Offline Handwritten Amharic Word Recognition using Deep Learning

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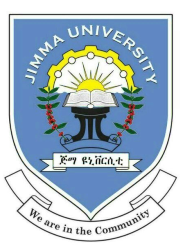
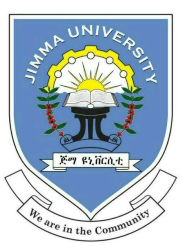
Outlines



Introduction

Study - Background

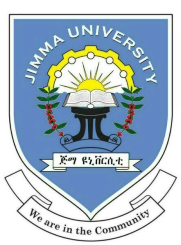
- **Amharic alphabets, known as *Fidel* is a syllable writing system for the language [1].**
  - 34 base characters among which 7 are derived e.g. ሸ from ሰ.
  - There are 238 core characters and 27 labialized forms.
- **HTR is transcription of handwritten text contained in scanned image(s) into digital text: ASCII or Unicode.**
  - For medical and magical texts originated from the too past.
  - For searching in a text, postal distribution of letters, payment of checks, form extraction, or machine translations, etc.



Introduction

Challenges in handwritten Amharic word recognition

- Different ways of writing the same word.
  - E.g. **አንበሳ, አምበሳ**
- Formation of compound words by joining words with or without modification.
  - E.g. **ሕገ-መንግሥት** or **ሕገመንግሥት**, **ምክርቤት** or **ምክር ቤት**
  - People use hyphenation or space to write compound words.
- Amharic character repetition where more than one symbol is used for the same sound.
  - Sets of characters of the same sound such as: **{ሀ,ሐ,ኀ,ኸ}**, **{ሠ,ሰ}**, **{አ,ዐ}**, **{ጸ,ፀ}**
  - People use such characters for semantically similar words interchangeably.



- **Historical documents and manuscripts are common in countries such as Ethiopia.**

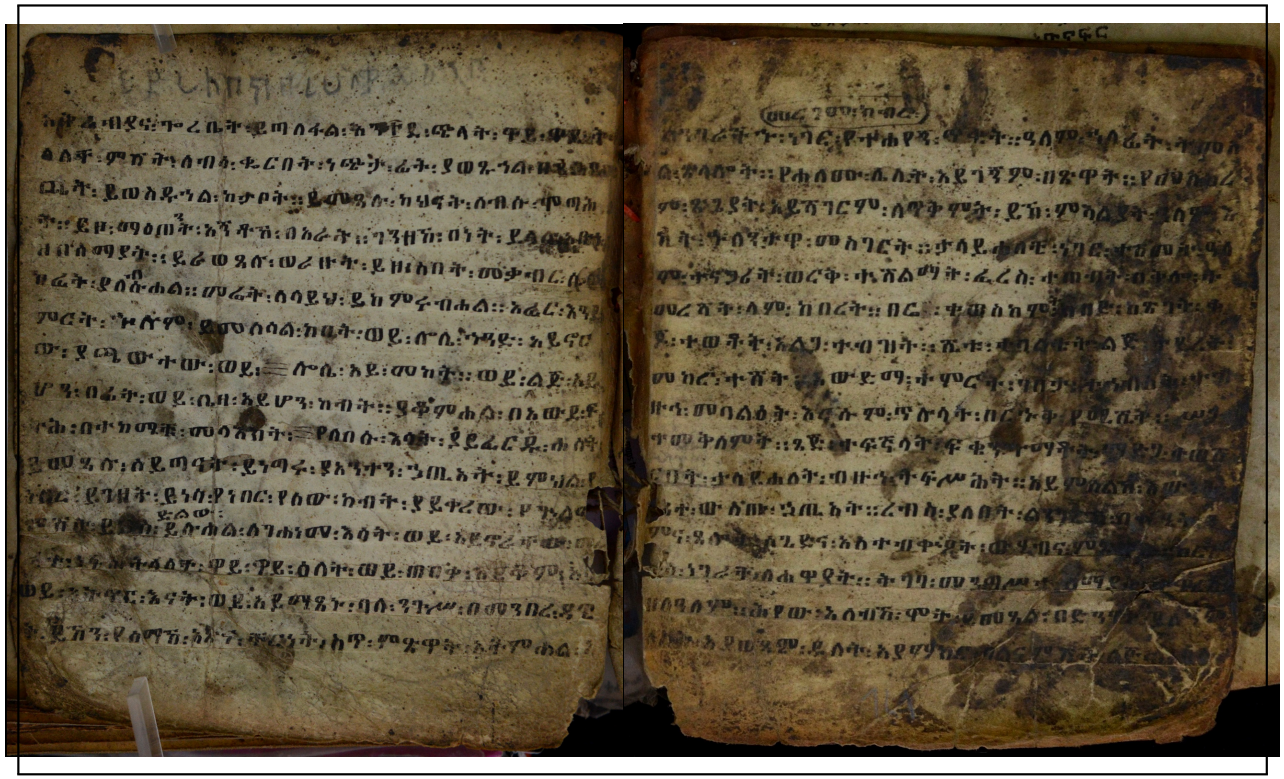
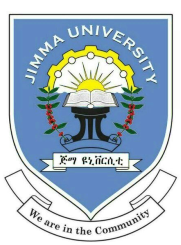


Figure 1: An old Brana poem in Amharic entitled Märgämä kəbr, *Condemnation of glory* (hence MärKL) [2].

- **Offline handwritten Amharic text transcription is still a research issue.**
  - Calligraphy and nature of handwriting differs personally in the writers.
  - Amharic text is morphologically complex.

Solution

Deep learning and CTC algorithm used for transcribing handwritten documents in to digital forms with greater performance become possible.

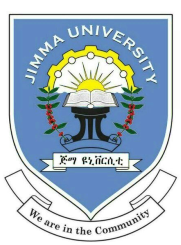


- **Main objective:** to develop offline handwritten Amharic word recognition algorithm using deep learning approaches.

- **Specific objectives:**
  - To develop the dataset of handwritten Amharic words for the language.
  - To optimize hyper-parameters' setting that works well for *AWR* model by using *Bayesian* hyper-tuning.
  - To evaluate and measure performance of *AWR* algorithm with and without augmentation, and apply *10-fold* cross validation.
  - To compare the result with pre-designed architectures such as: *VGG*, *ResNet*, *DenseNet* and *EfcientNet*.

- **High performance in the transcription of handwritten Amharic words.**
- **Thesis contributions are:**
  - Prepared handwritten Amharic word dataset, called *HAW-DB*.
  - Hyper-tuned and well-performing model on the dataset.
  - Less biased validation.
  - Application of pre-designed CNN architectures in place.
- **Potential applications are:** preserving historical heritages, old documents, medicinal or magical books and manuscripts
- Also, bank check processing, or used to read students and lectures handwritten notes in to digital format, etc.

- Only offline scenario is considered and recognizes handwritten Amharic words after trained.
- The system do not handle any misspellings made in the source or by classifications in the system itself.



Quatro pilares definem uma rede SDN, :

- Separação dos planos de controle e dados. Dispositivos de rede -> encaminhadores.
- Decisões de encaminhamento são baseadas em fluxo, ao invés de destino.
- Lógica de controle -> controlador externo.
- Rede é programável através de aplicações de *software*.

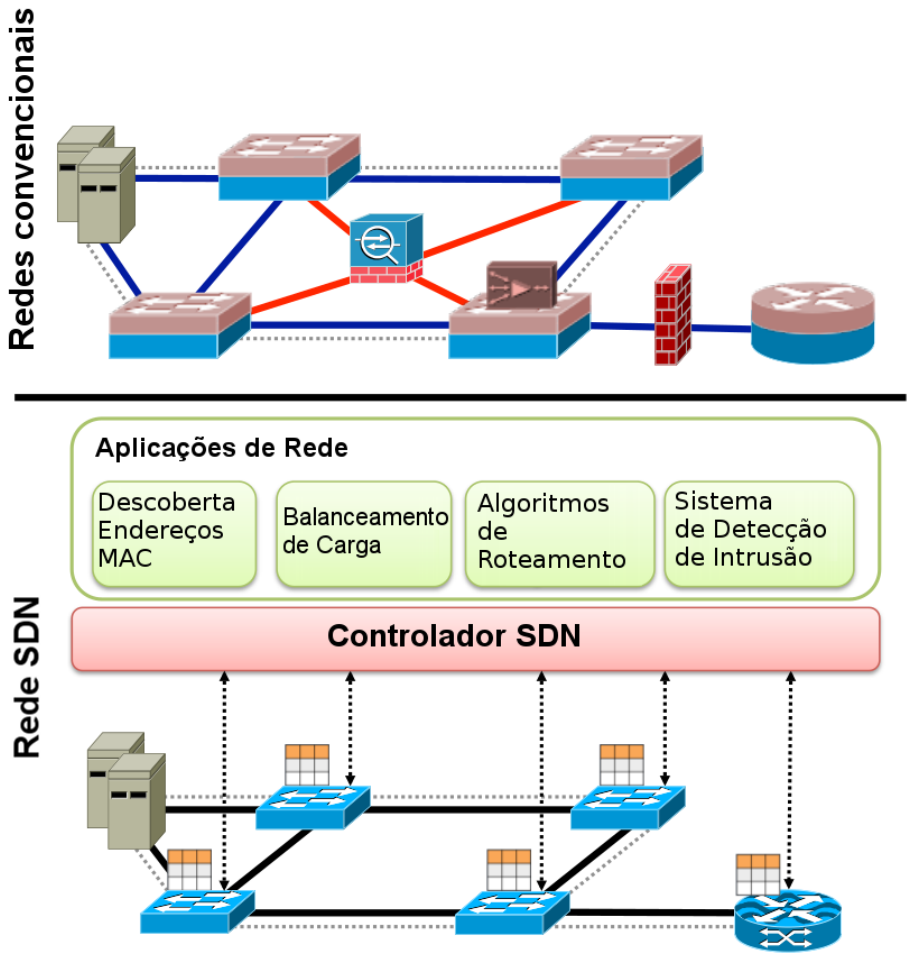
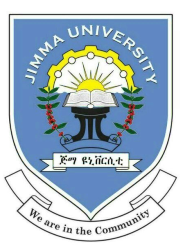
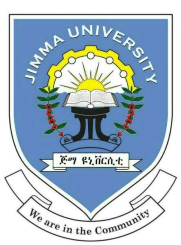


Figure 2: Redes convencionais *versus* SDN, adaptado de .

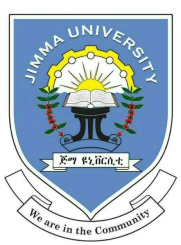
- Crescimento exponencial de equipamentos e aplicações.
- Complexidade de configuração.
- Provisionamento de QoS nas redes convencionais:
  - Alocação fixa de recursos rede.
  - Configurações manuais.



- Parâmetros de desempenho da rede só são restaurados após a degradação da QoE.
- Prestação e entrega de serviços independentemente do grau de criticidade do usuário/serviço.
- Necessita-se uma arquitetura de rede flexível.
- Adaptar-se a diferentes demandas.
- Ação pro-ativa no gerenciamento dos recursos.



- *OpenFlow*, não é suficiente para provimento de QoS em redes SDN.
  - *OpenFlow Management and Configuration Protocol* (OF-CONFIG)
  - *Open vSwitch Database* (OVSDB) *Management Protocol*



- Composição do ambiente:
  - Banco de Dados – *Knowledge Base*.
  - Controlador e módulos SDN.
  - Emulador de rede e *switch OpenFlow*.

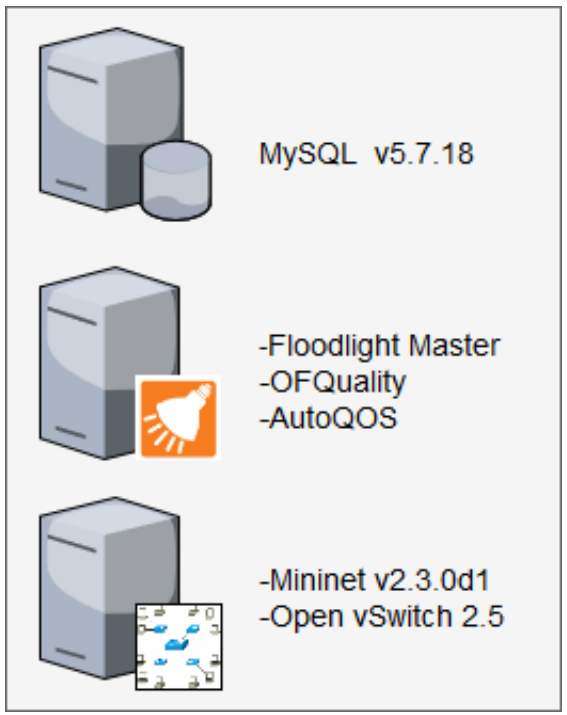


Figure 3: Composição do ambiente experimental.

Amb. Experimental - Emulador e *switch*

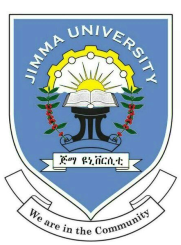
Emulador de rede

- Emulador Mininet:
  - Documentação e comunidade (baixo custo).
  - Virtualização a nível de processo.
  - Implementar *scripts*.
    - Criação de topologias de rede.
    - Inicialização de gravadores de *log*.
    - Testes de vazão (*Iperf*).
    - ..entre outros..
- Switch Open vSwitch:
  - Impl. *software* (aberto) de um *switch* multi camadas virtual.
  - Documentação e comunidade (baixo custo).
    - OVSDB
    - OVSDB *Management Protocol*
    - interfaces, portas, filas, VLANs, políticas QoS
    - ..entre outros..

Conclusion

Conclusion

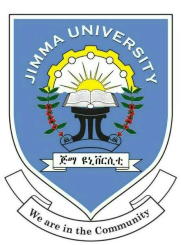
- Proposta de uma arquitetura para gerenciamento autônomo, para prover QoS de maneira pró-ativa em ambientes de redes definidas por software (SDN).
- Validação da arquitetura através de duas contribuições importantes: a aplicação *AutoQoS* e o módulo *OFQuality*.
- Gerenciamento automatizado de banda dos fluxos, prioridade e mudança de caminhos de rede quando os *links* estavam congestionados ou com problemas de latência.
- Otimização do uso de recursos.



Conclusion

Conclusion

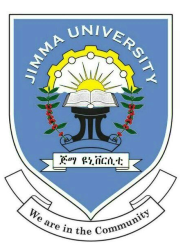
- Compilação de um trabalho exclusivo sobre o módulo *OFQuality*.
- Comparar e avaliar o uso de outra API *Southbound* para gerenciamento de configurações de QoS no plano de dados (ex. OF-CONFIG).
- Propor um modelo de abstração (ponto de vista do controlador) do gerenciamento dos recursos no plano de dados.



Conclusion - Recommendation

Future work

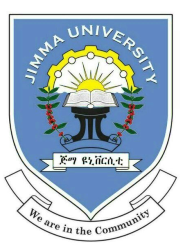
- A ampliação do escopo das métricas de QoS para além do que foi usado neste trab. (ex. *jitter*).
- Comparar e avaliar métodos diferentes (ex. DSCP, *meter table*), de implementação de QoS em SDN e seus resultados.
- A análise e consideração de CPU e memoria (no *switch*) para auxiliar na tomada de decisão de mudanças de rotas.



Conclusion - Recommendation

Future work

- Experimentos em um ambiente não virtual, utilizando *switchs* de hardware.
- Idealizar uma estrategia de detecção automática da camada de aplicação dos fluxos, para posterior configuração de QoS.
- Disponibilização de codigo *OFQuality* e *AutoQoS*.



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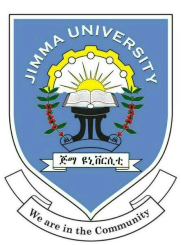


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