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Centralized Inward Patient Care System For Government Hospitals In Sri Lanka

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***Abstract*— At present the hospitals are filled with patients for various diseases and the doctors use a manual system for enter patients' diseases and treatments in the bed head ticket so it has taken time and accuracy is less, in future, there will be a need for the development of a system to have automated system. The purpose of this study is to automate the bed head ticket. The Sri Lankan health care system has a public sector that provides a free health care system. The overall objective of a health system is to improve health through reducing diseases, disability, and death. Nonexistent effective mechanism to manage Inward patients and patient Bed Head Ticket is a visible problem. Therefore, as a solution the Inward Patient Management System and electronic Bed Head Ticket are developed to solve the above problem and introduce new features under the title Inward Patient Care System. Another objective of the project was to build and maintain a patient database for analysis of data and to facilitate evidence-based decision-making processes. maintained hospital health statistics to have a paperless hospital information system and to reduce costs and improve the accuracy and timeliness of hospital information systems. The inward patient system was exceptionally user-friendly. It will improve satisfaction among patients and their families. Further improve the resource allocation and give better productivity among clinicians and staff. Inward patient care system improved reputation inside the organization and demonstrated when patient values and preferences are prioritized.**

Keywords*— SPCS - Smart Patient Care System, AE-BHT - Automated Electronic Bed Head Ticket, Predicting systems, Machine Learning, Prognosis modules, HealthCare, Smart Systems

I. INTRODUCTION

The health sector is known as a major sector in any country. Looking back from the present to the past, we can see incredible growth in the healthcare sector, with the latest developments in the field of technology. But sadly, the health sector in Sri Lanka is not up to date. The World Health Organization (WHO) introduced a health information system to Sri Lanka two decades ago but that is not up and running by now because it is not feasible and customizable to Sri Lanka [10]. By maintaining a good health management information system [10] with accurate data enables physicians to make the most accurate decisions and to provide the most effective treatment to patients. The two leading challengers in the health sector are the low level of technical knowledge and the complexity of the health sector. By analyzing current challenges and existing health management systems such as openMRS and e-Hospital in Dompe, we introduced a new system called Smart Patient Care System (SPCS) for managing inward patients in more advanced and effective ways. Our system consists of four modules. The automated Electronic Bed Head Ticket module is the main component in our system, followed by the Inward Patient managing module, Medical Chatbot module, and medical predictions module related to the electronic bed head ticket.

According to the Manual on Management of District Hospitals, Peripheral Units and Rural Hospitals [11], BHT is a very important document of legal value. It is used to record everything that happens during an inward patient's admission to discharge. At present, a manual system is used in hospitals in Sri Lanka. There the patient's details are taken and computerized manually. This can lead to errors in the computerization of patient data and misplaced BHT records. But the e-Hospital in Dompe has electronic BHT. But the system does not function according to the Bed Head Ticket standards. One major defect is that there must be doctor and nurse notes separately. But no nurse notes are visible. Improper maintenance in BHT can lead to morbidity, mortality, and legal complications.

Smart Patient Care System is a web-based application that is implemented using ReactJS, Python, and ML algorithms. It mainly forces on Automated BHT and apart from that, it contains a medical chatbot for communicating with patients and predicting systems like heart failure and pneumonia. We used correct standards for implementing BHT and for security purposes, when patients' discharge, death, or transfer from the hospital data will be stored in a blockchain. The utilization of AI technology, Machine learning algorithms, and blockchain technology will revolutionize the health sector in Sri Lanka.

II. METHODOLOGY

In the proposed system Agile methodology is used as the software development life cycle. Agile is a light weighted development module. This model uses iteration as a key feature. That is, when a project is finished, we can go back to the initial stage and fix the shortcomings and we can connect with the stakeholders who are connected to the system and get their satisfaction.

Frontend application is where web application is implemented, and it is designed using ReactJS and NodeJS. As for back-end Python Flask is used and Mongo DB is used as Database. Overall, most python libraries used for train machine learning algorithms and google colab, Jupiter notebook and visual studio code are used as IDEs. Figure 1 state flow of the overall system.

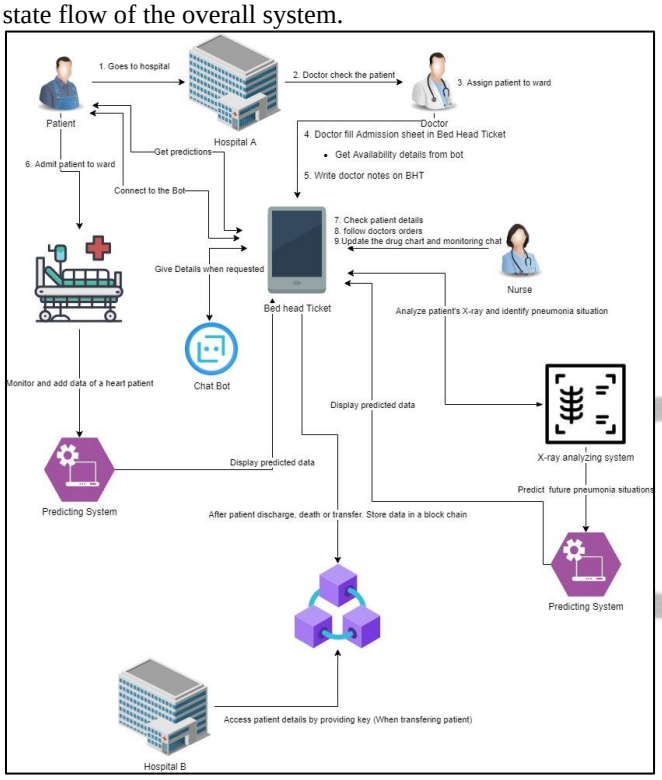

Figure 1. System overview diagram

A. Automated Electronic BHT Module

An automated electronic BHT is a requirement in Sri Lankan government hospitals. This automated electronic BHT entire module is a web-based application. Because of that, it requires an internet connection to work. The main characteristic of this electronic BHT is automated with speech recognition. And there is a text facility also. There are many advantages of using speech recognition technology in the healthcare industry. A more accurate diagnosis and documentation: Speech recognition speeds up the process of documentation and can reduce errors related to transcription by providing accurate medical information. Mainly doctor's notes and nurse's notes are automated with speech recognition in this automated electronic BHT. As the database of this automated electronic BHT is used a cloud database. The reason for using a cloud database is that there are lots of details to be stored. Using Patient id can track all the details of the patient. As patient details, there are patient admission details, personal details, patient's prescription details, doctor's notes, nurse's notes, etc.

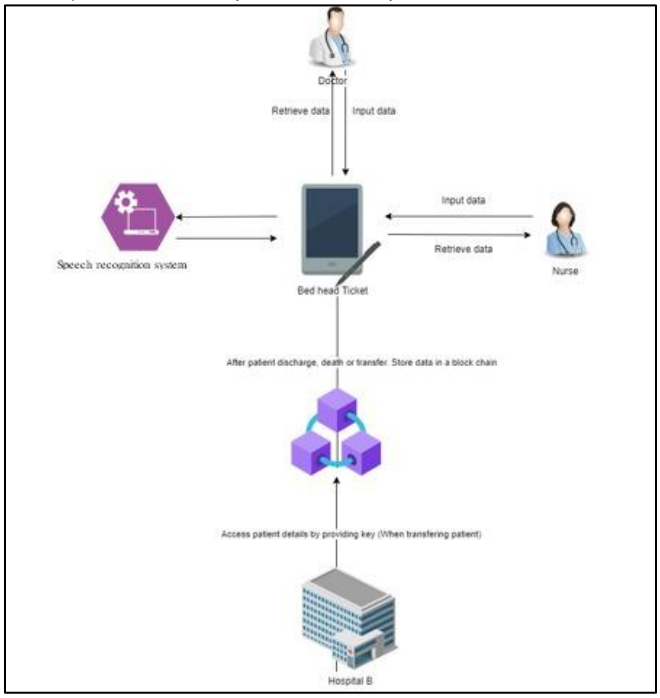

Figure 2.AE-BHT data flow

When patients transfer to another hospital from another, patients are facing lots of difficulties. Because it is restricted to pass the medical reports. To overcome this difficulty this proposed system has a more secure feature to pass the patient's reports and details. When the patient is discharged from the hospital and if the patient is dead there is a secure and effective feature in this proposed system to handle those situations.

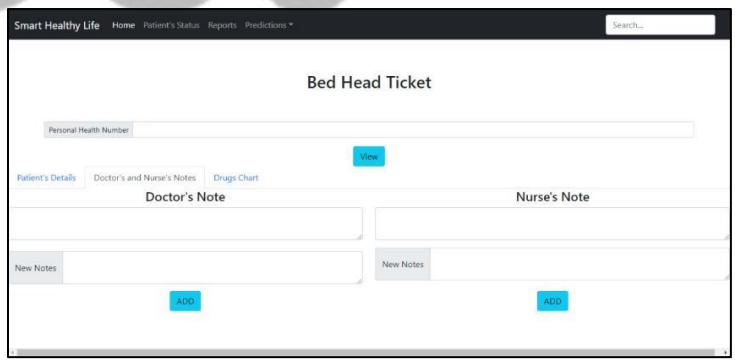

Figure 3.New interface of BHT

B. AI Based Healthcare Chatbot System

A Chatbot, in the form of a chat interface, offers a solution to the healthcare sector by improving the way patients communicate with doctors or any healthcare institution. Based on the symptoms the AI can predict the diseases and give the list of available treatments. The actual worth value of a chatbot can be realized only when it can diagnose all types of diseases and deliver necessary information to the user. The system processes all the information it receives from users using algorithms, and it produces correct and timely responses. The problem with a patient's personal interaction with their physician is that it is typically conducted in an 8-10-minute consultation, which is insufficient. Chatbots are

expected to save healthcare expenditures when used in place of humans or to aid them as a preliminary step in assessing a condition and offering self-care recommendations using AI and machine learning techniques. A chat bot (Bot, chatterbox, or Artificial Conversational Entity) is a computer software that conducts a conversation through textual means. These programs are frequently built to successfully replicate how a human might behave as a conversational partner, passing the Turing test. The suggested system is a virtual chat assistant that can empathically answer health-related inquiries based on a doctor-patient communication model. The proposed assistant is not only informative but also provides a positive user experience.

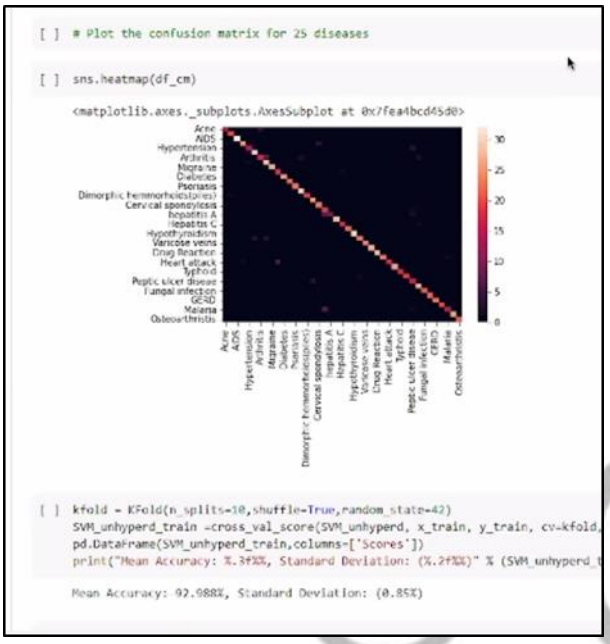

Figure 4. plot of the confusion matrix for 25 diseases

A Chatbot is an AI-based program that is embedded in a device application, website, or other network to help and assist users in doing a particular work. It analyzes the data and generates the results using a natural language processing algorithm. Natural language processing (NLP) is an artificial intelligence field that assists in the development of programs that process and evaluate natural language input. It enables natural language interactions between computers and humans. The proposed technology is sometimes known as a chatterbot or a dialog system. In here mainly use the random forest algorithm implement to chatbot. The proposed system is a chat interface that is based on Retrieval based model of NLP language. the bot is trained for a set of questions with a set of possible answers. Such an intelligent chatbot can guide the concerned patients by understanding and assessing their symptoms that they are experiencing and identify the correct diseases. We create special model for chatbot.in chatbot data manly train in google colabs

```python
# Add a comment
@app.route('/api/message', methods=['POST'])
def add_comment():
    message = request.json['message']
    result = predict_disease(message)

    return jsonify({'status': 1, 'data': result})
```

Figure 5. backend API message for predict disease

C. Predicting Modules

1) Pneumonia Prediction Using X-ray

Additionally, physical diagnosis encompasses the examination and identification of frequent causes of aberrant physical symptoms in medicine. As a result, a picture of the damaged physical location can also be uploaded into the chatbot to facilitate a more accurate patient diagnosis [1], [2]. Software technology software scripts can be justified based on data on their reliability and use. TensorFlow, which supports several levels of output, should be chosen to meet the requirements. Through the Keras API advanced, you may have to start with it TensorFlow and machine learning while upgrading training models. The Distribution Strategy API was used to do so we spread the training in all the many hardware configurations without changing the description of the model, which allows for greater flexibility, enthusiasm, fast, intuitive repetition bug fixes, as well as large machine learning training tasks. The lessons and innovations presented so far show how fast machine learning technology grows while we keep 'wow' the original applications. So, to introduce algorithms and branches are highly developed, e.g., Advanced Learning, which makes use of the Neural Network algorithms, most relevant. These are inspired by how neuroscience systems process information, such as the brain, which enables computers to see and learn patterns for every piece of data they represent. As a result, TensorFlow is a key software tool for in-depth learning, productive open-source information library models from data flow graphs. Allows programmers to create large neural networks with multiple layers. TensorFlow is mainly used for Image Visibility to distinguish, to see, to understand, to discover, prediction, and creation. The goal of image recognition is to they also point to people and things in pictures, too to understand the content and context of the images. TensorFlow algorithms for object recognition enable object classification and identification within larger images. This is typically used in engineering applications for shape recognition to facilitate modeling (Constructing three-dimensional space from two-dimensional images) and social media platforms for photograph tagging (Facebook's Deep Face). For instance, by analyzing thousands of photographs of trees, the technology can develop the ability to recognize a tree it has never seen before. According to studies, the process of image recognition has begun to establish a foothold in the healthcare industry, where TensorFlow algorithms are more data-processing and pattern-detection capable than their human counterparts. Computers can now analyze scans and detect more diseases than humans [3], [4]. Keras is a Python library for developing and evaluating deep learning models that are free and open source. It is compelling and easy to use. It encapsulates the libraries for high-performance numerical computation TensorFlow and Theano and enables the neural

network model definition and training utilizing only a few lines of code [5]. OpenCV has a user community of over 47,000 members and an estimated approximate download count of over eighteen million. The library is heavily utilized by large and small businesses, research groups, and governmental entities [6].

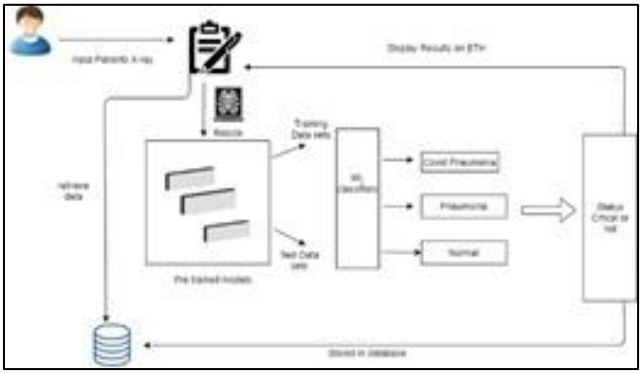

Figure 6. Image Processing by Machine Learning & Predicting Pneumonia and identifying the critical situation of the patient component overview

TensorFlow, is a free and opensource software library for machine learning and artificial intelligence is primarily used by social media platforms, telecommunications companies, and handset manufacturers; for Image Search will be used to recognize the patient's pneumonia situation. We will use here the open-source Python library Keras, NumPy, Python's core library for scientific computing. And here we used Parallel 2D Convolutional Neural Network which is a convolutional neural network (CNN Or ConvNet) a deep neural network class used to recognize pattern present in images etc. Additionally, OpenCV will be developed to serve as a foundation for developing computer vision applications. The library contains numerous optimized algorithms for detection. To facilitate implementation, a generated report function will be generated based on the diagnosis performed using pneumonia detection. Finally, after integrating all the components, a result will be made available via the automated bed head ticket and a web application.
Specific systems focus on this Pneumonia prediction system and web application. To further analysis of the disease, I identify the critical situation of the of the patient. To get l used various types of chest x-rays having features to classify I used Kaggle data set. The add by the user data will be sent to the image processing platform. Then we can identify the critical situation of the of the patient. This system can be commercialized to all hospitals, laboratories local market and global market by finding various ways. By targeting various aspects of commercialization, we can easily identify this application.

2) Heart Failure, Risk Score and,Survival Months Prediction

. In Sri Lanka near 28,000 dies within a year from heart disease Problem. It is not possible to diagnose this disease in advance. In present doctor will perform a physical exam and ask about patient personal and family medical history. Then doctor will perform test to examine the patient. From predicting heart disease, we can identify patient situation and can treat immediately, get predicted health diagnosis and aid patients.

There is much research to identify heart diseases. According to the literature review Although there are existing systems to predict heart failure, there is still no system that gives the most accurate results. We are proposing a new system that cover all the defects that existing systems have.

Prognosis models are Used for this predicting system, by using Logistic regression algorithm, Decision tree algorithm, Kaplan Meier estimator and random forest algorithm. First the system will classify the patient whether patient is affected or not. After the classification if the patient is affected, system will predict the risk score, survival percentage and how many months the person will survive. Also, it can predict how to reduce the risk. After the patient classification if the person is not affected system will check the person health and predict early-stage diagnosis. This system has above 90% accuracy and cover all the defects that current systems have.

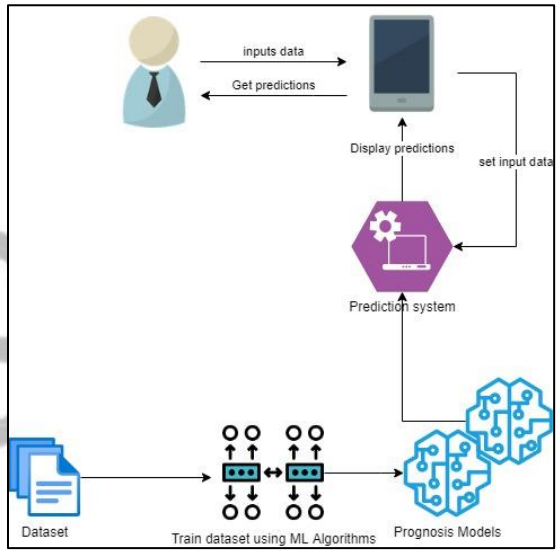

Figure 7.Predicting system flow

D. BlockChain Module

This research is designed to use blockchain technology to protect patient data when transferring a patient from one hospital to another and in the event of a patient's death. Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system. in our research we use permissioned blockchains that limit the access to the records. Only authorized people have access to the records. From this we can secure patients details.

III. Research Findings

Even though a literature survey, it was identified that there are many systems to manage patients however they were not according to the requirement of our target market which is local government hospitals.[10] Because of that previous Inward patient care systems need more enhancement features' which haven't been implemented properly. The research team found that hospital policies differ from hospital to hospital and there aren't common policies available yet. Therefore, the systems currently available differ. The research findings were not only considered from a user perspective but also a

patient perspective as well.[10] Because of this, it needs the same policy for all the government hospitals. Then it'll be easy to handle data from hospital to hospital. Normally patient details are stored in papers in the current situation. And those documents are restricted to transfer to another hospital. And this documentation is hardly reused to retrieve patient data. Because of that, there is an effective mechanism to transfer patient data through this proposed system.

And there is no existing system that automatedly records patient details. When there is an automated mechanism to record patient details it will be more effective for the system. Because of that in this proposed system, there is an automated electronic BHT to record patient details.

There is no existing system that predicts all the features at once. In this system, we created a prognosis model that can predict early-heart failure detection, classify patients, predict risk percentage, surviving months of the patients, and the risk reduction methods.

Our findings show that more deaths are being reported due to the inability to diagnose heart disease and pneumonia earlier. Accordingly, we make it easier to diagnose outpatients and outpatients by applying that concept to our system.

IV. Conclution of future works

Artificial intelligence and machine learning are the basis of the rapidly evolving technology. Adding those concepts to the health sector can make a big difference. By centralizing, automating, and predictability of the Government Hospital system in Sri Lanka as a first step by our system.

By implementing Smart patient care system (SPCS) we can prevent medical error that happening in current system. also, all the data are well organized and centralized. We can get health statistic by managing the smart patient care system. one of the main functions is patient details transferring. We must secure Sensitive data for security purpose of the hospital. By our system that challenge achieved from implementing a blockchain technology-based storage. That will be a huge milestone for the Sri Lanka information technology systems.

With the rapid growth in technology in near future the smart patient care system (SPCS) can be expanded on supply on demand. One of the areas can be expanded is Predicting module. We can add more predicting, and AI based system that can give decision making for doctors. We can add IOT device connection for the Automated Electronic Bed Head Ticket and manpower need will decrease down from these implementations. From that we can get real time detection for the monitoring charts in AE-BHT.

Our Smart patient care system (SPCS) will inevitably be a new milestone in IT in Sri Lanka soon as we interact with technology.

Acknowledgment

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