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ARTIFICIAL INTELLIGENCE FOR SMART ENERGY INFRASTRUCTURES FOR NEXT GENERATION SMART CITIES

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Abstract : With the expansion of smart meters, like the Advanced Metering Infrastructure (AMI), and the Internet of Things (IoT), each smart city is equipped with various kinds of electronic devices. Therefore, equipment and technologies enable us to be smarter and make various aspects of smart cities more accessible and applicable. The goal of the current paper is to provide an inclusive review on the concept of the smart city besides their different applications, benefits, and advantages. In addition, most of the possible IoT technologies are introduced, and their capabilities to merge into and apply to the different parts of smart cities are discussed. The potential application of smart cities with respect to technology development in the future provides another valuable discussion in this paper. Meanwhile, some practical experiences all across the world and the key barriers to its implementation are thoroughly expressed. Health monitoring and remote diagnosis can be realized through Smart Healthcare. In view of the existing problems such as simple measurement parameters of wearable devices, huge computing pressure of cloud servers, and lack of individualization of diagnosis, a novel Cloud-Internet of Things (C-IOT) framework for medical monitoring is put forward. Methods.

Smart phones are adopted as gateway devices to achieve data standardization and preprocess to generate health gray-scale map uploaded to the cloud server. The cloud server realizes the business logic processing and uses the deep learning model to carry out the gray-scale map calculation of health parameters. A deep learning model based on the convolution neural network (CNN) is constructed, in which six volunteers are selected to participate in the experiment, and their health data are marked by private doctors to generate initial data set. Results. Experimental results show the feasibility of the proposed framework. The test data set is used to test the CNN model after training; the forecast accuracy is over 77.6%. Conclusion. The CNN model performs well in the recognition of health status. Collectively, this Smart Healthcare System is expected to assist doctors by improving the diagnosis of health status in clinical practice. In This research author are going to develop and Modify CNN algorithm, by using this the private doctor evaluates the user's health condition according to the data on the cloud server and establishes the initial data set. The cloud server uses the deep learning algorithm (CNN) to train the user health evaluation model according to the initial data set. The newly uploaded data are calculated by a depth model to automatically give health assessment results. The model is a process of dynamic change. The private doctor will manually evaluate the users' health status and update the user data set on a regular basis as well as the parameter values of the depth model. The model can realize personalized health

IndexTerms **- cloud platform; Internet of Things (IoT); smart city; demand response, smart cities; machine learning; sensor networks; artificial intelligence; healthcare**

1. INTRODUCTION

1.1. Concepts

Because of the rapid rise of the population density inside urban environments, substructures and services have been needed to supply the requirements of the citizens. Accordingly, there has been a remarkable growth of digital devices, such as sensors, actuators, smartphones and mart appliances which drive to vast commercial objectives of the Internet of Things (IoT), because it is possible to interconnect all devices and create communications between them through the Internet [1]. In the past, it was difficult or even impossible to combine these digital devices. Likewise, gathering their information for day-to-day management of activities and long-term development planning in the city is essential. For example, some public transport information, e.g., real-time location and utilization, occupancy of parking spaces, traffic jams, and other data like weather conditions, air and noise pollution status, water contamination, energy consumption, etc. should be gathered continuously. To this end, different technologies have been applied to address the specific features of each application. The required technologies cover a wide range and layer from the physical level to the data and application layers. One of these technologies, proposed in [2], considered a two-way together by global grid infrastructures. IoT can be typically defined as a real object, largely dispersed, with low storage capabilities and processing capacities, while aiming at enhancing reliability, performance and security of the smart cities as well as their infrastructure [3]. On this basis, in the present paper, a survey of the IoT-based smart cities information from related reports is conducted. The IoT consists of three layers, including the perception layer, the network layer, and the application layer, as shown in Figure 1. The perception layer includes a group of Internet-enabled devices that are able to perceive, detect objects, gather information, and exchange information with other devices through the Internet communication networks. Radio Frequency Identification Devices (RFID), cameras, sensors, Global Positioning Systems (GPS) are some examples of perception layer devices. Forwarding data from the perception layer to the application layer under the constraints of devices' capabilities, network limitation and the applications' constraints is the task of the network layer. IoT systems use a combination of short-range networks communication technologies such as Bluetooth and ZigBee which are used to carry the information from perception devices to a nearby gateway based on the capabilities of the communicating parties [4]. Internet technologies such as WiFi, 2G, 3G, 4G, and Power Line Communication (PLC) carry the information over long distances based on the application. Since applications aim to create smart homes, smart cities, power system monitoring, demand-side energy management, coordination of distributed power storage, and integration of renewable energy generators, the last layer which is the application layer, is where the information is received and processed. Accordingly, we are able to design better power

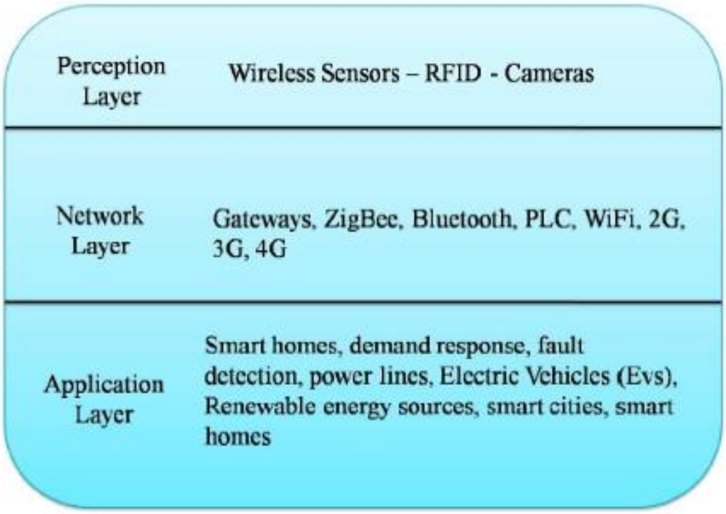

Figure 1.1 IoT Different layers.

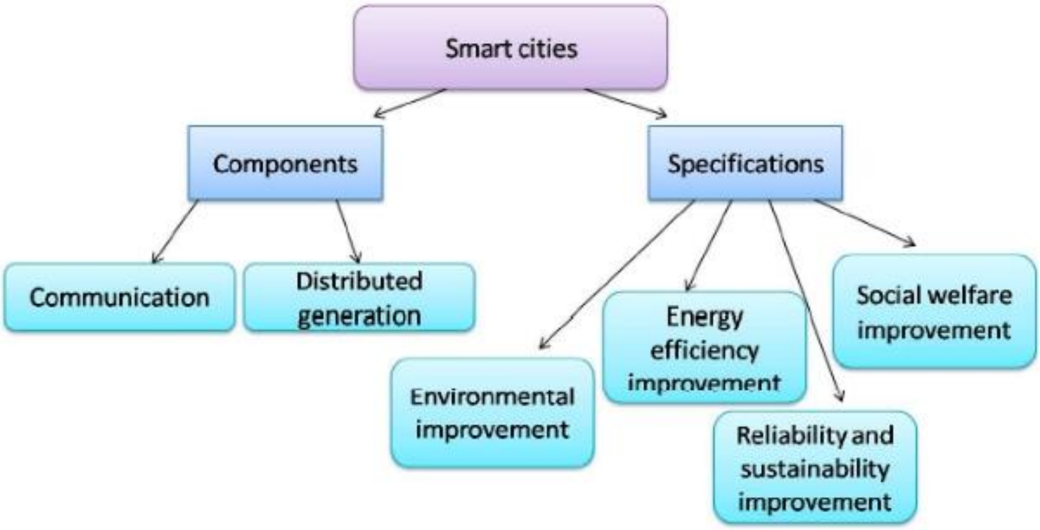

Figure 1.2. The key aspects of smart cities.

In an IoT environment, devices can be aggregated according to their geographical position and also assessed by applying analyzing systems. Sensor services for gathering specific data are utilized with some ongoing projects regarding the monitoring of each cyclist, vehicle, parking lot and so forth. There have been a lot of service domain applications which utilize an IoT substructure to simplify operations in air and noise pollution control, the movement of cars, as well as surveillance and supervision systems. The developments on the Internet provide a substructure that enables a lot of persons to interlink with each other. The following development on the Internet may make it more applicable to arrange proper interlinks between objects. In 2011, the number of interconnected things was far higher than the amount of population [8]. Figure 3 shows the interconnection among the various objects based on the IoT [8]. Consequently, providing IoT improves cities and affects the different features of humans' life by creating cost-effective municipal services, enhancing public transformation, reducing traffic congestion, keeping citizens safe and healthier. Moreover, it plays a vital role in the national level associated with policy making (e.g., energy conservation and pollution reduction), monitoring systems, and needed infrastructures. Thus, it helps to supply a system with more efficiency, lower cost and more secure operation through energy conservation rules, economic attention as well as reliability level. In personal and home applications, it can provide not only virtual entertainment but also real friendships. Controlling appliances like refrigerators and washing machines by IoT makes houses offer better energy management. Through the expansion of body area networks at home, it is possible to monitor the health situation of the elderly in their house, and this reduces treatment costs. Social networking applications like Facebook can collect the people of a city for an event or ceremony. It is helpful for making a connection with self-created communities either in texting, video or voice framework.

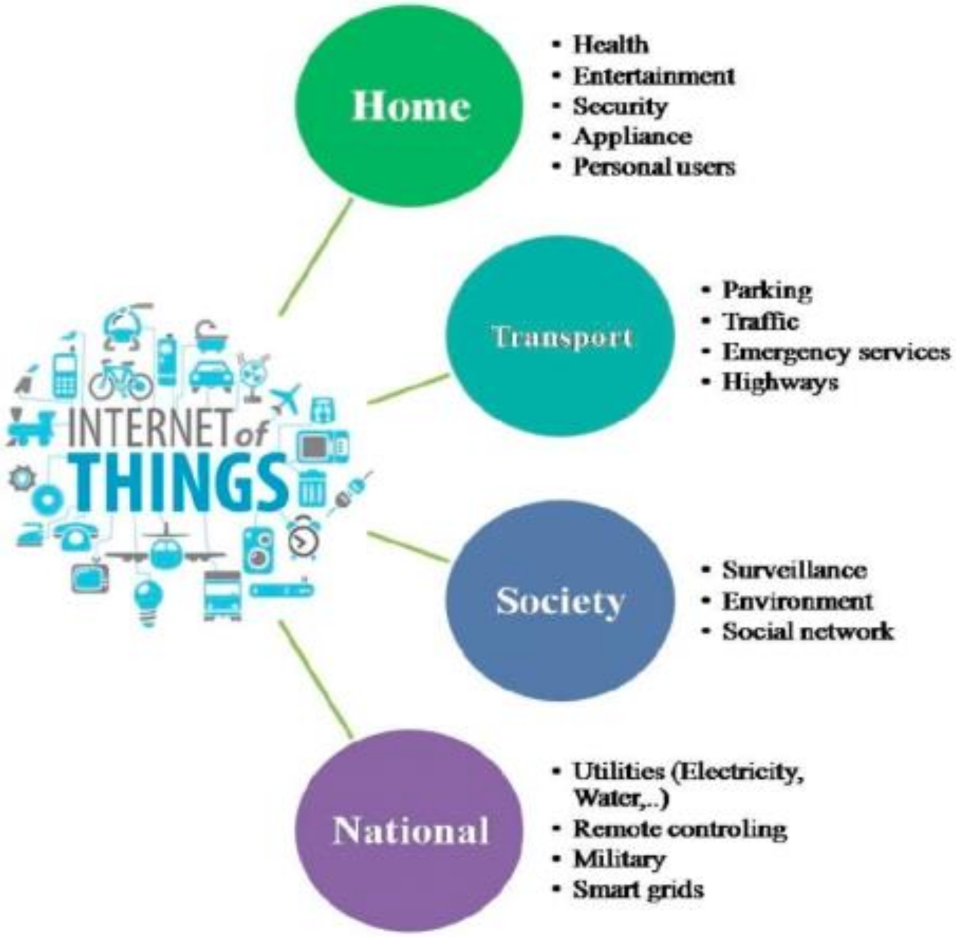

Figure 1.3 IoT-based linkages

1.2 IoT Technologies for Smart Cities

The IoT is a broadband network which employs standard communication protocols [10], whereas the Internet would be its convergence point. The major notion of the IoT is the widespread existence of objects which are able to be measured and inferred, as well as it is able to modify the situation. Accordingly, IoT is empowered by the expansion of several things and communication equipment. Things in the IoT involve smart equipment such as mobile phones and other facilities including foodstuff, appliances and landmarks [12] that can collaborate to achieve a joint objective. The main characteristic of the IoT is its effect on consumers´ life [7]. In the concept of IoT, since the cabling cost for millions of sensors is expensive, the communication between sensors should be wireless. Low-power standard communication is suitable for interconnection among many devices. According to location and distance coverage, some networks are introduced as follows.

1. Home Area Networks (HAN) which use short-range standards like, ZigBee, Dash7, and Wi-Fi. All monitoring and control components in a home are connected by the HAN.
2. Wide Area Networks (WAN), provide communication between customers and distribution utilities which require much broader coverage than HAN and for implementation needs fiber cable or broadband wireless like 3G and LTE.
3. Field Area Networks, which are used for connection between customers and substations [5].

1. 2.1. Radio-Frequency Identification (RFID)

RFID including readers and tags has a vital task in the framework of the IoT. Employing the technologies on each related thing, accomplishing their automatic identification and dedicating the single digital identity to any of the things will be possible, to include the network associated with the digital information and services [13]. RFID provides some applications in smart grids, including tracking and localization of objects, healthcare applications, parking lots and asset management. Each tag can be as a sensor because they have not only data which is written manually but also capture data like environmental information.

1.2.2. Near Field Communication (NFC)

Near Field Communication (NFC) is used for bidirectional short distance communication, especially in smart-phones. This range usually involves a centimeter range. The application of NFC in smartphones enables us to use it in smart cities, as well. One of its applications includes using smartphones with NFC as a wallet which enables us to use smartphones as our personal cards such as bank card, identification card, public transportation card, access control cards. Moreover, since NFC is bi-directional, it can be used to share data between devices, multimedia, and documents [5]. By placing NFC at a strategic position at the house and providing an interface with the central controller, it is possible to change the status of objects by checking the location for example switch on the Wi-Fi when the user comes home.

1.2.3. Low Rate Wireless Personal Area Network (LWPAN)

LWPAN is amongst short-range radio technology that covers large distances of up to 10–15 km. The energy consumption of this technology is extremely low and battery lifetime is about 10 years [2]. According to the IEEE 802.15.4 standard, it provides low cost and low-rate communication for sensor networks. It has the lowest two layers of protocols including physical and medium access level, besides upper layers protocols including 6LoWPAN and ZigBee [14].

1.2.4. Wireless Sensor Networks (WSNs)

WSNs make diverse proper data available and might be applied in lots of uses like healthcare, as well as government and environmental services [12]. Moreover, WSNs can be aggregated with RFIDs to obtain several targets such as gaining data related to the position of people and objects, movement, temperatures, etc. A WSN consists of wireless sensor nodes which include a radio interface, an analog-to-digital converter (ADC), multiple sensors, memory and a power supply [5]. The different parts of a wireless sensor node are illustrated in Figure 4. According to the wireless sensor node framework, it includes various kinds of sensors which measure data in analog format which are converted to digital data through an ADC. Some procedures are processed on the data through a memory and microcontroller according to data requirements. Finally, data are transmitted by a radio interface. All of this equipment needs to be equipped with a power supply.

1.2.5. 3G and Long Term Evolution (LTE)

3G and LTE are standards for wireless communication for mobile phones and data terminals. Regarding the development and expansion of wireless communication infrastructures, LTE and 3G are available everywhere, even in third world countries. This technology is for broadband Connectivity and was not designed for short range uses. Hence, it is applied for WANs which require longer distance ranges. Nevertheless, there are some barriers to their implementation that should be A completed WSN is an extremely tiny low-power, low-cost sensor node which can be applied in any environment and works continuously for a few years. In reality, this utopic WSN has not been realized. WSN has severe source constraints like reliance on battery life. With a large number of sensor nodes in smart cities, replacing or recharging their batteries is infeasible. Designing a protocol for sophisticated power management schemes like solar panels is essential for WSN power sources.

1.2.6. Dash7

Dash 7 is a promising standard for WSNs used in long distance and low power sensing applications such as building automation and logistics. This protocol is for kilometer-distance range and operates at 433 MHz which not only has better penetration through walls than 2.4 GHz but is also appealing for HANs. It is worth noticing that Dash is very attractive in military application especially substation construction. Some of its applications are hazardous material monitoring, manufacturing and warehouse optimizations and smart meter development [16].

1.2.7. Addressing

The Internet empowers a significant interconnection among persons, and similarly, the current tendency in the IoT creates an interconnection of things and stuff, for providing smart environments [8]. For this purpose, the ability of exclusively identifying devices and things is essential for desirable results of the IoT. The reason behind this is the fact that exclusively addressing the large-scale mixture of things is crucial to control them through the Internet. Besides the expressed exclusivity idea, reliability, scalability and strength indicate the main needs to establish an improved unique addressing structure [8].

1.2.8. Middleware

Due to several concerns regarding the heterogeneity of contributing objects, to the limited storage and process ability, along with to the huge different kinds of application, the middleware has a vital task in the interconnection of the things to the applications' layers. The main target of the middleware is to briefly aggregate the functionality and communication abilities of all included devices.

1.2.9. Smart Cities Platforms and Standards

The relationship between the physical and IT infrastructure constructs a novel machine-to-machine (M2M) communication for smart cities which along with new features of network drives smart cities' communication platforms. These platforms help to cover the communication requirements between heterogeneous access technologies and application suppliers. Moreover, these platforms help form the IoT with real world sensors and communication networks.

One of these platforms

1.3 Actual IoT Applications for Smart Cities

The IoT uses the Internet to merge various heterogeneous things. Accordingly and for providing the ease of access, all existing things have to be linked to the Internet. The reason behind this is that smart cities include sensor networks and connection of intelligent appliances to the internet is essential to remotely monitor their treatment such as power usage monitoring to improve the electricity usage, light management, air conditioner management. To get this aim, sensors are able to be extended at various locations to gather and analyze data for utilization improvement [3]. Figure 5 illustrates the major utilizations of the IoT for a smart city. The key aims in this field of knowledge are expressed in the following subsections.

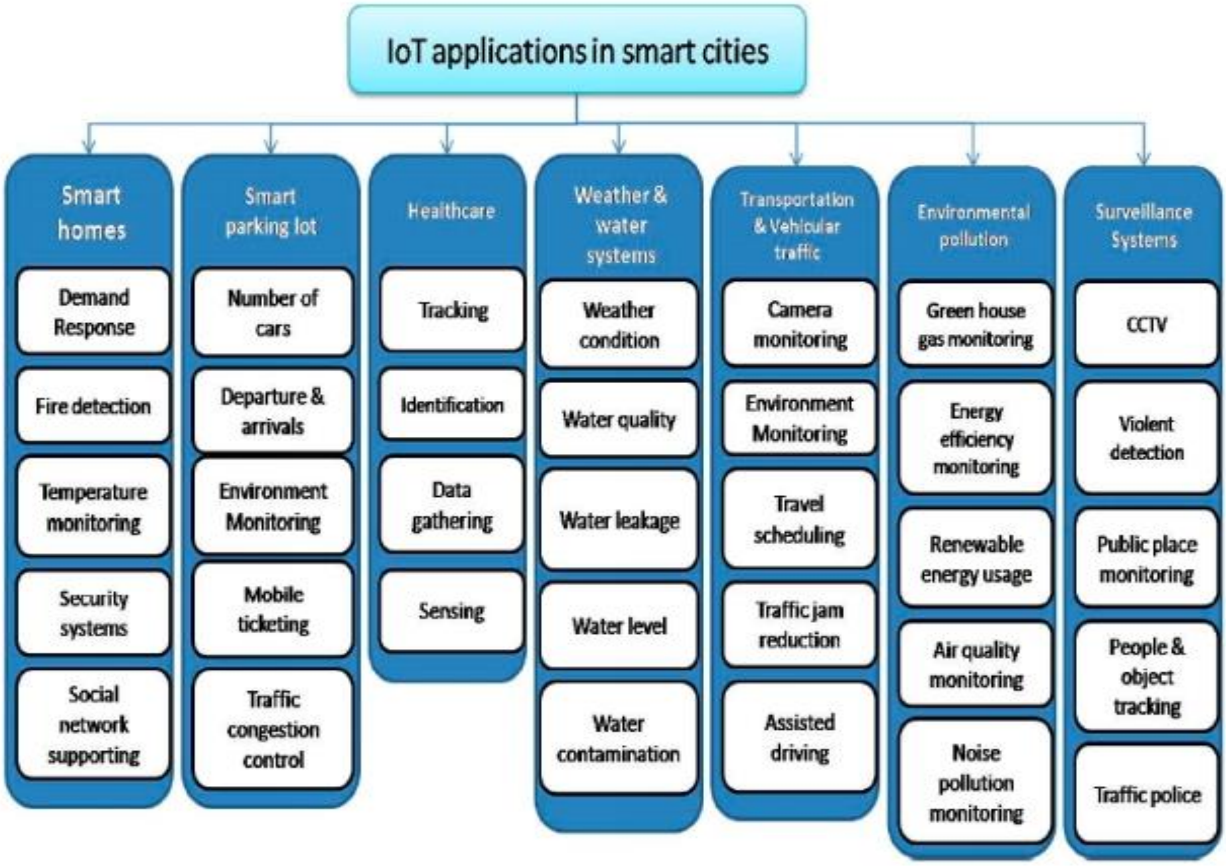

Figure 1.4. The main applications of the IoT.

1.4 What is Smart City?

In general, a smart city is a city that uses technology to provide services and solve city problems. A smart city does things like improve transportation and accessibility, improve social services, promote sustainability, and give its citizens a voice.

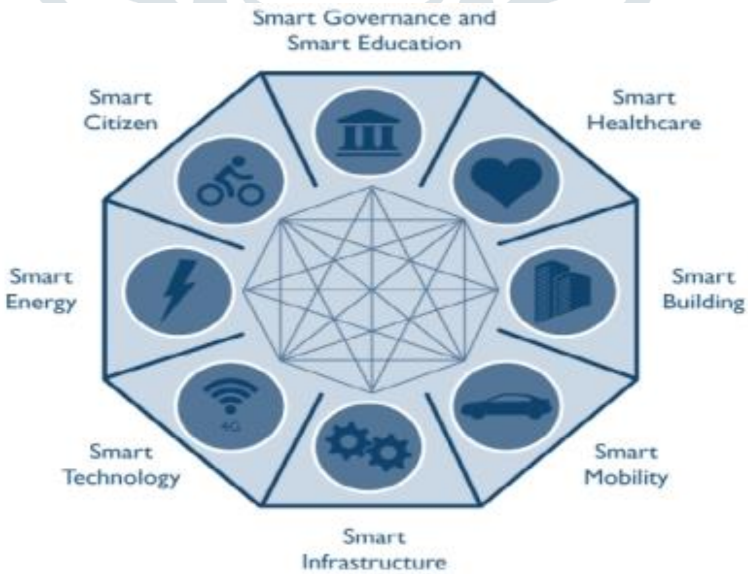

Figure 1.5. Smart City Applications

1.5 What is Internet of Things?

The Internet of Things connects devices such as everyday consumer objects and industrial equipment onto the network, enabling information gathering and management of these devices via software to increase efficiency, enable new benefits. The term was first proposed by Kevin Ashton, a British technologist, in 1999 when he was at MIT.

1.6 India AND IOT

- IoT architecture for India is dependent on social and entrepreneurial value applications, current technology advances and competencies that make IoT sustainable and affordable. Communication systems, data, city people and devices play crucial roles in the IoT ecosystem. To drive a sustainable and practical IoT business architecture following points should be considered –
- IoT has unique value proposition due to the direct interaction between "Things" and "Humans".
- To generate actions, which are driven by intelligence, it is important to capture interactions between "Humans" and "Things" in the physical and virtual worlds.
- Meaningful analytics, based on "Big" and "Little" data, done on information from multiple sources within IoT architecture helps in data driven decision making.
- Instead of going for massive deployment of sensor networks it is more advantageous to utilize symbiotic infrastructure and rely on existing widely adopted standards.
- ICT solutions with latest capabilities for advanced economies are less preferred over reusable sensors and devices.
- IoT provides great opportunities for entrepreneurship and innovation. It is important to ensure transparency in sharing, usage and data ownership and sharing. Availability of better operating models using data brokering, which encourages open data sharing by users with businesses.

2. LITERATURE SUVEY

2.1 Related work

In this section literature related to the IoT, smart cities, smart healthcare, blockchain and AI in the IoT is reviewed. Emerging trends in smart healthcare applications and key technological developments that have a direct impact in these transitions. The authors also reviewed different security considerations in smart healthcare systems and their consequences and counter measures [1].

It analyzed security and privacy issues in the IoT's application in smart cities and identified their proposed solutions. Authors tend to use graph theory for rectification of highlighted issues since the conventional approaches do not provide optimal results for security and safety critical systems [2].

Smart city systems as a whole and discuss how a smart healthcare system interacts and collaborates with smart city infrastructure and how it works for the healthcare field. Several case studies are also reviewed by the authors and they suggest how a more powerful, integrated and effective system can be built out of smart healthcare systems [3].

IoT technologies for smart cities and the main components and features of a smart city. The authors also explained practical experiences and challenges faced by implementers around the world. It presented a comprehensive survey of potential techniques and applications of collaborative drones with the IoT which have been recently used to enhance the smartness of smart cities based on data collection, privacy, security, public safety, disaster management, energy consumption and quality of life in smart cities [4].

It presented a comprehensive review of the applications of machine learning techniques for big data analysis in smart healthcare systems. The authors also highlighted several strengths and weaknesses for existing approaches with a special focus on research challenges in this aspect [5].

The proposed architecture claims to acknowledge the underlying problems of a clinic-centric healthcare system and change it to a smart patient-centric healthcare system. It presented a comprehensive review of the published surveys using deep learning-based methods for brain tumor classification, covering the main steps including preprocessing, features extraction, classifications, achievements and limitations. The authors also investigated state-of-the-art convolutional neural network models for BTC by performing extensive experiments using transfer learning with and without data augmentation [6].

2.2 Literature Survey

Monica Mundada et al. [1]: The main idea of this study to understand the development of Smart cities is a trending concept with a focus of development in urban areas from all edges. The primary aim of this research work, is concentrated for literature review on Smart Economy, Smart Environment, Smart Government, Smart Living, Smart Mobility, Smart People integrated with technology research themes with a key focus on data analytics approach towards sustainable development. Our conclusion reveals that a lot of research in smart cities is focused on prescriptive analytics, which indicates that smart cities initiatives aligned on taking the data analytics perspective for sustainable development in urban areas. Smart cities and sustainable development from the data analytics analytical research perspective. Along with identifying what are the new innovative methods in the above mentioned research themes, our study also tries to identify to what extent data analytics have been adopted into the research of smart cities with a key focus on sustainable development. Our findings indicate that high number of research articles are in prescriptive analytics, which is good sign as it will contribute to more accurate future analytics and adaptive measures for smart cities with a focus on sustainable development goals.

Yi Huang et al. [2]: This study has used the dataset of "Firewall" for validation purposes. The experimental results of the approach show that the hybrid deep learning model (based on convolution neural network and support vector machine) outperforms than decision1 rules and random forest by generating a recognition rate of 95.5% for the hybrid model, 68.5% for decision rules, and 78.3% accuracy for random forest. The validity of the proposed model is also tested based on other performance metrics such as f score, error rate, recall, and precision. This high accuracy rate and other performance values show the applicability of the proposed hybrid model to secure data traffic purposes in smart devices. This can be used in many research areas of the smart city for security purposes.

Hadi Habibzadeh et al. [3]: In this article, Author present a multi-faceted survey of machine intelligence in modern implementations. We partition smart city infrastructure into application, sensing, communication, security, and data planes and put an emphasis on the data plane as the mainstay of computing and data storage. We investigate (i) a centralized and distributed implementation of data plane's physical infrastructure and (ii) a complementary application of data analytics, machine learning, deep learning, and data visualization to implement robust machine intelligence in a smart city software core. We finalize our article with pointers to open issues and challenges.

Sriganesh K. Rao et al. [4]: This paper describes the concept of Smart Cities and enumerates its various benefits. It describes various Services and Applications required to make a City Smart and the role of ICT technologies in their implementation. Further, the challenges in the current ICT systems are discussed in their role to Smart City implementation. The paper discusses the proposed features of 5G technologies and describes how 5G could be the best answer for successful, implementation of Smart Cities. It lists down a few Smart City Use Cases which are enabled by 5G. 5G will act as the backbone of IoT and pave the way for the development of Smart Cities.

Jiaying Liu et al. [5]: In this paper, author study the evolution of AI at the beginning of the 21st Century using publication metadata extracted from 9 top-tier journals and 12 top-tier conferences of this discipline. We find that the area is in sustainable development and its impact continues to grow. From the perspective of reference behavior, the decrease in self-references indicates that AI is becoming more and more open-minded. The influential papers/researchers/institutions we identified outline landmarks in the development of this field. Last but not least, we explore the inner structure in terms of topics evolution over time. We have quantified the temporal trends at the topic level and discovered the inner connection among these topics. These findings provide deep insights into the current scientific innovations, as well as shedding light on funding policies.

Junaid Qadir et al. [6]: In the article ``Tensor voting techniques and applications in mobile trace inference'', have proposed the use of tensor voting techniques to address the tracking problem of inferring human mobility traces. While the use of tensor mathematics is common in math and physics, very little work has focused on the use of tensor techniques that have significant applications for the AI task of automatic inference and perceptual grouping in wireless networks. The human-tracking mobile trace inference problem is becoming increasingly important with the emergence of location- based networking services in modern life where smartphones are becoming the hub of interpersonal communication. The authors consider the mobile trace inference problem when the recorded location information is noisy and missing data and propose a tensor voting based approach that uses a sparse tensor voting algorithm.

Andreea Claudia et al. [7]: In this research work author exploit the recent developments on the AI adoption for RE sector in European Union (EU). In this respect, we analysed (i) the efficiency of the transformation processes of the RE within the energy chain from Gross Inland Consumption to Final Energy Consumption, (ii) its implications on the structure of renewable energy by source (solar, wind, biomass etc.), (iii) the labour productivity in RE sector compared to the economy as a whole and its correlation with investments level, (iv) the implication of the adoption of AI for RE towards Future Smart Cities Research. The main contribution of this research is the development of a framework for understanding the contribution of AI in the RE sector in Europe. Another bold contribution of this work is the discussion of the implications for Future Smart Cities Research and future research directions.

Andreea Claudia .Erban et al. [8]: This study is focus on one of the most challenging areas of Future Smart Cities Research is the Smart Energy domain. Critical issues related to optimization, provision of smart customizable networks and sophisticated computational techniques and methods enabled by artificial intelligence and machine learning need further investigation. The renewable energy (RE) is a powerful resource for the future global development in the context of climate change and resources depletion. Artificial intelligence (AI) implies new rules of organizing the activities in order to respond to these new requirements. It is necessary to improve the design of the energy infrastructure, the deployment and production of RE in order to face the multiple challenges that will affect the sector's growth and resilience. In this research work we exploit the recent developments on the AI adoption for RE sector in European Union (EU). In this respect, we analyzed (i) the efficiency of the transformation processes of the RE within the energy chain from Gross Inland Consumption to Final Energy Consumption, (ii) its implications on the structure of renewable energy by source (solar, wind, biomass etc.), (iii) the labor productivity in RE sector compared to the economy as a whole and its correlation with investments level, (iv) the implication of the adoption of AI for RE towards Future Smart Cities Research. The main contribution of this research is the development of a framework for understanding the contribution of AI in the RE sector in Europe. Another bold contribution of this work is the discussion of the implications for Future Smart Cities Research and future research directions.

İbrahim KÖK et al. [9]: In this research work author Internet of Things (IoT) concept has become a promising research topic in many areas including industry, commerce and education. Smart cities employ IoT based services and applications to create a sustainable urban life. By using information and communication technologies, IoT enables smart cities to make city stakeholders more aware, interactive and efficient. With the increase in number of IoT based smart city applications, the amount of data produced by these applications is increased tremendously. Governments and city stakeholders take early precautions to process these data and predict future effects to ensure sustainable development. In prediction context, deep learning techniques have been used for several forecasting problems in big data. This inspires us to use deep learning methods for prediction of IoT data. Hence, in this paper, a novel deep learning model is proposed for analyzing IoT smart city data. We propose a novel model based on Long Short Term Memory (LSTM) networks to predict future values of air quality in a smart city. The evaluation results of the proposed model are found to be promising and they show that the model can be used in other smart city prediction problems as well.

Chun Sing Lai et al. [10]: In this research work author work on Smart cities employ technology and data to increase efficiencies, economic development, sustainability, and life quality for citizens in urban areas. Inevitably, clean technologies promote smart cities development including for energy, transportation and health. The smart city concept is ambitious and is being refined with standards. Standards are used to help with regulating how smart cities function and contributing to define a smart city. Smart cities must be officially recognized by national and international authorities and organizations in order to promote societal advancement. There are many research and review articles on smart cities. However, technical standards are seldom discussed in the current literature. This review firstly presents the study of smart city definitions and domain. The well-known smart city standards will be presented to better recognize the smart city concept. Well-defined standards allow meaningful comparisons among smart cities implementation. How smart city initiatives make a city smarter and improve the quality of life will be discussed for various countries. This review highlights that technical standards are important for smart cities implementation. This paper serves as a guide to the most recent developments of smart cities standards.

Saiyan Cheng et al. [11]: The study focus on artificial intelligence (AI) is highly inter disciplinary, which involves increasing number of researchers from different academic fields. In order to provide an overview for the researchers on recent publications in related fields, we conducted a statistic analysis using bibliometric methods. Using the data source from Web of Science (ISI), we have studied the articles published in the SCI and SSCI journals on the subject of AI between the year of 2000 and 2011. The data were analyzed from six aspects, including article distribution by years, journals, languages, countries/regions, research fields, and authors. The result revealed the most influential journals, language and authors in this field, which could help researchers from the related area to find useful information and direct their researches.

Eisley Dizon et al. [12]: This paper presented the utilities of a streetlights in Sheffield and how different councils tackle the issue by using different lighting schemes. Investigation of current implementations of information and communication technologies (ICT) such as Internet of Things (IoT) in streetlights will be necessary to understand different proposed models that are used in 'smart' street lighting infrastructure. Case studies from Doncaster and Edinburgh are explored as they are using similar technology and having a similar sized topology as Sheffield. To analyze different models, Streetlights, an open-source streetlight simulator, is used to present different lighting schemes. There will be four time-based schemes: Conventional, Dynadimmer, Chromosomes and Part-Night which have varying capabilities that will be simulated to present a plethora of solutions for Sheffield's street lighting problem. The results from the simulations showed mixed readings, the time-based schemes showed reliable data from Street light Sims own evaluations, however its adaptive approach will need to be further analyzed to demonstrate its full capability.

Luminita Hurbean et al. [13]: In this research work author focus on Machine learning (ML) has already gained the attention of the researchers involved in smart city (SC) initiatives, along with other advanced technologies such as IoT, big data, cloud computing, or analytics. In this context, researchers also realized that data can help in making the SC happen but also, the open data movement has encouraged more research works using machine learning. Based on this line of reasoning, the aim of this paper is to conduct a systematic literature review to investigate open data-based machine learning applications in the six different areas of smart cities. The results of this research reveal that: (a) machine learning applications using open data came out in all the SC areas and specific ML techniques are discovered for each area, with deep learning and supervised learning being the first choices. (b) Open data platforms represent the most frequently used source of data. (c) The challenges associated with open data utilization vary from quality of data, to frequency of data collection, to consistency of data, and data format. Overall, the data synopsis as well as the in-depth analysis may be a valuable support and inspiration for the future smart city projects.

Hoe-Han Goh et al. [14]: In this research work author focus on Artificial intelligence which is producing a revolution with increasing impacts on the people, planet, and prosperity. This perspective illustrates some of the AI applications that can accelerate the achievement of the United Nations Sustainable Development Goals (SDGs) and highlights some of the considerations that could hinder the efforts towards them. In this context, we strongly support the development of an 18thSDG on digital technologies. This emphasizes the importance of establishing standard AI guidelines and regulations for the beneficial applications of AI. Such regulations should focus on concrete applications of AI, rather than generally on AI technology, to facilitate both AI development and enforceability of legal implications.

Xiuming Liu et al. [15]: In this paper, author present a distributed machine learning framework for IoT in smart cities. It enables machine learning algorithms to be run on heterogeneous nodes with different capabilities, including end devices, edge devices, and the cloud. We first describe a distributed machine learning-assisted framework for network management in IoT for smart cities. We then provide a case study of urban monitoring using vehicular sensor network. A secure and distributed information fusion scheme based on statistical machine learning is proposed. Finally, we discuss potential extensions on scalable computation and other distributed machine learning methods for large scale networks.

Roozbeh Jalali et al. [16]: In this paper author proposed a cloud based general architecture for smart cities that allows the community service providers, city management and citizens to access the real time data which has been gathered from the city through IoT to ensure the provision of essential services and improved quality of life for city inhabitants. In future work we will demonstrate an extended version of this architecture through the integration of Apollo, a remote monitoring approach demonstrated within the context of monitoring neonatal intensive care unit graduates in the home.

Mangmang Geng et al. [17]: This paper designs and implements the bionic robot which is as an implementation of soldiers in the strategy game, and the robot has three parts: perception system, target and path system and decision-making system .The perception system is responsible for perceiving information inside the scene; the target and path system is to find the best position for attacking and the optimal path for the robot; the decision-making system determines the behavior of the robot in the next frame. This paper also introduces map information updated in real time in the game. The bionic robot system designed has a good expansibility, and soldiers of different arms using this system, the game is running well.

Pramathi J Navarathna et al. [18]: This paper highlights some major technologies and solutions to various problems faced by the citizens due to lack of digitization. It features issues relating to infrastructure of the city, public safety, security and provides optimal solutions for the same. It emphasizes not only on AI, but also on the application of Internet of Things (IoT), deep learning, machine learning, pattern recognition, Big Data Analytics and Cloud Infrastructures in developing a fully functional smart city**.**

Rozeha A. Rashid et al. [19]: This paper proposes a smart energy monitoring system for home appliances incorporating CIoT which consists of three parts. Firstly, a Raspberry Pi-based smart plug serving as the gateway, that is able to read current data from individual home appliances, load the trained model from training server and test the verified data using the model. Secondly, Google Colab as the training server will be used to store the training data set and building the Tensor flow-based Long Short-term Memory (LSTM) model. This recurrent neural network model will forecast electricity bill and notify users if abnormal energy consumption of individual home appliances is detected.

Miguel Castro et al. [20]: In this research work author focus on Smart cities play an increasingly important role for the sustainable economic development of a determined area. Smart cities are considered a key element for generating wealth, knowledge and diversity, both economically and socially. A Smart City is the engine to reach the sustainability of its infrastructure and facilitate the sustainable development of its industry, buildings and citizens. The first goal to reach that sustainability is reduce the energy consumption and the levels of greenhouse gases (GHG). For that purpose, it is required scalability, extensibility and integration of new resources in order to reach a higher awareness about the energy consumption, distribution and generation, which allows a suitable modelling which can enable new countermeasure and action plans to mitigate the current excessive power consumption effects. Smart Cities should offer efficient support for global communications and access to the services and information. It is required to enable a homogenous and seamless machine to machine (M2M) communication in the different solutions and use cases. This work presents how to reach an interoperable Smart Lighting solution over the emerging M2M protocols such as CoAP built over REST architecture. This follows up the guidelines defined by the IP for Smart Objects Alliance (IPSO Alliance) in order to implement and interoperable semantic level for the street lighting, and describes the integration of the communications and logic over the existing street lighting infrastructure.

Jeannette Chin et al. [21]: This paper explores the potential of Machine Learning (ML) and Artificial Intelligence (AI) to lever Internet of Things (IoT) and Big Data in the development of personalized services in Smart Cities. We do this by studying the performance of four well-known ML classification algorithms (Bayes Network (BN), Naïve Bayesian (NB), J48, and Nearest Neighbor (NN)) in correlating the effects of weather data (especially rainfall and temperature) on short journeys made by cyclists in London. The performance of the algorithms was assessed in terms of accuracy, trustworthy and speed. The data sets were provided by Transport for London (TfL) and the UK MetOffice. We employed a random sample of some 1,800,000 instances, comprising six individual datasets, which we analyzed on the WEKA platform.

Ioannis Antonopoulos et al. [22]: The papers are classified with regards to both the AI/ML algorithm(s) used and the application area in energy DR. Next, commercial initiatives are presented (including both start-ups and established companies) and large-scale innovation projects, where AI methods have been used for energy DR. The paper concludes with a discussion of advantages and potential limitations of reviewed AI techniques for different DR tasks, and outlines directions for future research in this fast-growing area.

M. Fouad et al. [23]: In this article author have clarified the complementarity, synergy and correlation between the field of ML for prediction, the IoT for information collection and the SG intelligent network which ensures the transfer of electrical energy in two-way and agile communication between all stakeholders in the network. In addition, we proposed a simplified model made up of five layers (IoT, Electrical, Communication, Information, Artificial Intelligence) grouped into three entities (IoT, Smart Grid, Machine Learning) and linked with four relationships (Sensing, Actuating, Training, Forecasting) which facilitates the understanding of the interaction between all the elements constituting our study

Himanshu Sharma et al. [24]: In this research work author work on smart cities, the major IoT applications are smart traffic monitoring, smart waste management, smart buildings and patient healthcare monitoring. The small size IoT nodes based on low power Bluetooth (IEEE 802.15.1) standard and wireless sensor networks (WSN) (IEEE 802.15.4) standard are generally used for transmission of data to a remote location using gateways. The WSN based IoT (WSN-IoT) design problems include network coverage and connectivity issues, energy consumption, bandwidth requirement, network lifetime maximization, communication protocols and state of the art infrastructure. In this paper, the authors propose machine learning methods as an optimization tool for regular WSN-IoT nodes deployed in smart city applications. As per the author's knowledge, this is the first in-depth literature survey of all ML techniques in the field of low power consumption WSN-IoT for smart cities. The results of this unique survey article show that the supervised learning algorithms have been most widely used (61%) as compared to reinforcement learning (27%) and unsupervised learning (12%) for smart city applications.

Arunmozhi Manimuthu et al. [25]: In this paper, author address the technology-driven applications that are capable of influencing the existing city infrastructures during their transformation towards smart cities with contactless technologies. We present applications, design principles, technology standards, and cost-effective techniques that leverage BIC for contactless applications and discuss user interfaces deployed in smart city environments. We further discuss state-of-the-art sensing methods and smart applications that support cities with smart contactless features. Finally, a case study is reported on how BIC can assist in efficiently handling and managing emergency situations such as the COVID-19 pandemic.

Saraju P. Mohanty et al. [26]: In this research work author work on smart city is primarily a concept, and there is still not a clear and consistent definition among practitioners and academia. As a simplistic explanation, a smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital, and telecommunication technologies to improve the city's operations for the benefit of its inhabitants. Smart cities are greener, safer, faster, and friendlier. The different components of a smart city include smart infrastructure, smart transportation, smart energy, smart health care, and smart technology. These components are what make the cities smart and efficient. Information and communication technology (ICT) are enabling keys for transforming traditional cities into smart cities. Two closely related emerging technology frameworks, the Internet of Things (IoT) and big data (BD), make smart cities efficient and responsive.

Uma Choppali et al. [27]: In this research work author work on smart city is primarily a concept and there is still not a clear and consistent definition of among practitioners and academia. In a simplistic explanation, a smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants. Smart cities are greener, safer, faster and friendlier. The different components of a smart city include smart infrastructure, smart transportation, smart energy, smart healthcare, and smart technology. These components are what makes the cities smart and efficient. Information and communication technology (ICT) are enabling keys for transforming traditional cities to smart cities. The two closely related emerging technology frameworks Internet of Things (IoT) and Big Data (BD) make smart cities efficient and responsive. The technology has matured reasonably to allow smart cities to emerge. However, there is much need in terms of physical infrastructure, renewable energy, ICT, and IoT, and BD to make the majority of cities worldwide smart.

Andreea Corici et al. [28]: This paper introduces an infrastructure for reliable Smart City, investigates a number of use cases scenario and propose possible solutions. The proposed architecture is based on a Smart City platform and an ETSI M2M/ oneM2M compliant Machine-to-Machine communication framework. The population movement will affect the consumption rate of natural resources i.e. water, soil, and plants. Therefore, innovative management and monitoring systems are required to enhance citizen's quality of life. Additionally, the power grid complexity is increasing as more private or enterprise buildings become virtual power generation facilities by deploying clean energy generators based on renewable energy sources (e.g. Photo voltaic cells). By installing small smart and affordable devices in key points around the city, the information about environment status and resources consumption can be collected and transmitted (over different network technologies) to higher level control systems**.**

Pranaya.Y.C et al. [29]: In this research work author focus on the energy infrastructure is one of the crucial aspect in realization of sustainable smart cities. In pursuit of achieving optimized energy supply and demand, the deployment of smart grids is becoming a strategic act in many countries. There is a void of telecommunication and information support in smart grid. Adopting Information and Communication Technology (ICT) and Internet of Things (IOT) will transform the existing grids into a smarter one. In this paper we propose a framework for smart-grid based on IOT and ICT solutions with an aim towards improving energy conservation, reducing operational cost and empowering the customer with usage analytics. A 3 tier cognitive architecture consisting of Perception layer, Attention-Memory layer and Decision layer is introduced. Various ICT and IOT solutions applicable at these 3 layers are discussed. This architecture can pave a way for future intelligent Grids there by upgrading level of urbanization.

R.J.Solomonoff et al. [30]: This paper is reviewed certain approaches to artificial intelligence research-mainly work done since 1960. An important area of research involves desk machine that can adequately improve its own performance as well as solve other problems normally requiring human intelligence. Work in heuristic programming tasted most relevant to this goal will he disc 4 at length. Important sub problems are devising techniques for self-improvement, the general problem of deciding what task to best work on next in a network of tasks, and the general problem of how to mechanize learning or inductive inference. Some work in linguistics and pattern recognition is directly concerned with the indention problem. Another area of research that will be treated is simulation of organic evolution.

Claudio Tomazzoli et al. [31]: In this paper author illustrate how the Internet of Things paradigm and machine learning techniques may be beneficial to achieve autonomous energy efficiency. A new system architecture has been devised to effectively monitor and act on distributed sub-networks of electric appliances. Several state-of-the-art technologies to allow the enactment of this architecture has been discussed. Then, a method has been presented to automatically extract behavioral rules from consumption data in order to be applied or fed to embodiments of such architecture. Rules are extracted from efficient environments, so as to be deemed as best practices. The method takes into account the fact that there cannot be a general solution because each situation has its own peculiarities, so that there will be more than one "best practice", one per group of similar installations.

Zahra Heidari Darani et al. [32]: In this paper, author presented a reconfiguration of SESs and their problems and solutions using an anticipatory system lens through juxtaposition of Rosenian concepts of anticipatory system and SESs. Anticipatory system framework of energy is ambitiously intended to offer a common ground for a trans disciplinary, post-normal discussion with, bottom-up approach that should disentangle the complexity of energy systems. In this paper, we presented a reconfiguration of SESs and their problems and solutions using an anticipatory system lens through juxtaposition of Rosenian concepts of anticipatory system and SESs. Anticipatory system framework of energy is ambitiously intended to offer a common ground for a trans disciplinary, post-normal discussion with, bottom-up approach that should disentangle the complexity of energy systems.

Simon Elias Bibri et al. [33]: This study shows that smart and smarter cities are associated with misunderstanding and deficiencies as regards their incorporation of, and contribution to, sustainability. Nevertheless, as also revealed by this study, tremendous opportunities are available for utilizing big data analytics and its application in smart cities of the future to improve their contribution to the goals of sustainable development by optimizing and enhancing urban operations, functions, services, designs, strategies, and policies, as well as by finding answers to challenging analytical questions and thereby advancing knowledge forms. However, just as there are immense opportunities ahead to embrace and exploit, there are enormous challenges and open issues ahead to address and overcome in order to achieve a successful implementation of big data technology and its novel applications in such cities.

Abbas Sharifi et al. [34]: The present article's objective is to investigate the effects of COVID-19 on each of the various fields of medicine, industry, and energy. What sets this article apart is studying the impact of artificial intelligence and digital style on reducing the damage of this fatal virus. Energy and related industries are of the areas affected by the SARS-CoV-2 virus. The most exciting approach in this article is to encourage countries with economies based on non-renewable energy to develop solar and wind energies. Renewable energies can operate well in the event of another phenomenon such as COVID-19 and reduce the virus's destructive effects and lead to economic prosperity.

Will Serrano et al. [35]: This paper has presented the concept of Digital as a Service: DaaS, which virtualizes Smart Infrastructure and Cities on four levels: Systems, Transmission, Server and Management. Any complete Digitalization can be implemented independently of its associated physical infrastructure. DasS would enable an interoperable Virtual Digital Infrastructure. Independent systems and solutions are becoming smarter; this paper proposes their full interconnection, integration and virtualization into a higher layer of abstraction. The fifth industrial revolution, based on the progress of Artificial Intelligence, will completely remove humans from operative and management decisions. The implementation of Digital as a Service brings major challenges. As the Big Data becomes the most valuable asset; it shall be protected against cyber security attacks. In addition, commercial and economic interests from competing individuals, products and organizations need to be efficiently managed. DaaS business cases shall consider stakeholder and user requirements and the entire whole life cycle, both CAPEX and OPEX.

T.M. Vinod Kumar et al. [36]: In this research work author work on Emerging patterns of urbanization world over show differing scenarios in different continents, requiring diverse approaches, policies, and strategies. Amazing democratization of ICT around the world leads to a discussion on sustainable, resource-conserving, and resilient smart cities, and smart city economic development appropriate to different cities, countries, and continents. It can be possible that each city in a particular country and continent may possess differing challenges to smart city economic development. When ancient rural economy gives way to urban economy, which contributes a major share of national domestic product, the emerging question is what constitutes smart city economic development. How is it different from conventional urban economy? Is the theory and practice of conventional urban economy valid in a smart city economy or is it necessary to investigate newer theory and practice of smart city economic development? What is a food shed in a smart city economy in smart cities? What a smart city industry looks like? What constitutes smart city commerce services, transportation, and communication, and how they impact on smart city economy? How do smart cities fit in the urban dynamism and policy dialogue at the global, regional, and national levels? Can smart cities and smart economy be socially inclusive? How to strategize social inclusion in smart city development? What sort of governance and institutional support would smart cities require to fulfil their role with regard to smart economy? What may constitute a Sustainable Model of smart city's economic development, and what may be Smart Cities Standards.

YINGYING RE et al. [37]: This paper investigates the problem of fault detection for 2-D systems with lock-in-place sensor faults. Our attention is focused on detecting sensor faults in the presence of disturbances. To this end, a fault detection later is designed, through which a residual signal is generated for both the fault-free and faulty cases. In light of the generalized Kalman Yakubovich Popov lemma for 2-D systems and matrix inequality techniques, convex later design conditions are derived. Based on these conditions, an algorithm is proposed to calculate the parameters of a desired fault detection alter. Moreover, a residual evaluation function and a threshold are proposed for 2-D systems. Finally, an example is employed to illustrate the effectiveness of the proposed fault detection method.

Tooba Batool et al.[38] This proposed research integrates a city into a smart city using the Internet of Things (IoT) which focuses on the smart ecosystem. In this research work, a model is proposed to overcome an ecosystem's IoT and Machine Learning techniques issues. The Levenberg-Marquardt (LM), Bayesian Regularization (BR), and the Scaled Conjugate Gradient (SCG) algorithms are implemented with an ANN-based approach named to empower the ecosystem of the smart city while developing an efficient and smart ecosystem model. The proposed method's evaluation indicates that the BR algorithm achieves promising results concerning accuracy and miss rates. The predicted accuracy of the proposed model shows 91.55% performance of the ecosystem on the given factors.

2.2. Research Advances

In Research advances Deep learning model whish based on the convolution neural network (CNN) is constructed, in which six volunteers are selected to participate in the experiment, and their health data are marked by private doctors to generate initial data set. Results. Experimental results show the feasibility of the proposed framework. The test data set is used to test the CNN model after training; the forecast accuracy is over 77.6%. Conclusion. The CNN model performs well in the recognition of health status. Collectively, this Smart Healthcare System is expected to assist doctors by improving the diagnosis of health status in clinical practice.

2.3 Comparative study of research articles / Research Gap

Table 2.1: Data extraction of primary studies

Sr. No.	Author	Title	Challenges	Research Theme
[1]	D‟Angelo, G., Ferretti, S., & Ghini, V.	Multi-level simulation of Internet of Things on smart territories	Huge number of involved sensors and devices, and the heterogeneous scenarios.	Research Methodology
[2]	Ejaz, W., Naeem, M., Shahid, A., Anpalagan, A., & Jo, M.	Efficient Energy Management for Internet of Things in Smart Cities Efficient Energy Management for Internet of Things in Smart Cities	Devices continue to grow in both numbers and their requirements	Research Architecture
[3]	Hefnawy, A., Bouras, A., & Cherifi, C.	IoT for Smart City Services: Lifecycle Approach	High complexity of modern city operation	Adoption Strategy
[4]	Hefnawy, A., Elhariri, T., Bouras, A., Cherifi, C., Robert, J., Kubler, S., Lyon, U. L.	Lifecycle Management in the Smart City Context: Smart Parking Use-Case Lifecycle Management in Manufacturing and Servitization Context	Heterogeneous sensors and devices	Discusses the use of Lifecycle Management Adoption Strategy
[5]	Orsino, A., Araniti, G., Militano, L., Alonso-Zarate, J., Molinaro, A., & Iera, A.	Energy efficient IoT data collection in smart cities exploiting D2D communications	High energy consumption	Research Methodology
[6]	Rathore, M. M., Ahmad, A., Paul, A., & Rho, S.	Urban planning and building smart cities based on the Internet of Things using Big Data analytics	An increase in the request for embedded devices, such as sensors, actuators, and smartphones	Research Architecture
[7]	Trilles, S., Calia, A., Belmonte, Ó., Torres-Sospedra, J., Montoliu, R., & Huerta, J.	Deployment of an open sensorized platform in a smart city context	No free access to the provided data	Research Methodology
[8]	Gaur, A., Scotney, B., Parr, G., & McClean, S.	Smart city architecture and its applications based on IoT	The increasing amounts of data	Research Architecture
[9]	Torino, P	Designing a Smart City Internet of Things Platform with Microservice Architecture Politecnico di Torino Porto Institutional Repository	Dynamically changing IoT environment	Research Architecture
[10]	Mitton, N., Papavassiliou, S., Puliafito, A., & Trivedi, K. S.	Combining Cloud and sensors in a smart city environment	Differences in the appliances	Research Architecture

3. MOTIVATION

The motivating factor of this research is that the smart city is becoming smarter than in the past as a result of the current expansion of digital technologies. Smart cities consist of various kinds of electronic equipment applied by some applications, such as cameras in a monitoring system, sensors in a transportation system, and so on. Furthermore, utilization of individual mobile equipment can be spread. Hence, with taking the heterogeneous environment into account, various terms, like characteristic of objects, participants, motivations and security policies would be studied [6]. It presented some of the key features of potential smart cities in 2020. Smart citizens, smart energy, smart buildings, smart mobility, smart technology, smart healthcare, smart infrastructure, smart governance and education. The smart city is becoming smarter than in the past as a result of the current expansion of digital technologies. Smart cities consist of various kinds of electronic equipment applied by some applications, such as cameras in a monitoring system, sensors in a transportation system, and so on. Furthermore, utilization of individual mobile equipment can be spread.

4. PROBLEM STATEMENT

Based on Current/Existing studies following are the existing problems which are faced-

(1) The measurement parameters of existing wearable health monitoring devices are relatively simple, such as pedometers and intelligent sphygmomanometers. The common pedometer devices can connect with smart phones via Bluetooth and other communication means, and upload data to the cloud server, so it is possible to view data such as exercise amount and sports assessment report through the phone APPs. Various forms of wearable health monitoring devices fail to share data due to different manufacturers and communication protocols.

(2) Limited by memory capacity and computing power, wearable devices may upload the collected data to the cloud server through smart phones or home gateways. The cloud server needs to store and process a large amount of collected data. The server and network have great transmission pressure, which reduces the real-time processing capacity.

(3) At present, many telemedicine monitoring systems based on IOT carry out certain disease early warning according to a set of diagnostic schemes, and it is difficult to develop personalized diagnosis and treatment schemes according to individual physiological characteristics and historical parameter changes.

(4) Intelligent diagnosis methods based on the uploaded data of health monitoring devices mainly include system-based diagnosis methods of experts and intelligent diagnosis methods based on sample data. Back Propagation (BP) neural network algorithm [13] and Support Vector Machines (SVM) algorithm have been applied to the classification of diagnosis results. Although deep learning algorithm has been applied in sleep quality and other fields [12], the application of intelligent diagnosis algorithm based on deep learning is rarely seen.

5. RESEARCH OBJECTIVES AND SCOPE

The objectives and scope of this Research is that-

In view of the above problems, a healthcare monitoring system based on Cloud-Internet of Things (C-IOT) and deep learning is proposed, and the major work includes the following aspects:

(1) To develop C-IOT Mechanism which is health data acquisition system is designed based on C-IOT and the acquisition of parameters such as human blood pressure, body temperature, body weight/fat, and exercise amount is realized. The shortcoming that the acquisition of simple physiological parameters fails to evaluate and diagnose the user’s health effectively is avoided.

(2) To develop and design data acquisition device for Data preprocessing of each acquisition device which is realized locally to eliminate noise interference. By communicating with the user’s smart phones through Bluetooth, the smart phones may display the collected data in real time, preprocess the data of each device, and upload them to the cloud server. The processing and integration of local data can reduce the computing pressure of cloud server and transmission pressure of network.

(3) To develop and Modify CNN algorithm, by using this the private doctor evaluates the user’s health condition according to the data on the cloud server and establishes the initial data set. The cloud server uses the deep learning algorithm (CNN) to train the user health evaluation model according to the initial data set. The newly uploaded data are calculated by a depth model to automatically give health assessment results. The model is a process of dynamic change. The private doctor will manually evaluate the users’ health status and update the user data set on a regular basis as well as the parameter values of the depth model. The model can realize personalized health assessment.

6. PROPOSED METHODOLOGY

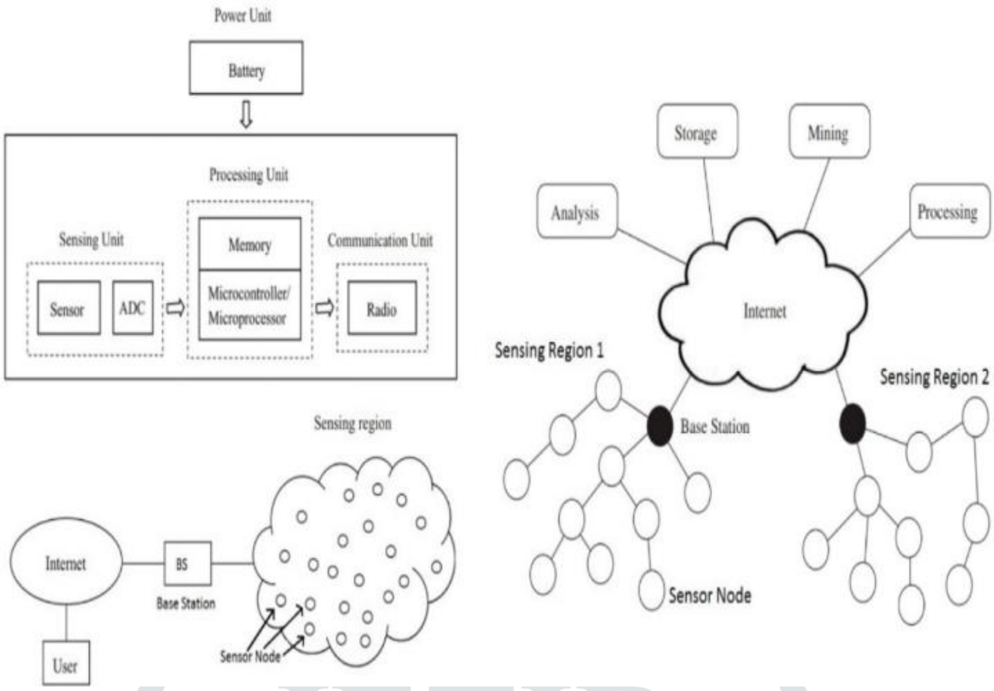

Figure 6.1 Healthcare IOT Application scenario

A wireless sensor network (WSN) is a computer network comprised of sensor nodes which are organized in one network to monitor their surroundings using sensors Figure 6.1. While the first sensor networks consisted of comparatively few, largely wired and relatively large sensors, this changed at the end of the 1990s. In particular, the progressive miniaturization of processors, radio modules and sensors finally led to the introduction of wireless sensor networks at the turn of the millennium. These are networks without a fixed infrastructure between the sensor nodes themselves and the end devices (gateway). The origin of wireless sensor networks lies in the field of wireless, self-configuring ad hoc networks. Ad hoc networks are meshed networks in which the sensor nodes and end devices spontaneously connect to one or more of their neighboring nodes without defined hierarchies and can thus exchange data or commands; thereby, multi-hop communication is also enabled, in which data is passed from node to node until it reaches its destination. However, this also means that these networks are characterized by unpredictable, dynamic behavior. The network topology is different from permanently installed computer networks, as there are no fixed specifications for the network infrastructure. Thus, nodes can be added during operation or without warning. The strengths of ad-hoc networks with multi-hop are that they have a much simpler configuration, are more stable communication and have self-healing capabilities [25].

6.1 Main Study Area-Healthcare

In the healthcare domain, IoT technologies have many advantages in smart cities. Some of those applications are tracking of people and objects including patients, staff and ambulance, identification of people, and automatic data gathering and sensing. In terms of people and objective tracking, the status of patients in a clinic or hospital is monitored in order to provide better and faster work-flow in the hospital. The location of the ambulance, blood products and different organs for transplantation are monitored to check the availability on-line. In terms of people identification, in a database, patients are recognized to decrease the risk of mistake for prevention of getting wrong drugs, doses and procedures [26]. The staff authentication aims to improve the employee's behavior toward patients. Regarding the data collection and sensing, it helps to save time for data processing and preventing human errors. Through sensor devices, diagnosing patient conditions, providing real-time information on patient health indicators such as prescription compliance by the patient is implemented. By using bio-signal monitoring, the patient condition is investigated through heterogeneous wireless access-based methods to enable for getting the patient data anywhere [9].

6.2 Proposed Approach-

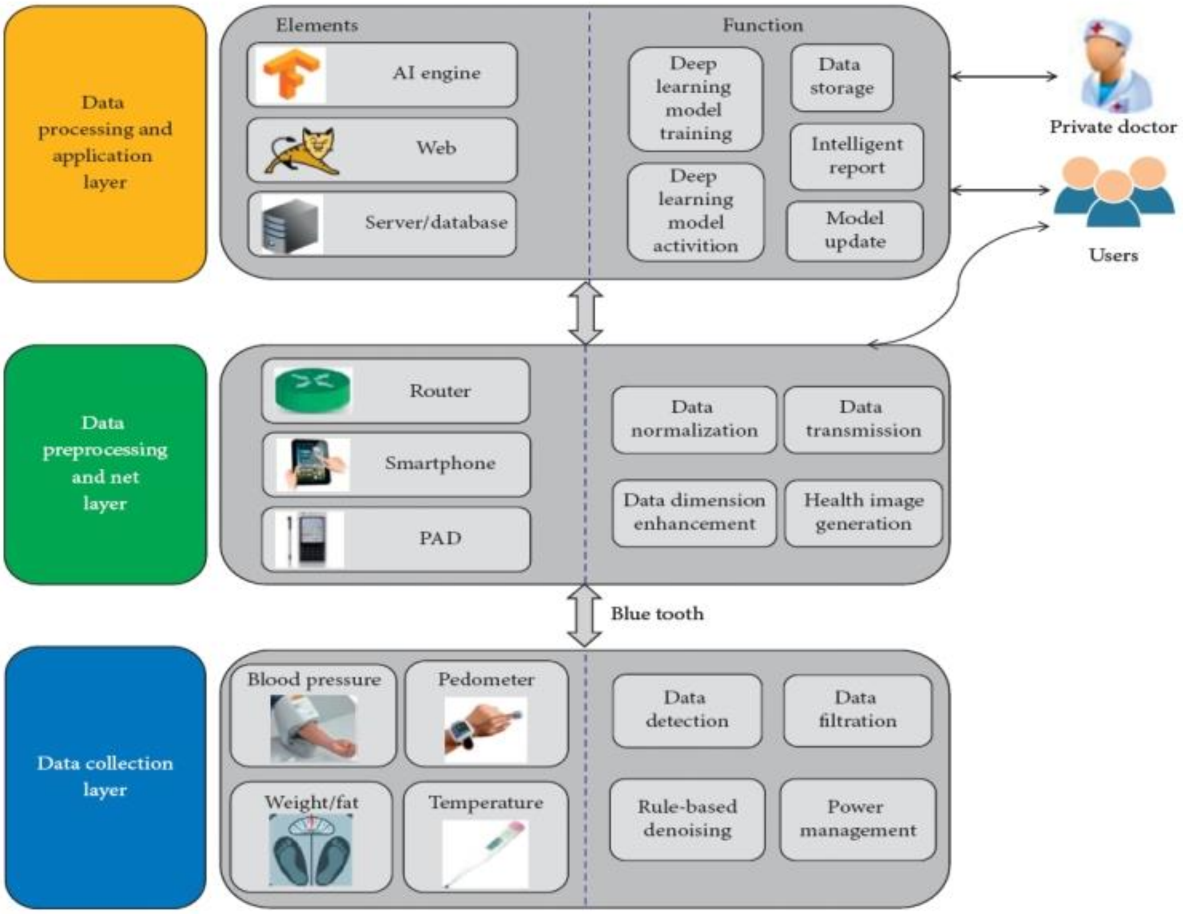

Figure 6.2 Proposed Healthcare Application for Smart Cities

Figure 6.2 indicates the architecture of health monitoring system based on C-IOT and deep learning proposed in this paper. It is improved from the traditional three-layer architecture of the IOT, and described from the perspective of system implementation and data flow, including data collection layer, data preprocessing and net layer, data processing, and application layer.

Data collection layer is responsible for the acquisition of physiological parameters of health, which is mainly composed of a number of Internet-connected or wearable devices. Temperature, body fat/weight, blood pressure parameters, and exercise parameters are measured. In general, data collection layer devices have small data storage capacity and low computing capacity [14–16]. In order to reduce data redundancy, network transmission pressure, and power consumption, the data de-noising, digital filtering, and power management based on rules can be realized locally. High-frequency noise is eliminated by digital low pass filter and band-pass filter. In addition, the special value in the collected data is removed based on rules. The data collection layer device may be connected to smart phones or other mobile intelligent terminals through Bluetooth. The data preprocessing and net layer are mainly composed of smart phones and other intelligent mobile terminals. Smart phone devices not only serve as network layer devices to realize data communication function of medical IOT gateway, but also install application layer APP software to realize local data preprocessing, parameter display, and device control. The smart phone connects to the data collection layer device through Bluetooth to receive measurement information reported by the blood pressure meter, weight/fat meter, pedometer, thermometer, and other data acquisition devices, and display the real-time information on the mobile APPs. Preprocessing data are uploaded to the cloud server through Wifi, 4G, and other communication means. Data preprocessing includes data normalization, data dimension transformation, data fusion, and other functions to generate images of health parameters. In terms of data normalization, body weight, body temperature, and other measurement parameters are normalized according to the grade to the gray value ranging from 0 to 255. In terms of data dimension transformation, original measurement parameters are extended in dimension, such as heart rate, systolic pressure and diastolic blood pressure measured by sphygmomanometer extended to ambulatory pulse pressure (APP), mean arterial pressure (MAP), and ambulatory rate pressure product (ARPP), which are often used to diagnose cardiovascular diseases more effectively. The application software of mobile phones can also fuse the physiological parameter measurement data after normalization of gray value and dimension expansion into the image of health parameters, upload them to the cloud server in the form of two-dimensional image, and use the deep learning model to solve the health parameter image to give the health index report. The users may receive and display the health report issued by the cloud server through smart phones. Making full use of the computing power of intelligent equipment for data preprocessing can effectively reduce the transmission pressure of database and network. With the rapid improvement of the computing power of intelligent terminal equipment, more and more data processing functions will be completed directly in the intelligent terminals. The data processing and application layer mainly includes database and distributed server, web server, and deep learning model engine. The database stores and manages users' personal information/health monitoring data, personal doctor information, equipment information, etc., the distributed server realizes various business processing logic, and the web server provides users and personal doctors with friendly web interface for background operation. The deep learning model engine is used to train the deep learning model, and the trained deep learning model is used to solve the health parameter image. With the increase of user data, private doctors can annotate the data, enrich the personal health data set, and retrain and update the deep learning model.

6.3. Hardware& Software Requirements

Hardware Requirements	Software Requirements
Processor - Intel i3 core	Operating System XP, Windows7/8/10
Speed - 1.1 GHz	Coding language - Java, Servlet, JSP, HTML, CSS etc. or Python
RAM - 2GB	Software - JDK1.7
Hard Disk - 50 GB	Tool - Eclipse Luna
Monitor - SVGA / LCD	Database - MySQL 5.0

7. IMPLICATIONS

It will required huge data set and hardware devices (Sensor and Microcontroller).
Implementing Machine Learning & AI on the data will be challenging.

8. CONCLUSION (EXPECTED RESULT)

In view of the existing problems in the existing IOT medical system, a new IOT architecture for medical monitoring is proposed in this paper, in which smart phones are used as gateway devices to realize data preprocessing of measurement node devices, thus greatly reducing the computing pressure of cloud servers and transmission pressure of network. Based on the data sets generated from such data annotated by private doctors, a CNN health recognition model is constructed to realize personalized diagnosis and treatment of human health. Six subjects are selected to wear wearable measuring devices for a long time and physiological parameters are measured as required. The test sample set is input into the deep learning model for identification, with a prediction accuracy of over 77%. In the future work, the measurement types of human health parameters will be added, such as ECG and EEG signals, etc. In addition, the scale of the data set will be expanded, and the training depth learning model will be updated continuously to improve the prediction accuracy.

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