

ARTIFICIAL INTELLIGENCE FOR BIG DATA: Issues and Challenges

Author: Adriana Silva

Email: as1344829@gmail.com

University of Algarve, Portugal

Abstract:

Artificial intelligence (AI) concerns the study and development of intelligent machines and software. The associated ICT research is highly technical and specialized, and its focal problems include the developments of software that can reason, gather knowledge, plan intelligently, learn, communicate, perceive and manipulate objects. AI also allows users of big data to automate and enhance complex descriptive and predictive analytical tasks that, when performed by humans, would be extremely labour intensive and time consuming. Thus, unleashing AI on big data can have a significant impact on the role data plays in deciding how we work, how we travel and how we conduct business. This paper explores how Artificial Intelligence, in conjunction with Big Data technologies, can help organizations to bring about operational and business transformation. Deep learning will also be connected to other major learning frameworks such as reinforcement learning and transfer learning. A thorough survey of the literature on deep learning for wireless communication networks is provided, followed by a detailed description of several novel case-studies wherein the use of deep learning proves extremely useful for network design. For each case-study, it will be shown how the use of (even approximate) mathematical models can significantly reduce the amount of live data that needs to be acquired/measured to implement data-driven approaches.

1. INTRODUCTION

Big data describes the stunningly increasing growth, availability and utilization of information in today's world.

The continuously increasing volume of structured and unstructured information, the variety of it, and the speed with which it is generated, through social media, sensor data as well as transaction data, poses today's leaders and specialists with both increased opportunities and devilish challenges.

With big data benefitting from increased storage capabilities, thinking moves away from what records to keep to ponder the question of how to make sense of these large volumes of data. About 90% of all data in the world has been generated in the last two years, coming in from traditional databases, text documents, email, meter-collected data, video, audio, stock ticker data and financial transactions. It is estimated that of all this data, only 20 percent is numeric, leaving 80% of non-numeric data. The sources and channels through which this data manifests is manifold. To access this data, to determine its relevance and to figure out ways to turn it to their advantage, businesses have turned to a subdivision of computer science that since its conception has spoken to the imagination: artificial intelligence.

The WSN played the tremendous role in improving the life of the people in several fields such as health, industry, surveillance, environment-monitoring, battle etc. [1-2]. For the last few years, the population of aged persons has been increasing worldwide, and therefore the rising prices of medical treatment triggered the advancements in remote monitoring of body's condition and surrounding environments [3]. A traditional medical care system use stationary wired medical apparatus which are inconvenient and have a higher impact on the standards of living of patients and involves a high cost of implementation and maintenance [4]. While diagnosing for diseases is additionally restricted in hospital in addition doctors faces difficulties in early detection and long observation of diseases. To overcome these problems a new monitoring system is emerged as Wireless Body Area Network [5]. A WBAN consists of small and intelligent sensors which are either placed on or with in human body. These sensors monitor body conditions and a coordinator collects this vital information and sends them to concerned healthcare centre through existing network links [6].

During this process of transmitting the data from the coordinator, the WBAN faces energy exhausting attacks such as collision, denial of sleep, and selfish. These attacks reduces the lifetime of the sensors and compromise the WBAN, which results in decrease in the quality of healthcare [7]. Since we are dealing with the human life, these energy consumption attacks must be addressed.

The mitigations of collision and denial of sleep and selfish attacks are not proposed [8-10]. In this paper a genetic algorithm is proposed to mitigate selfish attack by detecting selfish node and blocking unusual activities.

The remaining paper is organized as follows. Section II explains the related work done in the field, Section III discusses the proposed SDMAC protocol, the Simulation Setup and Results are discussed in section IV and the paper is concluded in Section V.

2. Issues

There are following issues with Wireless Networks.

Quality of Service (QoS):

One of the primary concerns about wireless data delivery is that, unlike the Internet through wired services, QoS is inadequate. Lost packets and atmospheric interference are recurring problems of the wireless protocols.

- For application where mobility not required a wired connection provide a faster, reliable and cost-effective solution.
- Higher loss-rates due to interference (due to other communication)
- Restrictive regulations of frequencies (e.g., wlan operates in ISM is unlicensed spectrum which has huge deployment)
- Wireless network technology has low data throughput and data transmission rates due to collisions
- Higher latency, higher jitter due to channel access.
- Wireless technology does not provide the same bandwidth guarantees as a wired connection and is additionally shared with other users who are connected to the same access point.
- Wireless networks are subject to interference from any electromagnetic sources
- The signal strength is greatly reduced by obstacles.
- Congestion problems or even failure under error conditions or high or malicious traffic, the actions of a few can potentially affect the network connections of many.
- Limited channel selection induces “co-channel interference”. This interference happens when the access points are stepping on each other and is harmful to the performance of your network.

3. Security Risks

A data transfer over a wireless network. Basic network security mechanisms like the service set identifier (SSID) and Wireless Equivalency Privacy (WEP); these measures may be adequate for residences and small businesses, but they are inadequate for the entities that require stronger security.

- **Denial of Service:**

The intruder floods network with valid or invalid messages affecting the availability of the network resources. The low bit rates of WLAN can be exploited to leave them open to denial of service attacks. Radio interference can be used to disable WLAN to communicate.

- **Spoofing and Session Hijacking:**

The attacker may gain access to privileged data and resources in the network by using identity of a valid user. Attackers spoof MAC addresses, and act as illegitimate AP. To avoid spoofing, authentication and access control mechanisms need to be placed in the WLAN.

- **Eavesdropping:**

Eavesdropping is the most significant threat because the attacker can intercept the transmission, as it is impossible to control who can receive the signals in wireless LAN as medium is shared.

4. Related Work

The WBAN technology is the consequence of the existing WSN technology. A number of tiny wireless sensors, strategically placed on the human body, create a wireless body area network that can monitor various vital signs, providing real-time feedback to the user and medical personnel. In a WBAN, each medical sensor monitors different vital signs such as temperature, blood pressure, or ECG. The system consists of multiple sensor nodes that monitor body motion and heart activity, a network coordinator, and a personal server running on a personal digital assistant or a personal computer [8].

Figure 1 shows secure 3-level WBAN architecture for medical and non-medical applications. Level 1 contains in-body and on-body BAN Nodes (BNs) such as Electrocardiogram (ECG) – used to monitor electrical activity of heart, Oxygen saturation sensor (SpO₂) – used to measure the level of oxygen, and Electromyography (EMG) – used to monitor muscle activity [9].

Level 2 contains a BAN Network Coordinator (BNC) that gathers patient's vital information from the BNs and communicates with the base-station. Level 3 contains a number of remote base-stations that keep patient's medical/non-medical records and provides relevant (diagnostic) recommendations. The traffic is categorized into on demand, emergency, and normal traffic. On-demand traffic is initiated by the BNC to acquire certain information. Emergency traffic is initiated by the BNs when they exceed a predefined threshold. Normal traffic is the data traffic in a normal condition with no time critical and on-demand events [11].

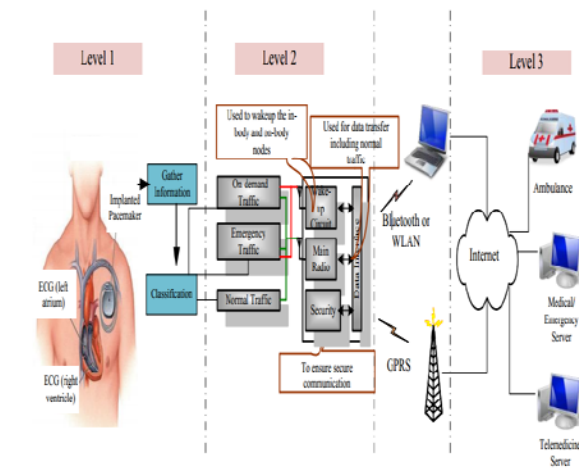


Figure 1: Secure 3-Level WBAN Architecture For Medical And Non-Medical Applications

The normal data is collected and processed by the BNC. The BNC contains a wakeup circuit, a main radio, and a security circuit, all of them connected to a data interface. The wakeup circuit is used to accommodate on-demand and emergency traffic. The security circuit is used to prevent malicious interaction with a WBAN [10], [14], [13].

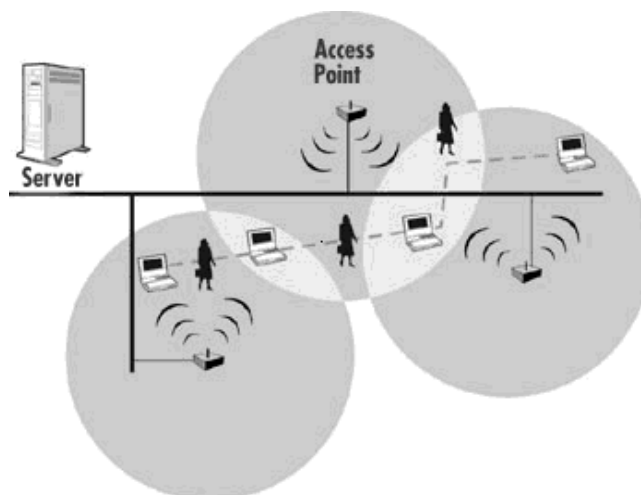


Figure 1-3: Microcells and Roaming

5. EOS Blockchain Protocol

MAC protocols used in WBAN must be low power consuming, accurate and with less latency. The most important thing is the protocol should give good performance on varying traffic load. Some popular protocols for WBAN are TMAC, SMAC, ZigBee MAC and Baseline MAC [4].

A. *TMAC:*

It is a duty-cycling protocol. In this protocol the node is awoken for a particular period that is called active time. Duty cycle changes according to the information traffic load of the network. When traffic load is high than the duty cycle becomes large so that nodes can handle high traffic load. When traffic load is low then duty cycle is adjusted to small value so that nodes can save their power reducing the problem of idle listening. TMAC protocol is able to handle varying load with low power consumption.

B. *SMAC:*

SMAC protocol is similar to TMAC but only difference is its fixed duty cycle. This protocol is the previous version. This protocol is not efficient in handling continuously varying data rates in WBAN.

C. *ZigBee MAC:*

ZigBee MAC protocol can use two schemes- CSMA/CA or TDMA. While using CSMA/CA mechanism this protocol gives average performance but using TDMA mechanism (applying Guaranteed Time Slot or GTS) it reduces the power consumption up to a great extent. At high rates the data loss becomes high in TDMA mechanism so it is best when there is less no of nodes or low traffic load.

D. *Baseline MAC:*

This MAC protocol uses CSMA/CA scheme. The performance of Baseline MAC in terms of energy consumption is not average but throughput is average.

6. LITERATURE SURVEY

In [13] (2012) proposed a reliable topology design and provisioning approach for Wireless Body Area Networks (named RTDP-WBAN) that takes into account the mobility of the patient while guaranteeing a reliable data delivery required to support healthcare applications' needs. To do so, they first proposed a 3D coordinate system able to calculate the coordinates of relay-sensor nodes in different body postures and movements. This system uses a 3D-model of a standard human body and a specific set of node positions with stable communication links, forming a virtual backbone. Next, they investigated the optimal relay nodes positioning jointly with the reliable and cost-effective data routing for different body postures and movements. Therefore, they use an Integer Linear Programming (ILP) model, that is able to find the optimal number and locations of relay nodes and calculate the optimal data routing from sensors and relays towards the sink, minimizing both the network setup cost and the energy consumption. They solved the model in dynamic WBAN (Stand, Sit and Walk) scenarios, and compare its performance to other relaying approaches.

In [14] (2013) presented an analytically discussion about energy efficiency of Medium Access Control (MAC) protocols for Wireless Body Area Sensor Networks (WBASNs). For this purpose, different energy efficient MAC protocols with their respective energy optimization techniques; Low Power Listening (LPL), Scheduled Contention and Time Division Multiple Access (TDMA), are elaborated. They also analytically compared path loss models for In-body, On-body and Off-body communications in WBASNs. These three path loss scenarios are simulated in MATLAB and results shown that path loss is more in In-body communication because of less energy level to take care of tissues and organs located inside human body. Secondly, power model for WBASNs of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) and beacon mode is also presented. The results shown that power of CSMA/CA mode is less as compared to beacon mode. Finally, they suggested that hybrid mode is more useful to achieve optimization in power consumption, which consequently results in high energy efficiency.

In [15] (2014) proposed a mechanism to route data in WBANs with minimum path-loss over the link; and in which the merits of single-hop and multi-hop are utilized. The proposed scheme uses a cost function to select the most appropriate route to sink. This cost function is calculated based on their distance from the sink as well as their residual energy. Nodes with lesser value of cost function are elected as parent node. Other nodes become children of that parent node and forward their data to parent node. Two of the eight nodes forward their data directly to sink as they are placed near the sink; and will serve as the parent nodes. The channel for wearable BAN can be basically described by path loss

models with two parameters of frequency and distance. It is calculated from its distance to sink with constant frequency 2.4GHz. The results shows that proposed routing scheme has considerably enhanced the network stability time and in terms of cross-layer application, it has reduced the path-loss to a significantly low-level

7. CONCLUSION

The increasing use of wireless networks and the constant miniaturization of electrical devices has empowered the development of Wireless Body Area Networks (WBANs). In these networks various sensors are attached on clothing or on the body or even implanted under the skin. The wireless nature of the network and the wide variety of sensors power numerous new, practical and innovative applications to improve health care and the Quality of Life. The sensors of a WBAN measure for example the heartbeat, the body temperature or record a prolonged electrocardiogram. In this survey, we have reviewed the current research on Wireless Body Area Networks. In particular, this work presents an overview of the research on the human body, MAC-protocols in WBAN, challenges in WBAN and also describes the various applications in WBAN.

8. References

- [1] Z. Haider, M. Saleem, and T. Jamal, "Analysis of Interference in Wireless", in Proc. of ArXiv, arXiv:1810.13164 [cs.NI], Oct. 2018.
- [2] T. Jamal and P. Mendes, "Relay Selection Approaches for Wireless Cooperative Networks", in Proc. of IEEE WiMob, Niagara Falls, Canada, Oct. 2010.
- [3] T. Jamal, P. Mendes, and A. Zúquete, "Opportunistic Relay Selection for Wireless Cooperative Network", in Proc. of IEEE IFIP NTMS, Istanbul Turkey, May 2012.
- [4] T. Jamal and P. Mendes, "Cooperative relaying in user-centric networking under interference conditions", in Proc. of IEEE Communications Magazine, vol. 52, no. 12, pp. 18–24, Dec 2014.
- [5] P. Mendes, W. Moreira, T. Jamal, and Huiling Zhu, "Cooperative Networking in User-Centric Wireless Networks", In: Aldini A., Bogliolo A. (eds) User-Centric Networking. Lecture Notes in Social Networks. Springer, Cham, ISBN 978-3-319- 05217-5, May 2014.
- [6] T. Jamal, P. Mendes, and A. Zúquete, "Relayspot: A Framework for Opportunistic Cooperative Relaying", in Proc. of IARIA ACCESS, Luxembourg, June 2011.
- [7] T. Jamal, and SA Butt, "Malicious Node Analysis in MANETS", in Proc. of International Journal of Information Technology, PP. 1-9, Springer Publisher, Apr. 2018.
- [8] T. Jamal, and P. Mendes, "COOPERATIVE RELAYING FOR DYNAMIC NETWORKS", EU PATENT, (EP13182366.8), Aug. 2013.
- [9] T. Jamal, and P. Mendes, "802.11 Medium Access Control In MiXiM", in Proc. of Tech Rep. SITILabs-TR-13-02, University Lusófona, Lisbon Portugal, Mar. 2013.
- [10] T Jamal, M Alam, and MM Umair, "Detection and Prevention Against RTS Attacks in Wireless LANs", in Proc. of IEEE C-CODE, Islamabad Pakistan, Mar. 2017.
- [11] L. Lopes, T. Jamal, and P. Mendes, "Towards Implementing Cooperative Relaying", In Proc. of Technical Report COPE-TR-13-06, CopeLabs University Lusofona Portugal, Jan 2013.

- [12] T. Jamal, P. Mendes, and A. Zúquete, "Interference-Aware Opportunistic Relay Selection", In Proc. of ACM CoNEXT student workshop, Tokyo, Japan, Dec. 2011.
- [13] T. Jamal, "Cooperative MAC for Wireless Network", In Proc. of 1st MAP Tele Workshop, Porto, Portugal, 2010.
- [14] T. Jamal and P. Mendes, "Analysis of Hybrid Relaying in Cooperative WLAN", In Proc. of IEEE IFIP Wireless Days (WD), Valencia, Spain, November 2013.
- [15] T. Jamal, and P. Mendes, "Cooperative Relaying for Wireless Local Area Networks", In: Ganchev I., Curado M., Kassler A. (eds) Wireless Networking for Moving Objects. Lecture Notes in Computer Science, vol 8611. Springer, Cham, (WiNeMo), Aug. 2014.
- [16] T. Jamal, and SA Butt, "Cooperative Cloudlet for Pervasive Networks", in Proc. of Asia Pacific Journal of Multidisciplinary Research, Vol. 5, No. 3, PP. 42-26, Aug 2017.
- [17] T. Jamal, P. Mendes, and A. Zúquete, "Wireless Cooperative Relaying Based on Opportunistic Relay Selection", in Proc. of International Journal on Advances in Networks and Services, Vol. 5, No. 2, PP. 116-127, Jun. 2012.
- [18] SA Butt, and T. Jamal, "Frequent Change Request from User to Handle Cost on Project in Agile Model", in Proc. of Asia Pacific Journal of Multidisciplinary Research 5 (2), 26-42, 2017.
- [19] T. Jamal, and P. Amaral, "Flow Table Congestion in Software Defined Networks", in Proc. of IARIA 12th ICDS, Rome Italy, Mar. 2018.
- [20] R. Sofia, P. Mendes, W. Moreira, A. Ribeiro, S. Queiroz, A. Junior, T. Jamal, N. Chama, and L. Carvalho, "Upns: User Provided Networks, technical report: LivingExamples, Challenges, Advantages", Tech. Rep. SITI-TR-11- 03, Research Unit in Informatics Systems and Technologies (SITI), University Lusofona, Lisbon Portugal, Mar. 2011.
- [21] T. Jamal, and P. Mendes, "Cooperative Relaying in Wireless User-Centric Networks", Book Chapter In: Aldini, A., Bogliolo, A. (eds.) User Centric Networking. Lecture Notes in Social Networks, Springer, Cham, pp. 171–195, 2014.
- [22] T. Jamal, P. Mendes, and A. Zúquete, "Design and Performance of Wireless Cooperative Relaying", PhD Thesis MAP-Tele, University of Aveiro, Oct. 2013.
- [23] T. Jamal, P. Mendes, and A. Zuquete, "RelaySpot: Cooperative Wireless Relaying", in Proc. of MAP-Tele Workshop, Aveiro, Portugal, May 2011.
- [24] T. Jamal, and P. Mendes, "Cooperative Wireless Relaying, Key Factors for Relay Selection", in Proc. of MAP-Tele Workshop, Porto, Portugal, Dec. 2009.
- [25] SA Butt, and T. Jamal, "Study of Black Hole Attack in AODV", in Proc. of International Journal of Future Generation Communication and Networking, Vol. 10, No.9, pp. 37-48, 2017.
- [26] T. Jamal, and SA Butt, "Low-Energy Adaptive Clustering Hierarchy (LEACH) Enhancement for Military Security Operations", In Proc. Of Journal of Basic and Applied Scientific Research, ISSN 2090-4304, 2017.
- [27] T. Jamal, and P. Mendes, "RelaySpot, OMNET++ Module", Software Simulator Extension In Proc. of COPE-SW-13-05, 2013.
- [28] T. Jamal and Z. Haider, "Denial of Service Attack in Cooperative Networks", in Proc. of ArXiv, arXiv: CoRR Vol. arXiv:1810.11070 [cs.NI], Oct. 2018.

- [29] M. Asam and T. Jamal, "Security Issues in WBANs", in proc of Arxiv, Volume arXiv:1911.04330 [cs.NI], November 2019.
- [30] M. Asam and Z. Haider, "Novel Relay Selection Protocol for Cooperative Networks", in proc of Arxiv, Volume arXiv: 1911.07764 [cs.NI], November 2019.
- [31] SA Butt and T. Jamal, "A multivariant secure framework for smart mobile health application", in Transactions on Emerging Telecommunications Technologies, Aug. 2019.
- [32] S. A. Butt, T. Jamal, and M. Shoaib, "IoT Smart Health Security Threats," in proc. of 19th International Conference on Computational Science and Its Applications (ICCSA), Saint Petersburg, Russia, 2019, pp. 26- 31. doi: 10.1109/ICCSA.2019.000-8.
- [33] M. Asam and A. Ajaz, "Challenges in Wireless Body Area Network", in Proc. of International Journal of Advanced Computer Science and Applications, Volume 10, No. 11, Nov. 2019.
- [34] SA Butt and T. Jamal, "Predictive Variables for Agile Development Merging Cloud Computing Services", in Proc. of IEEE Access, Volume 7, 2019. DOI: 10.1109/ACCESS.2019.2929169.
- [35] T Jamal, P Amaral, A Khan, SAB, Kiramat, "Denial of Service Attack in Wireless LAN", in Proc of 12th ICDS 2018, Rome Italy.
- [36] M. Asam, K. Ghmman and Z. Haider, "Ubiquity of Healthcare System", in Proc of e-LIS [Preprint], Dec 2019, <http://eprints.rclis.org/39303/>
- [37] A Khalid, SA Butt, T Jamal, and S Gochhait, "Agile Scrum Issues at Large-Scale Distributed Projects: Scrum Project Development At Large", in International Journal of Software Innovation (IJSI), Vol 8, Issue 2, Pages: 85-94, IGI Global 2020.
- [38] S Gochhait, SA Butt, T Jamal, and A Ali, "Cloud Enhances Agile Software Development" Book Chapter in Cloud Computing Applications and Techniques for E -Commerce, Pages: 28-49, IGI Global, 2020.
- [39] Zeeshan Haider, Tauseef Jamal, Muhammad Asam, Shariq Butt and Aleena Ajaz, "Mitigation of Wireless Body Area Networks Challenges using Cooperation", International Journal of Security and Its Applications (IJSIA), ISSN: 1738-9976(Print); 2207-9629(Online), NADIA, (2020), Vol. 14, No. 1, pp. 15-30.
- [40] M. Naeem, Tauseef Jamal, Jorge Diaz-Martinez, Shariq Aziz Butt and Nicolo Montesano, , "Trends and Future Perspective Challenges in Big Data", in Proc. Of The Sixth Euro-China Conference on Intelligent Data Analysis and Applications (ECC2019) Arad-Romania, March 2020.