MASTER THESIS

USER POSITION PREDICTION IN 6-DOF MIXED REALITY APPLICATIONS USING ARTIFICIAL RECURRENT NEURAL NETWORK

VORHERSAGE DER BENUTZERPOSITION IN 6-DOF-MIXED-REALITY-ANWENDUNGEN UNTER VERWENDUNG EINES KÜNSTLICHEN REKURRENTEN NEURONALEN NETZWERKS

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Statutory Declaration

I herewith formally declare that I have written the submitted master thesis independently. I did not use any outside support except for the quoted literature and other sources mentioned in the paper.

I clearly marked and separately listed all of the literature and all of the other sources which I employed when producing this academic work, either literally or in content.

I am aware that the violation of this regulation will lead to failure of the thesis.

29.06.2022.. Oleksandra Baga

Acknowledgments

Contents

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Listings

List of Abbreviations

AR	Augmented Reality
CNN	Convolutional Neural Network
CPU	Central processing unit
DoF	Degree of freedome
DL	Deep Learning
KF	Kalman Filter
GRU	Gated Recurrent Unit
HMD	Head-Mounted-Display
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAT	Look ahead time
LSTM	Long-Short-Term Memory
M2P	Motion-to-Photon
MAE	Mean Absolut Error
MEC	Mobile Edge Computing
ML	Machine Learning
MR	Mixed Reality
NLP	Natural Language Processing
ReLu	Rectified Linear Unit
RNN	Recurrent Neural Network
SDG	Stochastic Gradient Descent
VR	Virtual Reality
3-DoF	Three degree of freedome
6-DoF	Six degree of freedome

Introduction

This thesis is focusing on designing and evaluation of the new approach for the predicting human head motion with a 6-dimensional degree of freedom (DoF) for Extended Reality (XR) applications.

1.1 Problem statement

A non-full-text database that typically contains article metadata, abstracts, and subject classifications. Used by researchers to locate publications relevant to their research [**chirico:smart_card**].

1.2 Motivation for the research

The following chapter introduces the preprocessing pipeline, architecture, and evaluation process used to develop ahead motion prediction algorithm.

1.3 Structure of the thesis

The organization of this thesis is as follows. The literature review chapter introduces the concepts of XR technologies and principles of motion prediction algorithms. It follows an overview of previous research.

Chapter 1 - Introduction.
The following chapter introduces the preprocessing pipeline, architecture, and evaluation process used to develop ahead motion prediction algorithm.

Background 2

The length and complexity of your theoretical framework depends on your field and topic. Some studies have an obvious basis in a well-established theory, while others require more detailed explanation and justification.

2.1 Mixed reality

This chapter introduces the background of the thesis to investigate head motion prediction. First, the concept of extended reality (XR) related to the research problem is presented, followed by introducing different headmotion prediction approaches.

2.2 Six degrees of freedom

This chapter introduces the background of the thesis to investigate head motion prediction. First, the concept of extended reality (XR) related tothe research problem is presented, followed by introducing different head motion prediction approaches.

2.3 Motion-to-photon latency

Motion-to-photon latency describes the time gap between a user's physical motion and the resulting displayed content of an HM. Extended Reality enables 3D content to be experienced with six degrees of freedom with head-mounted displays (HMD).

2.4 Cloud-based volumetric video streaming

This chapter introduces the background of the thesis to investigate head motion prediction. First, the concept of extended reality (XR) related tothe research problem is presented, followed by introducing different head motion prediction approaches.

2.5 Head motion prediction

In the last decade, Recurrent Neural Network (RNN) algorithms have been adopted for motion prediction of 3D sequences.

2.5.1 Challenges

This chapter introduces the background of the thesis to investigate head motion prediction.

2.5.2 Kalman Filter

This chapter introduces the background of the thesis to investigate head motion prediction.

2.5.3 Deep Learning Algorithms

ML refers to a range of techniques that aim to allow statistical models and algorithms to obtain information from given data.

Related work

<div style="text-align: right; font-size: 3em;">3</div>

This chapter introduces the background of the thesis to investigate head motion prediction. First, the concept of extended reality (XR) related to the research problem is presented, followed by introducing different head motion prediction approaches.

3.1 Predicting head position in 3-DoF

This chapter introduces the background of the thesis to investigate head motion prediction.

3.2 Previous methods in 6-DoF

Microsoft HoloLens, known under development as Project Baraboo, are a pair of mixed reality smartglasses developed and manufactured by Microsoft.

3.3 Deep Learning models in 6-DoF

This chapter introduces the background of the thesis to investigate head motion prediction.

Data and Model

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It allows web pages to be updated asynchronously by exchanging data with a web server behind the scenes.

4.1 6-DoF Dataset

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

4.1.1 Data collection from HMD

It allows web pages to be updated asynchronously by exchanging data with a web server behind the scenes.

4.1.2 Data preprocessing

It allows web pages to be updated asynchronously by exchanging data with a web server behind the scenes.

4.2 Network Architecture

The history of artificial neural networks is filled with colorful, creative individuals from a variety of fields, many of whom struggled for decades to develop concepts that we now take for granted.

4.3 Network input

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

4.4 Training methods

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

Implementation and experiments 5

Here some code for my super neural network. The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

```python
class StudentFactory(DjangoModelFactory):
    class Meta:
        model = Student
    student_card = factory.SubFactory(StudentCardFactory)
    first_name = factory.Faker('first_name')
    second_name = factory.Faker('last_name')
```

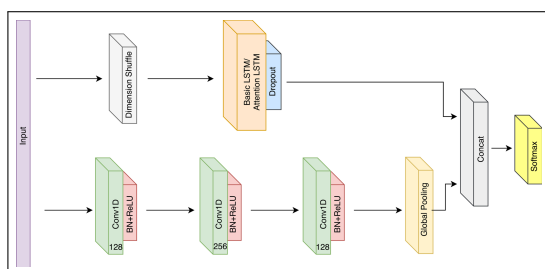**Listing 5.1:** StudentFactory

Figure 1: LSTM Fully Convolutional Networks for Time Series Classification

You might already know that you want to apply an established theory or set of theories to a specific context (for example, reading a literary text through the lens of critical race theory, or using social impact theory in a market research project).

5.1 Implementation

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

Figure 2: LSTM FCN WRAP

5.2 Experiments

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.
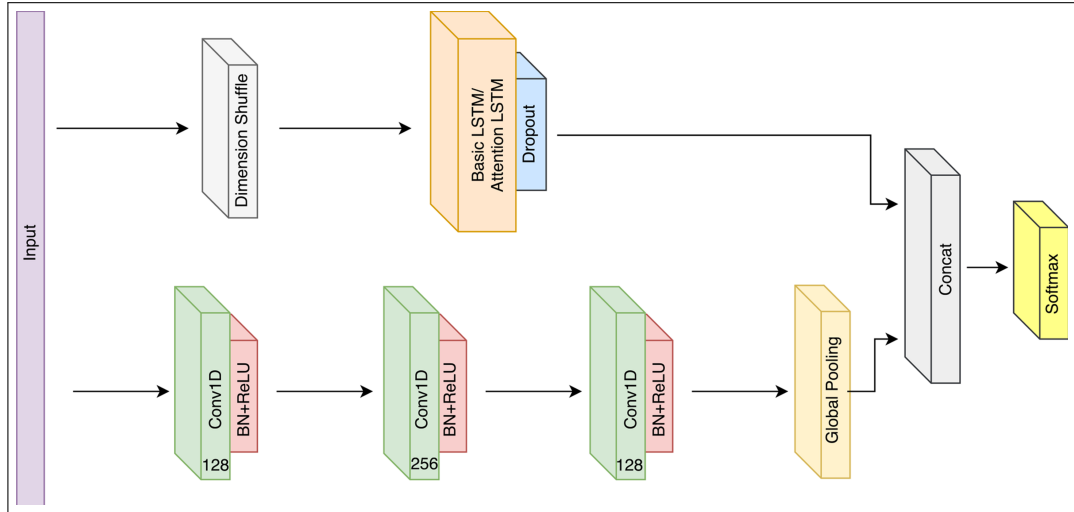
5.3 Evaluation metrics

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

5.4 Results

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

Analysis 6

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

6.1 Limitations

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

6.2 Conclusion

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

6.3 Suggestions for future work

The artificial neural networks discussed in this text are only remotely related to their biological counterparts. In this section we will briefly describe those characteristics of brain function that have inspired the development of artificial neural networks.

Glossary

AJAX

AJAX (asynchrones Javascript und XML) ist der allgemeine Name für Technologien, mit denen asynchrone Anforderungen (ohne erneutes Laden von Seiten) an den Server gestellt und Daten ausgetauscht werden können. Da die Client- und Serverteile der Webanwendung in verschiedenen Programmiersprachen geschrieben sind, müssen zum Austausch von Informationen die Datenstrukturen (z. B. Listen und Wörterbücher), in denen sie gespeichert sind, in das JSON-Format konvertiert werden.