

Smart City Vehicular Network Models Based On Iov Technology

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Abstract

The Internet, which is one of the biggest innovations altogether is a basic necessity of every human beings. In the current scenario the smart transportation can be viewed by integrating IoT with connecting vehicular technology. Though the concept of connected vehicles, talking cars, driver-less cars present from many years, research and development is still in progress. The substantial performance focusses the road safety, comfortable drive, maximizing fuel efficacy, reduction in traffic jamming and accidents. This paper presents the application, challenges and issues related to smart city setting in associated vehicles with IoV models.

Keywords: IoT, Internet of Vehicles, Smart city, Vehicular Network.

1. INTRODUCTION

Since there is a tremendous increase in the population density in cities, there is a requirement of sub-structures and basic amenities to fulfill the requirement of citizen living in the city environment. The fast growth of information technology (IT) has carried onward in internet connected world in which items are well communicated to the mobile devices and there is well intercommunication exists between them. In current century, everyone is required to be connected universally and the same happens in every aspect of living hood and also across different cities from place to place. The core module of this overexcited connected the world is IoT [1, 2], which is also mentioned to as Internet of Everything (IoE). In the creation of a smart city, an intelligent transportation system (ITS) may be thought to be the most critical function given the fabrication of vehicles and the continuous development of road-networks. During the past years, the number of vehicles in the city increased faster than the population [3]. Thus, ITS is helpful both in terms of increasing the effectiveness of traffic management, as well as providing interesting applications for a smart city. Based on the growing technologies in the vehicular ad hoc networks (VANETs), vehicular networks may be raised both for vehicle-to-vehicle (V2V) communications and vehicle-to-infrastructure (V2I) communications [4], as well as for transmitting and integrating vital information connected to a city's process for stopping traffic jams and warning messages about obstacles in the road in VANET environment.

Vehicles are connected through wireless communication such that they can communicate with in-house as well as outdoor environments. The supporting interactions in connected vehicles are shown in Figure 1. The convergence of connected vehicles and IoT [5] is Internet of Vehicles (IoV). It includes communication of information, protection of environment, conservation of energy and safety which is a prominent parameter for everyone.

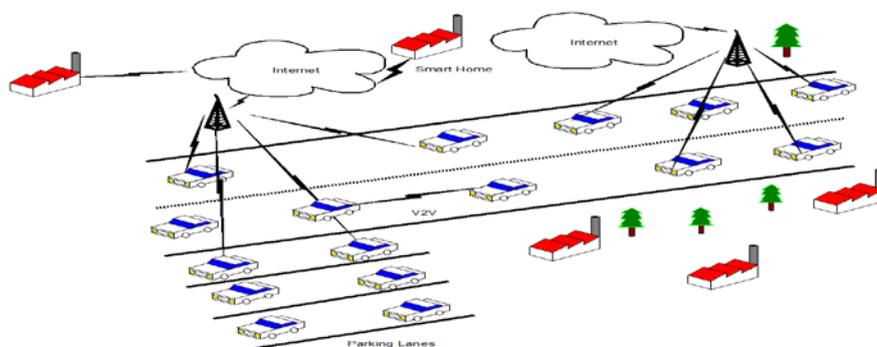


Figure 1: Architecture of Internet of Vehicles (IoV)

2. RELATED WORK

The various applications of IoT makes better living style of human beings. The study of previous literature shows that number of authors has suggested the key design issues and their implementation of IoT technology. Still, there is big difference between the IoT AP commercial IoT gateways. However, earlier literature discussed about a key difference between the communication technologies and classification useful to home automation.

The authors of [6] examined about home computerization framework dependent on web services. The web services are utilized to execute home checking highlight to electrical gadgets. The web framework required PC as a server that will expand the expense in keeping up with the equipment as well as software.

A remote system proposed in [7] through transmission control protocol and Internet protocol (TCP/IP) protocol through diminished equipment cost for controlling water temperature. However, the working technique for some sensors simultaneously is troublesome in light of the fact that the remote system controlling gadget needed to introduce an exceptional software that presents issue.

Because of the complexity of wired home computerization framework meets a few inconveniences, for example, the arrangement of correspondence lines among gadgets and the establishment of back-end frameworks in wire provisioning. These issues decline the interest of administrators in home automation framework because of cost.

The authors of [8] and [9] proposed a home door to observing the air poison and homecare applications for ZigBee networks and Ethernet networks. In any case, conventional AP didn't hold the functionalities of proposed ZigBee/Ethernet gateway. The gateway didn't furnish cell phone with Internet access, it can just trade detecting information or compliments between two gadgets over Internet or Intranet. The recommended IoT AP incorporates the functionalities of a gateway and an AP, not just supporting the office of Internet access for handheld gadgets yet additionally lessens the equipment expenses and energy utilizations as contrasted and the current gateway functionalities. The clients can distantly control home substances by advanced mobile phones without additional installation for Internet access by carried out IoT AP. Yuanpan Zheng et al, [10] proposed a certificateless group signature anonymous authentication scheme for the VANETs of a smart city. They have implemented the process of adding, signing, verifying, and revoking group members only by simple multiplication of the elliptic curve and synchronization factor technology, which shortens the length of the signature and improves the efficiency of the signature. Corresponding to the performance verification, this scheme has lower calculation overhead and higher authentication efficiency. Daming Li et al, [11] analyses the intelligent vehicle network system and smart city administration based on genetic algorithms and image insight. By using distributed and parallel computing, huge metropolitan data can be speedily stored, administered and analyzed, useful information can be obtained, which can support smart cities make actual decisions and improve the effectiveness of setup and resources use. The results demonstration that the proposed management approach can attain the minimum energy consumption scheduling, thus maximizing the benefits of the data center, therefore improving the urban road traffic capacity, and easing metropolitan traffic congestion.

In [12] authors had proposed remote sensor networks-based home robotization framework. The hardware cost is high in this framework since it's anything but an elite PC to design this one as a server. Gill et al. [13] proposed a low-power ZigBee wireless sensor network for shrewd life application. The three sorts of gadgets like lightning control, natural security framework and warming machine that have ZigBee correspondence capacities. This framework required a notebook to control ZigBee gadgets and remote access to construct a gateway through ZigBee and Wi-Fi communication capabilities, for example setting a criticism edge to the temperature sensors for inside wellbeing, setting the radiator temperature, and turning the light switch on/off.

The authors of [14] smart vehicle parking framework offers a complete leaving answer for the user just as the board of the leaving region. It offers the element for a held stopping space and perceive saved user. In this, user can explore to the close by leaving region subject to the size of the vehicle. The user can hold stopping opening dependent on hourly, every day, week by week or month to month premise. A calculation is intended to perceive the closest stopping as per the size. The portable application gave to the user is utilized to hold and pay-more only as costs arise administration. Ongoing advances in sensor networks, correspondence innovation, pervasive processing, computerized reasoning, and wireless sensor network (WSN) acquired force to the appropriation of IoT based applications [15]. Users applying the application through the Internet to control ZigBee gadgets. A

personal computer or notebook required the ZigBee gadgets to be joined for arranging and associating with the Internet that will expand the structure cost.

3. CHALLENGES AND ISSUES IN INTERNET OF VEHICLES

The Internet of Vehicle (IoV) is a vehicle that is equipped with Internet access, and can also connected with a wireless local area network (WLAN) just like connecting to a wireless network in a home or office which permits the vehicle to access internet service by other devices in inside as well as outside the vehicle. The vehicle is furthermore equipped with the technologies that tap into wireless LAN or the internet which provide services for information retrieval, improving traffic safety, increase in efficiency of traffic, implementing supervision and control and other features that will make millions of people take pleasure in more calm, appropriate and secure travel service. For safety region the vehicles will be connected with Dedicated Short Range Communication (DSRC) radios, which is operated at 5.9GHz band with very low latency.

The need of synchronization and communication among the vehicles is a major challenge to IoV implementation. V2V (vehicle to vehicle) communication, connection and scaling are difficult due to lack of standards in vehicular networks. The present system can be incorporated into an effectual arrangement for the downy distribution of information by adopting open standards. With the aid of effective IoV, the idea to add intelligence in automatic transportation drive system can become reality. The partnering across traditional boundaries are required both for technological innovation and business model innovation in this Internet era. A joint effort is needed to resolve barriers to build a sustainable environment by enforcing a plan for improving products, services and experience. Thus, the entire industrial chain can attain combined development.

In this paper we focus on implementation of an IoV based smart city in terms of safely usage of home appliances [16] and home security with the help of IoV shown in figure 2 and smart home with infection alert system protection.

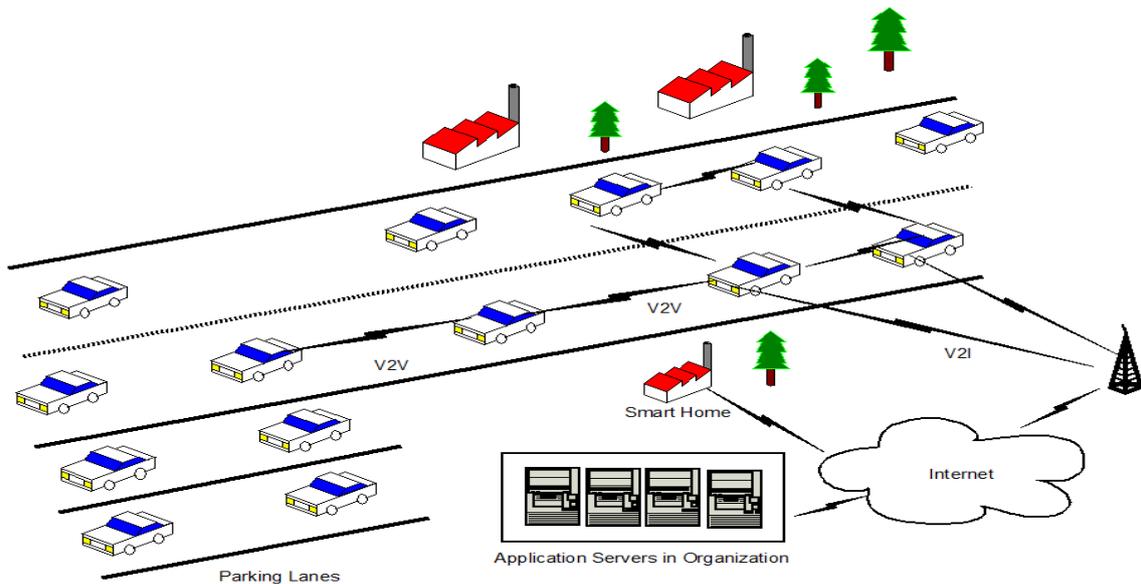


Figure 2: IoV implementation for Smart Home

4. SAFELY USAGE OF HOME APPLIANCES AND HOME SECURITY WITH THE HELP OF IOV

The vehicles are equipped with smart onboard chipset that connects the home Wi-Fi with the vehicle through Internet. Home appliances have sensors so that any undesired data can be recorded and immediately send to the vehicle on move or to smartphone of a user. Thus, smart home can be viewed by utilizing the relevant data produced by respective sensors [17]. Accordingly, the remedial action can be taken by the smart device. For

example, users can be warned by any unwanted happenings in the home by sending the corresponding signals sensed by the sensor. The IoV technology emphasizes to have home smarts that includes home appliances like smart TV, automated doors, home security system, lighting control, monitoring of temperature and detection of fire [18]. The sensors regularly monitor the conditions of home appliances and send the relevant data to a central controller at home which is Wi-Fi enabled. The central controller sends the data to the user through wireless network and it is also controlled from the outside of home [19].

5. SMART CITY IMPLEMENTATION MODELS BASED ON IOV

In recent times, various governments have been aiming to implement smart city based on IoT through the structure of a trial bed for IoT authentication and an incorporated infrastructure [20]. The government and administration should give emphasis based on Internet of Vehicle (IoV) in the implementation smart city models [21] so that a lot of physical problems can be handled without difficulty.

5.1. Smart Traffic Service

Leading smart traffic facilities comprise smart parking plan to stop unlawful vehicle parking, facilitate appropriate parking to the legal resident participation-oriented [22], avoiding unlawful parking, and smart harmless crosswalk facilities. Smart parking talk about to the building of a boards that facilitates real-time monitoring of available parking space and parking charges that need parking space and permit booking and payment can be done by using mobile and web networks. The resident participation-oriented unlawful parking avoidance facility is an enhancement of the unlawful parking restriction scheme of the traffic authority by permitting residents to suitable statement of traffic violations through their smartphones. Moreover, the smart safe crosswalk facility can contribute to the avoidance of ordinary accidents and vehicle accidents by identifying foot-travelers in kid’s protection areas, and informing walkers and approaching upcoming vehicles through electronic display board system.

5.2. Smart Car Parking System

In big cities, there has been a number of different vehicle parking spaces, e.g., for guests, public transports, office members, etc. Metropolitan parking has its place for housing and public car parking. Every day, people have to devote generally a lot of time to find a vacant vehicle parking space. This is an energy-wasting and timewasting exercise, but it may create traffic jams also. The intelligent smart city based vehicular parking facility proposed here, an effective use of vacant parking service area could be accomplished inside a smart city scenario.

Exclusive method to meet this is to have all vehicle parking space fitted out with a sensor which is capable to sense the existence of a vehicle in it shown in Figure 3. An information system working in the vehicle parking zone, intermittently gathers and aggregates the vehicle existence information from whole sensors installed in the zone or through other short-range wireless technology. In the situation of paid vehicle parking, noncompulsory parking meters could be activating among the information system and the sensors. As soon as the occupation place of a vehicle parking space is changed, information about changed parking space is pushed by the information system to the vehicle parking Information Centre via the smart city Intranet.

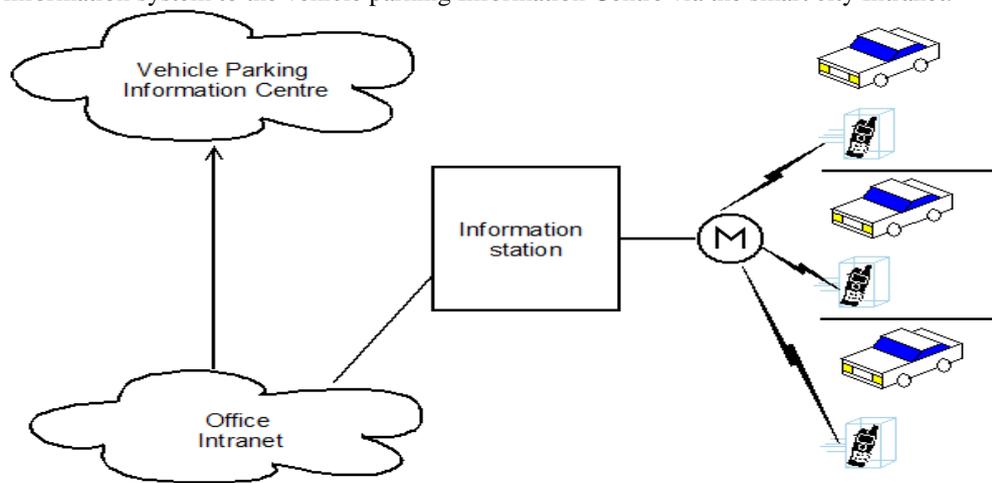


Figure 3: IoV based Smart Parking Service Implementation

5.3. Smart home with infection alert system Protection

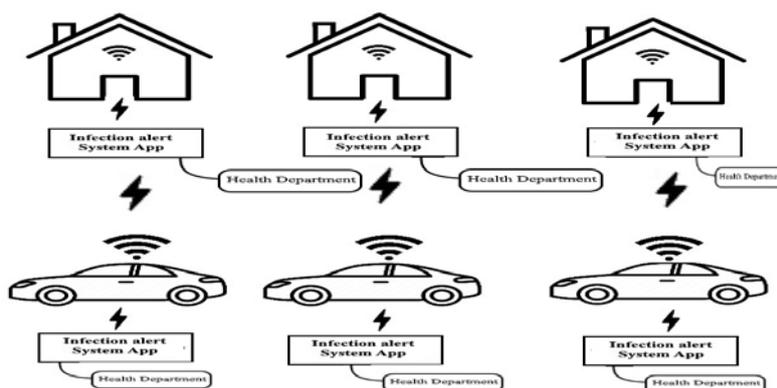


Figure 4: Smart home with infection alert system Protection

Figure 4. Shows that, each home is a smart home which has the facility to connect with the entire world with the help of the internet. Hence every smart home has the internet facility with the help of the Wi-Fi router installed on it. The smart home has the android based device that can install various smart apps for providing the all the facilities to its owner. With the help of these android based devices we can install the infection alert system apps [23]. Infection alert system app is a mobile based software that relying on tracking system that decide connection between an infected person and a user. In other words, we can say that it is the process to recognizing patients who may have in contact with the infected individual [24]. Infection alert system app is a mobile application to keep people up to date of their potential risk of infection alert system infection. The app uses a contact tracing mechanism with the help of Bluetooth technology. It shows details of all the person you have come in touch or contact with as you go about your daily routine’s activities. The infection alert system app will inform and alert you if any one of your contacts gets infected. This app also helps to provide you medical advisories affecting to the infection alert system pandemic.

This app can also identify potential hotspots near your location. It also provides the self-assessment test facility on the app, by correlating the symptoms that you report along with your location information, the app will be able to identify potential hotspots early enough. This will assist take essential mediations to control and mitigate the spread of infection alert system.

Every infection alert system Apps is connected with the health department so that health department can take appropriate action when needed and also track all the infected patients of infection alert system.

As we all know about the internet of vehicular network, it is the distributed network that provide the facility to create data with the help of connected cars and vehicular Adhoc networks (VANETs). Our system uses the facility of Vehicle to Infrastructure known as V2I system that provide the exchange of data or information wirelessly between vehicles and supporting infrastructure like smart home or rode side units (RSU) [25].

In our system Internet of Vehicular (IoV) also have the android based system in the Vehicle and installed infection alert system apps in it. With the help of internet, we can connect smart home to internet of Vehicles. After successfully connection with IoV to V2I, we can communicate with infection alert system apps and we can easily track the infected patients with the users. If any user has infection of infection alert system, we can make distancing from that patients.

Algorithm

Step 1: Install Router for internet in Smart home

Step 2: Install infection alert system Apps in Smart Home that has android based system and Internet facility.

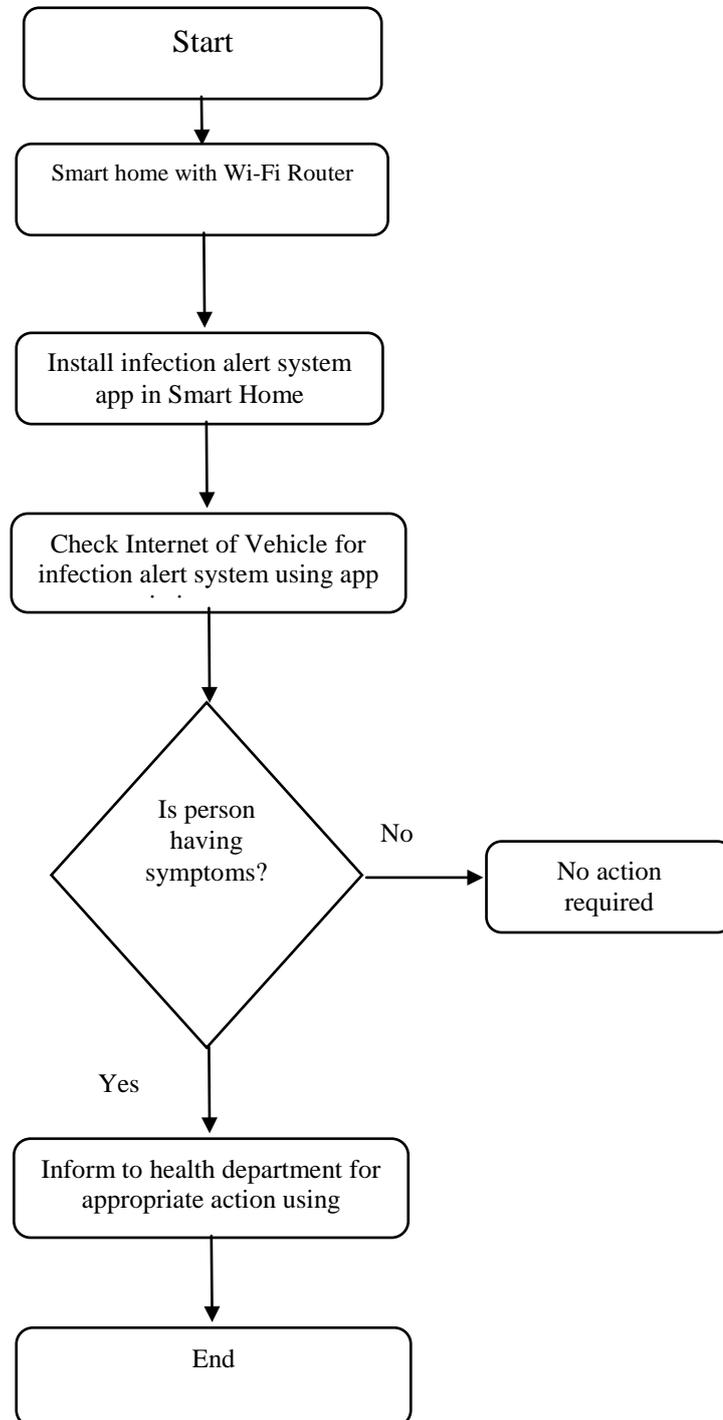
Step 3: Install infection alert system Apps in the vehicle that also has android based system and Internet facility

Step 4: With the help of router we can connect both the Smart home and the Internet of Vehicle in its range.

Step 5: we can identify about the infection of infection alert system with the help of the infection alert system.

Step 6- if any person has infection of infection alert system, it communicates the message to the smart home with the help of infection alert system.

Step 7: The message will also communicate to the health department so that appropriate action could take.



6. Conclusion

This study focuses on the convergence of connected vehicles and IoT that lead to Internet of Vehicles (IoV). It encompasses information communication, environmental protection, energy conservation and safety. The paper raises the challenges and issues in IoV implementation like lack of coordination and communication among the

vehicles and implementation of an IoV based smart city in terms of safely usage of home appliances, home security and smart home with infection alert system with the help of IoV is described and also the challenges faced in implementation of smart parking is explained.

References

- [1] Shancang Li, Li Da Xu & Shanshan Zhao. "The internet of things: A survey," Information Systems Frontiers, 17, pages243–259 2014. <https://doi.org/10.1007/s10796-014-9492-7>.
- [2] Luigi Atzori, Antonio Ierab, Giacomo Morabito. "The Internet of Things: A Survey, Computer Networks", 2010. Vol- 54, Issue 15, Pages 2787-2805. <https://doi.org/10.1016/j.comnet.2010.05.010>
- [3] J Joyce. Dargay, D Dermot. Gately, and M Martin. Sommer, "Vehicle ownership and income growth, worldwide: 1960-2030," The Energy Journal, vol. 28, no. 4, pp. 143–170, 2007. <https://www.iaee.org/en/publications/ejarticle.aspx?id=2234>
- [4] Ravi Shankar Shukla, Neeraj Tyagi, Ashutosh Gupta, Kamlesh Kumar Dubey. "A New Position Based Routing Algorithm for Vehicular Ad Hoc Networks", Telecommunication Systems., pages: 1-16, Springer US, 2015, ISSN: 1018-4864, DOI=10.1007/s11235-015-0130-6
- [5] European Commission, "Internet of things in 2020 road map for the future," Working Group RFID of the ETP EPOSS, Tech. Rep., May 2008. http://ec.europa.eu/information society/policy/rfid/documents/iotprague2_009.pdf [Accessed on: 2011-06-12].
- [6] A.R. Al-Ali; M. Al-Rousan . "Java-Based Home Automation System". IEEE Transactions on Consumer Electronics. 2004, 50, 498 – 504. DOI: 10.1109/TCE.2004.1309414
- [7] Juing-huei Su; Chyi-shyong Lee; Wei-chen Wu . "The Design and Implementation of a Low-Cost and Programmable Home Automation Module". IEEE Transactions on Consumer Electronics, 2006, 52, 1239–1244. DOI: 10.1109/TCE.2006.273139
- [8] Lucia Lo Bello; Emanuele Toscano. . "Coexistence Issues of Multiple Co-Located IEEE 802.15.4/ZigBee Networks Running on Adjacent Radio Channels in Industrial Environments". IEEE Transactions on Industrial Informatics. 2009, 5, 157–167. DOI: 10.1109/TII.2009.2018541
- [9] K. Shuaib; M. Boulmalf; F. Sallabi; A. Lakas. . "Co-Existence of ZigBee and WLAN, a Performance Study". In Proceedings of the 2006 IFIP International Conference on Wireless and Optical Communications Networks, 2006; pp. 1–6. DOI: 10.1109/WOCN.2006.1666534
- [10] Yuanpan Zheng, Guangyu Chen, Liguan Guo, "An Anonymous Authentication Scheme in VANETs of Smart City Based on Certificateless Group Signature", Complexity, vol. 2020, ArticleID 1378202, 7 pages, 2020, <https://doi.org/10.1155/2020/1378202>
- [11] Daming Li, Lianbing Deng, Zhiming Cai. Intelligent vehicle network system and smart city management based on genetic algorithms and image perception. Mechanical Systems and Signal Processing. Volume 141, 2020, 106623, Doi: 10.1016/j.ymsp.2020.106623
- [12] Guangming Song; Zhigang Wei; Weijuan Zhang; Aiguo Song. "Design of a Networked Monitoring System for Home Automation". IEEE Transactions on Consumer Electronics. 2007, 53, 933– 937. DOI: 10.1109/TCE.2007.4341568
- [13] Khusvinder Gill; Shuang-Hua Yang; Fang Yao; Xin Lu. . "A ZigBee-Based Home Automation System IEEE Transactions on Consumer Electronics . . 2009, 55, 422–430. DOI: 10.1109/TCE.2009.5174403
- [14] J. Cynthia, C. Bharathi Priya, P. A. Gopinath. IOT based Smart Parking Management System. International Journal of Recent Technology and Engineering, 6, (2018) <https://www.ijrte.org/wp-content/uploads/papers/v7i4s/E1996017519.pdf>
- [15] Ejaz, W Waleed.; Basharat, M Mehak.; Saadat, S Salman.; Khattak, A.M Asad Masood.; Naeem, M. Muhammad; Anpalagan, A Alagan. Learning paradigms for communication and computing technologies in IoT systems. Computer Communications. 2020, 153, 11–25. <https://doi.org/10.1016/j.comcom.2020.01.043>
- [16] Valentina Cecchi, and Arindam Mukherjee. "A Survey of Communications and Networking Technologies for Energy Management in Buildings and Home Automation". *Journal of Computer Networks and Communications*. 2012, 2012, 932181. <https://doi.org/10.1155/2012/932181>
- [17] Miadreza Shafie-khah; Ehsan Heydarian-Forushani; Gerardo J. Osório; Fábio A. S. Gil; Jamshid Aghaei; Mostafa Barani and João P. S. Catalão. Optimal Behavior of Electric Vehicle Parking Lots as Demand Response Aggregation Agents. IEEE Trans. Smart Grid 2016, 7, 2654–2665. DOI: 10.1109/TSG.2015.2496796
- [18] Stratigea, A. The concept of "smart cities". Towards community development? Netcom. Réseaux Commun. Territ. 2012, 26-3/4, 375– 388. <https://doi.org/10.4000/netcom.1105>
- [19] Xu Li; Rongxing Lu; Xiaohui Liang; Xuemin Shen; Jiming Chen; Xiaodong Lin.-Smart community:

- An internet of things application. IEEE Communications Magazine. 2011, 49, 68–75.
DOI: 10.1109/MCOM.2011.6069711
- [20] Aditya Gaur, Bryan Scotney, Gerard Parr, SallyMcClean. Smart city Architecture and its applications based on IoT, Procedia computer science, (2015), Vol.52, pp.1089-1094.
<https://doi.org/10.1016/j.procs.2015.05.122>
- [21] D. Pavithra; Ranjith Balakrishnan. "IoT based Monitoring and Control System for Home Automation." In proceedings of 2015 Global Conference on Communication Technologies (2015).
DOI: 10.1109/GCCT.2015.7342646
- [22] Antoine Bagula, Lorenzo Castelli, and Marco Zennaro. On the design of smart parking networks in the smart cities: An optimal sensor placement model, Sensors, (2015), Vol.15, No.7, pp.15443-15467.
<https://doi.org/10.3390/s150715443>
- [23] https://en.wikipedia.org/wiki/COVID-19_apps
- [24] https://en.wikipedia.org/wiki/Digital_contact_tracing
- [25] <https://whatis.techtarget.com/definition/Internet-of-Vehicles>

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