School of Computer Science and Engineering

Thesis Defense

Feedback Analytics

MINING USER INSIGHTS FOR TECH ADVANCEMENTS IN E-WALLET APPLICATIONS

Presented by Dang Quoc Anh Duy

Supervisor: Assoc. Prof. Nguyen Thi Thuy Loan

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01 INTRODUCTION

01 INTRODUCTION

PROJECT BACKGROUND

- The global adoption of e-wallets has **surpassed 4 billion** users **in 2023**, marking a significant transformation in financial transactions
- Forecasted to **reach 5.2 billion** users **by 2026**

Challenges:

- Issues ranging from security concerns to usability problems and a lack of personalized features
- The gap between user experiences and the rapid evolution of e-wallet technology

→ **The need of feeback analytics for improvement**

01 INTRODUCTION

PROBLEM STATEMENT

Research Scope:

- Analyze Vietnamese reviews on digital wallet apps
- Include multiple e-wallet platforms to capture a diverse set of users

Objectives:

- Develop a robust model to analyze **user insights** and recommend **actionable improvements**
- Perform **sentiment classification** to determine the feedback is **Positive, Neutral or Negative**
- **Aspect extraction** with **10 different categories** related to user's experiences

02 LITERATURE REVIEW

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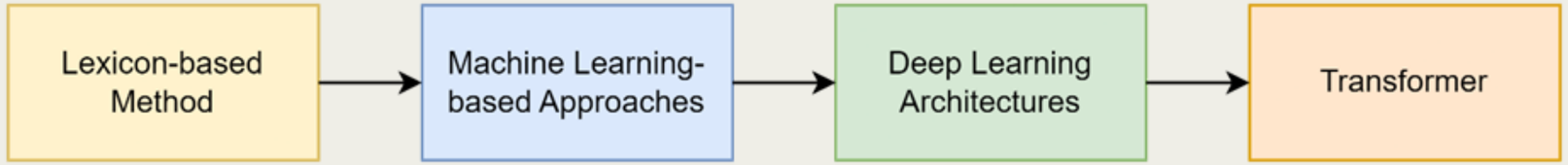
EXISTING APPROACHES

Evolution of NLP methods for text classification

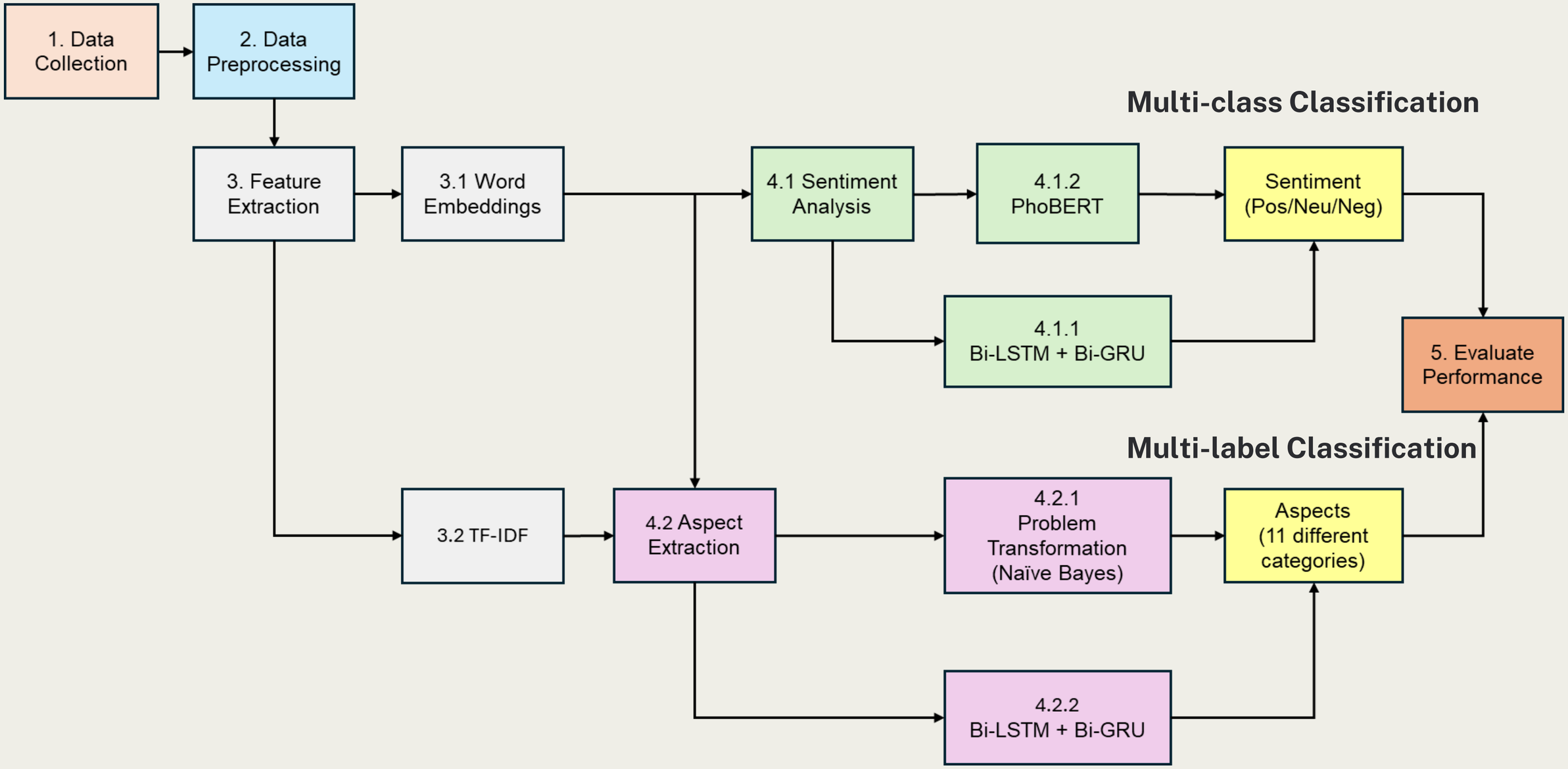


- **RNNs** are the most commonly used neural network architectures for text data mining and classification, especially for serial data such as textual information [1]
- **Transformer** focus on self-attention mechanisms to process data in parallel, it can capture long-range dependencies without relying on recurrence [2]

→ Most advanced architecture in NLP but require large amount of data and computing power for training

03 METHODOLOGY

WORKFLOW


1. Data Collection
2. Data Preprocessing
3. Feature Extraction
3.1 Word Embeddings
3.2 TF-IDF
Multi-class Classification
4.1 Sentiment Analysis
4.1.2 PhoBERT
4.1.1 Bi-LSTM + Bi-GRU
Sentiment (Pos/Neu/Neg)
Multi-label Classification
4.2 Aspect Extraction
4.2.1 Problem Transformation (Naïve Bayes)
4.2.2 Bi-LSTM + Bi-GRU
Aspects (11 different categories)
5. Evaluate Performance

03 METHODOLOGY

DATA COLLECTION

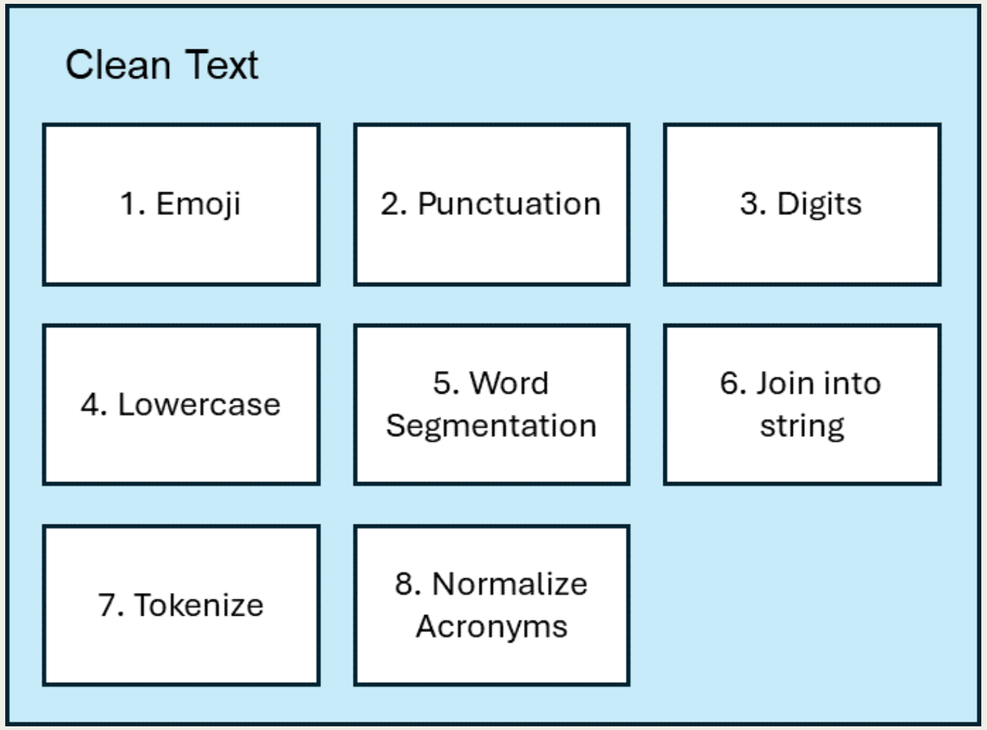
- Customer Reviews on Top 5 Digital Wallet Apps in Vietnam
- Was scrapped using google-play-scraper
- Contain more than 50000 samples with 12 different variables

	reviewId	userName	userImage	content	score	thumbsUpCount	reviewCreatedVersion	at	replyContent	repliedAt	appVersion	app_name
0	54f7bfdb-dfec-4c2d-8939-664624831002	tin bui	https://play-lh.googleusercontent.com/a/ACg8oc...	Tại sao ngân hàng vpbank e đang liên kết với m...	1	0	4.1.20	2024-06-03 04:53:44	NaN	NaN	4.1.20	com.mservice.momotransfer
1	a34ebc89-8f99-46ef-aff6-3be452f0dadd	Ngủ Kiến	https://play-lh.googleusercontent.com/a/ACg8oc...	Nạp tiền lỗi đợi 3 ngày mới đc, xong rút tiền ...	1	0	4.1.20	2024-06-03 04:13:43	NaN	NaN	4.1.20	com.mservice.momotransfer
2	0ae64e79-347b-4e01-89ef-c4f889601785	Đăng Nguyễn Khánh	https://play-lh.googleusercontent.com/a-/ALV-U...	quá tốt khong gì để chê !	5	0	4.1.12	2024-06-03 04:00:46	NaN	NaN	4.1.12	com.mservice.momotransfer
3	77301c99-5508-4bf6-8e3b-82985f0d51ca	Thông Lê	https://play-lh.googleusercontent.com/a/ACg8oc...	Ok	5	0	4.0.13	2024-06-03 03:20:07	NaN	NaN	4.0.13	com.mservice.momotransfer
4	62a7d230-a5c2-4c2d-accd-b0811874c405	Luân Kim	https://play-lh.googleusercontent.com/a-/ALV-U...	Lag quá	1	32	4.1.20	2024-06-03 03:09:36	NaN	NaN	4.1.20	com.mservice.momotransfer

03 METHODOLOGY

DATA PREPROCESSING

2. Data Preprocessing → Drop irrelevant columns → Remove duplicates → Convert rating to sentiment → Clean text → One-hot Encoding → Data Augmentation → Label Aspect from Topic Modeling




```python
def sentiment(rating):
    if rating > 3:
        return "Positive"
    elif rating == 3:
        return "Neutral"
    else:
        return "Negative"
```

```python
def remove_accents(text):
    return unidecode(text)

df['reviews'] = df['reviews'].apply(remove_accents)
```

```python
# Function to replace words using the replace_list dictionary and filter out bad words

def normalize_acronyms(word_list):
    normalized_words = []
    for word in word_list:
        # Replace word if it exists in the replace_list dictionary
        replaced_word = replace_list.get(word, word)
        # Check if the replaced word is not a bad word
        if replaced_word.lower() not in bad_words:
            normalized_words.append(replaced_word)
    return normalized_words

reviews['tokenized'] = reviews['tokenized_text'].apply(normalize_acronyms)
```

03 METHODOLOGY

DATA PREPROCESSING

	reviewId	userName	userImage	content	score	thumbsUpCount	reviewCreatedVersion	at	replyContent	repliedAt	appVersion	app_name
0	54f7bfdb-dfec-4c2d-8939-664624831002	tin bui	https://play-lh.googleusercontent.com/a/ACg8oc...	Tại sao ngân hàng vpbank e đang liên kết với m...	1	0	4.1.20	2024-06-03 04:53:44	NaN	NaN	4.1.20	com.mservice.momotransfer
1	a34ebc89-8f99-46ef-aff6-3be452f0dadd	Ngủ Kiến	https://play-lh.googleusercontent.com/a/ACg8oc...	Nạp tiền lỗi đợi 3 ngày mới đc, xong rút tiền ...	1	0	4.1.20	2024-06-03 04:13:43	NaN	NaN	4.1.20	com.mservice.momotransfer
2	0ae64e79-347b-4e01-89ef-c4f889601785	Đăng Nguyễn Khánh	https://play-lh.googleusercontent.com/a-/ALV-U...	quá tốt khong gì để chê !	5	0	4.1.12	2024-06-03 04:00:46	NaN	NaN	4.1.12	com.mservice.momotransfer
3	77301c99-5508-4bf6-8e3b-82985f0d51ca	Thông Lê	https://play-lh.googleusercontent.com/a/ACg8oc...	Ok	5	0	4.0.13	2024-06-03 03:20:07	NaN	NaN	4.0.13	com.mservice.momotransfer
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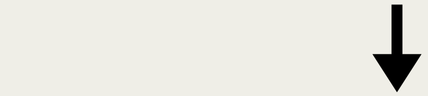
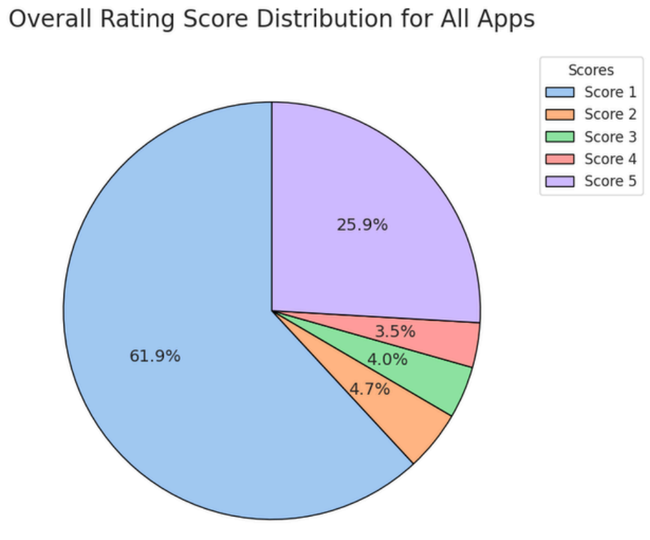
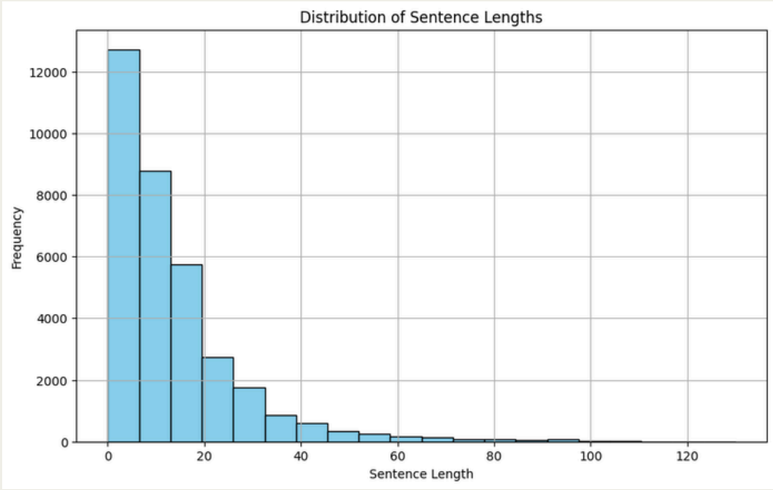


	reviews	label	convenience	payment_integration	accessibility	security_privacy	customer_support	technical_issues	updates	fraud	promotion	functionality
0	tại_sao ngân_hàng vpbank e đang liên_kết với m...	Negative	0	1	0	0	0	1	0	0	0	0
1	nạp tiền lỗi đợi ngày mới đc xong rút_tiền cũn...	Negative	0	1	0	0	0	1	0	0	0	0
2	quá tốt khong gì để chê	Positive	1	0	0	0	0	0	0	0	0	0
3	ok	Positive	1	0	0	0	0	0	0	0	0	0
4	lag quá	Negative	0	0	0	0	0	1	0	0	0	0

03 METHODOLOGY

EXPLORATORY DATA ANALYSIS





03 METHODOLOGY

FEATURE EXTRACTION

TF-IDF (Term frequency-inverse document frequency)

- Mainly use for ML approaches (Aspect Extraction)
- Formula:

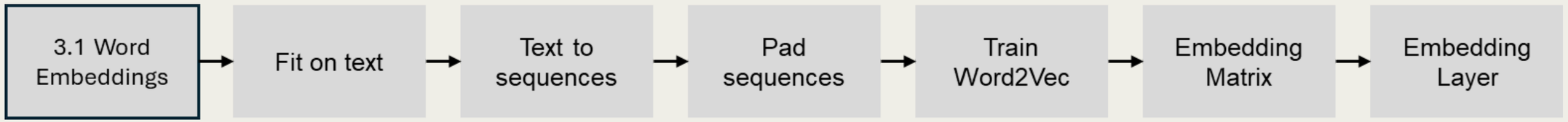
$$w_{x,y} = tf_{x,y} \times \log\left(\frac{N}{df_x}\right)$$

TF-IDF
Term x within document y

$tf_{x,y}$ = frequency of x in y
df_x = number of documents containing x
N = total number of documents

Word Embeddings

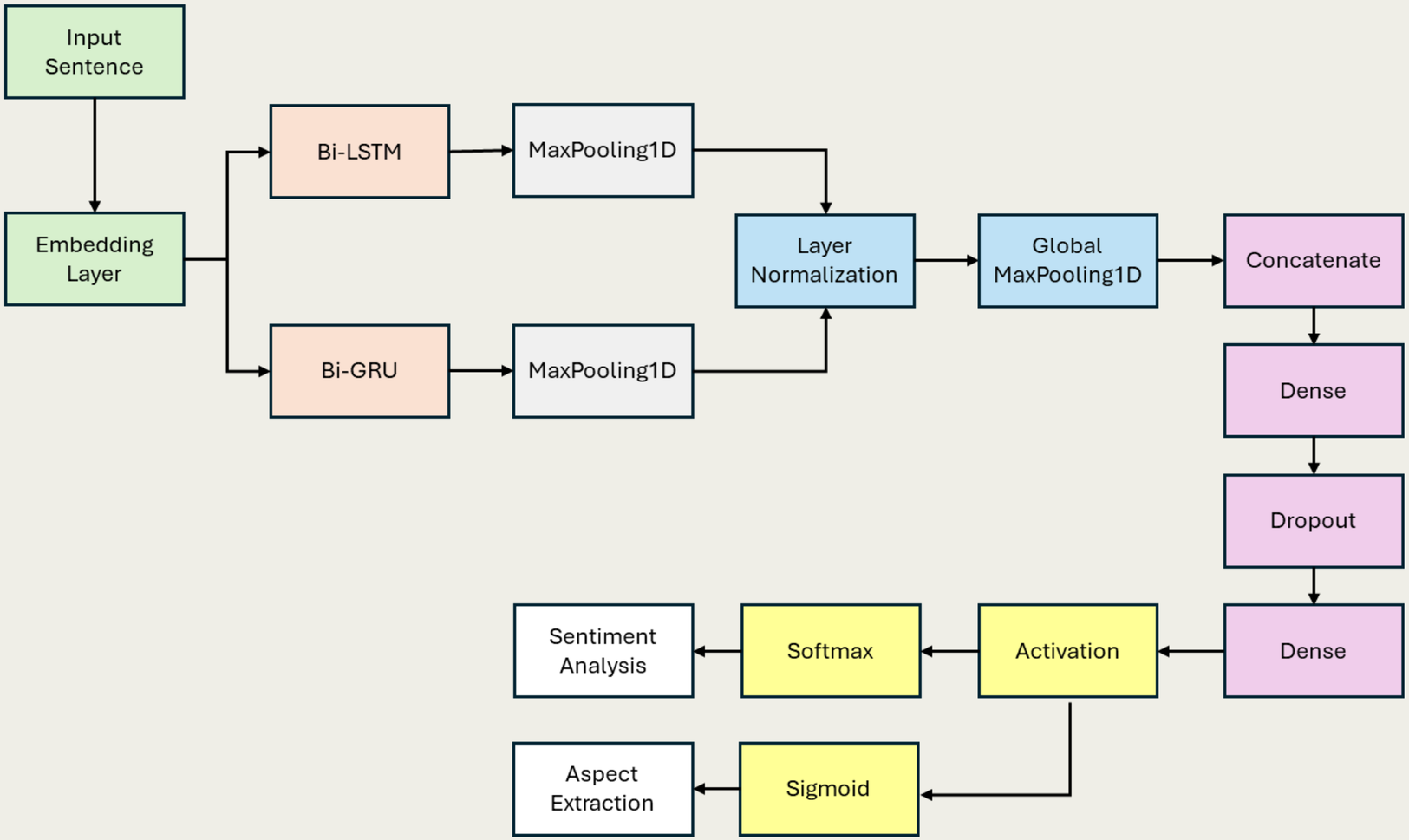
- Pre-trained Word2vec for Vietnamese
- Bype-Pair Encodings from pre-trained model PhoBert



03 METHODOLOGY

MODEL IMPLEMENTATION

Sentiment Analysis + Aspect Extraction (Bi-LSTM + Bi-GRU)



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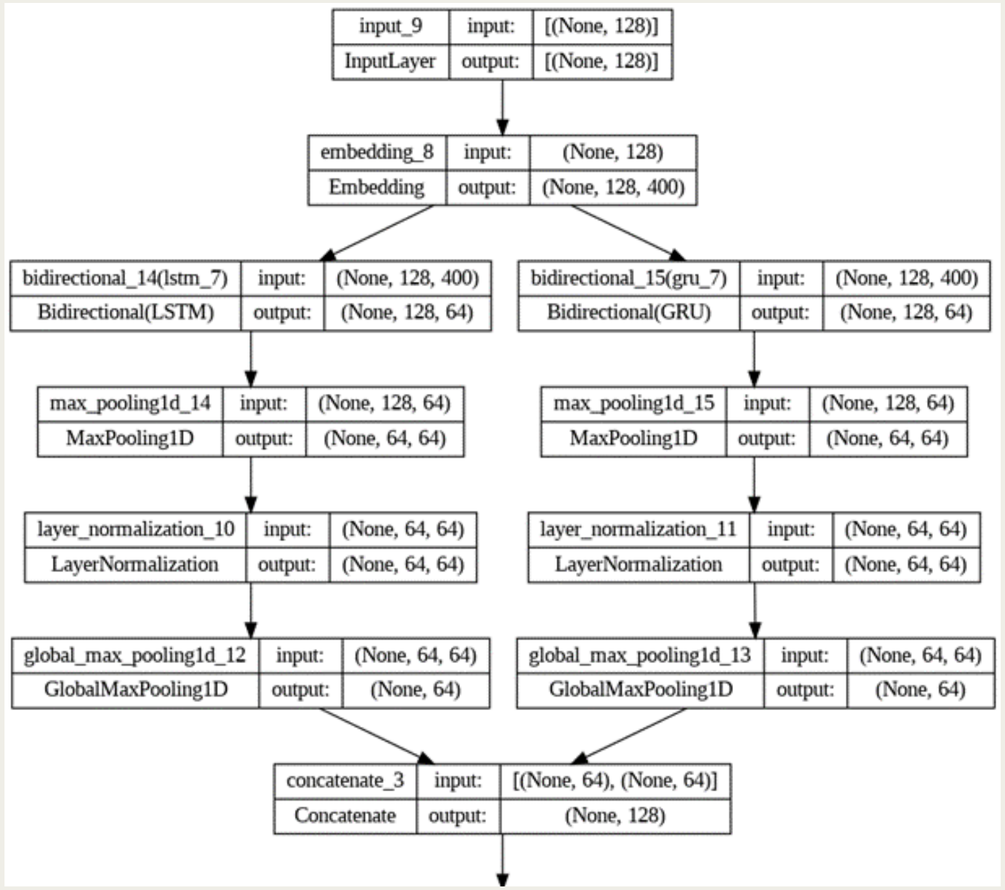
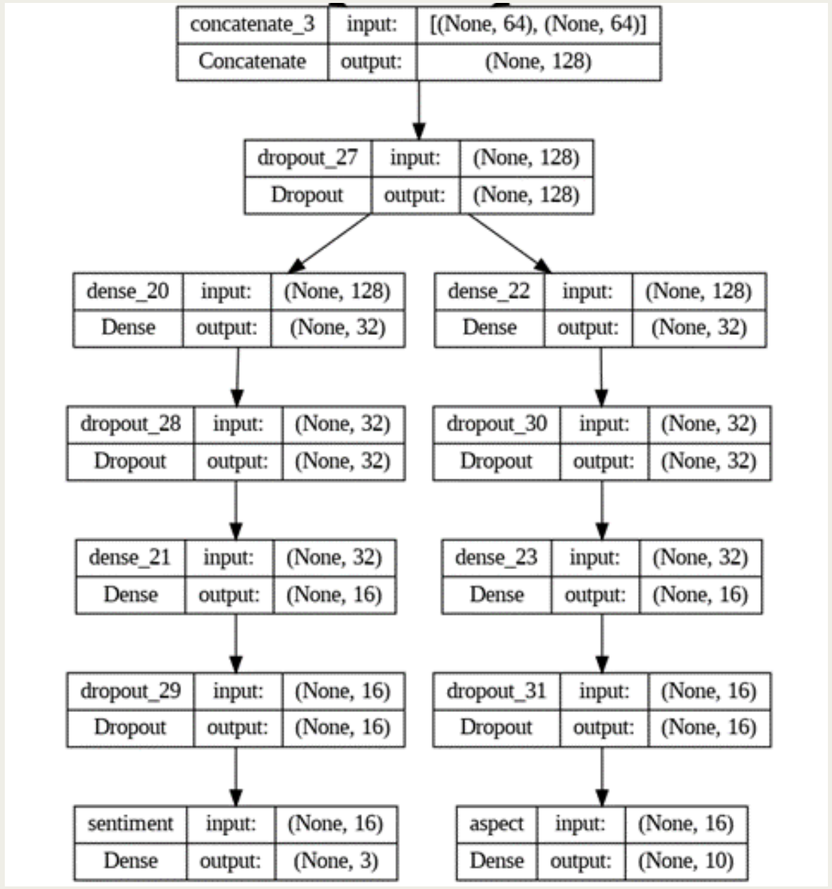
MODEL IMPLEMENTATION

Sentiment Analysis + Aspect Extraction (Bi-LSTM + Bi-GRU)





04 EVALUATION

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METRICS COMPARISON Sentiment Analysis

Models	Cross Loss	Accuracy	F1-Score	Run-time
Bi-LSTM + Bi-GRU (Pre-trained Word2Vec)	0.5382	0.7909	0.7704	231s
Bi-LSTM + Bi-GRU (Word2Vec on dataset)	0.5249	**0.7962**	**0.7842**	294s
Bi-LSTM	0.5416	0.7868	0.7769	**216s**
PhoBERT	**0.447**	0.773	0.702	9784s

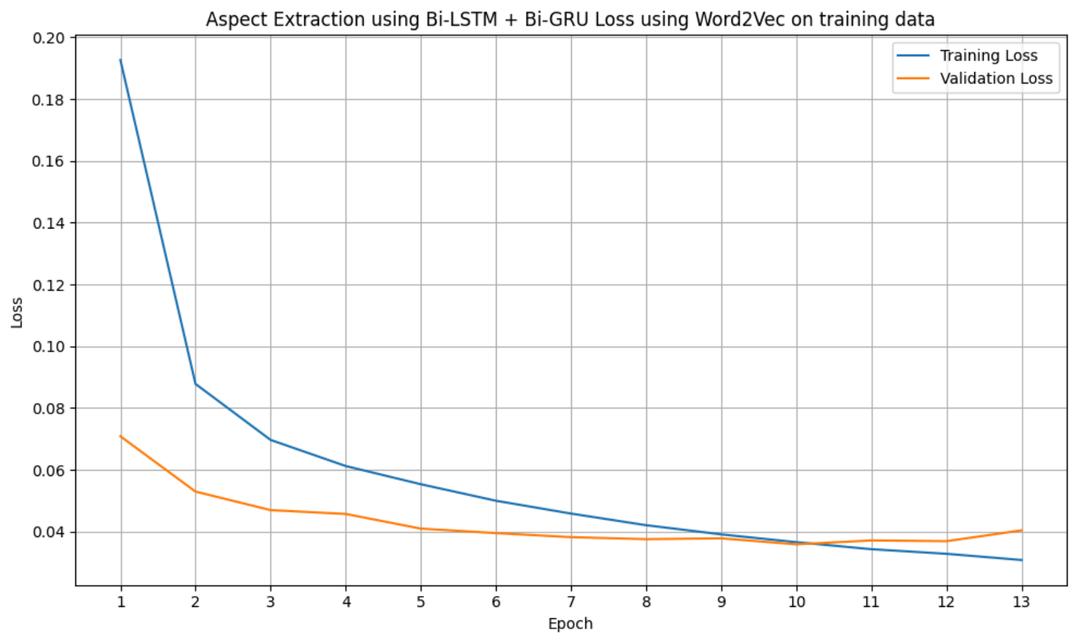
04 EVALUATION

METRICS COMPARISON Aspect Extraction

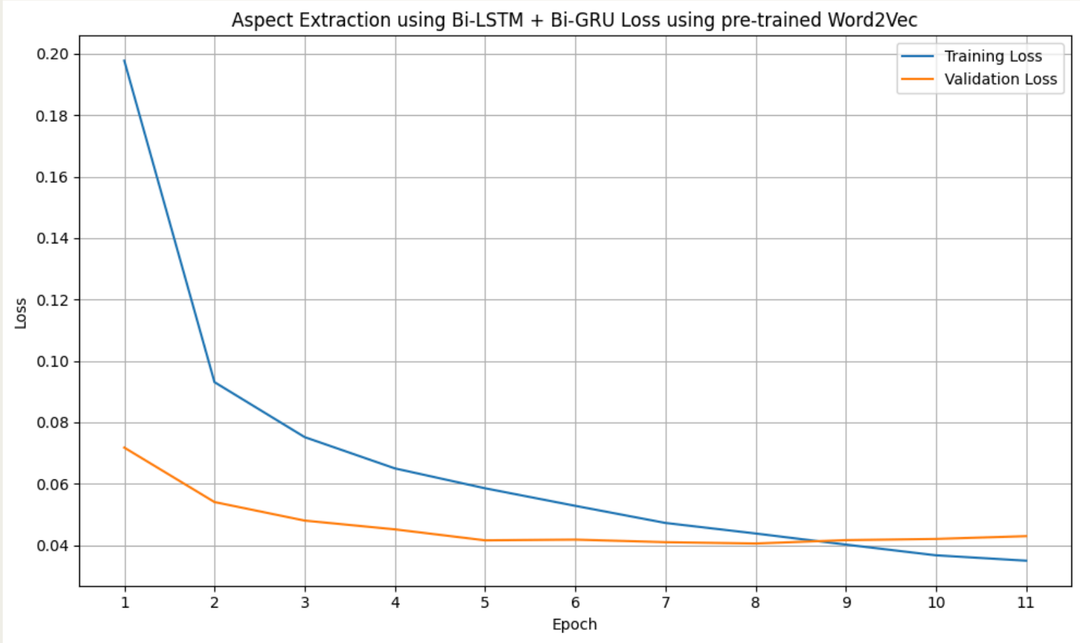
Models	Accuracy	Macro Precision	Macro Recall	Macro F1-Score	Hamming Score	Run-time
Binary Relevance	0.6110	0.9053	0.5575	0.6408	0.1743	17s
Classifier Chains	0.5946	0.8843	0.5528	0.6327	0.1760	21s
Label Powerset	0.5398	0.9377	0.3038	0.3405	0.1775	8s
Bi-LSTM + Bi-GRU (Pre-trained Word2Vec)	0.9116	0.9831	0.9395	0.9595	0.9506	497s
Bi-LSTM + Bi-GRU (Word2Vec on dataset)	**0.9181**	**0.9777**	0.9501	0.9633	**0.9529**	529s
Bi-LSTM	0.9140	0.9770	**0.9526**	**0.9644**	0.9523	**218s**

04 EVALUATION

METRICS COMPARISON Aspect Extraction



Word2Vec on the training data



Pre-trained Word2Vec

04 EVALUATION

BEST MODEL

Results of Bi-LSTM + Bi-GRU model

	precision	recall	f1-score	support
0	0.82	0.92	0.87	3014
1	0.64	0.46	0.53	933
2	0.86	0.75	0.80	984
accuracy			0.80	4931
macro avg	0.77	0.71	0.73	4931
weighted avg	0.79	0.80	0.79	4931

Sentiment Classification

Aspect Extraction Classification Report:

	precision	recall	f1-score	support
convenience	0.96	0.88	0.92	1292
payment_integration	0.99	0.96	0.98	2882
accessibility	0.97	0.97	0.97	920
security_privacy	0.88	0.77	0.82	203
customer_support	0.98	0.96	0.97	272
technical_issues	0.99	0.98	0.99	1654
updates	1.00	0.99	1.00	186
fraud	1.00	1.00	1.00	155
promotion	1.00	0.99	0.99	177
functionality	0.99	0.99	0.99	276
micro avg	0.98	0.95	0.97	8017
macro avg	0.98	0.95	0.96	8017
weighted avg	0.98	0.95	0.97	8017
samples avg	0.97	0.96	0.96	8017

Aspect Extraction

05 CONCLUSION

CONCLUSION

01

Summary

- Build a robust classification model for both sentiment analysis and aspect extraction tasks
- Comparison on different approach to find the best model
- Build up domain knowledge on digital wallet field

02

Future Plans

- Improve the data collection method
- Expand the complexity of the model by combining with CNN
- Real-time analysis system

Thank you!

FOR YOUR ATTENTION

REFERENCES

UPDATED VERSION

1. Make comparison of the proposed model with standard Bi-LSTM
2. Modify the report on the result evaluation