VEHICLE CRASH PREDICTION USING TRANSFORMER NETWORKS

Don Kalindu Sekarage

218541J

Master of Science in Artificial Intelligence

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree

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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of Supervisor: Dr.A.L.A.R.R Thanuja

30/06/2024

Signature of the Supervisor: Date:

DEDICATION

This thesis is dedicated to the notable individuals who have offered unwavering support and encouragement throughout my academic pursuits. I acknowledge with profound gratitude the essential role they have played in my journey.

I extend my deepest appreciation to my beloved family, whose relentless support and faith in my potential have pushed me forward. Your sacrifices and consistent encouragement have laid the foundation for my success. I am eternally thankful for your unwavering presence in my life.

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ABSTRACT

Road accidents pose a significant threat to human life, causing numerous injuries, fatalities, and economic damage worldwide. Recently, there has been growing interest in leveraging Artificial Intelligence (AI) to create systems that can predict vehicle crashes. This thesis focuses on vehicle crash prediction and aims to develop a solution using pre-trained Convolutional Neural Networks (CNN) and transformer networks to mitigate the occurrence of such accidents. By leveraging advanced deep learning techniques, this research addresses the limitations of traditional crash analysis methods. The objectives of this study involve critically reviewing the evolution of vehicle crash prediction systems, studying modern technologies employed in vehicle crash prediction, designing and implementing a crash prediction system using pre-trained CNN and transformer networks, and evaluating the solution's effectiveness. The motivation behind this research stems from the urgency to reduce the growing frequency of vehicle crashes and their associated consequences. Current approaches to road safety primarily rely on reactive measures, prompting the need for proactive strategies to prevent accidents. The Car Learning to Act (CARLA) simulator was used for data gathering, in that an ego-vehicle attached to RGB and RGB-Depth cameras were used. Ego-vehicle traveled through a simulated environment with different weather conditions and maps and captured a sequence of RGB and RGB-Depth (RGB-D) images in safe and unsafe scenarios. To extract features from RGB and RGB-D images pre-trained CNN were utilized. Four pre-trained CNNs were used for feature extraction. With those extracted features, a transformer network was employed to train a model. After model training and testing, it was observed that the transformer model trained with VGG16-based feature extraction performs better than other methods. This research can be implemented in the real world with real-time predictions and addresses the shortcomings of visual-based systems. Ultimately, it aims to improve road safety by enabling proactive crash prevention and minimizing the human and economic costs associated with accidents.

Keywords: CNN, Transformer Network, CARLA, Feature Extraction

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LIST OF ABBREVIATIONS

Abbreviation	Description
CNN	Convolutional Neural Network
LSTM	Long Short-Term Memory
GRU	Gated Recurrent Unit
RGB-D	RGB Depth
AI	Artificial Intelligence
SMOTE	Synthetic Minority Over-sampling Technique
RF	Random Forest
KNN	K-Nearest Neighbors
RNN	Recurrent Neural Network
SVM	Support Vector Machines
ReLU	Rectified Linear Unit
ML	Machine Learning
CARLA	Car Learning to Act]
GDP	Gross Domestic Production
CPN	Crash Prediction Network
NLP	Natural Language Processing

LIST OF APPENDICES