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IoT-Smart Surgical System Treatment to Augment Safety for Hospital Management

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A**BSTRACT**

Based on the smart IoT, an intelligent surgical reporting system was created and implemented. The adoption of the system to write and retrieve data by health care staff saves time spent preparing forms and lowers the occurrence of mistakes, consequently enhance patient outcomes and care quality. Furthermore, this method enables all of the gathered information during the procedure to be accurately preserved and disseminated. This approach also reduced the cost of printing surgical record sheet and health-care record sheets and may be utilised as a knowledge repository for future procedures. The surgical information will save health care staff' time by constantly storing their personal information. In order to facilitate access to the information we have also used the voice-based information access. A chat bot is also trained on the surgical data which aids as a knowledge base on the surgeries.

Keywords*:* IoT, Surgical records, Chatbot, knowledge repository

I. INTRODUCTION

The rise of the IoT becomes a key to innovation for health IoT, which enhances quality of patient care through more dependable and effective communication among physicians and nurses. The Internet of Things (IoT) is being incorporated into medical system in order to enable monitoring of patients and diagnostics through the use of intelligent healthcare equipment. Nurses may rapidly verify patient data using a smart phone, and updates are real-time. Information obtained from sensors in medical centers is steamed in real-time to perform accurate analysis. When executing a complex operation, the employment of an input technique by health care staff not only enables the rapid completion of numerous records required to finish the procedure, but also improves the completeness and quality of the input data. However, incidents of medical negligence such as inappropriate surgery sites, patient whose identification have not been verified, erroneous surgical processes and procedures, and other hazards continue to occur.

Because surgery is such an essential aspect of medical care, every examination and confirmation performed by nursing professionals from the point a patient is brought into the surgery room has an influence on the patient's safety. As a result, improving surgical processes is seen as a key safety indicator in enhancing treatment surgeries.

The standard surgical assistance system only provides a simple interface and does not give users with satisfactory operating results while utilising the system. Human mistakes and flaws in system validation procedures can readily compromise the quality and integrity of the medical data. Some articles advocated the construction of a surgical system that would utilise a new form of information technology to help health care staff manage the many data required throughout surgery. Furthermore, in terms of information system performance validation, various thesis studies used survey analysis to assess user satisfaction and operational effectiveness.

Furthermore, previous research offered six components for evaluating the performance of the system in terms of quantifying its success. In the regular procedure, On the day of the operation, the operating theatre control personnel alert the nurse’s stations to confirm the room number and patient's identification, finish all preparatory protocols, and wheel the patients into the surgery room. To maintain patient safety, before the anaesthetist gives anaesthetics, the nurse should validate data with the patients. Even before procedure, the physicians, anaesthesia nurse would take a "time off" from their job. This is the most crucial preparatory step: validate the patient's identification, surgical procedure, surgical location, and list of relevant medical professionals. Following surgery, the patient will be taken into the recovery area to wait for the anaesthetic to wear off.

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In this work, we develop a smart integrated system to enhance safety of patients while seeking medical treatment and to improve the openness of hospital information. Using RFID technology, the Internet of Things provides a new medical information system. It has become the primary IoT technique. Radio frequency identification not only helps us identify physicians, nurses, and patient in the health information system, but it also allows us to follow physicians, nursing staff, and patients around the hospitals. In order to build a smart data system, information is collected into the system. In this work, we create an autonomous surgery management system to eliminate textual mistakes caused by human error, reduce nurse and surgeon burden, and improve quality of healthcare services.

Documentation used in operations are removed and recorded in computers through the construction of the planned intelligent surgical management system. The intelligent surgical information system is a combination of recording the surgery, store the same in a cloud-based storage for ease of access and to convert text to speech recordings which can be used for future research. The system uses a smart recording based on sensors. The smart surgery information management system helps medical staff import medical notes, scanning reports, audit results, and other related details before, during, and even after surgery. If the records are incomplete, the checking system can automatically view their completeness and maintain a high level of integrity.

II. LITERATURE REVIEW

Imran Ahmed [1] proposed a paper in which indicates that the health sector is paying attention towards the development of smart sensing devices, gadgets, data storage, and healthcare technology. IoT, particularly in medical image analysis, has indeed been identified as among the most potential discoveries in the field of medical services. For the analysis of clinical images, technique combines ai technology with a variety of advanced machine learning approaches. Such recently founded methods for diagnostics could help doctors diagnose illnesses at a preliminary phase, give precise, reliable, efficient findings quickly, and lower the risk of mortality.

Coronavirus (COVID-19) is currently one of the most serious and virulent illnesses, and it is expanding around the globe. In this way, a smart medical system for automated detection and categorization of infectious illnesses (such as influenza) in chest X-ray images was demonstrated. This way this works uses a multi-layer convolution layer and feature selection technique together with two separate deep learning architectures to categorize X-ray pictures of viral disorders. The stages involved in this work are as follows: Data augmentation is utilised to increase the variety of data collection, and deep learning models like VGG-19 and Inception-V3 were combined using transfer learning enabling feature extraction. This multi-logistic regression regulated entropy variation technique is used for fusing of features extracted acquired from deep learning approaches, a parallel maximal correlation, as well as for selecting features.

According to Fatima Alshehri [2], an essential component of linked existence is smart healthcare. Another of the fundamental human needs is health care, and it is predicted that in the near future, smart health care will generate many incomes. An Internet of Things (IoT), the Internet of Medical Things (IoMT), medical sensors, artificial intelligence (AI), edge computing, cloud computing, and next-generation wireless communication technologies are all just a few of the elements that make up smart healthcare coverage. Therefore, we give a thorough analysis of journal publications from 2014-2020 that primarily focus on IoT and IoMT-based edge-intelligent smart healthcare coverage. Through addressing numerous study fields on IoT and IoMT, AI, edge and cloud computing, security, and medical signals fusion, we review this literature. We also discuss contemporary difficulties in research.

Mohd Javaid [3] indicated that Healthcare can see radical innovation with the Internet of Things (IoT). A need to research various IoT-enabled applications and services in light of the COVID-19 Epidemic. A quick study is needed for it to choose the best course of inquiry. To determine the potential of technology, studies on COVID-19 Pandemic and IoT within healthcare are conducted. This literature-based analysis might help analysts believe of solutions to connected issues and combat pandemics of the COVID-19 kind. Using the aid of a flowchart, quickly analysed the key IoT accomplishments. Subsequently list out seven key IoT technologies which appear to be beneficial for healthcare it during COVID-19 Pandemic. This report concludes by listing and briefly describing sixteen fundamental Iot systems for the health industry as during COVID-19 Pandemic.

Aravind H [4] introduced a paper on the vital signs as it is the crucial component of tracking a patient's improvement while they are being treated in a clinic because they enable prompt identification of situations that might impede recuperation or be unfavourable. Throughout a surgical procedure and the recovery phase, the vitals were continually or regularly checked. Several electrodes placed to the patient's body using the well-known monitoring and diagnostic tools in order to evaluate change in the electrical stress in the system. Every individual getting inspected is obstructed by these wires and valves. This idea suggests a simple diagnosis and surveillance facility for post-operative patients.
Yazdan Ahmad Qadri [5] proposed a paper on the growth of the health sector has been greatly impacted by the IoT devices (IoT). The introduction of Medical 4.0 has led to an increase in infrastructure development efforts, at both hardware and source code levels. Healthcare IoT (H - IoT) technologies have been developed as a result of this idea. The methods of communication in between sensor and the processor are

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among the fundamental technological solutions, are the computational methods used to provide an outcome from sensor information. Nevertheless, a number of new innovations are now supporting these technological solutions.

The H-IoT sector has undergone nearly complete transformations because to the usage of ai technology (AI). The fog / edge concept minimizes several issues by deploying computer power near to the packet network. Although processing massive amounts of data is made possible by big data. Furthermore, the network is flexible thanks to Software - Defined Networks (SDNs), whereas blockchains are discovering the most inventive applications in H - IoT systems. Development in H-IoT technologies is being driven by the Internet of Nano Things (IoNT) as well as the Tactile Internet (TI). This article examines the extent in which these technologies are changing H-IoT networks and pinpoints the best potential route for enhancing QoS with these emerging innovations.

According to G. Yang [6], the industry 4.0 in healthcare technology has become underway, and it is being driven by manufacturing-related technology (Healthcare 4.0). Latest generation home health care robotic systems (HRS) built upon cyber-physical systems (CPS) featuring better speed and so smarter implementation are developing as an illustration of this revolution. These innovative concepts and functions for the CPS-based HRS are put out in this paper. Analysis of the most recent developments in relevant technological solutions, such as a.i., basics of sensors, material, and machineries, cloud services, connectivity, motion detection, and geolocation. Furthermore, the prospects for the CPS-based HRS are examined, along with the technical difficulties encountered in each technological area. According to Obaidulla Al-Mahmud [7], Furthermore, a sophisticated IoT medical system was proposed that includes medication boxes having cognition linked to sensors and a database for ongoing health tracking. This wireless internet access of these sophisticated medication boxes enables simple communication between healthcare professionals and patients even when they are not at the same specific address. As well as an email that would help patients in taking the medication, the suggested medication pack aids the patient with taking the proper medication so at right time. A laptop is often used as a webserver to keep detailed info on the client and therapist, as well as the medication prescribed as well as the schedule of the visit. While going through this process, both doctor as well as the patient require IDs and passwords.

Yazdan Ahmad Qadri [8] proposed a paper on implementing IoT which has an influence on lowering healthcare costs and improving the patient's recovery. Consequently, through providing a potential pathway to combat this COVID-19 epidemic, our current study-based research aims to examine, analyze, and emphasize its broad applicability of well IoT concept. Several important IoT devices are eventually listed and explored. In the end, it has compelled experts, academics, and scientists to suggest several useful countermeasures towards this epidemic. IoT helps a COVID-19 patient monitoring patients and receive higher therapy more quickly. Patients, doctors, surgeons, and hospital admin systems can all benefit from it.

According to Shuo Tian [9], since informational advanced, the design of smart health had steadily gained attention. Technology mainly transforms the standard medicine scheme in a comprehensive way, allowing healthcare access that is quite effective, quite simple, and far more individualized. It does this by utilising a future group of technological advancement, including the iot devices (loT), big data, cloud services, and machine intelligence. In order to bring the idea of health care, we initially identify the major platforms that help it here in this assessment. We next discuss where smart approach is right there in a number of significant areas. Next, we discuss the issues that significant quality now facing and make some suggestions for how to address them. Lastly, we assess the possibilities for smart health in the ahead.

P. Sundaravadivel introduced a paper on the traditional physician visit had deteriorated its usefulness due to the growing global population. As a result, significant quality is crucial. Smart healthcare may be adopted throughout all stages, including measuring infants' body temperatures through elder patients' physiological parameters. Depending upon that needed accuracy of specific devices, functions, and complexities of applications with that they are employed, the effort and installation cost vary. These converging fields of integrated devices, big data, deep learning, cloud services, as well as cognitive computing have included smart healthcare. These chapter examines the significance, needs, and uses of healthcare as well as marketing trends and developed. Also, it provides a clearer understanding of the many venues by which additional study inside this subject may be conducted.

III. PROPOSED METHODOLOGY

The suggested surgical information app is a mobile device with a web-based interface organised as components which will handle all the procedures of the surgery. The nursing staff can check the surgical schedule data for the day prior to a surgery. This technology may be utilised throughout the operation to enter the surgical patient's physiological parameters, the number of surgical appliances used, surgery-related data, and nurse’s data.

The postoperative statistics of surgery patients may also be accessible by clinics and nurses’ stations, making it easier to tally and price back-end supplies, as well as for learning goals such as case research and teaching. It not only retains clear and accessible paper documentation of invasive procedures data, but it also offers validation and reminder methods to guarantee the fulfilment of the things that must be correctly filled

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out. Furthermore, the affirmation function enables the following attribution of accountability as well as the successful retention of experiences and knowledge during surgical operations, promoting future study advancement.

The initial information of the patients such as their personal data will be loaded in the system followed by the details on the surgical procedures. A unified format for maintaining a surgical record is created on the data base and the same format to be followed for all the surgeries making it efficient for future access and reference of data for research and other studies. A cloud based centralized storage is available to store the data which enables other doctors to verify the procedure done to the similar surgery on complex tasks.

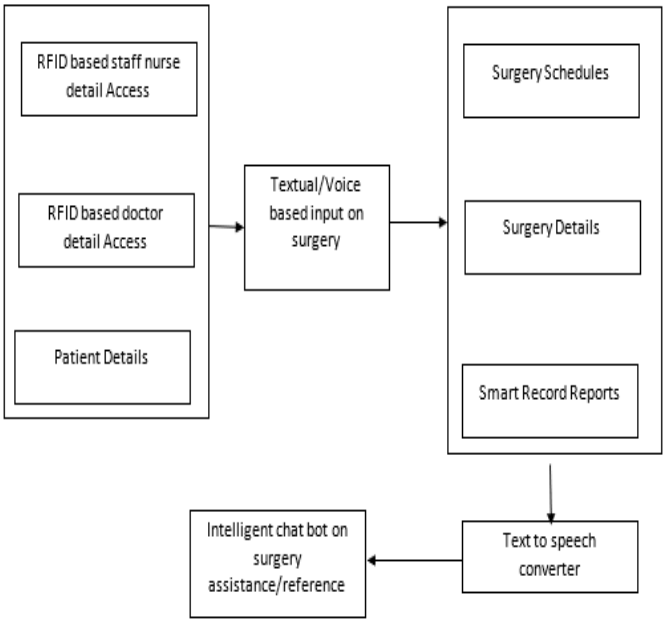

Figure 1. Architecture Diagram

The entire surgery details and the procedure will be recorded in digital format whereas the RFID tag details will be read by the smart system. The effective maintenance of the surgery records leads to an efficient and safe surgery. The findings of the details in the phase of surgery will also be recorded thus making it an effective knowledge base. A physician must verify the full health history information filled out before, during, after the surgery for discrepancies to assist the automated information gathering needed. The smart system also has a text to speech converter which aids in the form of hearing the entire surgery procedure in a voice form. An intelligent chat bot is also embedded in the design which is trained with the surgical data so as to assist the surgeries with the previously available data.
The primary goal of identifying the surgical site and special product placement site is to double-check the surgery markings on the patient before to surgery in order to avoid medical disputes caused by operating on the incorrect spot. The numbers of appliances utilised during the procedure is documented in the equipment logon. During the procedure, the use of the equipment may be documented several times. The system automatically adds the equipment utilised for the nurse to quickly tally and validate at the conclusion of the operation, after which the checker's name is inserted and the staff in responsibility of the equipment counting was recorded for the purpose of duty attribution.

IV. DESIGN AND IMPLEMENTATION

4.1 Textual/Voice Based Input

This voice to text conversion is carried out by using either voice to text models as well as context characteristics. The contextual specifications are utilized to influence the results which are produced over voice to text model. Since voice response technology enables medication data to be recorded and heard instead of being written by a doctor, the development of speech-based mobile applications might help to minimise a few of these errors. This report describes the development of a voice-based mobile prescriptions to enhance healthcare services.

4.2 Smart Record Reports

In the health sector, the process of documenting information and the people's clinical record is crucial and is termed as medical record data. This patient's medical record information may be utilized as a source for future patient health examinations and as verifiable proof of the

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patient's illness's diagnoses as well as the medical care she / he received. The development of an intelligent healthcare system must centre on the patient. Patients may rapidly get previous medical information, register online using a mobile application, and receive quick, measured treatments.

4.3 RFID Detail Access

Medical failure minimization is among the major promises that were made by complicated RFID systems. Its incorporation of an RFID system which self-regulates is essential when one of healthcare's top priorities is to assure patient safety. This system is unable to function independently. Any clinic will require qualified organizations to work the hardware and software enabling full-scale installation and control of the network. Professional training and education are among of the most difficult barriers for RFID to conquer since they are frequently time-consuming and expensive.

V. EXPERIMENTAL RESULTS

An effective technique to document the surgical operation in its three parts, including pre-operative information, operation information, and post-operative care. Accessibility to surgical data in the case of smart records is made possible via an interconnected system. Pre-operative, its smart surgical technology double-checks the patients' preoperative marks in order to prevent medical disputes brought on by improper operation. Mainly, to prevent human mistake in data upkeep throughout operational stages are developed. RFID-based data entry for personnel records on medical professionals and other staff members. For research and resource sharing, text to speech conversion makes it possible to voice out all of the information of the procedure. An intelligent assistant is a chatbots powered by neural networks that can autonomously adapt depending on surgery information.

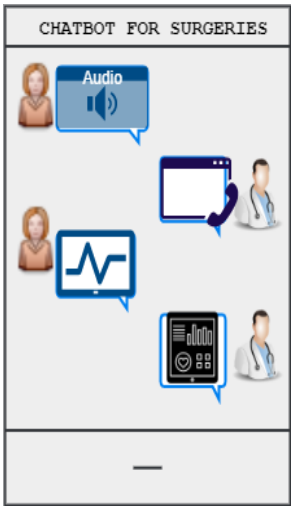

Figure 2: Chatbot for surgeries

Having improved access to large volumes of sensory data, data-driven approaches are increasingly appreciated for identifying potential flaws or variations from anticipated. Caretakers have access to real-time data through virtualized environments or other networking phenomena, enabling educated choices and providing evidence-based therapy. This guarantees prompt delivery of healthcare and enhanced therapeutic results. The patient's requirements are prioritised because of the internet of things' link with the healthcare system such as therapies that are swift, reactive, and increased in quality and reliability. Whenever it relates to diagnostics, prompt medical action and improved treatment results lead to responsible care that patients significantly value.

The IoT system is utilized to thoroughly identify and evaluate numerous specific health indicators and further mining this data. The difficulties of visiting a doctor can be considerably reduced with the remotely wireless health managed service system. The digitization and accessibility of hospital information have been fully accomplished through sophisticated treatment of patient equipment based on internet of Things. We investigate how to make training more humane, but we must additionally think about how to make instruction less problematic for such system detection phase.

VI. CONCLUSION

An intellectual surgery reporting technology was implemented and put into use relying mostly on smart IoT. Use of a system for medical professionals to enter and collect data reduces errors or time saving consumed filling out paperwork, which improves clinical outcomes and the

standard of care. Additionally, this technique makes it possible to precisely retain as well as share all the data that was obtained during process. The method could be used as a learning baseline for future treatments and also decreased reduced cost to produce surgery recording pages and patient records pages. By continuously saving the personal details of the medical team, the surgery data can save them time. We have implemented voice-based access to information to make it easier for people to get the data. Additionally, a chatbot that serves as a knowledge base for the procedures is educated on the medical data. An intelligent IoT-based surgery information management with RFID-based access to data for the medical team in the operating room will retain all surgical data entirely. Automatic Report Generation utilizing voice and text input during the surgical procedure. Smart Notes throughout the surgical procedure. Using a text-to-voice conversion to deliver out the full document and a CNN-powered intelligent chatbots to teach it all there is to know about the procedure and serve as a resource for subsequent usage.

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