

A Unified Approach to Cloud based Integrated Health Care Service Management System: Bhubaneswar Smart City as a Case study

Dillip Kumar Mahapatra, Sasmita Mishra, Ph.D, , Hari Narayan Pratihari, Ph.D

¹Ph.D Scholar, Dept. of CSE & Application, Indira Gandhi Institute of Technology, Odisha, India.

²Professor, Dept. of CSE & Application, Indira Gandhi Institute of Technology, Odisha, India.

³ Professor, Dept. of Electronics & Communication Engineering, St. Martin's Engineering College, Dhulapally, Secunderabad, Telangana, India.

¹research.dillip@gmail.com

²sasmita.mishra.csea@gmail.com

³drhnpratihari1@gmail.com

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Abstract: The cost of health care has been steadily increasing. Evaluate an organization's success by ensuring the overall effectiveness of the sector. There has been a rapid change in patient treatment. IoT-enabled integrated management systems are used in smart city hospitals to manage patient data. Because of the geographic diversity, technical inconsistency, socio-economic adaptability, and cultural or climatic differences, it can be difficult to share patient data between hospitals for improved treatment, especially in smart cities like Bhubaneswar. We'd like to enhance the flow of data via the HMS. This is the result of centralized hospital management. For important patient transfers, this architecture enhances information flow. It allows patients to visit nearby hospital doctors if transportation is impractical or impossible. Aim of this work is to model a healthcare management system that is both efficient and secure. As faulty models can cause delays and increase costs. There is a chance of inefficiency. Since, UML ensures the correctness of all planning models; hence software and its functions are described using object-oriented modeling. It also demonstrates how the logical and physical components of a healthcare database management system may be described using a Unified Modeling Language to develop software with object-oriented features.

Keywords: Health Care Sector, Unified Modeling Language, Smart City, IoT, Big Data

Introduction

The characteristics of smart cities are determined by a number of evaluation criteria, the exact nature of which varies depending on which worldwide agency is being consulted. The International Organization for Standardization (ISO), which is one of these worldwide agencies, recently implemented the ISO 37120 Smart City

standard, which specifies a standard of performance that is universal for cities. This standard identifies healthcare as one of the most important criteria for a Smart City. Healthcare indicators such as the number of in-patient hospital beds, physicians, and nursing personnel per 100,000 population, average life expectancy, mortality rate for children under the age of five per one thousand births, suicide rate per one hundred thousand population, and mental health practitioners per one hundred thousand population are some examples of healthcare indicators. In the course of our conversation, we will centre our attention on the first three symptoms. In a similar vein, the International Telecommunications Union (ITU) identifies the rate at which electronic medical records are used and the rate at which hospitals share resources and information as two of the most important factors for determining whether or not a city is considered a smart city. In the current environment, there are three major challenges that must be overcome in order to achieve the Smart City healthcare targets. These challenges include the following: continuous year over year increases in healthcare costs; a widening gap between the required and available medical workforce; and a lack of capabilities to share centrally available clinical data in real time [2].

The ultimate objective of Smart City healthcare is to improve both the quality of care and its accessibility, all while lowering the associated costs. The Internet of Things (IoT), which is propelled by the Digital 5 forces (i.e. mobility, big data, cloud, social, and robotics and artificial intelligence [AI]), is turning these obstacles into opportunities. According to Frost & Sullivan's projections, by the year 2025, the smart city healthcare sector will have the potential to generate commercial possibilities with a market value of \$220 billion. This article focuses on addressing these three difficulties by harnessing digital technologies that are most suited for diverse scenarios. Doing so will enable the administration of a city to improve their healthcare ratings and boost their candidacy to be recognized as a Smart City [15].

Background and Literature Review

Smart city and Bhubaneswar

As the world's population continues to grow and urban areas become more desirable, urbanization has taken place. In this context, urban areas refer to cities and towns that are more diverse in all aspects of life than rural areas. Rather than being a single integrated system, these cities are typically composed of many interconnected subsystems. The major goal of the smart city movement has always been to improve efficiency, sustainability, and security. Developing countries, on the other hand, are more likely to implement smart city programmes because they place higher emphasis on infrastructure upgrading and expansion [3].

These modern cities are viewed as full ecosystems that deal with a wide range of socioeconomic, economic and environmental issues. These industries include energy, education and media. Modern cities face issues in regularly maintaining and updating public services to fulfill residents' expectations, which necessitate smart city efforts to deliver effective solutions to current urban problems and enhance quality of life indicators. Cleaner production is essential, especially in developing countries like India, where pollution is a major problem. The term "smart city" does not have a single definition because it varies from country to country, from person to person, and from scenario to situation [3].

Any other country's smart city concept would not have the same advantages as India's because of its geographical location, resource accessibility etc. In an ideal smart city, every Indian would like to see a particular set of features and services. The four pillars of integrated structural, physical, political, and economic growth infrastructure must be created by city leaders in order to fulfill the needs and expectations of citizens. The mission plan for sustainable development is to support cities that can offer network infrastructure, adequate living conditions, a safe and sustainable environment, and the adoption of "Smart" Systems [15].

Services in a smart town like Bhubaneswar would mostly consist of: Electricity, Sanitation, Water, Public Transport, Housing, IT connectivity, Governance, Clean Environment, Security, Health and education etc.

With the Smart Cities Mission, districts may improve their quality of life while also boosting their economies. The city's overall quality of life would be improved if development in older neighborhoods, particularly ghettos, was reduced. Smart solutions can help cities enhance public services by combining infrastructure, technology, and evidence. As much as two-thirds of India's growth has come from urban areas, which account for 70 percent of the country's employment. Recently released statistics reveal a growing trend of people migrating from rural areas to urban centers in search of better jobs and other amenities that cities provide [15].

There hasn't been much involvement from the state or the federal government in urban planning, so private developers have stepped forward to fill the void. The development's goal is to incorporate technological improvements into urban planning organizations and cleaner production initiatives in order to address the concerns related with urbanization and to create creative, efficient answers to existing problems and thereby improve city quality of life [15].

Healthcare system

World health Organization (WHO) defines a health system as all organizations, individuals, and actions whose primary goal is to promote, restore, or preserve health in the population as defined by WHO Efforts to impact health-related factors as well as activities aimed at directly improving health are included [1]. There is more to the health system than the pyramid of publicly owned facilities that provide personal health services; it includes the institutions, people and resources involved in providing health care to individuals.

In addition to prevention, promotion, treatment, and palliation, rehabilitation is a crucial health service. One of the most important services provided in a complete health care system is rehabilitation. Improved coordination, accountability, quality assurance, and sustainability are predicted to arise from include rehabilitation services in health systems at various stages of life and for a wide range of health disorders (across the continuum of care). Long-term, this integrated approach will lead to improved rehabilitation service delivery, better personnel allocation, and enough financial support for those who need it [5].

However, there is evidence that many health systems around the world do not yet adequately incorporate rehabilitation. Individuals in many countries lack access to rehabilitation services. Integrating rehabilitation within universal health coverage is the greatest method to ensure that rehabilitation treatments are available to all persons who need them [5].

Building a harmonious health system requires well-trained and motivated people, a well-maintained infrastructure, a stable supply of medications and technologies, and appropriate money underpinned by robust health plans and scientifically sound regulations. The health care systems of different countries vary according to their economic and political growth. Worldwide, health care is a top priority and a major source of worry. Regardless matter whether a country has a private, public, or a mixed health care system, it faces issues with service quality, availability, and affordability [9].

Like other social institutions, health systems vary widely around the world and tend to be influenced by their respective countries' histories, cultures, and economies. Countries establish and develop their own health systems based on their own requirements and resources, although vaccinations and other public health initiatives are widespread in almost all health systems. Depending on the country, health system planning may be distributed among private health care providers or coordinated by government agencies, trade unions and charities, or religious organizations and other co-ordinated bodies, to provide targeted public health care services to the populations they serve [5].

A country's economy, growth, and industrialization can benefit greatly when health care is provided effectively. This is because it is traditionally seen as a major determinant in boosting people's overall physical, mental, and social well-being around the world. Rehabilitative services should be viewed as an investment rather than an expense because of the positive influence they have on individuals, families, and communities [9].

All of the people, not just a select few, should have access to health care services. Effective Primary Health Care services backed by an adequate referral system are the greatest approach to offer health care for the poor in rural and urban areas that are currently underserved by healthcare. Primary, Secondary, and Tertiary tiers of healthcare organizations exist[9]. (shown in figure: 1)

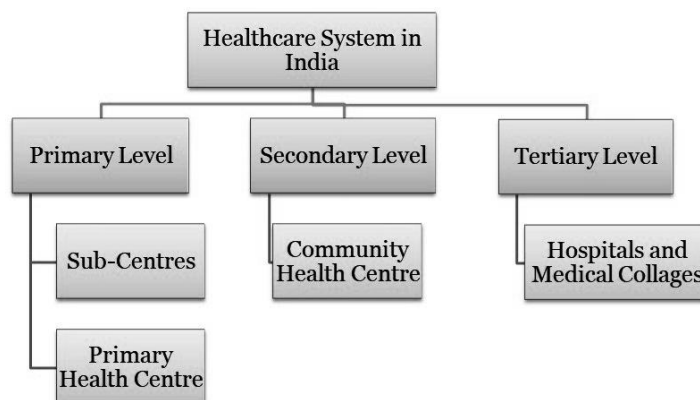


Fig. 1: Healthcare System in India

- 1. Primary Level:** Primary healthcare is the primary link between a patient and an organization that provides medical services. It encompasses both primary health centers and secondary health centers. In the case of primary health centers, the first point of contact between the community and the doctor is at the sub centre, which is located in the most remote part of the system and serves as the first point of contact between the patient and the healthcare facility [5].
- 2. Secondary Level:** The patient may initially be referred to the secondary level of care, which is the first referral level, depending on how serious the problem is. Incorporated inside it is the Community Health Center [5].
- 3. Tertiary Level:** Tertiary care is the second referral level, and it is provided by institutions such as hospitals and medical colleges[5].

To meet the Sustainable Development Goals and achieve Universal Health Coverage (UHC) by 2030, India has made a pact with the United Nations (UN). The 2017 National Health Policy has been put in place with the objective of The maximum possible degree of excellent health and well-being, achieved by a preventative and primitive health care orientation in all development strategies, and universal access to good quality health care services without anybody having to experience financial hardship as a result[5].

As a result, the country's healthcare system is underfunded. A number of structural issues also exist, such as a lack of synergy between disease control, family welfare programmes, non-communicable diseases control, and other social sector programmes. Throughout the years, there has been a lack of accountability for the results of primary health care and the new commitment to universal health care[5].

There have been several notable public health successes since independence, including the eradication of smallpox, Guinea worm sickness, and most recently, polio. Continuing vector-borne diseases, developing and re-emerging communicable diseases, and the ageing population coupled with non-communicable diseases including diabetes, malignancies, and heart diseases, as well as the silent killers of nutritional problems plague the country's public health system in 2019[5].

Access and accountability of healthcare services are hampered by insufficient regulatory frameworks for

pharmaceuticals and medical practice in countries with low health infrastructure. The country's public health system faces a number of challenges, including underutilization of modern technology and digital advancements, a lack of public health management capacity, a lack of public-private partnerships to supplement health services, and an underutilization of traditional medicine[5].

Obstacles to health and illness that arise because of cultural differences People's habits, a lack of national and provincial government investment, and a lack of coordinated attempts to harness Community Systems (Community System Strengthening) have resulted in a lack of community participation in preventative and promotional health care, adding to the challenges[5].

Iot in Healthcare

The healthcare industry is at its lowest ebb. Healthcare is more expensive than it has ever been, the world population is ageing, and the number of chronic diseases is escalating. As a result, the majority of the population will no longer be able to contribute to society's economic well-being as they become older and more vulnerable to chronic disease. While technological advancements cannot stop the ageing of the population or eliminate chronic diseases tomorrow, they can at least make healthcare more accessible by providing patients with cost-effective medical facilities [2]. Hospital expenditures are largely made up of the cost of medical diagnosis. Medical check-ups can be performed in the patient's home thanks to the power of modern technology (home-centric)[2].

The cost of treatment will be decreased if the patient outcomes are right. Known as the Internet of Things (IoT), a new paradigm has a wide range of applications, including healthcare. As a result of this paradigm shift, both patients and healthcare practitioners can look forward to improved outcomes in their respective fields of practice. Technology-based healthcare methods have numerous advantages that could enhance treatment quality and efficiency, thereby benefiting senior patients' well-being [3].

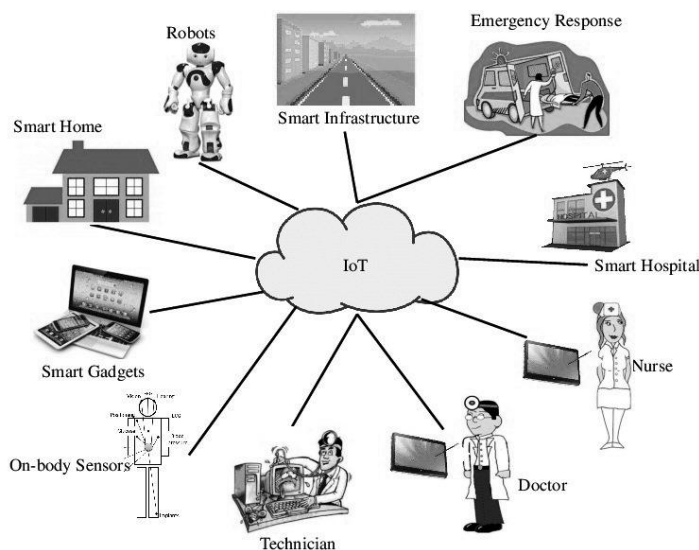


Fig. 2: IoT in Health Care

- **Simultaneous reporting and monitoring:** Remote health monitoring via connected devices can save lives in medical emergencies such as heart failure, diabetes, asthma attacks, and so on. Data from these devices can be sent to a doctor or a cloud platform for real-time monitoring via the smartphone's data connection. The Center for Connected

Health Policy reported that patients with heart failure experienced a 50% drop in 30-day readmission rates when monitored remotely. The IoT device captures and sends a variety of health-related data, including blood pressure, oxygen and blood sugar levels, weight, and ECGs. Because it is stored in the cloud, the collected data may be accessed from any location, at any time, and on any device by a doctor, insurance company, cooperating health firm, or an external consultant [4].

- **End-to-end connectivity and affordability**

New IoT technology and next-generation healthcare facilities can assist IoT automate patient care workflows in healthcare. The Internet of Things in healthcare enables interoperability, AI machine-to-machine communication, information exchange, and data mobility. It is possible for healthcare professionals to develop novel treatments and methods of treatment by using modern protocols such as Bluetooth LE and ZigBee, both of which are open standards. Healthcare costs are decreased by lowering the number of needless visits, using better quality resources and improving resource allocation [4].

- **Data assortment and analysis:** It's difficult to retain and handle the massive amounts of data a healthcare devices transmits in a short period of time because of their real-time applicability. Even for healthcare professionals, acquiring and analyzing data from a variety of sources and devices is a difficult challenge. Real-time data may be collected, reported, and analyzed using IoT devices, which eliminates the need to keep raw data. Final reports with graphs will be available only for providers over cloud computing. As a result, healthcare operations enable firms to gain critical healthcare analytics and data-driven insights that speed up decision-making and are less prone to errors [4].

- **Tracking and alerts:** Alertness is crucial for those with a long-term illness. Clinicians may monitor any ailment in real time using medical IoT devices that collect vital signs and send them to doctors via mobile apps and smart sensors. Reports and notifications convey a solid judgment regarding a patient's condition, regardless of location and time. Helps doctors and nurses make informed judgments and offer timely treatment. Consequently, the Internet of Things (IoT) offers real-time alerting and tracking, which allows for hands-on treatments, higher precision, suitable intervention by doctors, and improved patient care outcomes [3].

- **Remote medical assistance:** Using intelligent mobile applications, patients can contact a doctor located many kilometers away in the event of an emergency. With mobility solutions in healthcare, physicians may immediately examine patients and diagnose their problems while on the move. Also, various IoT-based healthcare delivery chains are planning to construct machines that may dispense medications depending on a patient's prescription and available disease-related data from connected devices. In hospitals, IoT will improve the quality of patient care. In turn, this will reduce people's healthcare costs [4].

- **Research:** Healthcare IoT applications can also be utilized for research. Because IoT enables us to acquire a vast amount of data on the patient's sickness that would take several years to gather manually. This obtained data can be used to support medical research through statistical analysis [11].

Thus, IoT has a significant impact on medical research. It permits the introduction of larger and more effective medical treatments and is deployed in a number of devices that improve the quality of healthcare services people get. Even existing devices are now being upgraded by IoT by simply integrating smart medical equipments with embedded chips. This chip improves the support and care required by a patient.

The IoT healthcare facility can be thought of as a collection of pervasive computing that focuses primarily on exterior operations. In the healthcare industry, IoT-based healthcare systems collect a range of patient data and get inputs from physicians. Continuous glucose monitoring for insulin pens is the ideal illustration of this concept [12].

All of these gadgets are capable of communicating with one another and taking life-saving measures in real time. After collecting data, an IoT healthcare gadget would transmit this vital information to the cloud so that physicians can take

action [11]. The prospective application of IoT in healthcare has the ability to improve not only patient health, but also the productivity of health professionals and hospital work flows.

Healthcare System Architecture

IoT implementation in healthcare makes it smarter, faster, and more precise than ever before. Healthcare has its own IoT architecture, which is what kicks off the entire healthcare system [3].

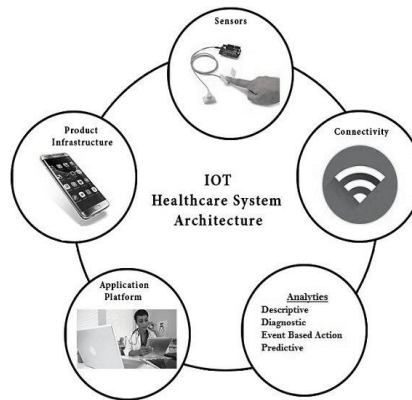


Fig.3: Healthcare System Architecture

Product Infrastructure: IoT product infrastructure such as hardware/software component read the sensors signals and display them to a dedicated device.

Sensors: IoT in healthcare has different sensors devices such as pulse-oximeter, electrocardiogram, thermometer, fluid level sensor, sphygmomanometer (blood pressure) that read the current patient situation (data).

Connectivity: IoT system provides better connectivity (using Bluetooth, WiFi, etc.) of devices or sensors from microcontroller to server and vice-versa to read data.

Analytics: AI-driven algorithms like Machine Learning (ML) analyzes the data from sensors and correlates to get healthy parameters of the patient and on the basis of their analyze data they can upgrade the patient health.

Application Platform: IoT system access information to healthcare professionals on their monitor device for all patients with all details.

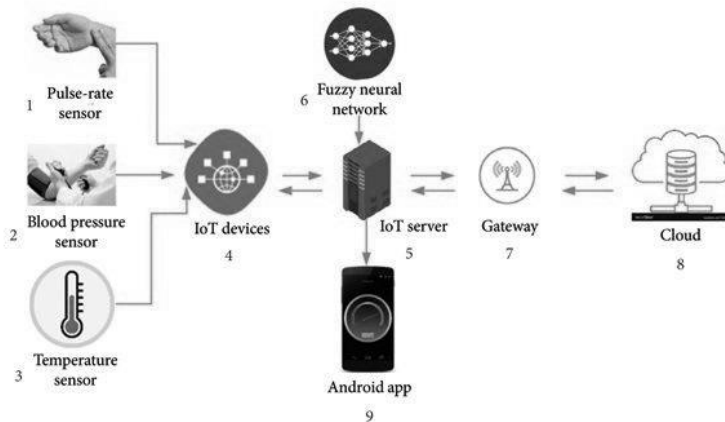


Fig.4: IoT in Health Monitoring

Smart city healthcare framework

When it comes to improving the health of cities, the Internet of Things (IoT) has a major role to play. The availability of low-cost, small-sized sensors, a wide range of connectivity options, and highly developed cloud services for data storage and processing have made the Internet of Things (IoT) incredibly important to this business[3].The figure below depicts a smart city's healthcare framework and the following are the framework's primary debate points:

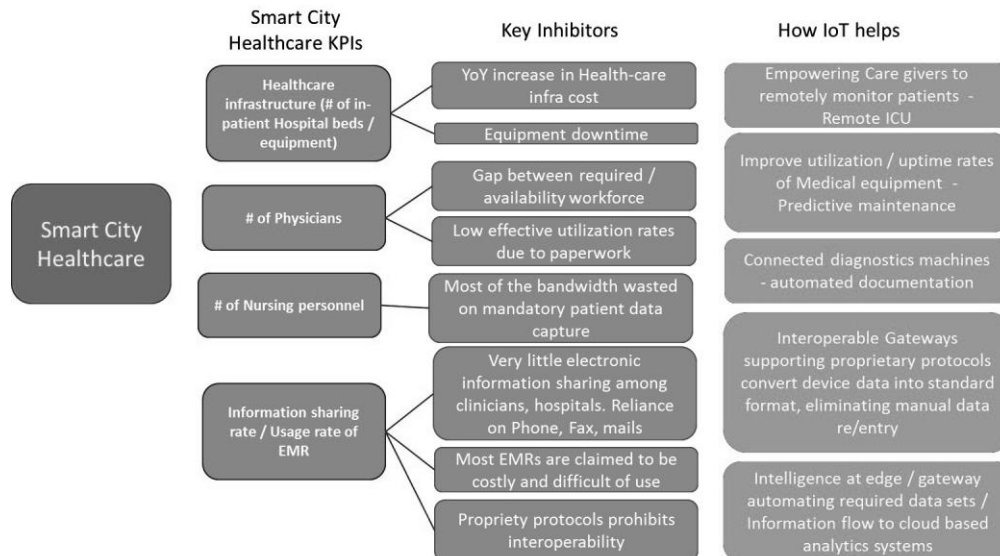


Fig. 5: IoT in Health Monitoring

1) Big data exchange between Ambulance Bus to Hospital network through internet in Telemedicine using computer communication network and 3G Mobile Antenna:

India has the world's second largest population. Moreover, road traffic is associated with a ggreater number of fatalities. Accidents typically result in death since emergency treatment and surgery cannot be administered on an ambulance bus. Specialized medical equipment is not carried on ambulance buses because these items demand more space than the ambulance bus can provide[15].

Critical emergency care could not be administered within the ambulance bus. As a result, there is an increase in critical patient mortality. The ambulance must go to the hospital before beginning care for the critically ill patient. Due of India's low economy, tiny hospitals are unable to use satellite-based Telemedicine for exchanging large amounts of data from an ambulance bus to hospitals. In this paper, a low-cost 3G/4G internet antenna in an ambulance bus is designed for Telemedicine using computer communication and mobile booster amplifier. This antenna can be used for the best transmission of big data exchange for patient report from the ambulance bus to the hospital network, and it can also reduce transfer delay[15].

The Internet-based mobile telemedicine bus can be used to save critical accident patients, and most emergency specialty treatment is also available in the ambulance bus, which is equipped with an X-ray machine for taking fracture images, a scanner machine, operation theatres, and inverters and solar panels to power the machines[15].

2) Design and implement of performance management system for hospital staff based on BSC:

In fact, the performance evaluations of the most of hospital medical staffs nowadays are typically extensive and unclear. Due to a lack of factual data, objectivity, and reason, it becomes considerably more difficult to accurately depict the actual working conditions of employees. The objective of this article's research is to develop a performance management system based on BSC in order to automatically collect the most important performance indicators from the

current hospital business management systems and HIS systems, which will lead to an automated and objective evaluation system by converting these indicators into quantitative evaluation values according to specified rules. As a case study on HangZhou First People's Hospital, it offered the concept of system model and functional component by investigating performance evaluation using AHP and Delphi poll. After completing system programme compilation, implementing a system with C code based on the .Net framework, and passing a series of tests involving performance assessment criterion analysis, data acquisition analysis, design of processing flow, and database design, it was possible to achieve a beneficial results[15].

3) Design and Implementation of Hospital Emergency Nursing Information Management System:

Making a card, registration, medical care, primary care, pharmacy dispensing, and so on are only a few of the many functions of this system[16]. These seven modules, which include the seven functions that make up this system, includes:

- 1) Emergency register management
- 2) Price making
- 3) Charge
- 4) Nurse station management
- 5) Report printing
- 6) Pharmacy dispensing and
- 7) Data dictionary maintenance.

Based on the above design, the proposed system can provide high quality treatments and good services for patients and their families.

4) Intelligent Hospital Management System (IHMS):

For the purpose of providing care and assistance at the front desk of hospitals, an intelligent hospital information management system has been designed. The patient will have the opportunity to get information regarding the specific medicine, doctors, appointment times, relevant departments, and laboratory tests that are pertinent to his or her medical condition. An intelligent front desk information service will be provided by the system for patients as they enter the hospital. It will also provide software aid for the doctors, allowing them to diagnose easily and quickly by using the program's decision mechanism [19].

Integrated Healthcare System

WHO defines integrated health systems like this: "The organization and management of health services so that people get the care they need, when needed, in a manner that is user-friendly and achieves the desired results and provides value for money." In today's world, where access to healthcare is increasingly difficult and the population is sicker than ever before, this is a critical topic [19].

The term "inter-professional health care" refers to a method that emphasizes close cooperation and communication among medical specialists. Patients' medical, psychological, and social requirements are all taken into consideration while developing an integrated treatment plan, which involves the exchange of information among the patient's care team members. There are many different types of health care providers who can be part of an inter-professional health care team, depending on the patient's specific need [19].

The basic goal of an integrated health system is to offer patients and their families with seamless and coordinated treatment. By ensuring that patients move smoothly through the healthcare system, the assumption goes, they would receive better care and have better health outcomes [19].

The major types of integration health system are;

- **Functional integration:** In which multiple relationships exist and are coordinated across the various units and departments as a way to provide the best value and service to patients [19].
 - This concept moves beyond patient care and refers to ancillary departments as well as the IT department and quality assurance departments [19].

- Making sure there is a strong connection between non-patient care departments and patient care departments allows for a better healthcare experience for patients as well as a more seamless transition throughout all aspects of healthcare [19].
- **Organization/Physician integration:** The physicians and the organizations they're working with and/or associated with share the same values, visions, and objectives as a way to limit differences in the patient care provided [19].
 - The physician and organization should view each other as allies working together for the same cause, allowing them to provide more efficient and better service, which leads to better overall health outcomes for patients [19].
- **Clinical integration:** In this case priorities given to facilitate the coordination of patient care across conditions, providers, settings, and time in order to achieve care that is safe, timely, effective, efficient, equitable, and patient-focused [19].
 - services provided to patients can come from many different providers and organizations are coordinated via a care coordinator [19].
- **Service Integration:** In this case, data is integrated, and enables the systems that contain it to communicate with each other, thereby leading to unified solutions [19].

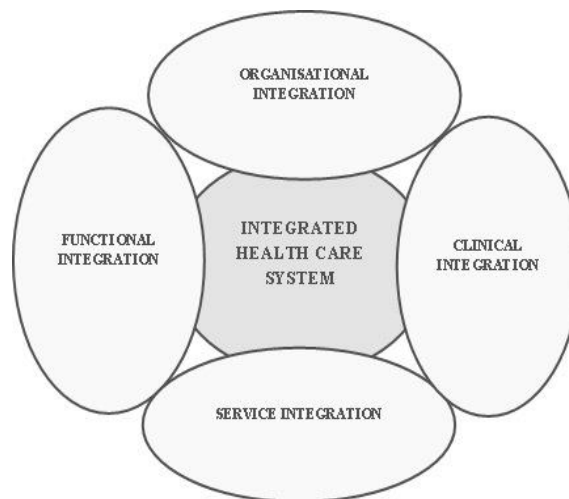


Fig. 6: Structural view of an integrated healthcare system

Integrated healthcare has a lot of great benefits for patients and doctors alike. Primarily, this includes:

- 1. Patient satisfaction** – According to research on inter-professional and integrated healthcare, patients report higher levels of overall satisfaction as a result. In order to deliver better overall outcomes for illness management, mental health difficulties, physical therapy, and much more, patients benefit from improved collaboration between their doctors. This improves their quality of life and their overall satisfaction with their healthcare provider [19].
- 2. Quality of care** – An integrated approach to healthcare improves the quality of health care services. Health care professionals can work together more closely to understand the unique needs of each patient, create a customized treatment plan, and ensure that they are receiving appropriate treatment to improve their overall well-being and manage their health conditions better [19].
- 3. Improved access to services** – There are many advantages to integrated health care, including better service access. As one example, a patient in need of counseling or other mental health services can easily get in touch with a counselor who works in the same organization as their primary care physician under an integrated healthcare paradigm. Psychiatrists and Therapists can also recommend you to a primary care physician in the form of reverse integration.

This means that patients will have easier access to the health treatment they need. The availability of healthcare services has never been better, thanks in part to the proliferation of telemedicine and virtual healthcare services offered by many integrated healthcare providers [19].

4. Lower overall healthcare costs – There is a lowering in the overall cost of healthcare when doctors and other medical professionals cooperate cooperatively. Appointments can be cut down significantly for patients. An integrated healthcare model's improved information exchange can also speed up diagnosis and assist remove unnecessary medical tests and exams, cutting expenses for patients and healthcare commercial entities [19].

III. Motivation

Significance of OOAD in Developing Integrated Smart Health Care System

Different combinations of professionals and teams engage to provide care for patients in a highly interconnected and dynamic healthcare system. Due to the interdependencies in the healthcare system, it is desirable to have a multi-facility, flexible simulation modeling methodology, where the modeling boundaries are sufficiently flexible to capture the complex interactions between service centers[19].

Until the final phases, Object-Oriented Development is a conceptual process regardless of programming language. It is inherently a different way of thinking than traditional programming methods. Its greatest advantages stem from its ability to aid specifies, developers, and customers in expressing and communicating abstract notions. In addition to programming, it can be used for specification, analysis, documentation, and interfacing [19].

The Unified Modeling Language (UML) is a graphical language for OOAD that provides a common method for writing the blueprint of a software system. It facilitates the visualization, specification, construction, and documentation of an object-oriented system's artifacts. It is utilized to illustrate the structures and relationships of a complicated system[19].

Unified Modeling Language (UML) is a standardized language that supports general-purpose modeling in the field of front-end software engineering, which is where the true value lies. UML contains a collection of graphical conceptual issues as opposed to back-end implementation notation strategies for creating abstract models of particular issues. UML model refers to design defects that appear during implementation of systems. The Unified Modeling is the most expensive to repair compared to those discovered before [19]. The Unified Modeling Language (UML) is a graphical language for visualizing; focusing on implementation difficulties too early limits the specifying, producing, and documenting the artifacts of design choices and frequently results in an inferior outcome, a software-heavy system. The Unified Modeling approach to object-oriented development encourages [19]. Language provides a standard way for software developers of a system to work and conceptualize in terms of blueprints, such as business application domain through the majority of software processes and system operations, as well as the engineering lifecycle [19].

OMG-supported QVT-like transformation languages allow for the automatic transformation of UML models into alternative representations (such as Java). UML is extendable and offers the following modification mechanisms: profiles and stereotypes. With the UML 1.0 major revision, the semantics of extension via profiles were enhanced. It is crucial to differentiate between the UML model and a system's set of diagrams. A diagram is a graphic representation of a portion of a system's model[19]. The model also includes a "semantic backplane," which consists of documentation such as textual use cases that drive the model's parts and diagrams. UML diagrams depict three distinct perspectives of a system model [19] such as;

Functional Requirements View: Puts considerable emphasis on the functional criteria that the system must fulfill from the point of view of the user. In addition, use case diagrams are included [19].

Static Structural View: Puts considerable emphasis on the system's predetermined structure, which is comprised of objects, properties, processes, and relationships. And this includes diagrams of composite structures as well as class structures [19].

Dynamic Behavior View: Puts considerable emphasis on the dynamic nature of the system by illustrating the partnerships that occur between objects and the changes that occur inside the items' internal states. Also included are activity diagrams, state machine diagrams, and sequence diagrams [19].

Use Case Diagram: An actor and a use case are used to model the system's capabilities in use case diagrams. The system's use cases are the services or functions it provides to its customers. Included in the use case diagram are the followings [19].

- **Actors:** External entities are depicted by actors. People or entities involved in the system under study can be included in this category.
- **Use Cases:** Use cases are functional parts of the system. When we say what an actor does, that's a use case. **Associations:** Associations are shown between actors and use cases, by drawing a solid line between them. This only represents that and actor uses the use case. There are also two kinds of relationships between use cases [19].
- **Includes [3]:** Use cases that are associated with actors can be very general. Sometimes they "include" more specific functionality. For example, the "pump gas" use case that is associated with the customer includes three use cases: Choose Gas Type, Fill Tank and Calculate Total. Includes relationship is represented by dashed arrows that point to the included functionality. Beside the arrow is <<includes>>.[19].
- **Extends [3]:** An extension use case is an insertion to the base use case. For example, some stores may allow for different payment options like credit card, debit card, or cash on delivery. These specific functionalities are extension of the general "pay for items." Extends relationship is represented by dashed arrows that point to the base functionality. Beside the arrow is <<extends>> [19].

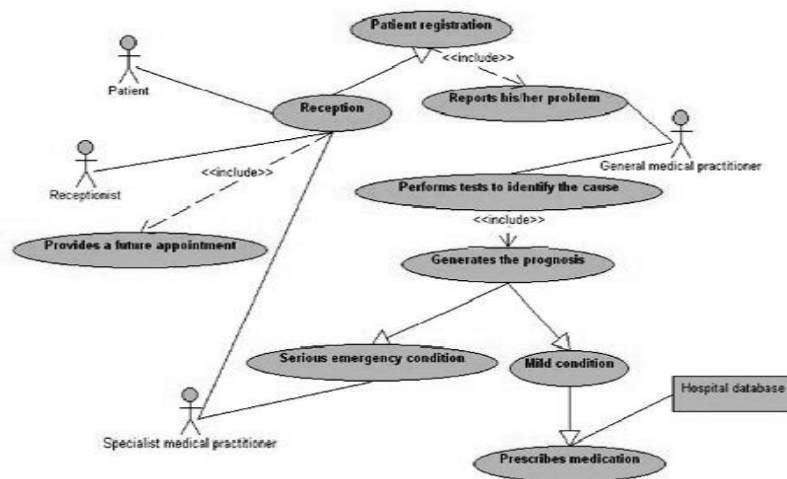


Fig. 7: Use Case diagram for Hospital Management

Here is an overview of how the hospital administration system works: Forms for registration are typically required when patients are admitted to the hospital[19]. The receptionist would need to know the patient's name, age, home address, phone number, and previous medical history, if any. Each patient's medical history, test results, and appointment dates are recorded in a file at the hospital, which is updated after each visit. The patient would be sent to a primary care physician. Determines the issue by conducting several diagnostics. Doctors recommend medicine for minor cases of illness. The patient is directed to a qualified medical practitioner who will run more testing to determine the exact cause of the ailment. Patients' conditions are recorded in the hospital database, which is regularly updated[19].

IV. Contribution

In the realm of patient care, the health industry is undergoing rapid transformations at the moment. The majority of today's hospitals make use of automated management systems in order to manage patient data, which includes both the patients' personal and medical information. However, there is still a barrier to overcome when it comes to

exchanging the patient information of patients who transfer from one hospital to another in search of better care, particularly across the hospitals in the smart cities like Bhubaneswar. The problem of information flow within hospitals as well as between distinct hospital management systems is the focus of this body of study. To accomplish this, a Centralized Health Care Service Management System will need to be designed. The information flow issue that arises during the transfer of critically ill patients from one hospital to another, as well as the transfer of critically ill patients for any number of other reasons, is the primary focus of this design. If there is difficulties in transporting patients due to their poor physical state, the proposed approach addresses the convenience of utilizing the services of experienced medical professionals from nearby hospitals[12].

During times of severe conditions, this system is designed to make the majority of the work done by hospital staff, including doctors and nurses, as well as across hospitals, easier. This system is being utilized by controlling it using a web application. Web applications are being used in the majority of locations across the globe these days. Therefore, for the sake of security and everything else, we prefer the same kind of application here as well. With the help of this application software, we are utilizing the capabilities that are available to each and every member of the hospital staff, including doctors and other medical professionals. Like: (1) Ease of use for everyone in the hospital; (2) Reducing difficulties in lab and pharmacy; (3) Reducing the difficulty of doctors and nurses; (4) Reducing the trouble of patients; and (5) Making an advance visitors checking system using it[12].

In this system, we are introducing new features that will assist hospital staffs, doctors, nurses, ambulance drivers, and hospital management in emergency situations[12]. Some examples of these new features include: 1) Providing an alert system from one hospital to another hospital when shifting hospitals; 2) Checking the availability of doctors for urgent cases from other hospitals; 3) Providing an IOT device in ambulances so that hospitals can give instructions to ambulances about shifting hospitals; and 4) Verifying whether or not blood is still available in a given hospital. The primary characteristic is the interconnectedness of the hospital. Because we believe that everyone would benefit from this system, we are implementing it with all of its existing and freshly developed features[12].

Unified approach for managing health care services in Bhubaneswar smart city: A case study

Centralized Health Care service management is proposed in this study to deal with the challenges outlined previously. Bhubaneswar smart City hospitals can join this centralized management system, but they can also operate independently. For medical crises, such as insufficient facilities, the centralized system makes it possible to share services such as expert doctors' services and patient data[14]. A patient's medical records can be exchanged across member hospitals if necessary through this system. If a patient is in a critical stage and the expert doctor is unavailable, this technology can be used to verify the availability of a doctor in any other hospital. When moving a patient is difficult for a variety of reasons, this is an excellent solution. The doctors can also use the same mechanism to deliver instructions or medical advice. A fundamental problem for such a system is data security notwithstanding the lack of attention given to it in the prototype now in use. The core database can be maintained using Cloud infrastructure services[14].

The proposed system performs 9 roles viz. (1) Super Admin (2) Admin (3) Superintend (4) Department Head (5) Doctors (6) Nurses (7) Lab (8) Pharmacy and (9) Gate Watchman.

In the case of a patient's shift, the system sends a notification to the hospital. if a hospital cannot accept the patient, they can do so with a solid explanation. Helps guide the patient to a different hospital." Streaming multimedia content over the internet is made possible by a technique called "Load Sharing." For all government-owned hospitals, the proposed system provides a safe and secure environment. Including the private sector[14]. The main advantages of this method include a significant reduction in the loss of disease information. Good care for all patients is something we eagerly anticipate. This programme can be used by anyone except patients in certain roles. In this application, there are distinct responsibilities for each role. Each of them is distinct from the rest. Like:

- 1) *Super Admin*: Super Admin have full control over this application like: (1) add/delete hospital (2)add/delete admin (3)add/delete doctors, nurses and departments (4)view patients (5)view lab and pharmacy sections (6)view visitors.
- 2) *Admin*: Admin control this application like: (1)add/delete appointments of doctors (2)check doctors are available or not (3)view patients details (4)view lab and pharmacy sections (5)view visitors[17].

- 3) *Superintend*: Superintend can use this application like: (1)Add/delete doctors/ nurses/ HOD (2)Assign nurses and doctors duty days (3)view patients details (4)Check the attendance of doctors, nurses and HOD[15].
- 4) *Department Head*: Department Head can use this application like: (1) To check the duty doctors (2) to check today’s appointments (3) view patients details (4) update the patient examinations by ward round or other way (5) Prescribe the medicines and test for the patients from which pharmacy and lab (6) give alter to shift the patient when conditions are become worse[17].
- 5) *Doctors*: Doctors can use this application like: (1) To check the duty days (2) to check today’s appointments (3) view patients details (4) update the patient examinations by ward round or other way (5) Prescribe the medicines and test for the patients from which pharmacy and lab (6) give alter to shift the patient when conditions are become worse[16].
- 6) *Nurses*: Nurses can use this application like: (1)To check the duty days (2)to check in which department today’s duty (3)view patients details (4)update the vitals of the patient by hourly or time prescribed (5)update which are the medicines are given to the patients (6)give alter to doctors whether the patient condition’s changes [16].
- 7) *Lab Section*: Lab Section can use this application to view the suggested tests or scan or etc. By the doctors to the patient and update the results[17].
- 8) *Pharmacy Section*: Tests or others to the patient’s page directly. Pharmacy Section can use this application to view the prescribed medicines from doctors to each patient and update which ones are delivered. This helps to the Patient care takers to avoid their difficulty in hospitals [17].
- 9) *Gate Watchman*: Gate Watchman can use this application to view the visitors now entered or update the in & out of the visitors from any gate. Also keep the details of visitors for each patients[16].

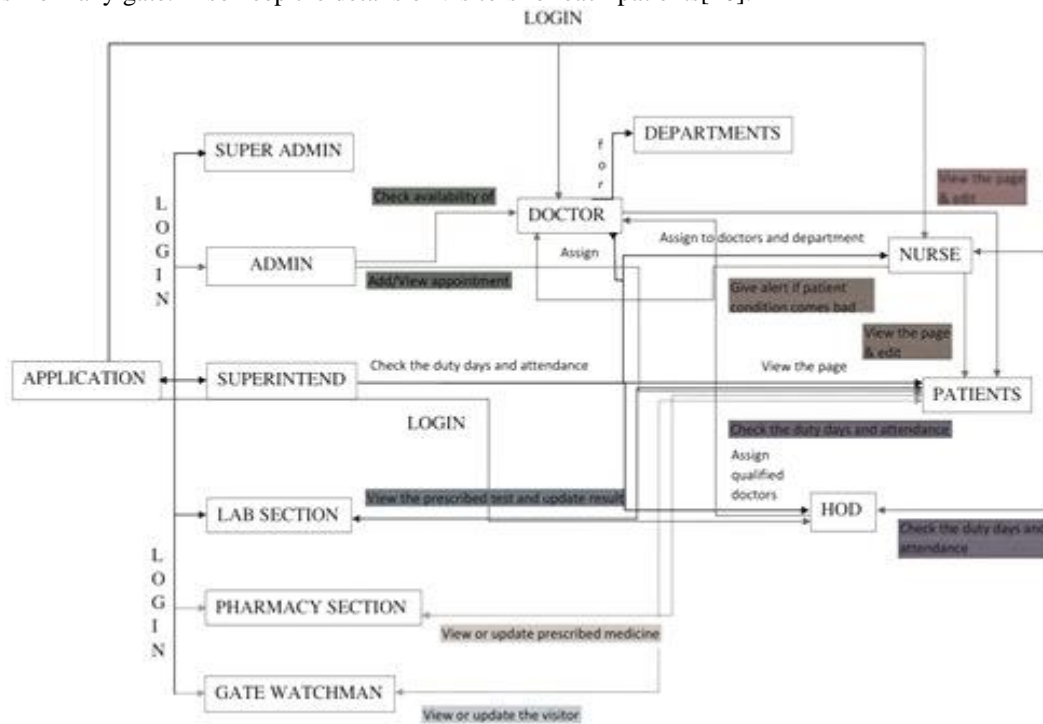


Fig. 8: Internal View of the Proposed System

Detailed description of new features added in the system

1. *Alerting to Hospitals Ambulance*: We are attempting to notify the hospital when a patient is transferred to another facility because of a serious circumstance via this mobile application. At the same time, we provide information

regarding the patient's transfer from the hospital to an ambulance. A simple functionality is included in this programme. It's possible to reject and have the patient referred to another facility if the intended hospital isn't able to accommodate them. At the time, this application offered the ambulance a new direction in regards to the new hospital [16].

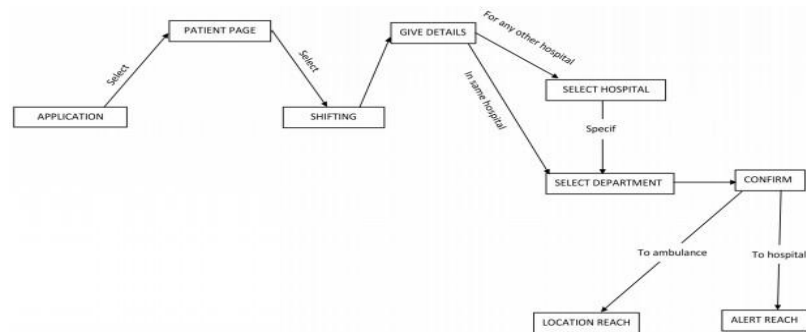


Fig. 9: Alert View

2. *Checking Availability of Doctors:* Our app can be used to check if there are doctors availability at any other hospital nearby, so that we can help if a patient needs immediate attention but their doctors is unavailable. Using the patient page, doctors can advise or prescribe patients using this app[16].

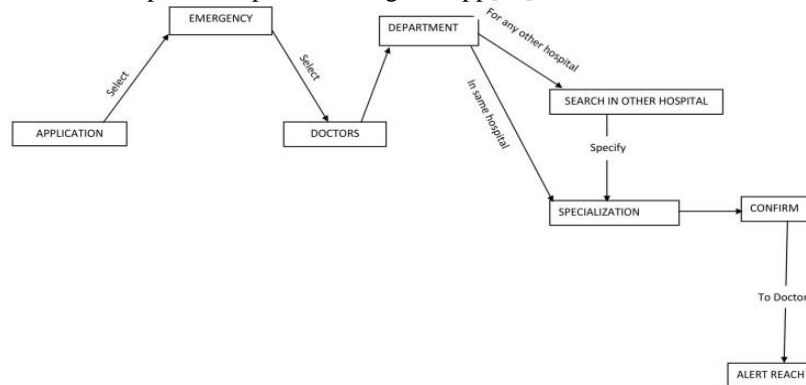


Fig. 10: Searching Doctor's Availability View

3. *About the IoT Device:* This is not some sophisticated new invention that was only just discovered. By affixing a GSM (Global System for Mobile communication) module to the existing equipment, we are bringing it up to date with the latest technological advancements (Global Positioning System). We provided the location to the GSM module, and it received it as text and gave it to the GPS, which enabled us to quickly locate the area. Additionally, we sent the name of the hospital, and it reads that out on the display [18].

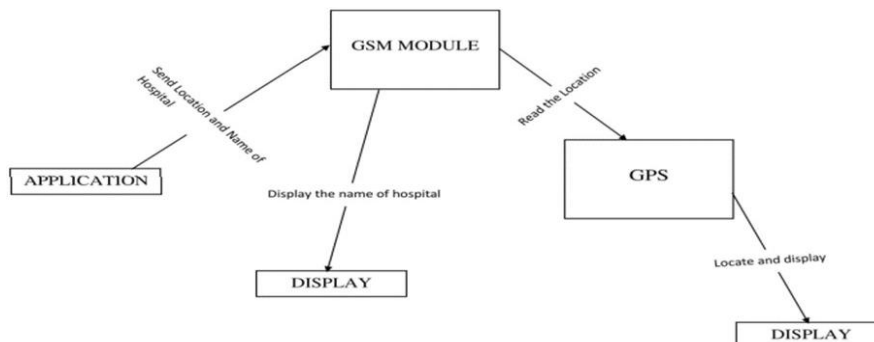


Fig. 11: Ambulance System View

4. *About the Data Sharing:* This is not some sophisticated new invention that was only just discovered. By integrating a GSM (Global System for Mobile communication) module to the existing equipment, we are bringing it up to date with the latest technological advancements (Global Positioning System). We provided the location to the GSM module, and it received it as text and gave it to the GPS, which enabled us to quickly locate the area. Additionally, we sent the name of the hospital, and it reads that out on the display [16].

V. Conclusion

The basic goal of an integrated health system is to offer patients and their families with seamless and coordinated treatment. By ensuring that patients move smoothly through the healthcare system, the assumption goes, they would receive better care and have better health outcomes. An integrated approach to healthcare improves the quality of health care services. Health care professionals can work together more closely to understand the unique needs of each patient, create a customized treatment plan, and ensure that they are receiving appropriate treatment to improve their overall well-being and manage their health conditions better. Different combinations of professionals and teams engage to provide care for patients in a highly interconnected and dynamic healthcare system. Because of the interdependencies in the healthcare system, it is desirable to have a multi-facility, flexible simulation modeling methodology for which UML is an object-based and web-empowered program growth methodology and is mostly preferable to model clear views of the service management activities in an integrated health care system.

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