# CERTIFICATE

This is to certify that the thesis entitled **"Securing the VANET through a hybrid approach by Mitigating DoS Attacks and its types with Self-healing and Immunization"** submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science,** is a record of original research work done by **Ms. S. Rama Mercy (17PHCSP011)** during the period of her study in the Department of Computer Science at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under my Supervision and Guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any University.

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# DECLARATION

I, S. Rama Mercy, hereby declare that the thesis entitled **"Securing the VANET through a hybrid approach by Mitigating DoS Attacks and its types with Self-healing and Immunization"** submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Computer Science,** is a record of original research work done by me during the period of my study under the Supervision and Guidance of **Dr. G. Padmavathi, M.Sc., M.Phil., Ph.D.,** Professor and Dean, Department of Computer Science, School of Physical Sciences and Computational Sciences at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, and it has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship or other similar title to any candidate of any University.

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**Rama Mercy. S**

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# ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| VANET | Vehicular Ad Hoc Network |
| AIS | Artificial Immune System |
| DoS | Denial of Service |
| DDoS | Distributed Denial of Service |
| IoT | Internet of Things |
| OBU | Onboard units |
| RSU | Road-side units |
| DSRC | Dedicated Short-Range Communication |
| ITS | Intelligent Transport System |
| V2V | Vehicle-to-Vehicle |
| V2I | Vehicle-to-Infrastructure |
| IDS | Intrusion Detection Systems |
| MANET | Mobile ad hoc networks |
| V2RSU | Vehicle-to-roadside unit |
| I2V | Infrastructure-to-Vehicle |
| PoD | Ping of Death |
| TCP | Transmission Control Protocol |
| SYN-TCP | Synchronised TCP |
| SSL | Secure Socket Layer |
| DNS | Domain Name System |
| UDP | User Datagram Protocol |
| RST | Reset |
| FIN | Finish |
| MITM | Man-in-the-Middle |

| | |
|---|---|
| HIDS | Host Based Intrusion Detection System |
| PSA | Positive Selection Algorithm |
| NSA | Negative Selection Algorithm |
| DCA | Dendritic cell algorithm |
| CSA | Clonal selection algorithm |
| SVM | Support Vector Machines |
| NN | Neural Networks |
| DT | Decision Trees |
| ML | Machine Learning |
| RL | Reinforcement Learning |
| AODV | Ad-Hoc On-demand Distance Vector |
| CMs | Cluster Members |
| CHs | Cluster Heads |
| WAVE | Wireless Access to Vehicle Environment |
| OSI | Open Systems Interconnection |
| RREQ | Route Request |
| MAC | Media Access Control |
| SOMs | Self-Organizing Maps |
| DAER | Distance-Aware Epidemic Routing |
| DTN | Delay-Tolerant Network |
| PKI | Public Key Infrastructure |
| CRL | Certificate Revocation List |
| SEMD | Secure and Efficient Message Dissemination Scheme |
| CPPA | Conditional Privacy-Preserving Authentication |
| AISBA | Artificial Immune System Based Algorithm |
| DAA | Defense Against Attacks |
| CNS | Communication Network Simulator |

| | |
|---|---|
| TPDs | Tamper-Proof Devices |
| DP | Differential Privacy |
| LTE-V | Long Term Evolution-Vehicle |
| MNO | Network Operator revenues |
| CRAN | Cloud Radio Access Networks |
| iNDC | intelligent Named Data Caching |
| V2X | Vehicle-to-Everything |
| DRL | Deep Reinforcement Learning |
| NDN | Named data networking |
| RND Vn | ROOF-based Named Data Vehicular Networking |
| CIC-IDS | The Canadian Institute for Cybersecurity Intrusion Detection System |
| IP | Internet Protocol |
| NS-2 | Network Simulator Version 2 |
| GLW | Glowworm |
| SLFN | Single Layer Feedforward Neural Network |
| MCOD-LR | Micro-Cluster Outlier Detection – Linear Regression |
| SVM | Support Vector Machine |
| GOF – SLFN | Glowworm optimized features for Single-layer feed-forward network |
| SUMO | Simulation of Urban Mobility |
| OMNET | Objective Modular Network Testbed |
| MSSQL | Microsoft SQL Server |
| SSDP | Simple Service Discovery Protocol |
| SYN | Synchronise |
| UDP | User Datagram Protocol |
| KDE | Kernel Density Estimation |

| | |
|---|---|
| PDR | Packet Delivery Ratio |
| DR | Detection Rate |
| EC | Energy Consumption |
| TF | Trust Factor |
| TRHE | Triple Random Hyperbolic Encryption |
| GPS | Global Positioning System |
| NN | Neural Network |
| DT-NN | Deep Trust Factorization Neural Network |
| MFO | Moth Flame Optimization |
| HTTP | Hypertext Transfer Protocol |
| NTP | Network Time Protocol |
| SNMP | Simple Network Management Protocol |
| CCL | Cache parallelized Circulation Link routing |
| RSU | Road Side Unit |
| RTA | Regional Trusted Authority |
| TA | Trusted Authority |
| TPR | True Positive Rate |
| FPR | False Positive Rate |
| FNR | False Negative Rate |
| MLP | Multi-Layer Perceptron |
| ANN | Artificial Neural Network |
| RF | Random Forest |
| TNR | True Negative Rate |
| SPPA | Stream Position Performance Analysis |
| MVSA | Multivariant Stream Analysis Approach |