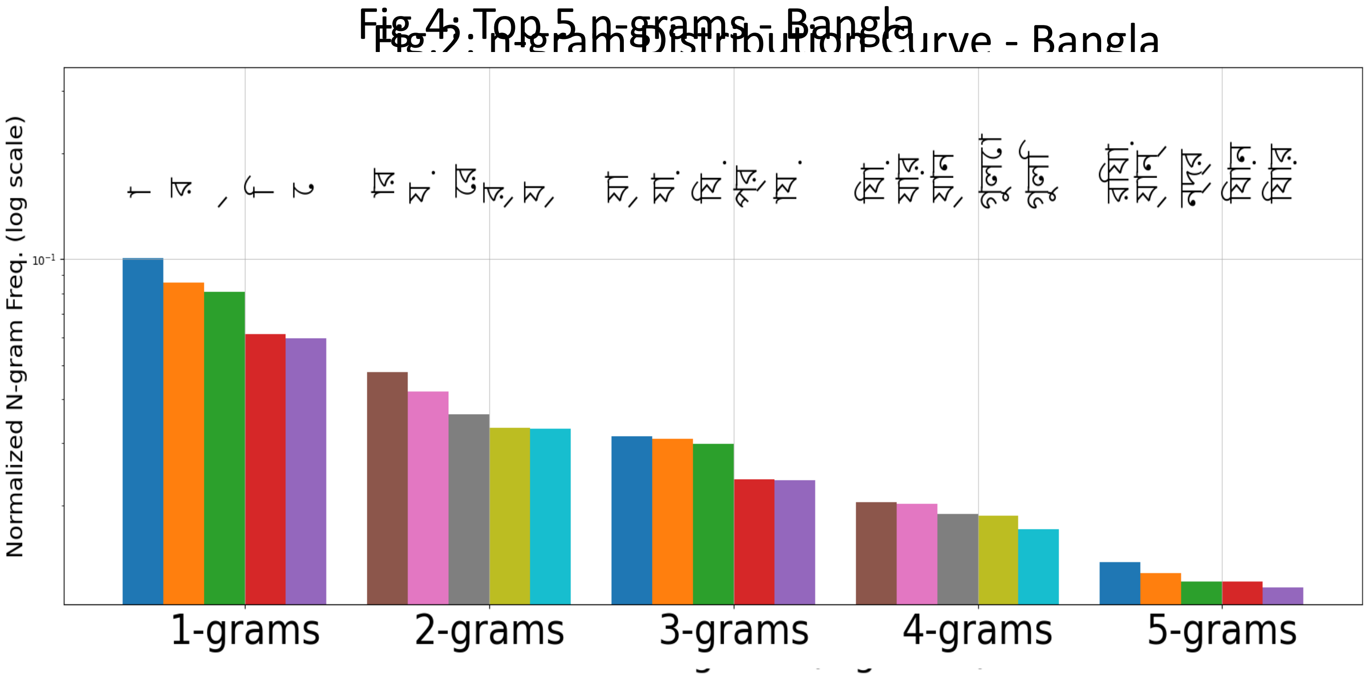
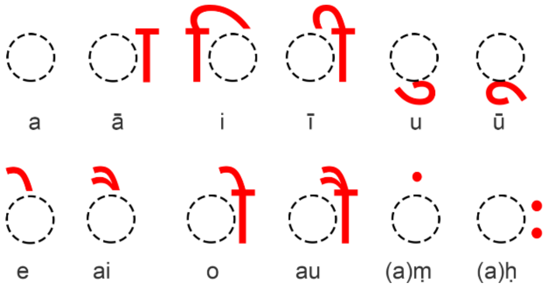
Motivation

Motivation

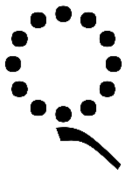
- We compared n-grams of a corpus of 2 million words of the six languages in this study and found many striking similarities.
- The overall distribution curves of n-grams seem similar for all the languages. (Ex: Fig.1, Fig.2)
- The top 5 n-grams are usually not well-formed words in these languages unlike in English.







Diacritic characters in Hindi


“Halanta”

Motivation

"Use of transfer learning boosts the performance of the task amongst languages."

❑ Based on the word length statistics and the similarity between scripts, we choose the below mentioned order for transfer learning.

- Gujarati -> Hindi
- Hindi -> Bangla
- Bangla -> Tamil
- Tamil -> Telugu
- Telugu -> Malayalam

Data & Methodology

Languages & Data

- Our study focuses on 6 most popular Indian languages - Bengali, Gujarati , Hindi, Malayalam, Tamil, Telugu.

- We create >2.5 million synthetic data for training recognition algorithms using the methodology proposed by Mathew et al.

Language	#Images	Train	Test	(μ , σ) Word Length	#Fonts
English	17.5M	17M	0.5M	5.12, 2.99	>1200
Gujarati	2.5M	2M	0.5M	5.95, 1.85	12
Hindi	2.5M	2M	0.5M	8.73, 3.10	97
Bengali	2.5M	2M	0.5M	8.48, 2.98	68
Tamil	2.5M	2M	0.5M	10.92,3.75	158
Telugu	5M	5M	0.5M	9.75, 3.43	62
Malayalam	7.5M	7M	0.5M	12.29, 4.98	20

[*[1]: Mathew et al., "Benchmarking Scene Text Recognition in Devanagari, Telugu and Malayalam," MOCR,2017*]

(#Actual S s)

- Gu words (105 scene
- Tamil - 2535 words (345 scenes)

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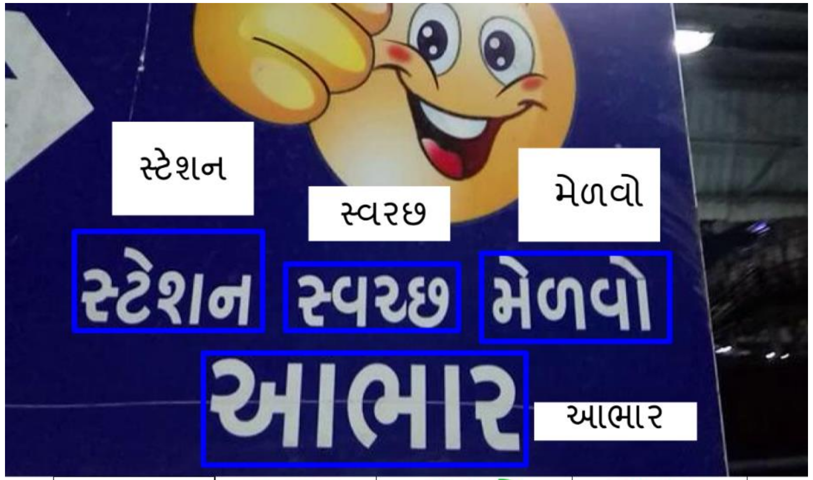
কে	এম	ঘোষ	রোড



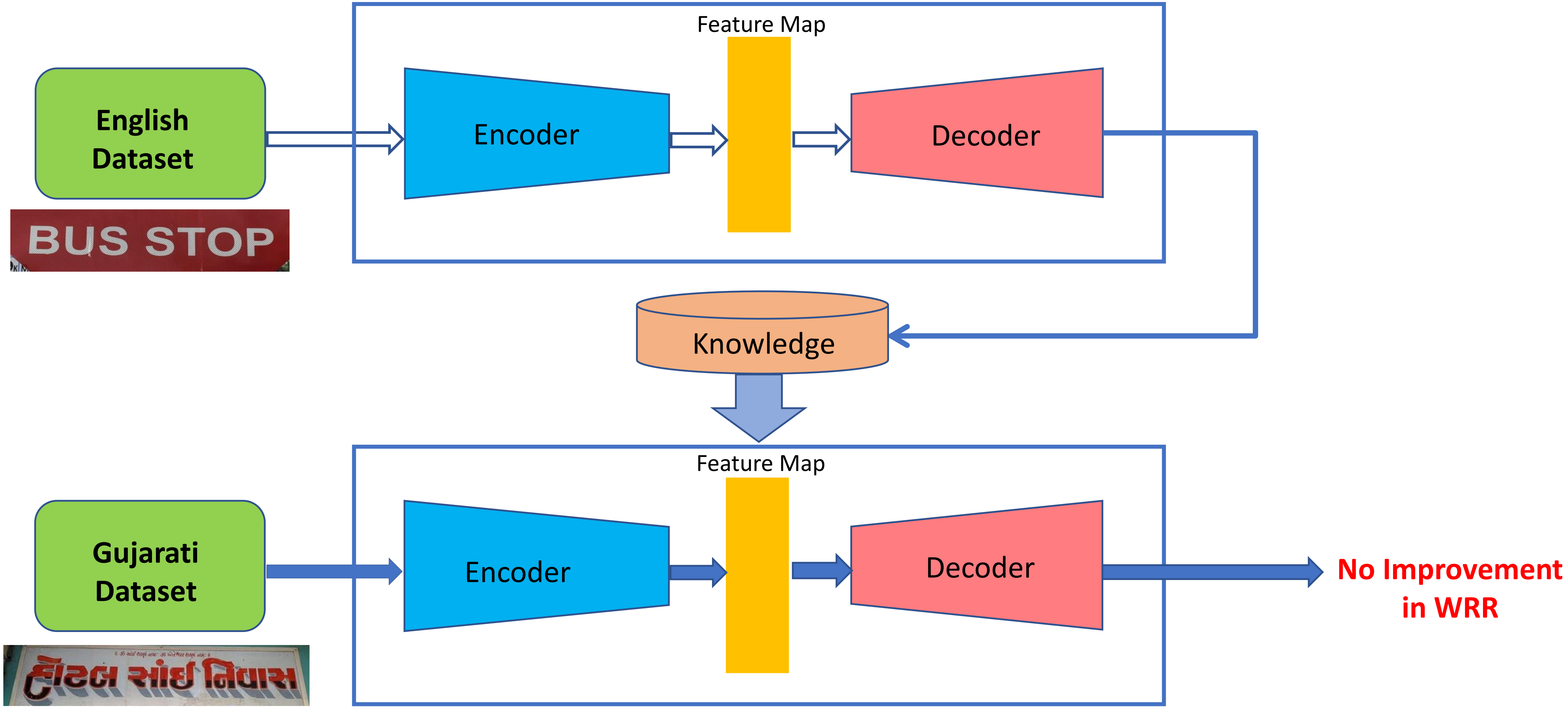
૨ટશમ	૨વ૨છ	મવવો	અભાર
સ્ટેશન	૨વ૨છ	મોળવો	આભાર

అనంతర	బ్యాంక్వెట్స్	డైనింగ్	ఫైన్
అనంతర	బ్యాంక్వెట్స్	డైనింగ్	ఫైన్

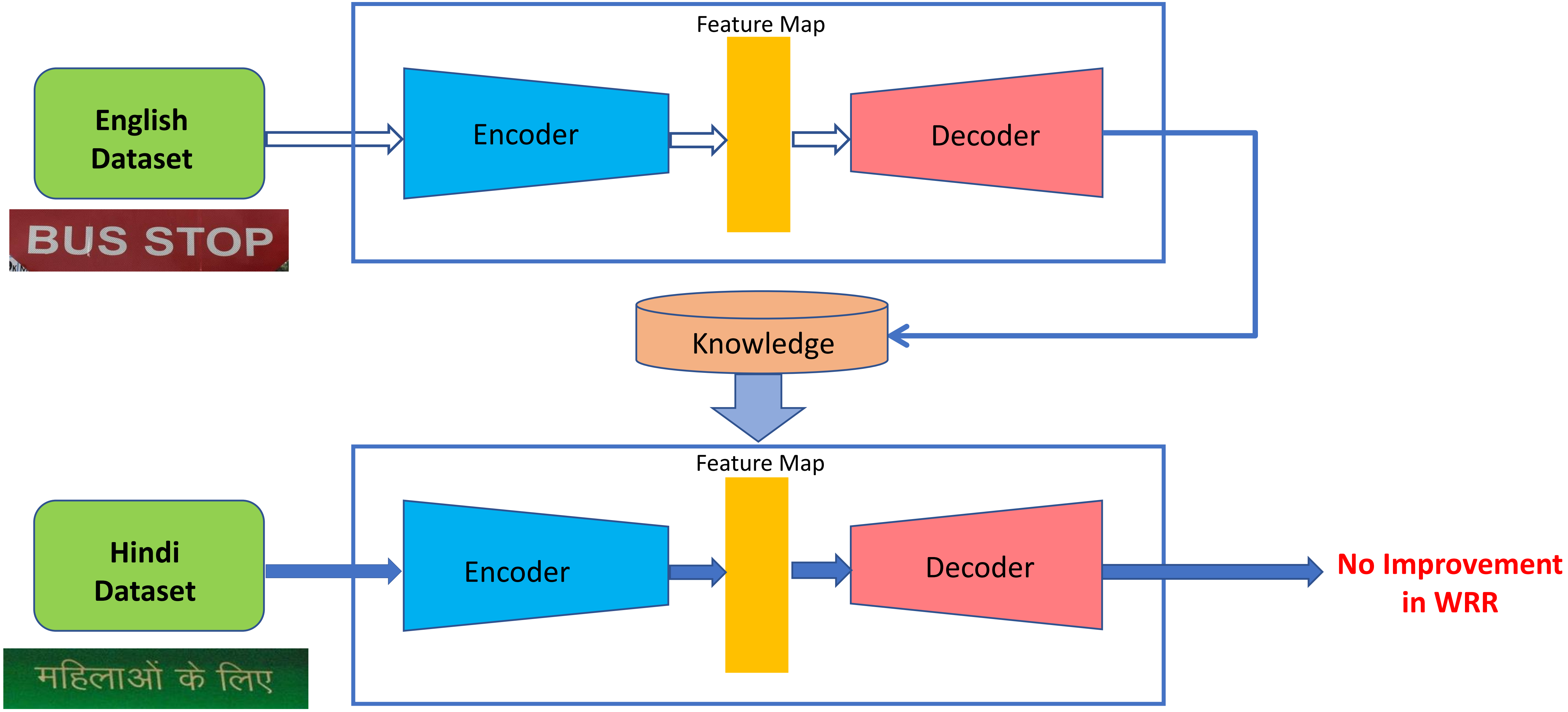
பரசமண்டவும்
உதகமண்டளம்

_ച്ച്_പി_ഓട്ടോ	കെയർ	കവടിയാർ
എച്ച്_പി_ഓട്ടോ	കെയർ	കവടിയാർ

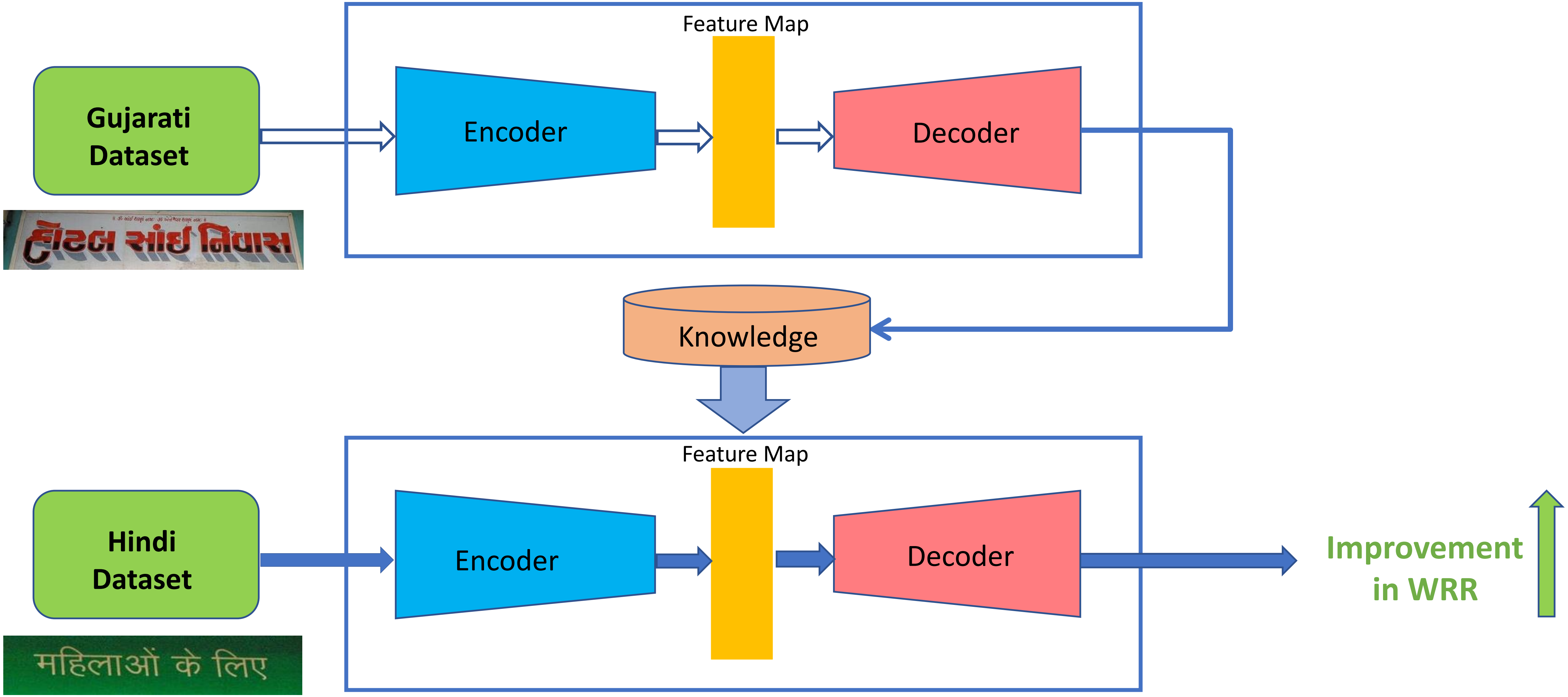
Our Contribution : Transfer Learning



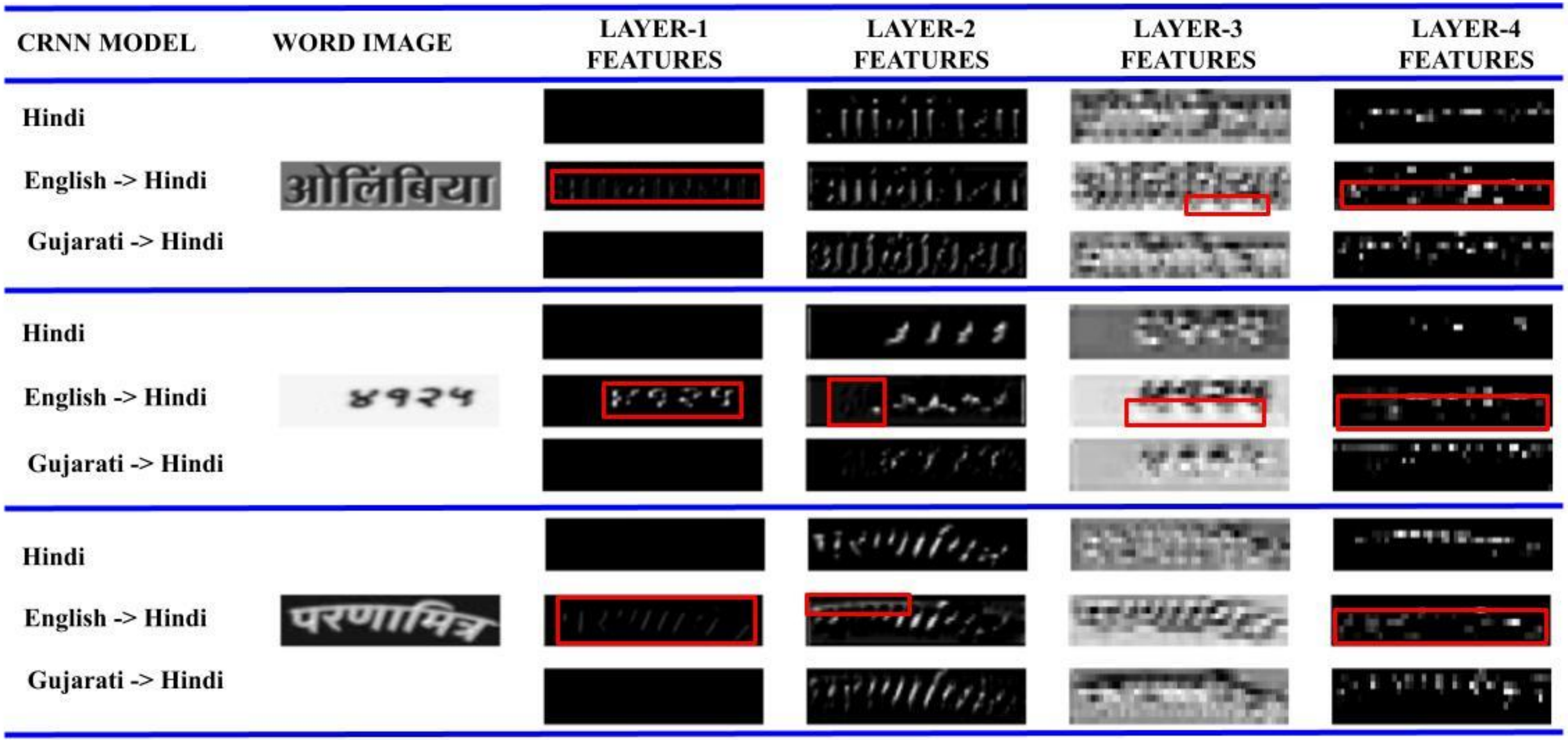
Our Contribution : Transfer Learning



Our Contribution : Transfer Learning



Visualizations

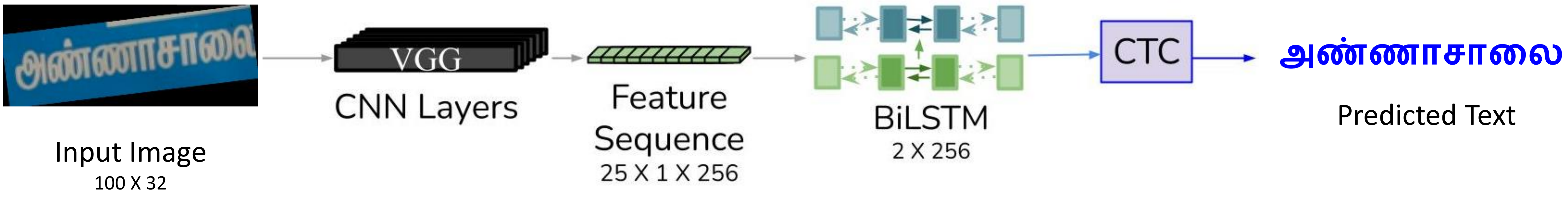


Activations pertaining to English transfer are shown in red boxes, which are not happening in better models, i.e. (Hindi and Gujarati → Hindi)

Methods & Experiments

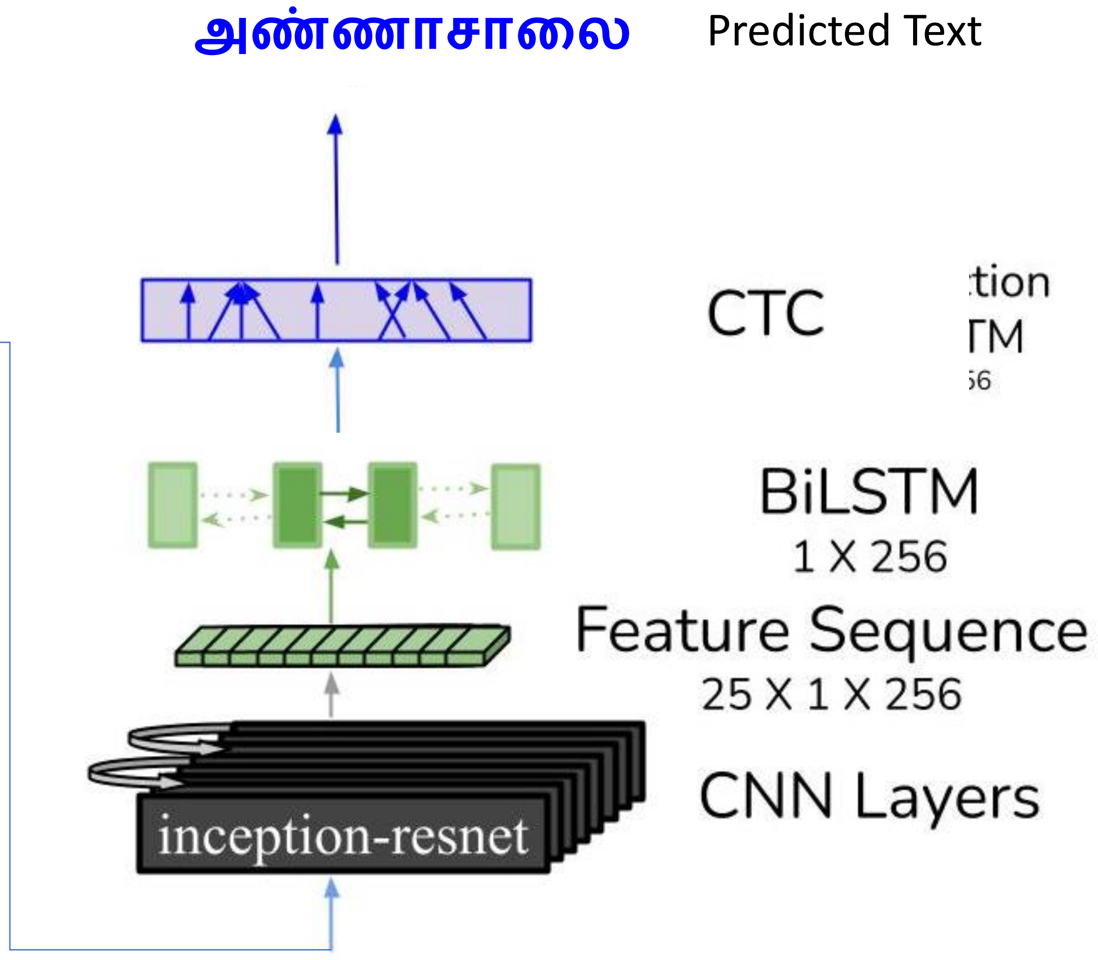
Pipeline : Overview

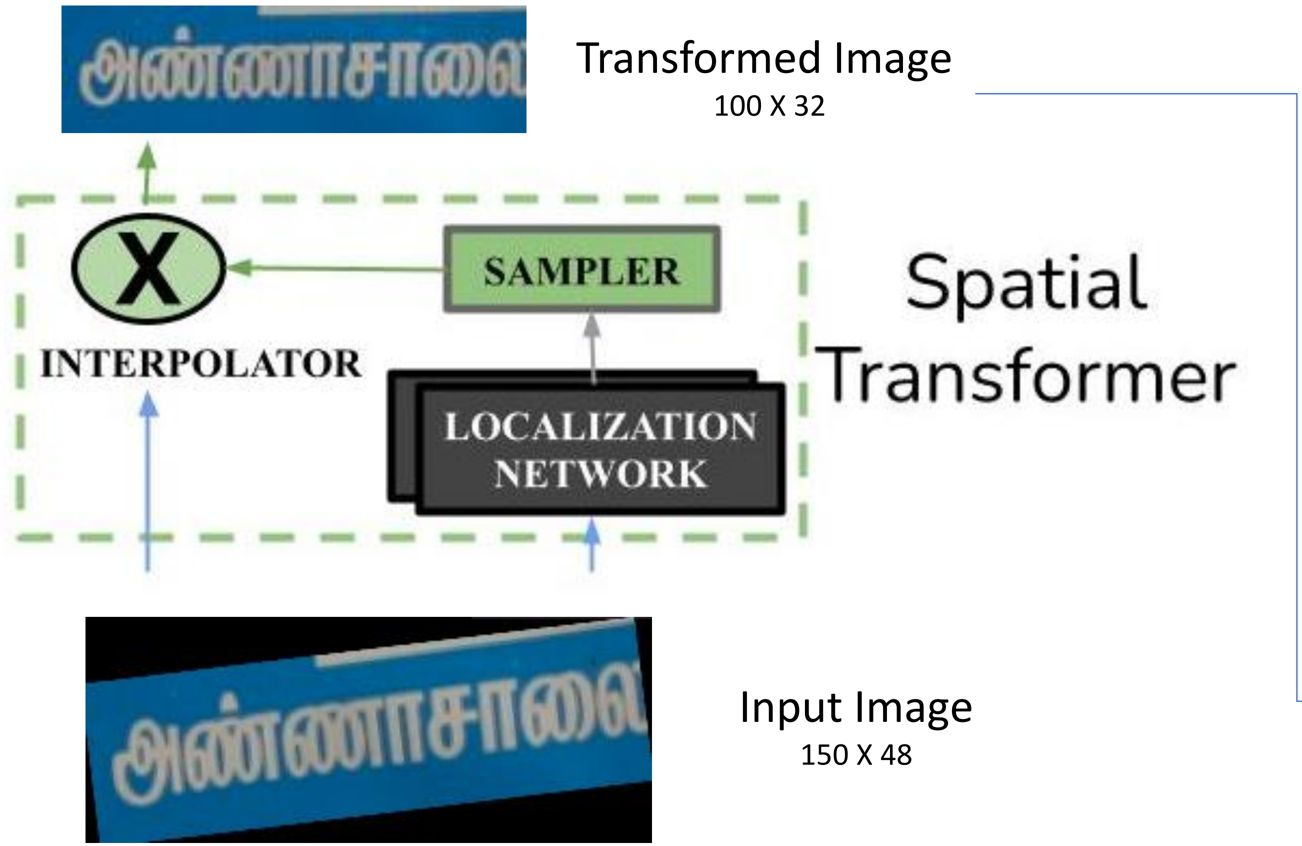
CRNN



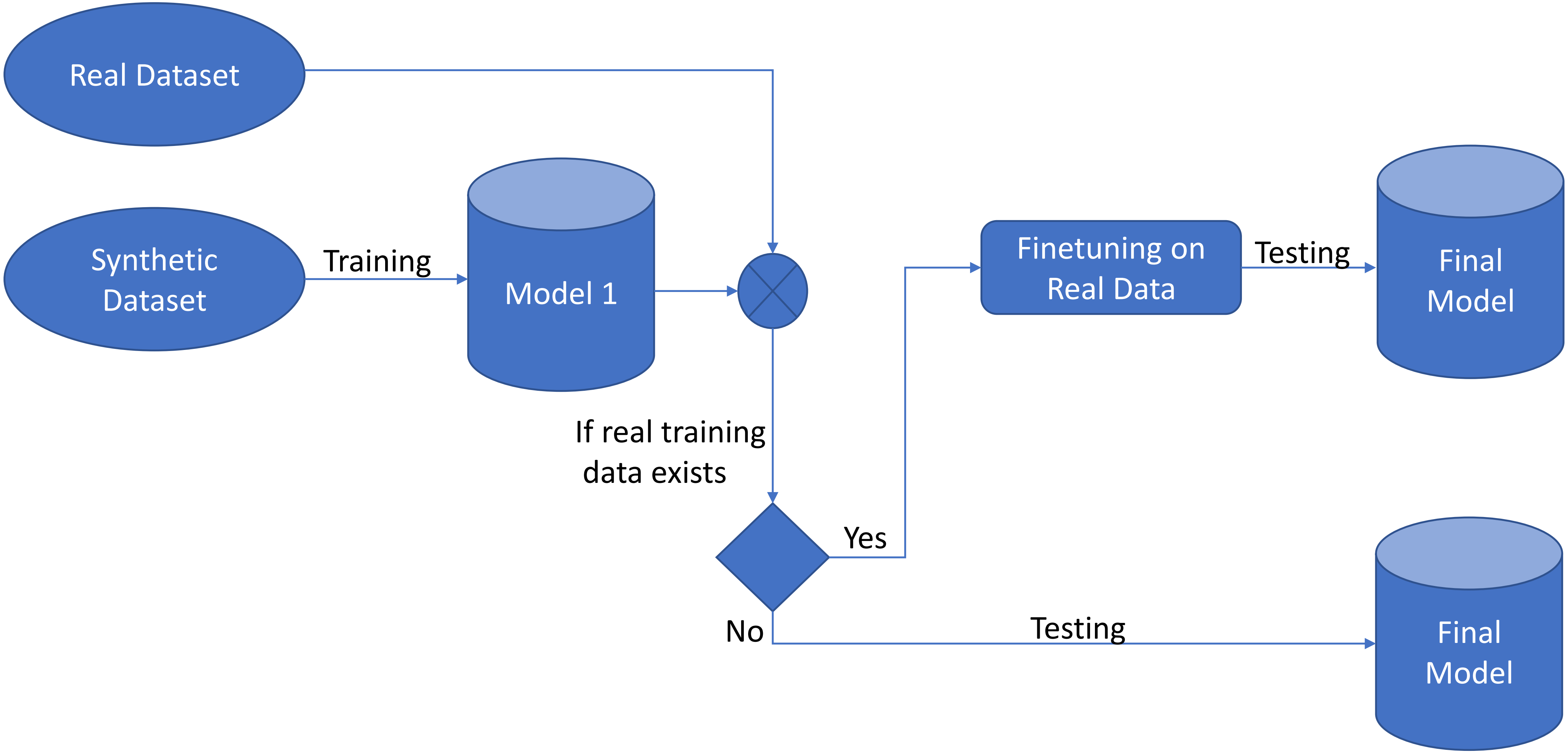
Pipeline : Overview

STAR-Net
(with a Correction BiLSTM)





Experiments

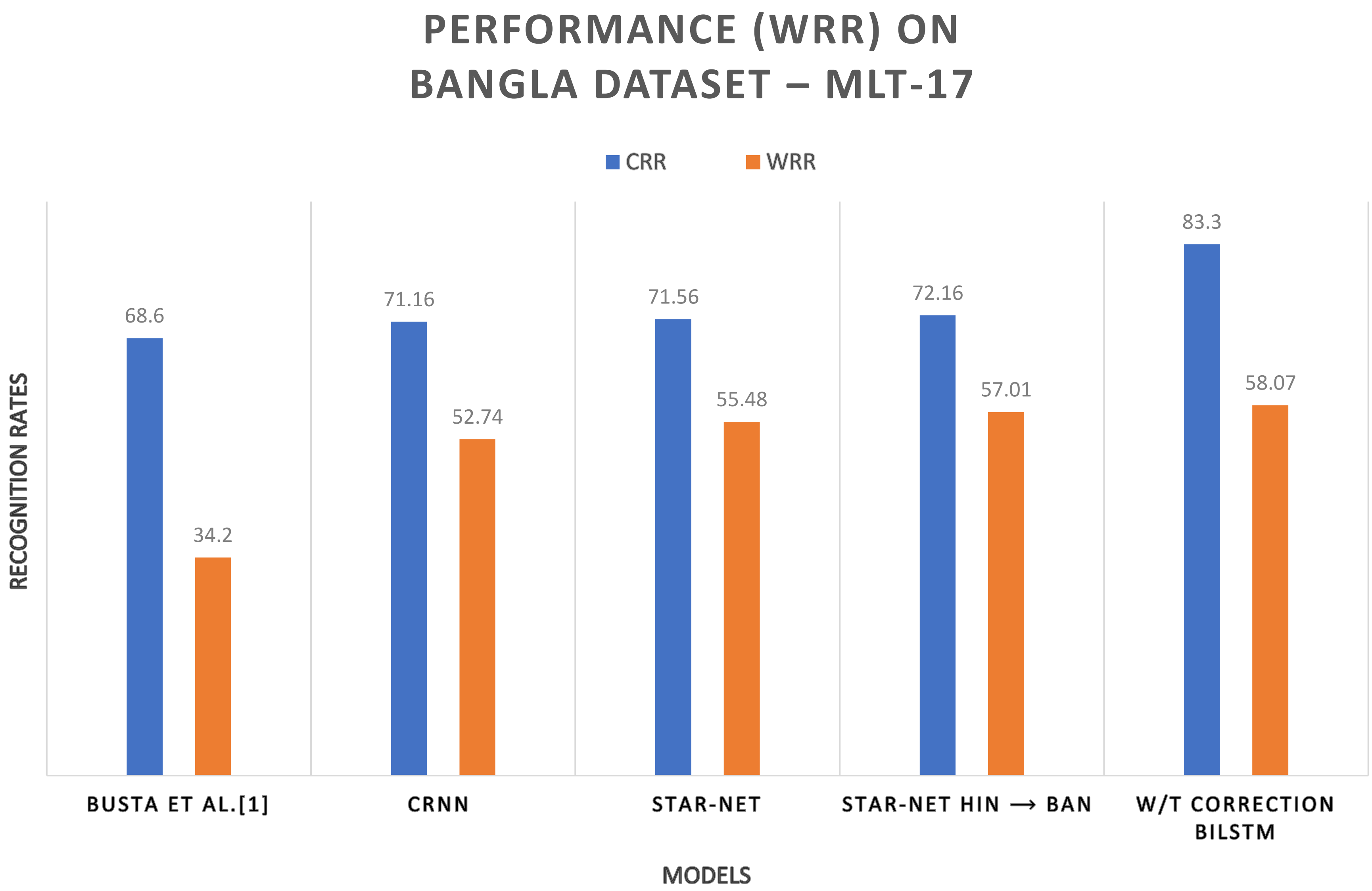


Results

Results : Synthetic Data

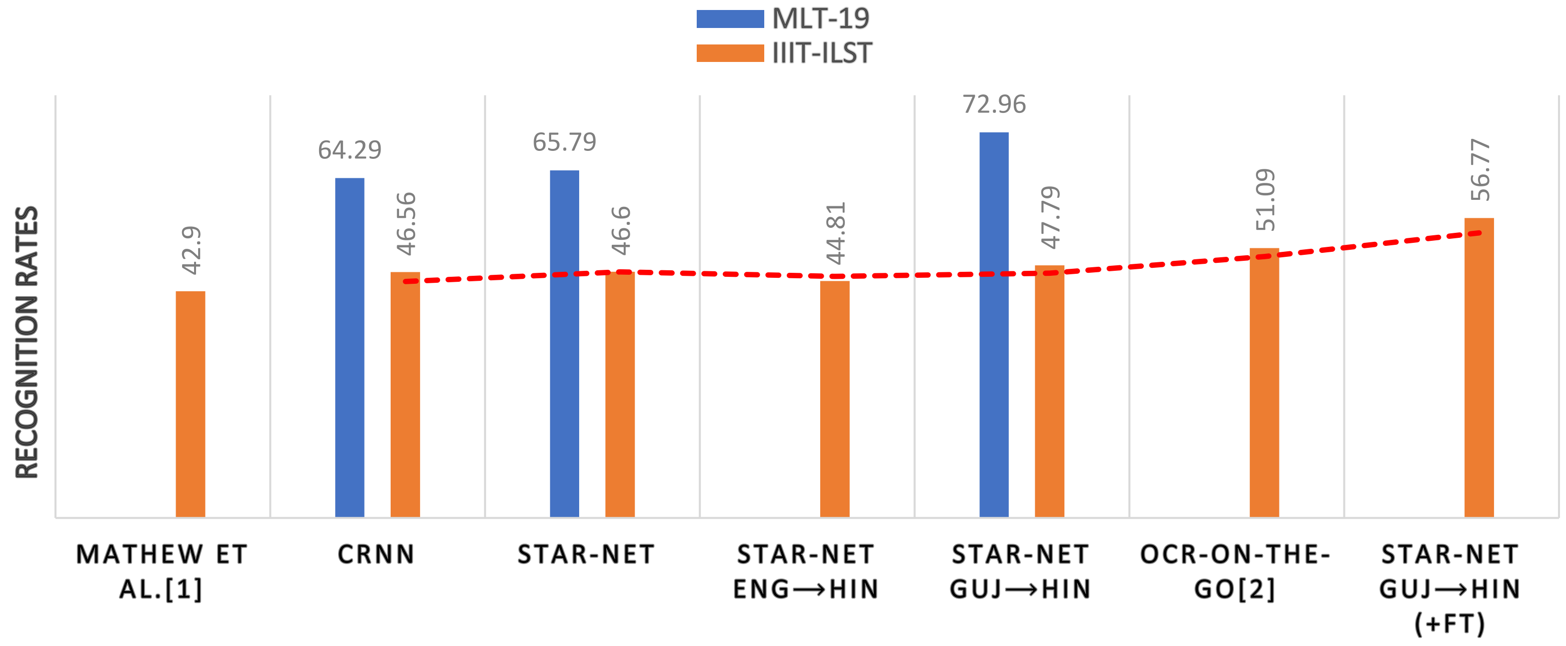
Individual Language Model	CRNN (WRR)	STAR-Net (WRR)	Trained with Transfer Learning	CRNN (WRR)	STAR-Net (WRR)
Gujarati	81.85	**91.40**	English → Gujarati	77.06	90.90
			Hindi → Gujarati	84.21	**92.81**
Hindi	73.15	**83.93**	English → Hindi	70.12	80.90
			Gujarati → Hindi	73.12	**84.32**
Bangla	70.76	**82.79**	Hindi → Bangla	70.22	**82.81**
Tamil	48.19	**79.90**	Bangla → Tamil	44.74	**81.73**
Telugu	58.01	**71.97**	Tamil → Telugu	56.24	**74.04**
Malayalam	70.56	**82.10**	Telugu → Malayalam	65.78	77.97

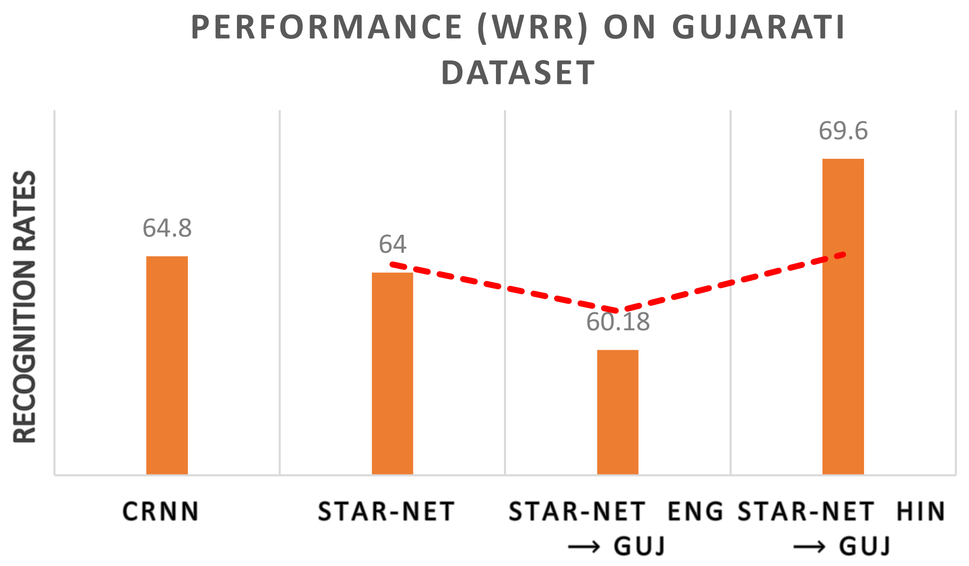
Results : Real Data

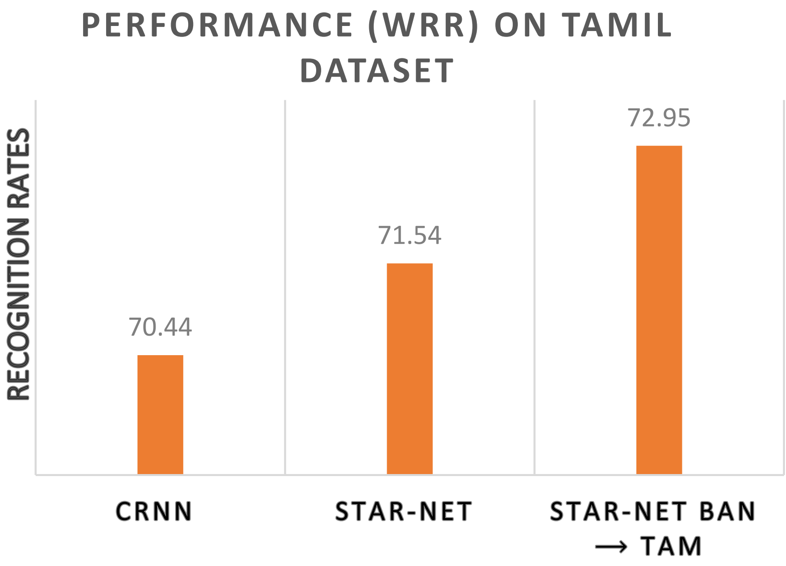


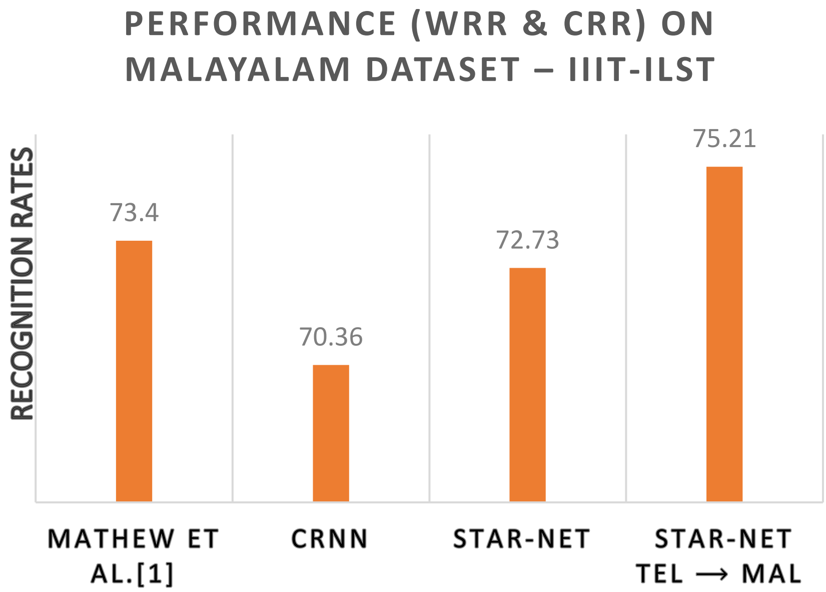
[[1]: Busta et al., "E2E-MLT-an Unconstrained End-to-End Method for Multi-Language Scene Text," ACCV, 2018]

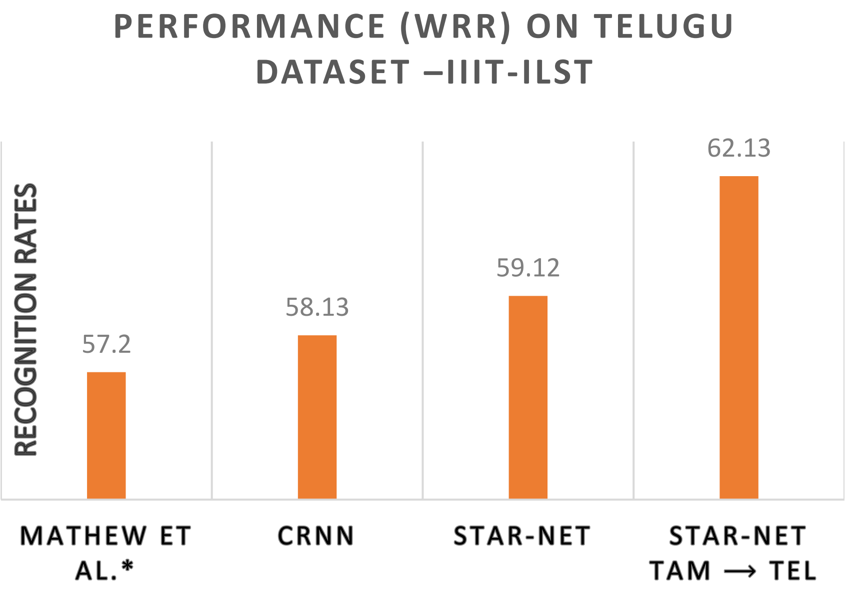
Results on other languages and datasets follow the similar pattern



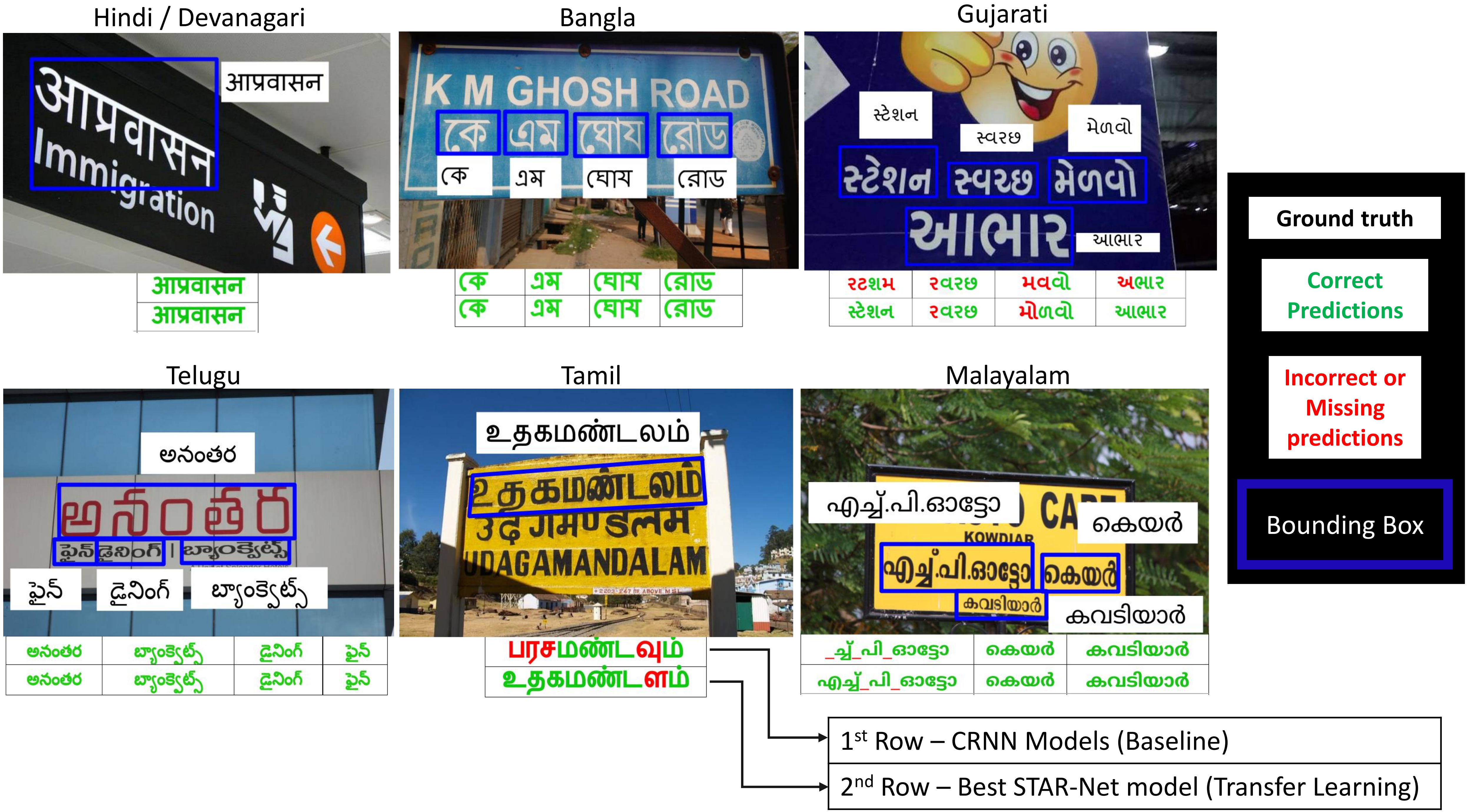








[[1]: Mathew et al., "Benchmarking Scene Text Recognition in Devanagari, Telugu and Malayalam," MOCR,2017]
[[2]: Saluja et al., ": OCR On-the-Go: Robust End-to-end Systems for Reading License Plates and Street Signs," ICDAR 2019]



Hindi / Devanagari
आप्रवासन
Immigration
आप्रवासन
आप्रवासन
Bangla
K M GHOSH ROAD
কে
এম
ঘোষ
রোড
কে এম ঘোষ রোড
কে এম ঘোষ রোড
Gujarati
સ્ટેશન
સ્વચ્છ
મેળવો
આભાર
૨ટશમ ૨વ૨છ મવવો અભાર
સ્ટેશન ૨વ૨છ મોળવો આભાર
Ground truth
Correct Predictions
Incorrect or Missing predictions
Bounding Box
Telugu
అనంతర
ఫైన్
డైనింగ్
బ్యాంక్వెట్స్
అనంతర బ్యాంక్వెట్స్ డైనింగ్ ఫైన్
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_ച്ച്_പി_ഓട്ടോ കെയർ കവടിയാർ
എച്ച്_പി_ഓട്ടോ കെയർ കവടിയാർ
1st Row – CRNN Models (Baseline)
2nd Row – Best STAR-Net model (Transfer Learning)

Conclusion

- Transfer learning boosts performance over synthetic and real-world datasets, thereby setting new benchmarks for STR tasks in Indian languages.

- Sources of scene-text in Indian languages involve hand-painted signboards and wall paintings.

- There is a potential to utilize data across different modalities (ex. handwritten text) to augment recognition rates.

- This possibility of developing an all-in-one model for the Indian languages can be explored in the future.

THANK YOU

Please contact us @ {sanjana.gunna, rohit.saluja}@iiit.ac.in for any further discussion or questions.