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Study of Current Trends in the smart Healthcare Sector using IoT

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Abstract— The Internet of Things is changing our lives with their increasing multidisciplinary applications. Applications of IoT are growing day by day in the smart healthcare sector. The wide range of applications of IoT includes healthcare services. In our daily life, traffic monitoring, healthcare, security, transport and logistics are major sectors for the study of applications of IoT. In smart healthcare sector, applications of IoT connect smart devices, machines, patients, doctors and sensors to the Internet. Healthcare is becoming a major socio-economic concern when it comes to health expenditure, the need and availability of resources and personal care, especially for the elderly in society. Efficiently and intelligently trends in healthcare are enabling physicians to provide remote monitoring, chronic disease management and elderly care of distant patients, and even care for institutional patients after being connected to the Internet. This article paper examines the various smart healthcare trends that have transformed traditional healthcare systems by makinghealthcare management more efficient through theirapplications.

Keywords— IoT, Smart Healthcare, telemedicine, wearable device, smart phone apps

I. INTRODUCTION

Internet of things is an ever growing network of smart objects connected to each other through the internet [1].It is playing an interesting role in improving the standard of life. Smart health care, smart cities, automation in industries, agriculture, and transportation are numerous knowledge base application of IoT wherever higher cognitive process is used [2].In IoT sense, sensing devices and objects collect relevant information which might be processed and analyzed for higher decision making. Thus permits the physical objects in the world to connect together to deliver computation based performance. Hence, IoT is an establishing network of smart phones, smart devices, actuators, and objects embedded with processors low on memory. It connects the network to exchange and collect info to avail desired services [3] [4].This research paper includes the study of current trends of the smart healthcare using IoT. IoT allows numerous dynamic applications connecting sensor-to-device, machine-to-machine, and patient-to devices, device-to- doctor, patient-to-doctor and communications [5].The healthcare IoT based many applications include remote monitoring, elderly care, early prevention, chronic illness management, medical treatment for institutionalized patients etc. The healthcare application of remote monitoring allows the doctors to remain connected to the patients remotely thus can provide care to them whenever the need arrive. The sensing devices could also be wearable and implanted. The sensing devices may be wearable and implanted. The sensors present in the nearby environment are connected to the internet from where the caregivers or doctors can provide timely and effective medication to the patients [6].For the old age population in the society, healthcare may be a major socio- economic concern so providing elderly care or personal health assistance to them may solve the problem to some extent. This research paper is beneficial for survey the smart healthcare applications of IoT along with the prevailing open issues and challenges and the major security concerns. Section II contains the introduction of Internet of Things (IoT). Section III focuses on the various applications of smart IoT healthcare applications that transform the traditional way of care giving significantly**.** Section IV contains related work of smart healthcare applications. Section V contains research design and analysis process of our study. In section VI we discuss some essential specifications need to improve in IoT based healthcare apps. In section VII, we highlight the challenges related to IoT based healthcare apps and system which require major attention. Section VIII describes result and discussion of the study. At last section IX concludes and gives future scope of the entire study about the trends of smart healthcare using IoT.

II. INTERNET OF THINGS (IoT)

IoT is the networking of physical objects that are embedded with sensors, software, and different technologies for the aim of connecting and exchanging knowledge with different devices and systems over the net. Advancements in medicine, power, agriculture, smart homes and smart cities are just a very few examples where IoT is strongly established (fig1).

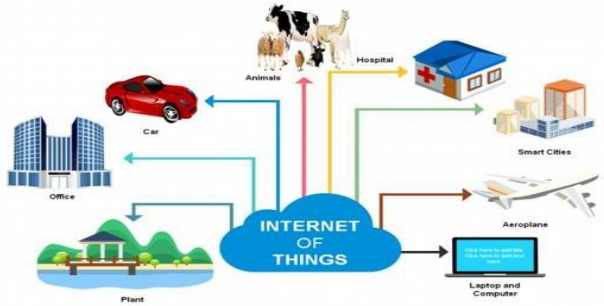

Fig1. IoT in different applications

Low-power embedded systems, cloud computing, availability of big data and networking connection are four main components used in IoT [7]. Less battery consumption and high performance are the inverse factors for the low- power embedded systems. Data collected through IoT devices is massive which are stored on a reliable storage server under cloud computing concepts. IoT relies heavily on sensors for a massive flux of big data. Each physical object is represented by an IP address which is possible with Internet connectivity. The Internet of things refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipments to conduct information exchange and communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administration. A separate internetwork between physical objects and expensive internet are two ways of building IoT. RFIDs sensors nanotechnology and smart networks are IoT enablers. RFIDs use radio waves for tracking the physical objects. Sensors detect changes in an environment [8]. Nanotechnology is extremely small devices with dimensions usually less than a hundred nanometers. Smart networks are useful to establish IoT. Massively scalable and efficient, IP- based addressing, an abundance of physical objects, less power consumed devices and intermittent connectivity are main characteristics of IoT. IoT is currently found in four different popular domains Manufacturing, Healthcare, Security and Retail Modern Applications are Smart Grids, Smart cities, Smart homes, Healthcare, Earthquake detection, Radiation detection/hazardous gas detection, Smartphone detection and Water flow monitoring.

III. SMART HEALTHCARE

Smart healthcare is a health service system that uses a new generation information technologies such as IoT, wearable devices, mobile, big data, cloud computing, and artificial intelligence etc. It is a higher stage of information construction in the medical service sectors. It uses sensors to perceive information, transmits information through the IoT, and processes the information using AI and cloud computing [9].Smart healthcare consists of multiple participants, such as patients and doctors, hospitals, and research centers. These participants can manage medical information through an integrated information platform. The use of mobile medical platforms can provide guidance's, caring instructions and enhance patients' experiences. Assisting diagnosis, treatment, Health management, Disease prevention and risk monitoring are major smart healthcare applications [10].Smart healthcare consists of three important components: regional, hospital, and family. Services for medical staff, services for patients, and services for administrators are three main types of services for smart hospital. Patients can access multiple functions, such as online appointments, and doctor- patient interactions etc. Virtual assistants communicate with users through techniques. It can be used to aid in the treatment of diseases. It helps users complete various tasks, from reminder creation to home automation.

The different patient health care applications are as follows:

1. Remote monitoring,
2. Personal digital Assistance
3. Smart wearable devices
4. Telemedicine
5. Elderly care, and
6. Smart Phone applications (Apps) for Healthcare

1. Remote Patient Monitoring:

This application allows monitoring of patients outside of typical clinical settings, like within the home or in a very remote space, which can increase access to worry and reduce provision costs [11]. This application is deployed for remotely watching essential parameters of the patients through the utilization of sensors, devices and objects surrounding them, during this application the real time information of the patient is transmitted and shared between the patient and the caregivers shown within the Fig.2. Its main connection is that the management of chronic diseases like diabetes, monitoring of cardiopathy, asthma, etc.

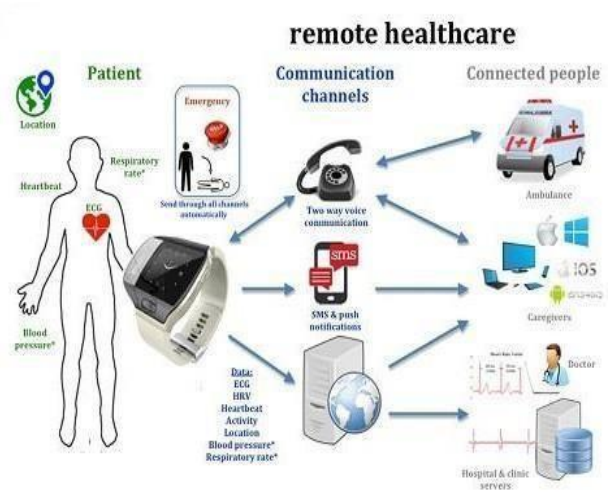

Fig.2: Remote Healthcare

2. Personal Digital Assistant:

Personal digital assistants (PDAs) are generic devices usually utilized in each personal and skilled spheres of society, because of their affordability and portability[12].PDA may be a term for a small, mobile, hand-held device that has computing and knowledge storage and retrieval capabilities for private use, typically for keeping schedules, calendars and address book data handy. as an example mobile digital assistant (fig3).This application uses mobile technologies to permit remote access to diagnostic systems or current caregivers. Smart mobile apps, websites etc., simply accessible to everybody, have created it straightforward to modify eHealth (electronic-health) systems.

Fig. 3: Mobile Digital Assistant

3. Smart Wearable Devices:

Wearable technology (also known as wearable gadgets) may be a class of technology devices that may be worn by a client and sometimes embrace tracking info associated with health and fitness [13]. Wearable gadgets include devices that have small motion sensors to require photos and adjust along with your mobile devices. Smart wearable devices (Fig.4) are utilized in care to store and manage key healthcare settings and to capture unwellness information. They're primarily deployed to produce fitness solutions by following target activities and diagnostic tools accustomed store device information. they are in the main used as a fitness solution to observe patient activities and use smart diagnostic devices like blood pressure monitors, pedometers, Google Glass, etc. to capture information from sensors for additional analysis by the doctor.

Fig4: Wearable Devices

4. Telemedicine:

Telemedicine refers to the practice of caring for patients remotely when the provider and patient are not physically present with each other (fig5). Modern technology has enabled doctors to consult patients by using video-conferencing tools [14].

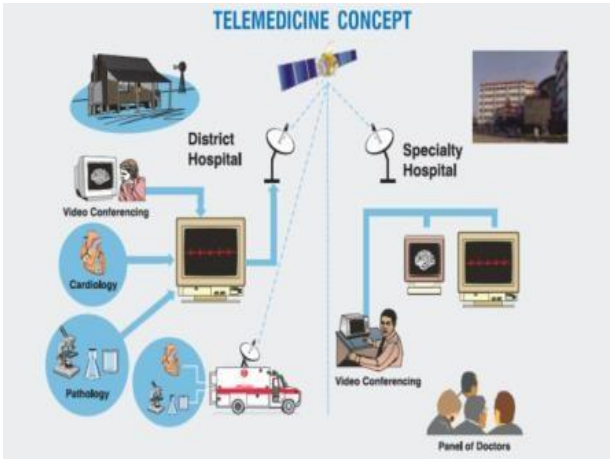

Fig. 5: Telemedicine

The application provides virtual assistance via remote connectivity and efficient solutions to enable virtual connectivity counseling, medication dispensing, education and more. Providing remote medical support such as tele-counseling, mobile video solutions has become very common in some countries and markets.

5. Elderly Care:

This application performs clinical monitoring of aging populations to make them independent. These devices include wearable and implanted sensors to monitor elderly patients without personal intervention [15]. The monitoring devices track (fig6) the vital signs of elderly care and transmit them to a standard mobile device that serves as a node to transmit real-time data to doctors. The information thus collected can be used to provide medical assistance to the elderly and in an emergency, nearby hospitals can be alerted.

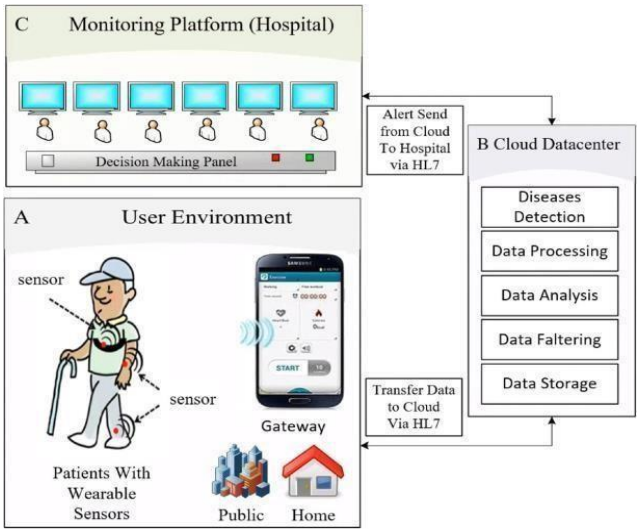

Fig.6: Monitor Elderly Patients

6. Smart Phone Apps for healthcare:

Modern smart phones like iPhones and the Samsung Galaxy android phone are progressively being programmed with algorithms that enable them to diagnose certain medical conditions like irregularities in heart rate

[16].An effective solution smart phone will be used as an interface to worry for the needy (fig7). Numerous open source applications are developed to offer healthcare solutions that provide efficient attention facilities. Some of them are:

Fig 7.Smartphones apps for healthcare

IV. RELATED WORK

Paper [7]:"Internet of Things (IoT): A vision, architectural elements, and future directions"
Authors: J. Gubbi, R. Buyya, S. Marusic, M. Palaniswami
Objective: This paper presents a Cloud centric vision for worldwide implementation of Internet of Things. A Cloud implementation using Aneka, which is based on interaction of private and public Clouds, is presented. It proposes a model of end-to-end interaction between various stakeholders in Cloud centric IoT framework by using IoT vision, its architectural elements and future directions.

Paper [8]: "Sensor-enabled RFID *tag handbook", BRIDGE – (Building Radio frequency* Identification solutions for the Global Environment), pp.46, pp.11-17, January 2008.
Authors: A. Ruhanen, M. Hanhikorpi, F. Bertuccelli, A. Colonna, W. Malik, D. Ranasinghe, T. Sánchez Lopez, M. Tavilampi
Objective: This book describes planning to incorporate sensors with RFID for students, researchers, hardware software suppliers and IC suppliers. It explains very nicely different types of sensors and sensors enabled RFID tags.

Paper [9]: "Smart Health Care System Using Internet of Things"
Authors: K. Natarajan, B. Prasath, P. Kokila
Objective: In this paper, Innovative uses of IoT technology in healthcare not only bring benefits to doctors and managers to access wide ranges of data sources but also challenges in accessing heterogeneous IoT data, especially in mobile environment of real-time IoT application systems. The big data accumulated by IoT devices creates the problem for the IoT data accessing.

Paper [10]: "The Internet of Things for Health Care: A Comprehensive Survey"
Authors: S. M. Riazul Islam, D. Kwak; MD. H. Kabir, M. Hossain, K. Sup Kwak
Objective: This paper surveys advances in IoT-based health care technologies and reviews the state of the art network architectures/platforms, applications, and industrial trends in IoT-based health care solutions. In addition, this paper analyzes distinct IoT security and privacy features, including security requirements, threat models, and attack taxonomies from the health care perspective.

Paper [11]:" Remote Patient Monitoring System"
Authors: S. Sebastian, N. R. Jacob, Y. Manmadhan, V. R. Anand, M. J. Jayashree
Objective: This paper analyze s the state of art of IoT in medical environment, illustrating an extended range of IoT-driven healthcare applications that, however, still need innovative and high technology-based solutions to be considered ready to market. In particular, problems regarding characteristics of response-time and precision will be examined. Furthermore, wearable and energy saving properties will be investigated in this paper and also the IT architectures able to ensure security and privacy during the all data-transmission process.

Paper [12]: "Use of Personal Digital Assistants (PDAs) in Medical Education"
Authors: R. Luanrattana, K. Win, J. Flusher,
Objective: This paper gives a systematic review of how the personal digital assistants (PDAs) have been used in healthcare professions and medical education has been conducted in order to identify current usage of PDAs in both areas. The major aim of this research is to study the feasibility of incorporating PDAs into problem-based learning (PBL) medical education.

Paper [13]: "Wearable Technology: Present and Future"
Authors: S. Wilson, R. Laing
Objective: This paper focuses on wearable technology which has a long history with rapid expansion since the beginning of the 21st century, which is also expected to continue. Trials comparing the performance of existing and new wearable devices to more traditional, evidence-based data collection procedures are critical. Long-term trials to determine the end-life of devices are also required, focusing on degradation of accuracy and reliability over time.
Interesting and useful wearable technology devices, textiles, and garments, have been developed, but the gap between laboratory and real-life applications remains.

Paper [14]:" Introduction to the practice of telemedicine"
Authors: J. Craig and V. Patterson
Objective: This paper deals with practice of telemedicine. This paper describes that there is no doubt that telemedicine is effective in certain situations. The transition to a world where telemedicine is employed to the maximum will not be realized, however, if governments and health-care organizations do not produce strategies to

encourage its development.

Paper [15]: "Remote health monitoring of elderly through wearable "
Authors: M. Al-khafaji, T. Baker, C. Chalmers. A., H. Kolivand, M. Fahim, A. Waraich
Objective: The smart healthcare monitoring system (i.e., SW-SHMS) has been proposed in this paper to handle the challenges of providing home based healthcare monitoring and avoiding hospitalization. The literature shows that there is a great demand of producing an effective healthcare solution that monitor elderly people in their home and in real-time. SW-SHMS can highly contribute to provide comfortable and safe environment for elder and disable people, thus, enable them to live independently without the fear of any emergency or critical healthcare situation through continuous monitoring of their health by SW- SHMS.

V. RESEARCH DESIGN AND ANALYSIS

Here we are using both quantitative and qualitative approach of research method for "The study of current trends in the smart healthcare sector using IoT" including fields such as IoT, Smart Healthcare, telemedicine, wearable device, smart phone apps. Firstly we will have to define both approaches quantitative and qualitative.
Quantitative analysis approach objectives are:

- To confirm frequency, extent and associated factors of a development
- To establish care services coverage
- To establish degree of user satisfaction with a service
- To establish levels of services utilization.
- To establish potency, efficacy, effectiveness of associate degree intervention

Qualitative analysis approach objectives are:

- To explore taken without any consideration observe (how waiting lists work)
- To perceive behaviors and develop explanations.
- To establish users viewpoint relating to quality and adequacy of care services.
- To perceive culture and designs in care services management.
- To analyze complicated health and social policies.

The core characteristics of a well-designed study throughout this analysis approach embrace the following:

- Assortment and analysis of all quantitative and qualitative information.
- Victimization rigorous procedures in assortment and analyzing information acceptable to every method's tradition, like guaranteeing the appropriate sample size for quantitative and qualitative analysis.
- Act as throughout information assortment, analysis, or discussion.
- Victimization procedures that implement qualitative and quantitative parts either at an identical time or consecutive, with an identical sample or with absolutely utterly completely different samples.
- Framing the procedures among philosophical/theoretical models associate analysis of study of research that seeks to know multiple views on one issue as Associate in Nursing example, what patients, caregivers, clinicians, and observe workers would characterize as "high quality treatment" in "the study of current trends of the wise health care by victimization IoT". This transient focuses on the potential uses of this methodology for analysis paper that supply come- at-able, info -rich information which might enhance ancient chemical analysis approaches.

Peer-reviewed open-access papers and grey literature that define" the study of current trends of the smart health care by using IoT from PubMed, Springer Link, and Google.com were randomized. ASCII text file software systems were used for analysis.

V. NEEDS TO IMPROVE SPECIFICATIONS IN HEALTHCARE APPLICATIONS

Some essential specifications ought to improve in IoT primarily based care apps are as follows:

- Smart IoT devices are computationally constrained because of low speed processors. These devices are designed for confinement environments to reduce prices and increase their potency. so a solution is required to reduce resource consumption and increase the protection.
- Same with memory computation in these devices. They need a restricted memory and thus only lightweight protocols or programs will be executed.
- The smart devices utilized in IoT care like pressure sensor, temperature sensor etc have limited battery power. Therefore, when no reading to be reported in respect of sleeping time of patients. Then sleep mode option must be deactivated automatically. So it will save power. Thus an effective solution should be implemented to manage the energy, power, mobility, measurability and machine limitation of those care apps.

VII. CHALLENGES AND SECURITY REQUIREMENTS IN IOT BASED HEALTHCARE APPS

This section highlights the open challenges, and customary security desires related to IoT primarily based attention applications. Some challenges related to IoT based healthcare apps are:

- In IoT technology, billions of sensible devices and objects are connected to the net. These wise devices collect great deal of knowledge that need to be processed, analyzed and even hold on for future use. Therefore quantifiability of IoT network and devices tend to be a major concern.
- An active participation of the govt. bodies ought to be thought-about towards creating rules for safety and security of objects, devices and associated people.
- In remote monitoring of the patients, sensors being

implanted or wearable might usually refrained from attention may cause a threat to the security of patients which can become crucial.

- Since IoT is an open network so security needs like confidentiality, integrity, and accessibility of patient's information should be ensured in order that threats related to security and privacy could also be prohibited.
- As the IoT technology is rising at fast pace, the challenges pertaining to design issues need to meet in the future. These challenges include overcoming energy limitation, memory and procedure limitations in IoT sensible devices.
- Since effective healthcare is everyone's right. Therefore IoT-based could services might even be perceived as a affordable technology.

Some security requirements for IoT systems are listed:
Confidentiality: Unauthorized parties haven't any access to medical info.

- Integrity: information in transit and keep information cannot be altered by adversaries.
- Non-repudiation: sending and reception of knowledge cannot be denied.
- Data freshness: Replay of previous information is excluded.
- Resilience to attacks: There should be no single points of failure and the system should adjust itself to node failures.
- Data authentication: Authentication of retrieved addresses and object information may be a necessity.
- Access control: data providers should implement access control on provided information.
- Client privacy: only the information provider should be able to infer from observant the utilization of the search system.
- Fault tolerance and self-healing: A security scheme ought to guarantee health service continuation even in the presence of battery energy ending or a fault in an IoT device.

VIII. RESULT AND DISCUSSION

Current trends in smart health care sector like a wearable tech, telemedicine, genomics, virtual reality (VR), artificial intelligence (AI) and robotics area unit ever-changing the landscape of the Indian health care system like several markets, Republic of India too is at the cusp of a 'digital health' revolution. Healthcare firms are ready to embrace innovation and rising trends to successfully steer new-age technologically driven business methods by capturing client interest. Because the pace of digital innovation in health care accelerates, therefore do the opportunities for health care firms and medical devices manufacturers across India who is willing to embrace the digital health space over the coming years.
Topline digital health statistics for India (according to indiahealth-exhibition.com):

- Digital intervention in health care is expected to drive the trade at a CAGR of 23% by 2020
- Telemedicine market in India is anticipated to rise at a CAGR of twenty percent during 2016-2020, reaching US$, thirty two million by 2020 The implementation of telemedicine technology would possibly save Asian country US$ 4-5 billion per annum
- The applications of AI at intervals the health care area in Asian country are aiming to be worth US$ 6 billion (INR ~431.97 bn) by 2021
- Seventy six percent of tending professionals in India already use digital health records (DHRs) in their practice.
- There are 4,892 start-ups in the Indian health-tech space.
- Health-tech startups in India raised a total of US$ 504 million between 2014-2018 India health-spaces.

Indian Health Care Sector:
India Brand Equity Foundation (IBF) anticipates that the health care sector can record a threefold rise, at a Compound Annual growth rate (CAGR) of twenty two percent during 2016-2022 to reach US$ 372 billion in 2022 from US$ one hundred ten billion in 2016. Similarly, the hospital industry in India stood at $61.79 billion in 2017 and is predicted to increase at a CAGR of 16-17% to reach $132.84 billion by 2022.The National Association of software and Services companies (NASSCOM) has pegged the Indian healthcare information and communications technology (ICT) market at US$ one billion in 2014. The industry is expected to grow 1.5 times by 2020, consistent with the 2015 report. a major portion of the projected growth is predicted to be driven by digital health start-ups. According to the future Health Index (FHI) 2019 report, India is leading in the adoption of digital health technology with 76 % of healthcare professionals within the country already using digital health records (DHRs) in their practice. The FHI is predicated on primary analysis conducted across 15 countries. The study explores the experiences of care professionals and people. Republic of India meets the 15-country average when it involves the usage of artificial intelligence (AI) within healthcare at 46%.In 2016, healthcare-related IoT revenues amounted to $24 billion worldwide and this range is anticipated to increase to over $135 billion by 2025. There are over twenty six billion IoT devices presently active and it's determinable that seventy five billion are in use worldwide by 2025.(fig8) according to https://www.statista.com/statistics/997959/worldwide-internet-of-things-in-healthcare-market-size.

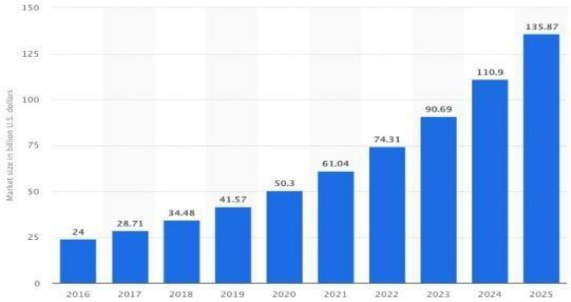

Fig8 .Graph of projected size of the Internet of Things (IoT) in healthcare market worldwide from 2016 to 2025 (in billion U.S. dollars)

IX. CONCULSION AND FUTURE SCOPE

FUTURE SCOPE**:** New digital tools and technologies are already beginning to create a control across the healthcare system in India and hold nice promise to rework the delivery of health services within the close to future by rising potency and remedial patient care in different fields as follows:

- Telemedicine will cut back the time it takes to consult a doctor to 10-15 min in both rural and urban areas by cutting wait times through optimum usage of doctors and by avoiding the necessity to visit a clinic or hospital, at a fraction of the price of current healthcare systems.
- Electronic Medical Records (EMRs) will digitize patient's data coming from various sources at one place, helping the doctor create an to create prognosis during a shorter time.
- AI can play an enormous part in improving clinical outcomes as increasing amounts of health data becomes more accessible and analysis techniques improve. From the automation of clinical tasks to virtual nursing assistants. AI has the potential to remodel everyday health management.
- Smart health monitors will collect personalized necessary signs and check finally ends up in fundamental quantity, which will facilitate with quick diagnosis, timely and proper treatment at an early stage, eliminating travel and wait times for diagnosing. It additionally will increase operational efficiencies for doctors and assures patients with improved support and feedback.
- Mobile health apps can facilitate in preventing serious diseases by increasing patient engagement, providing health education and skilled guidance from health care providers.

X. CONCLUSION

This paper in brief reviews the advance trends in smart health care as an IoT application that has remodeled the traditional medical system. Smart health care systems have reduced the complexness and the complications related to the utilization of IoT environment. The very important information relating to the patient's health is recorded by the deployed IoT objects resulting in economical decision making. In the development of health care IoT applications cooperation between computer scientists, ICT (Information and Communication Technology) professionals, health care professionals, health care investigator, and users of those applications could be a necessity. Interoperability between health care IoT devices and software component needs widely accepted standards for IoT architecture and security solutions. Standards for lightweight scientific discipline algorithms are particularly required in security solutions for health care IoT systems, since several healthcares IoT devices are resource constrained wearable technology devices. Analysis of IoT information must support evidence based health care otherwise it would be a huge data issue already for a single IoT health care application user and significantly for the entire user population.

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