



## Internet Of Things (IOT) In Healthcare: Transforming Remote Monitoring And Telemedicine

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### Abstract:

The Internet of Things (IoT) may alter medical services by means of far off persistent observing, upgraded illness the executives, and further developed wellbeing results. IoT gadgets, including wearables and sensors, may accumulate and send information continuously, empowering medical care experts to pursue instructed and brief decisions. This article dissects the current state of the Internet of Things in medical care, the potential it offers, and the issues experienced during arrangement. This article first diagrams the benefits of IoT in medical services, for example, upgrading patient results, diminishing medical services expenses, and growing admittance to therapy. Hence, we examine assorted IoT devices utilized in medical services, enveloping wearables, brilliant inserts, and clinical sensors. This study depicts the obstacles facing the utilization of IoT in medical services, including information security, protection concerns, and administrative hindrances. The paper wraps up with an assessment representing things to come of IoT in medical care and its forthcoming effect on the medical care area. The creators battle that IoT has the ability to upset medical services through the help of custom fitted medication, upgrade of disease the board, and increase of patient support. To completely outfit the commitment of IoT in medical services, it is fundamental for tackle execution issues and defend patient information.

**Keywords:** Internet of Things (IOT), Smartimplants, Remote Patient Monitoring, Artificial Intelligence

### Introduction:

The medical care area is seeing a significant change because of the development of new innovations, eminently the Internet of Things (IoT). The Internet of Things signifies an organization of interconnected gadgets, sensors, and things that can assemble, trade, and investigate information. Lately, the medical care industry has examined the possible impact of IoT on upsetting medical services conveyance, improving patient results, and

expanding generally functional effectiveness.

This undertaking, named "Effect of the Internet of Things on the Medical care Industry," looks to research and dissect the numerous manners by which the Internet of Things is changing the medical care area. Using IoT innovation, medical care organizations might expand patient observing, work with telemedicine, increment sickness the board, facilitate functional work processes, and improve

asset circulation. This exploration expects to look at the one of a kind purposes and benefits of IoT in medical services and to assess its possible effect on various features of the area.

The undertaking will outline the substantial benefits of IoT for medical services experts, patients, and different partners through extensive examination, information investigation, and contextual analyses. It likewise examines the snags and contemplations related with involving IoT in medical services, including information security, protection issues, interoperability, and administrative consistence.

The undertaking's decision outlines the way that IoT is disturbing the medical services area by improving dynamic in medical services associations, helping patient consideration, expanding productivity, and upsetting medical care conveyance. This will improve perception of how to work with additional versatile answers for the computerized period.

#### **Digital Devices and Internet of Things:**

Computerized devices and the Internet of Things (IoT) are more huge in our regular day to day existences, with connected thoughts changing different cultural components. Computerized gadgets incorporate electronic contraptions that can store, interaction, and move information. On the other hand, IoT means an organization of substantial gadgets, items, and vehicles coordinated with sensors, programming, and organization association that work with information assembling and sharing. The broad utilization of computerized gadgets and IoT innovations in medical care has brought about significant headways.

IoT gadgets assemble information and use calculations for examination, empowering medical care specialists to give cautions or recommend further treatments in light of the determined bits of knowledge. Additionally, IoT empowers the distant

reconnaissance of patients' important bodily functions and wellbeing boundaries [11]. Besides, brilliant houses coordinated with IoT innovation have the capacity to work with autonomous residing for older people and those with handicaps by means of remote checking and the board of family hardware [11]. In outline, the reconciliation of computerized gadgets and IoT advancements can possibly change medical services conveyance, prompting better quiet results, expanded productivity, and cost reserve funds. It is fundamental to fastidiously address protection and security issues to ensure that the advantages of new advancements are accomplished securely and morally [11].

#### **Architecture of IoT-Based Health Care:**

Medical services plans utilizing the Internet of Things (IoT) frequently have three levels: the understanding layer, the organization layer, and the application layer. The insight layer involves different sensors and gadgets expected to gather wellbeing related information from patients. These gadgets incorporate wearable innovation, smartwatches, circulatory strain screens, glucose meters, and similar to gadgets. They gather essential signs, action levels, pulse, and more appropriate information, handing-off it to the organization layer for additional examination.

The organization layer gives the fundamental association and correspondence system to empower information transmission between the discernment and application levels. The Internet of Things generally centers around high-recurrence gadget correspondence, however lower and medium frequencies are likewise feasible.

The correspondence advancements utilized in this layer incorporate Bluetooth, Zigbee, remote sensor organizations, RFID, low-power Wi-Fi, and overall frameworks for portable correspondence.

The application layer is liable for

handling and dissecting information acquired from the insight layer. It incorporates different programming instruments and calculations that examine accumulated information and give huge experiences to medical care experts. Applications inside this layer range from essential portable applications that permit individuals to screen their wellbeing information to cutting edge AI calculations that can gauge wellbeing results and recognize potential issues.

An IoT-based medical services engineering outfits medical services professionals with continuous, significant information, working with worked on understanding results, improved care conveyance, and cost decrease. It is fundamental for address protection and security issues to safeguard patient information and assurance the moral and safe utilization of these advancements [9].

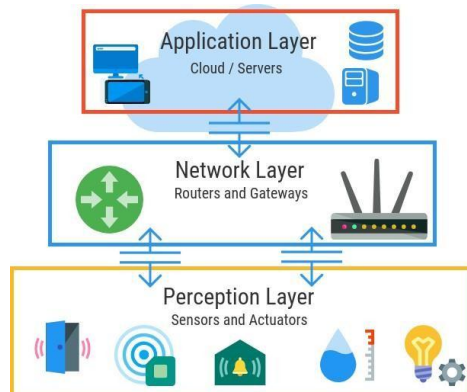


Figure 1. Three-tier IoT architecture [13]

The engineering of the Internet of Things has a few functionalities that might be refined into three essential parts. The main part is the sensor layer, including sensors, actuators, and end gadgets that associate with the surrounding climate. The subsequent component is the sensor layer. The organization works related to the application layer to empower the revelation, association, and move of organization gadgets, while the application layer directs information the board, stockpiling, and concentrated administrations, assuming a vital part in conveying usefulness to clients

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(as found in Figure 1).

### Global Statistics for IoT-Based Healthcare:

Projections show that the worldwide Internet of Things (IoT) industry inside the medical care area will see significant turn of events. The market esteem is projected to increment from \$180.5 billion of every 2021 to \$662.3 billion out of 2028, demonstrating a build yearly development rate (CAGR) of 25.9%.

Esteemed at around \$60 billion, IoT-based medical services arrangements are expected to achieve a build yearly development pace of 25%, surpassing \$300 billion by 2025. The expected expansion in the amount of internet-associated medical care gear is significant, with an expected 3.7 billion gadgets anticipated for use by 2025.

The joining of IoT in medical care has huge potential. The organization of IoT gadgets, including wearables, is supposed to bring about huge expense reserve funds, possibly accomplishing a 30% decrease in medical clinic expenses, a 40% drop in crisis division visits, a half decrease in medical clinic readmissions, and a 33% decrease in the normal length of clinic stays. These upgrades are fundamental in the administration of persistent sicknesses like as diabetes and coronary illness, where IoT-empowered arrangements might improve patient results and save medical services costs.

These numbers underscore the developing meaning of IoT-based medical care arrangements and their significant effect on the area sooner rather than later.

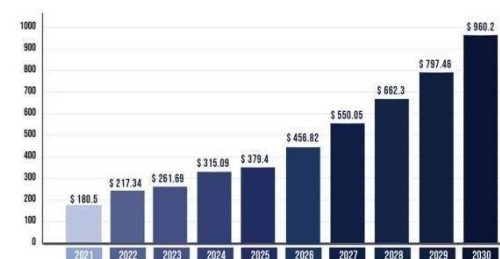


Figure 2. IoT in Market, 2021 to 2030 (USD Billion) [6]

The representation portrays the piece of the pie of the Internet of Things (IoT) from 2021 to 2030, showing the market size in billions of dollars. In 2021, the health business comprised 59% of the pay, and the medical services area addressed 35%. In 2021, North America is projected to give the best income share, surpassing 40.3%. The Asia Pacific district is expected to see a build yearly development rate (CAGR) of 18.50% in examination, programming, and documentation processes from 2022 to 2030. The market has seen significant development inferable from uplifted interest for clinical gear, a rising number of dynamic patients, and an accentuation on productive gadgets. Upgraded digitalization, legislative help, and specialized progress furthermore impel market development during the projection time frame (allude to Figure 2).

#### Uses of AI and ML for Designing IoT-Based Healthcare Systems:

The coordination of man-made consciousness (artificial intelligence) and AI (ML) with the Internet of Things (IoT) has earned critical premium inside the medical care area. By examining information gathered from IoT gadgets, computer based intelligence and ML calculations give huge experiences into patient wellbeing, working with individualized treatments and upgrading gadget usefulness. This incorporation has critical commitment for expanding patient results, diminishing medical care expenses, and lifting the general nature of administration. Besides, the examination of shrewd city thoughts has focused on changing medical services by upgrading proficiency and cost-adequacy.

A critical utilization of IoT in medical care is the remote checking framework, which widely uses man-made intelligence and ML to break down different records and measurements. Besides, AI methods are utilized in clinical choice

emotionally supportive networks to give scientific portrayals. This report offers a broad examination that depicts fundamental IoT wellbeing applications worked with by savvy city foundation. Appraisal of innovation and frameworks relating to telemedicine checking administrations. The review explains the primary imperatives of the subject, so upgrading logical comprehension and proposing imminent headings for future request in this area [2].

Far off quiet consideration (RPM) is a creative medical services system that utilizes IoT advancements, for example, telemedicine, wearable gadgets, and specialized apparatuses, to help medical care experts in giving clinical consideration. RPM incorporates the evaluation of fundamental signs and actual variables to work with clinical navigation and treatment arranging. Man-made brainpower frameworks examine clinical pictures and information to distinguish and quantify ailment. AI calculations work with the understanding of multifaceted information and the expectation of wellbeing state. Coordinating IoT models with focal control places might advance ordinary tasks and improve patient wellbeing. RPM is utilized in rustic, home consideration, and medical clinic conditions, upgrading medical services through progressions in man-made brainpower and AI (allude to Figure 3).

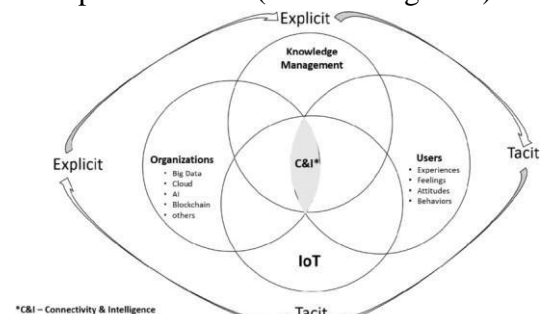


Figure 3. Knowledge Management in IoT Ecosystems [10]

Associations need information the board (KM) to flourish in the information economy. Information The executives might be viewed as a temperament, item, resource,

interaction, capacity, and information/data/information. Associations need culture, faculty, design, and data innovation for compelling information the executives. The SECI worldview portrays four levels of information creation: social, extraneous, mixture, and incorporated. Information the board incorporates the capacity and recovery of information by means of semantic and rambling memory, the transmission of data through sharing and recovery, and the use of information through directions, processes, and cooperative endeavors. The Internet of Things, Large Information, and Man-made consciousness might help undertakings with data the executives.

#### **Literature Review:**

The growing more seasoned segment and the rising worldwide populace thickness are really difficult for medical care specialists. The arrangement of excellent medical care administrations with compelled assets has arisen as a basic issue. In this way, there is an earnest requirement for a constant frame framework that really controls and gives medical care administrations, particularly for the consistent checking of the old. This study looks to analyze the impacts of utilizing Internet of Things (IoT) innovation in medical care the board to handle this issue. It offers a complete investigation of how IoT might work on the capacities of emergency clinic the board frameworks. Besides, it stresses the advantages, challenges, and forthcoming exploration roads connected with the combination of IoT in medical services. The outcomes show that IoT-empowered shrewd medical care might give more fast and better medical services administrations than patients. This might be achieved by utilizing Internet-associated brilliant gadgets and wearable clinical sensors to screen patient wellbeing

and get ideal symptomatic data [1].

The medical services area can altogether utilize the capability of the Internet of Things (IoT), especially according to the Coronavirus pandemic. Broad review has been attempted to investigate the conceivable outcomes of IoT in medical services during this emergency. Specialists have distinguished seven head advancements and sixteen fundamental IoT applications that are exceptionally helpful in medical care during the pandemic. These applications incorporate record-keeping, testing, gadget reconciliation, and the distinguishing proof of ailment etiologies. The sensor-based innovation of IoT can possibly alleviate careful dangers in mind boggling occasions and aid the treatment of Coronavirus patients by means of constant checking of fundamental boundaries. This assistance situated philosophy offers novel possibilities for medical services conveyance, enlarging therapy frameworks and refining the training of clinical understudies in sickness recognizable proof and helpful planning. Moreover, IoT can handle a few clinical troubles, including rate, cost, and intricacy, and can be tweaked to screen and treat sicknesses like asthma, diabetes, and joint pain, as well as measure caloric admission. The Internet of Things (IoT) may further develop medical services effectiveness during the Coronavirus pandemic through a carefully overseen wellbeing the board framework. In synopsis, IoT can possibly change medical services during the pandemic by upgrading clinical practices and giving novel ways of handling related hardships [7].

The Internet of Things (IoT) is an idea that joins contraptions and actual things to the internet, working with computerized admittance and cooperation. The idea was brought about by Kevin Ashton, who presented the word while looking at radio recurrence ID innovation. The Internet of

Things (IoT) has huge potential in the medical care area. Versatile wellbeing checking devices give distant patient observation and empower prompt reactions from doctors. By the by, reliable internet access is fundamental for brief information investigation. Despite the fact that IoT is advancing in medical services, its extensive use isn't yet predominant across every clinical area. IoT information investigation might better ailment analysis and work on personal satisfaction. financial matters recognize the Internet of Things (IoT) as a practical system for medical services progression, requiring collaboration among financial aspects, medical services chairmen, and clinical experts. The reconciliation of IoT with man-made intelligence innovation gives a few benefits in the clinical business, reforming medical care conveyance, improving correspondence, and reinforcing contemporary medication. Tending to obstructions like inadequate cognizance and the requirement for a careful development plan requires more request. All in all, the Internet of Things (IoT) addresses a progressive creation with huge commitment, particularly in the medical care area [12].

Customized medical services expects to give open therapies to individuals regardless of their geological area or fleeting imperatives. This availability is worked with by trend setting innovations like the Internet of Things (IoT), which joins things implanted with sensors, programming, gadgets, and organization association. The IoT uses existing framework to permit remote detecting and control of things, thus improving on effective information assembling and sharing. Late headways in RFID, canny sensors, correspondence advancements, and Internet conventions have worked with the reasonable acknowledgment of the Internet of Things. The essential goal of the IoT is to

foster independent applications in which clever sensors associate freely of human contribution. This paper features the significance of IoT in medical services, particularly in sickness determination and forecast, while likewise talking about the constraints of integrating IoT into clinical applications. Proposed security and protection shields intend to more readily mind conveyance through IoT. IoT-empowered continuous patient checking takes out pointless visits, hospitalizations, and readmissions. It works with proof based decision-production for doctors, upgrades straightforwardness, and aids the early conclusion of infections.

The Internet of Things upgrades drug and gear the board, diminishing missteps and expenses. In any case, hardships incorporate foundation upgrade, virtualization execution, and the confirmation of capacity, protection, security, and quick correspondence need center. Proposed arrangements in different examination work with the coordination of IoT in medical services. Eventually, utilizing 5G association and incorporating man-made reasoning, IoT has the ability to change the medical care industry.

### **Applications of IoT:**

#### **IoT Sensors and Devices:**

IoT-empowered sensors and contraptions are utilized in the ICU to accumulate different patient information, enveloping essential signs, physiological measurements, and natural conditions. These contraptions might incorporate wearable sensors, shrewd beds, ventilators, heart screens, circulatory strain screens, temperature sensors, among others. Sensors ceaselessly gain information from the patient and the general climate.

#### **Data Collection and Transmission:**

IoT gadgets accumulate patient information, which is then conveyed to a

unified framework continuously. Information might be sent remotely utilizing conventions like Wi-Fi or Bluetooth, or by means of a wired association. Continuous information gathering ensures that medical care work force have current information about the patient's status.

#### **Centralized Monitoring System:**

The concentrated observing framework gets and processes the sent information. This framework solidifies and presents information from different people, offering a broad outline of their ailments. The framework might have dashboards and alarms that help medical care specialists in checking significant information and recognizing anomalies or demolishing progressively.

#### **Real-Time Alerts and Notifications:**

The IoT framework might give continuous cautions and directives for medical services specialists when a patient's important bodily functions or different measurements show a serious state or need speedy intercession. Cautions might be shipped off medical services faculty through numerous modalities, remembering visual warnings for the checking framework, hearable signs, or cell phone alarms.

#### **System Design:**

Wise clinical devices utilize surrounding sensors and wearable innovation to screen the wellbeing and security of patients and the old. This innovation determinedly accumulates information, including clinical history, to aid analysis, taking care of oneself, and fundamental capabilities, for example, record-keeping and treatment appraisal. Ongoing headways in man-made consciousness and huge information handling have changed wearable information examination, working with proficient and exact handling approaches. Information gathering is redone to meet

dynamic prerequisites and works with informed dynamic cycles [15].

Our idea coordinates WBAN (remote body region organization), LPWAN (low-power wide-region organization), and IoT developments to work with security checking in remote innovation, including LPWAN network inclusion, sensor hub use, and IoT gadget arrangement. The extensive design comprises of three separate subsystems: (1) wearable sensor hubs, (2) an IoT entryway, and (3) an Internet cloud.

#### **Wearable Network:**

The mix of a remote sensor network is fundamental in medical care frameworks, permitting nonstop and brief evaluation of physiological signs while lessening data over-burden and exertion. Important bodily functions, including pulse, pulse fluctuation, internal heat level, skin conductance, respiratory rate, circulatory strain, blood glucose level, oxygen immersion, and more boundaries, might be surveyed utilizing appropriate hardware that can be helpfully worn on or over apparel. It was precisely identified and recognized. might be joined straightforwardly to the body [15]. In clinical settings, the assessment of the four basic pointers — internal heat level, pulse, breath rate, and circulatory strain — is frequently restricted to actual tests or clinical conferences, regularly utilizing little hardware. Regardless, there is a requirement for improved accuracy and progressing observation of these indispensable signs and related factors. The fundamental point of clinical and accuracy medication gadgets is to give ideal data to medical services experts and patients, empowering high-accuracy longitudinal estimation [4].

Every member is furnished with two classes of wearable sensor hubs: a solid hub for ecological observing and a wellbeing hub for physiological estimation. The wellbeing hub involves a BLE module for WBAN correspondence, a PPG sensor for

pulse observing, and an internal heat level sensor. The framework involves four ecological norms and two radio modules: BLE for intra-WBAN correspondence and LoRa for LPWAN transmission [14].

In a protected setting, a Bluetooth Low Energy (BLE) part is fundamental for getting sensor information from the WBAN clinical line. This information is then shipped off remote spots inside the LoRa organization. Bluetooth Low Energy (BLE) works with effective information move with little battery use; by the by, its transmission range is limited. On the other hand, LoRa has a decreased information rate and higher energy utilization, despite the fact that it is fit for communicating information over broad distances. The proposed crossover network design utilizes LoRa for long-range information transmission and BLE for information move in WBAN [14].

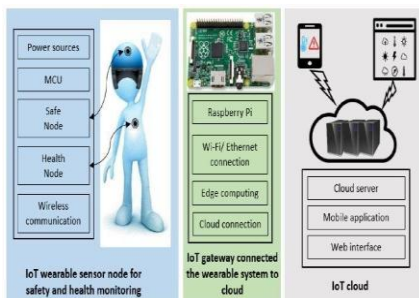


Figure 4. Designing wearable sensor network for environmental and health monitoring [14]

#### IoT Gateway:

The essential capability of the Internet of Things entryway is to connect existing gadgets from distributed computing to the edge inside the system of the Internet of Things (IoT). A door involves a Raspberry Pi, an Internet association, and a LoRa module [14]. Passages give correspondence between sensor organizations and nearby switches or internet associations utilizing different correspondence systems. It gets information from a few subnets, does convention change, and offers additionally refined administrations like information collection,

separating, and size decrease [16].

#### Internet Cloud:

The IoT cloud server safely documents information got from an IoT passage in a cloud-based MySQL data set, working with additional examination [14]. Cloud IoT, the coordination of cloud innovation with IoT, gives an original philosophy to making a firm medical care framework, working with the interconnection and information trade of different IoT-based medical services applications for effective arrangements. Cloud IoT settle the imperatives of limited usefulness and capacity in sensor hubs by offering a technique to oblige the developing information prerequisites of correspondence and medical care applications across different gadgets. The cloud IoT engineering ensures continuous application and administration arrangement while conforming to cloud administration necessities [8].

#### Network Implementation:

Figure 5 shows the data stream all through the organization. Networks are ordered into two essential sorts: neighborhood known as LPWANs, including WBANs, and Internet of Things networks that point of interaction with the cloud. The information accumulated by Wellbeing Hubs and Safe Hubs is shipped off the IoT door and hence to the cloud server. Our IoT network utilizes MOTT (Message Lining Telemetry Move) for information transmission among doors and cloud servers [14].



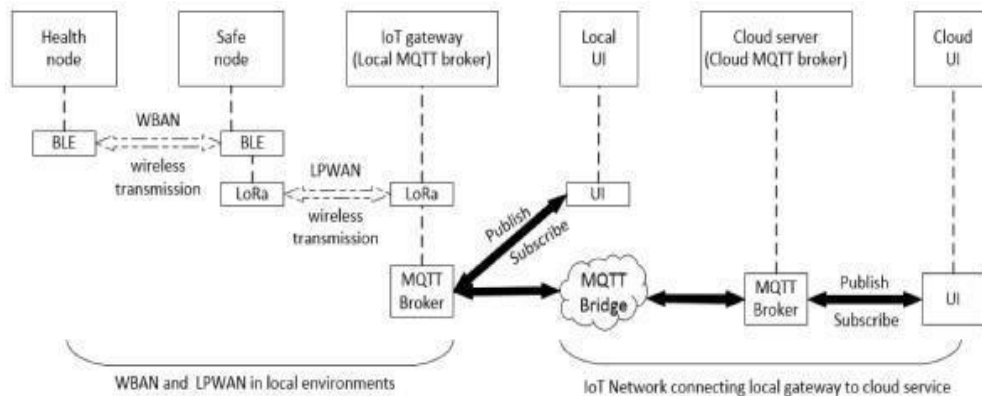


Figure 5. Implementation of connectivity from Wireless Body Area Networks (WBANs) to the cloud server [14]

This venture examines the reception of Internet of Things (IoT)- based medical care frameworks and their possible advantages, especially zeroing in on altered medical services. It analyzes the difficulties and impediments of these frameworks and proposes commonsense suggestions for their effective goal. The paper gives an exhaustive survey of the present status of IoT-based medical services and its various applications across a few ventures.

### Conclusion:

The Effect of Internet of Things (IoT) on medical care project yielded huge experiences into the troublesome capacities of IoT inside the medical care area. The consequences of this study highlight the many benefits and potential outcomes that IoT offers to medical services associations, patients, and partners.

The combination of IoT gadgets permits medical services specialists to expand patient checking, work with far off care, and lift illness the board. The social affair and examination of ongoing information empower proactive and customized medical care mediations, bringing about upgraded patient results. The consistent association and interoperability of IoT gadgets and wearables improve successful data trade, working with

coordinated effort and upgrading tasks.

It is fundamental to defy the obstructions and issues connected with IoT reception in medical care. Information security, protection issues, interoperability, and administrative consistence should be carefully figured out how to ensure the solid and moral utilization of IoT innovation in medical services conditions.

The fate of IoT in medical services has huge potential outcomes. Proceeded with innovative work in shrewd clinical sensors, program structures, man-made intelligence reconciliation, and tending to foundational imperatives will work with the acknowledgment of IoT's maximum capacity in medical services. By taking on and utilizing IoT, the medical services area might understand a fate of interconnected care, expanded effectiveness, and more prominent patient government assistance.

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