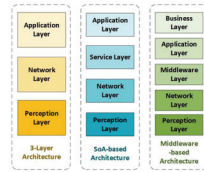


DOI: 10.3390/electronics11040556

Machine-Learning-Based Darknet Traffic Detection System for IoT Applications

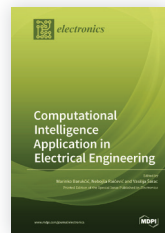
Authors: Qasem Abu Al-Haija, Moez Krichen and Wejdan Abu Elhaija

Abstract: The massive modern technical revolution in electronics, cognitive computing, and sensing has provided critical infrastructure for the development of today's Internet of Things (IoT) for a wide range of applications. However, because endpoint devices' computing, storage, and communication capabilities are limited, IoT infrastructures are exposed to a wide range of cyber-attacks. As such, Darknet or blackholes (sinkholes) attacks are significant, and recent attack vectors that are launched against several IoT communication services. Since Darknet address space evolved as a reserved internet address space that is not contemplated to be used by legitimate hosts globally, any communication traffic is speculated to be unsolicited and distinctively deemed a probe, backscatter, or misconfiguration. Thus, in this paper, we develop, investigate, and evaluate the performance of machine-learning-based Darknet traffic detection systems (DTDS) in IoT networks. Mainly, we make use of six supervised machine-learning techniques, including bagging decision tree ensembles (BAG-DT), AdaBoost decision tree ensembles (ADA-DT), RUSBoosted decision tree ensembles (RUS-DT), optimizable decision tree (O-DT), optimizable k-nearest neighbor (O-KNN), and optimizable discriminant (O-DSC). We evaluate the implemented DTDS models on a recent and comprehensive dataset, known as the CIC-Darknet-2020 dataset, composed of contemporary actual IoT communication traffic involving four different classes that combine VPN and Tor traffic in a single dataset covering a wide range of captured cyber-attacks and hidden services provided by the Darknet. Our empirical performance analysis demonstrates that bagging ensemble techniques (BAG-DT) offer better accuracy and lower error rates than other implemented supervised learning techniques, scoring a 99.50% of classification accuracy with a low inferring overhead of 9.09 μ second. Finally, we also contrast our BAG-DT-DTDS with other existing DTDS models and demonstrate that our best results are improved by (1.9~27%) over the former state-of-the-art models.

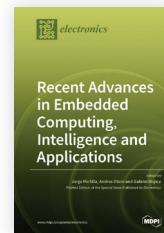


Special issue books

Computational Intelligence
Application in Electrical
Engineering



Recent Advances in
Embedded Computing,
Intelligence and Applica-
tions



Invitation to submit

Feature Papers in Computer Science & Engineering

Guest Editors: Prof. Dr. Juan M. Corchado, Prof. Dr. Byung-Gyu Kim, Dr. Carlos A. Iglesias, Prof. Dr. In Lee, Prof. Dr. Fuji Ren and Prof. Dr. Rashid Mehmood
Deadline: **31 March 2023**



Recent Applications of Emerging Digital Technologies in Economy and Society

Guest Editors: Prof. Dr. Claudiu George Bocean, Prof. Dr. Adriana Grigorescu and Dr. Anca Antoaneta Vărzaru
Deadline: **31 July 2023**



Deep Learning in Image Processing and Pattern Recognition

Guest Editors: Prof. Dr. Yuji Iwahori, Dr. Aili Wang and Dr. Haibin Wu
Deadline: **31 May 2023**



Metaverse and Digital Twins

Guest Editors: Prof. Dr. Yiyu Cai, Prof. Dr. Xiaoqun Wu, Prof. Dr. Qi Cao and Prof. Dr. Xiao Zhang
Deadline: **31 December 2022**



Security and Privacy in Blockchain/IoT

Guest Editors: Dr. Junaid Arshad, Prof. Dr. Jonathan Loo and Dr. Omair Shafiq
Deadline: **31 December 2022**



Machine Learning in Electronic and Biomedical Engineering, Volume II

Guest Editors: Dr. Laura Falaschetti and Prof. Dr. Turchetti Claudio
Deadline: **31 March 2023**



[mdpi.com](https://www.mdpi.com)

[mdpi.com/journal/electronics](https://www.mdpi.com/journal/electronics)

Visit [mdpi.com](https://www.mdpi.com) for a full list of offices and contact information.
MDPI is a company registered in Basel, Switzerland, No. CH-270.3.014.334-3,



electronics

an Open Access Journal by MDPI

IMPACT
FACTOR
2.690

CITESCORE
3.7

Affiliated Society:

Polish Society of Applied Electromagnetics
(PTZE)

Section
Computer Science & Engineering



Section Editor-in-Chief

Prof. Dr. Juan M. Corchado BISITE Research Group, Edificio Multiusos I+D+i, University of Salamanca, 37007 Salamanca, Spain

corchado@usal.es

Section Information:

The primary focus of the "Computer Science & Engineering" section is the field of advanced computer science and engineering. It presents high-quality papers that address state-of-the-art technology, including Deep Tech, Edge Computing, Fog Computing, Artificial Intelligence, Machine Learning, Deep Learning, Emotional Systems, Fintech, Blockchain, IoT, Industry 4.0, Smart Cities, Smart Grids, Intelligent Textiles, Distributed Computing, as well as other chief technologies in this field.

Author Benefits

- Open Access Unlimited and free access for readers
No Copyright Constraints Retain copyright of your work and free use of your article
Thorough Peer-Review
2021 Impact Factor: 2.690 (Journal Citation Reports - Clarivate, 2022)
No Space Constraints, No Extra Space or Color Charges No restriction on the length of the papers, number of figures or colors
Coverage by Leading Indexing Services Scopus, SCIE (Web of Science), CAPlus / SciFinder, Inspec, and other databases
Rapid Publication First decision provided to authors approximately 16.6 days after submission; acceptance to publication is undertaken in 2.7 days (median values for papers published in this journal in the first half of 2022)

Featured Papers

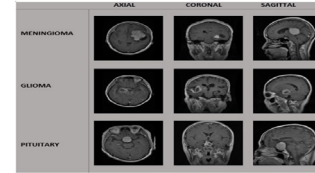
DOI: 10.3390/electronics11071146

A Hybrid Deep Learning-Based Approach for Brain Tumor Classification

Authors: Asaf Raza, Huma Ayub, Javed Ali Khan, Ijaz Ahmad, Ahmed S. Salama, Yousef Ibrahim Daradkeh, Danish Javeed, Ateeq Ur Rehman and Habib Hamam



Abstract: Brain tumors (BTs) are spreading very rapidly across the world. Every year, thousands of people die due to deadly brain tumors. Therefore, accurate detection and classification are essential in the treatment of brain tumors. Numerous research techniques have been introduced for BT detection as well as classification based on traditional machine learning (ML) and deep learning (DL). The traditional ML classifiers require hand-crafted features, which is very time-consuming. On the contrary, DL is very robust in feature extraction and has recently been widely used for classification and detection purposes. Therefore, in this work, we propose a hybrid deep learning model called DeepTumorNet for three types of brain tumors (BTs)—glioma, meningioma, and pituitary tumor classification—by adopting a basic convolutional neural network (CNN) architecture. The GoogLeNet architecture of the CNN model was used as a base. While developing the hybrid DeepTumorNet approach, the last 5 layers of GoogLeNet were removed, and 15 new layers were added instead of these 5 layers. Furthermore, we also utilized a leaky ReLU activation function in the feature map to increase the expressiveness of the model. The proposed model showed its superiority over the existing models for BT classification from the MRI images.



DOI: 10.3390/electronics11050788

A Conceptual Framework for Determining Quality Requirements for Mobile Learning Applications Using Delphi Method

Authors: Mohammed Amin Almaiah, Fahima Hajjei, Abdalwali Lutfi, Ahmad Al-Khasawneh, Tayseer Alkhdour, Omar Almomani and Rami Shehab



Abstract: The development of mobile learning apps might fail due to poor selection of the suitable technical requirements for mobile devices. This will affect the quality of mobile learning applications and, thus, will increase the development cost of mobile learning apps. Due to the above issues, we need to determine the most appropriate technical quality requirements for the development of mobile learning apps that meet user requirements. To achieve that, we propose a comprehensive framework to capture the most suitable technical quality requirements for mobile learning apps. A Delphi method was used to collect, evaluate, and analyze the data for this study. As a result of our Delphi study, we have identified nineteen technical quality requirements, divided into six quality dimensions, for the development of mobile learning applications. The proposed framework is expected to be a guideline for mobile apps designers and developers to successfully develop mobile learning apps.



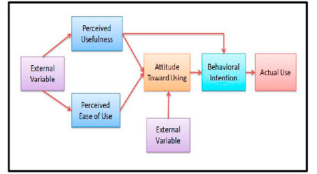
DOI: 10.3390/electronics11081259

Employing the TAM Model to Investigate the Readiness of M-Learning System Usage Using SEM Technique

Authors: Mohammed Amin Almaiah, Shaha Al-Otaibi, Abdalwali Lutfi, Omar Almomani, Arafat Awajan, Adeb Alsaaidah, Mahmood Alrawad and Ali Bani Awad



Abstract: During COVID-19, universities started to use mobile learning applications as one of the solutions to support distance learning. The readiness of universities to apply new systems, such as mobile learning applications, is considered one of the critical issues to ensure the system's success. Determining the most important aspects of readiness to use mobile learning is a key step to adopt mobile learning in an effective way. To address this issue, this research aims to determine the most important determinants influencing mobile learning readiness by employing the Technology Acceptance Model (TAM). The Structural Equation Modelling (SEM) method was used to test the hypotheses in the proposed model. The results showed that the relationship between mobile learning readiness and awareness, IT infrastructure and top management support was positively significant. In conclusion, the findings will be of value to decision makers and mobile learning developers in universities to enhance the development of mobile learning applications. In addition, it may help facilitate and promote the usage of mobile learning applications among users.



DOI: 10.3390/electronics11040630

Blockchain for IoT Applications: Taxonomy, Platforms, Recent Advances, Challenges and Future Research Directions

Authors: Abdelzahir Abdelmaboud, Abdelmuttlib Ibrahim Abdalla Ahmed, Mohammed Abaker, Taiseer Abdalla Elfadil Eisa, Hashim Albasheer, Sara Abdelwahab Ghorashi and Faten Khalid Karim



Abstract: The Internet of Things (IoT) has become a popular computing technology paradigm. It is increasingly being utilized to facilitate human life processes through a variety of applications, including smart healthcare, smart grids, smart finance, and smart cities. Scalability, interoperability, security, and privacy, as well as trustworthiness, are all issues that IoT applications face. Blockchain solutions have recently been created to help overcome these difficulties. The purpose of this paper is to provide a survey and tutorial on the use of blockchain in IoT systems. The importance of blockchain technology in terms of features and benefits for constituents of IoT applications is discussed. We propose a blockchain taxonomy for IoT applications based on the most significant factors. In addition, we examine the most widely used blockchain platforms for IoT applications. Furthermore, we discuss how blockchain technology can be used to broaden the spectrum of IoT applications. Besides, we discuss the recent advances and solutions offered for IoT environments. Finally, we discuss the challenges and future research directions of the use of blockchain for the IoT.

