

# Smart Hospital Diabetic Clinic Patient Management System

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**Abstract** – Sri Lanka provides health facilities freely for everybody and most individuals benefit from these free health services. One of the main problems captured with the significant ongoing clinical process is lots of time-wasting, because of the manual paperwork system. This research aims to automate hospitals' clinic patient management system and develop a diabetic prediction system using machine learning algorithms. The main objectives of this study are to make this manual clinic process an automated, time-saving and efficient one, and to add more value to this significant process of the health sector, with a newly added feature – the diabetic prediction system. This proposed system is highly beneficial for doctors in the process of updating or retrieving patients' records. The main focus here is to automate the diabetic clinic as the first step. This paper presents a clearer clarification of the objective of this study and the relevance and motivation of the study. The proposed solution is a web application with multiuser login. The backend of the web will relate to the MySQL database, which is created by PHP MyAdmin. Initially, it is kept at localhost and build by using Xampp server software. A smart ID card that contains barcode technology is used for the authentication process, and there is no need of maintaining manual records. Fingerprint scanning is used at a sudden admit of a diabetic clinic patient, who does not have to bring the clinic ID. The recommendation system included on the web can be used by both clinic patients and normal users.

**Keywords:** *smart hospital, diabetic clinic, web-based patient management system.*

## I. INTRODUCTION

Every hospital in Sri Lanka holds clinics for patients under various categories as diabetic, heart, paediatric, dermatology and mental. Here is the normal process which is going on the present; When a patient is admitted to the

hospital due to any disease, if that patient is needed to be treated continuously, then that patient is assigned to a monthly clinic of the hospital. When a patient is assigned to some clinic, is given a registration number which is used to identify and a booklet that includes the details of the patient such as register number, clinic type, clinic date, clinic time, details of diseases, and the medicines assigned by the doctors. The patient is assigned a specific date and a time to attend the clinic and must bring the record book otherwise cannot attend the clinic. Then the record book is handover to the staff members. Then the hospital staff search for the clinic cards according to the patients' identification number and they record patient details to the relevant cards and hand over the record book and card to the patients. Then the patients are directed towards the doctors and the doctors record the patients' pressure levels, diabetic levels or other check-ups and the medicines assigned in the record book. Then patients are directed to go to the pharmacy and obtain medicines by hand over the cards. This process takes at least 4 hours per patient according to the research done with some selected patients at selected clinics. It means the patient must wait and spend at least 4 hours to meet the doctor and take medicine. This manual based paperwork system is extremely time-consuming. This study aims to automate the ongoing manual clinic process in case of saving time and to propose a methodology for the process, when a clinic patient is admitted to the hospital due to a sudden severe condition there is no way to identify he/she as a clinic patient if he/she has not brought their clinic record book as it is impossible to remember the clinic's register number for most of the patients.

This paper has selected the diabetic clinic to automate as the first step. because the diabetic

clinic has an outstanding speciality when comparing to other clinics. According to the prevailing statistics, Sri Lanka is seeing a huge increase in diabetes cases regardless of age range. At present one in 12 adults in the country suffers from diabetes, which totals 1.16 million of the total population ('talkingeconomics - Beat Diabetes in Sri Lanka: Too Much Sugar is Not that Sweet', no date).

## II. LITERATURE REVIEW

### A. *Regarding the architecture of clinic patients' management system*

The Design, Implementation and Evaluation of Computerized Clinic Patient Management and Clinician Order Entry Systems in a PMTCT Clinic in Uganda (Kavuma, 2011) is a research and in that they proposed a computerized clinic patient management system (CCPMS) and a portable clinician electronic order entry system designed for the HIV/AIDS PMTCT research and programme activities at Mulago hospital which positively impacted on the patient care. The objectives of them were important improvement of patient load handling among the analysis clinic by providing information to help to supply designing and clinic management, impact on patient care, drug management, knowledge management and reduction of report missing. Challenges with their implementation enclosed synchronous running of the paper-primarily based systems and processed solutions throughout piloting, rotation of clinicians amongst units. The project showed that acceptable and cheap technology solutions will be developed and integrated into health care and analysis to boost method potency in patient care and temperament by clinicians to adopt these technologies.

The Recommender System for a Cloud-Based Electronic Medical Record System for Regional Clinics and Health Centers in China (Hu et al., 2017b) is a research and in that they proposed a cloud-based EMR system integrated with recommended functionality. Drug recommendation and decision support in diagnosis are featured with this counselled. In their research, experiments to test the ranking of

drug recommendation and the auxiliary diagnosis support are presented.

Automated clinic record management system, a case study of Ahmadu Bello university sick-bay (Ahmed, no date) is a research and in that he proposed to design & introduce the use of an automated clinic record management system to improve the services of Ahmadu Bello University sick-bay. A qualitative analysis was adopted and additionally interviews, questionnaires and observations were. And at the top of the analysis, the findings were analyzed that led to the comiproducing same system. However, the study has disclosed the issues related to the manual methodology of record-keeping like difficulties in sorting, retrieving and change records, lack of security of records, loss of relevant info and then on. The program developed for this project is employed to handle the right storage of all records and connected info during a clinic, the patients' treatment reports, date of treatments, doctors answerable and different relevant info are going to be entered into the system.

Advanced Hospital Database Management System (Yadav et al., no date b) is a research and in that, they proposed this system in case of reducing paperwork as well as saving a lot of time and for computerizing the working in a hospital. The distributed information is going to be transferred from hospital to hospital and each patient can have the access to their personal information. The system takes care of all the wants of a mean hospital and is capable to produce straightforward and effective storage of data associated with patients that return up to the hospital. The system is additionally distributed so creating it accessible for each individual. therthere islikelihood of loss of information| since having a backup of every data. This projected system has utterly reduced the paperwork so reducing the workload of operating workers.

The Role of Information System in Hospital Management and its Developing Process (Mazanec, 2014) is research and in that they describe how the quality of the implemented information system influences the management of a hospital with the focus on the risk resulted from working with bad information & the possible ways to implement new current

information in a hospital and the advantages and disadvantages of them.

“Automated Hospital Clinic Maintaining System for Government Hospitals in Sri Lanka” (Gunarathne and Wijethunga, no date) is research-based on the difficulties of the existing manual hospital clinic management system and the way it upgraded to the automated computerized system. The methodology which they have been used is a qualitative and quantitative-based nonprobability sampling survey methodology to conduct their research. Their research aimed to explore the regression of the existing system for maintaining hospital clinics and to upgrade the ongoing manual system to the automated and computerized government hospital clinic maintaining system.

*B. Regarding the technologies used*

Clinics management system (CMS) based on patient-centric process ontology (Jayaweera et al., 2006) is a research and in that they proposed to develop a clinics registration system for the General Hospital, Matara, based on the proposed ontological framework which has done in a 3 layered process in case of providing value-added services to the patients. There are five interfaces to the CMS knowledgebase. Three of them are to interact and to monitor the process layers. The remaining two interfaces are to provide value-added healthcare services to patients and administrative services to relevant authorities.

A Clinic Ontology Construction Method in Distributed Hospital Information Systems (Boyi Xu, Hongming Cai, and Lihong Jiang, 2013b) is a research and in that they proposed an ontology construction method. In this, they aimed to help users in integrating clinic data for decision making. Finally, this approach is demonstrated in a clinic data analysis project. The result shows that the method is efficient in ontology engineering. During this approach, to support the complete method of information analysis, they build ontology from information schema semi mechanically to explain the information sources.

Intelligent and Convolutional-Neural-Network based Smart Hospital and Patient Scheduling System (Rajakumari and Madhunisha, 2020) is a research and in that they proposed a new Decision-Support environment to help patients

to be relaxed while waiting at clinics without any hardness to consult a doctor for their respective needs. This focuses on developing a system to boost the potency and quality of delivering an online based mostly appointment system to scale back waiting time. To rectify these difficulties, this planned system uses Convolutional Neural Network (“CNN”) for a clinician's schedule analysis via experimental setup. within the proposed system, the data-driven prototypal model is dependent on method discovery, patient arrival rate “analysis, and repair time analysis. Likewise, a progression of steps to infer the best improvement technique from the prototypal investigation is remembered for the system.

Hospital Management System Using RFID (Radio Frequency Identification) " ('International Journal of Advanced Research in Computer Science and Management Studies', 2015) is research and in that they describe; this system is meant to cut back the manual intervention to the utmost level potential and Identification of patients WHO (World Health Organization) area unit unable to speak is completed with efficiency by the employment of RFID cards. The most purpose of this method is to form data management tasks easier and to develop a software package that replaces the manual hospital system with the automatic hospital management system. Having RFID tracking suggests that hospitals will use RFID-based HMS to trace whether infant’s area unit even within the hospital that is beneficial if they lose track of patients. A similar idea is often applied for the aged-care management victimization RFID-based HMS.

The summary of the literature review is as follows.

Table 1: Summary of Literature review

<b>Paper Title and Year</b>	<b>Methodology Used</b>	<b>Objectives</b>	<b>Drawbacks</b>
The Design, Implementation and Evaluation of Computerized Clinic Patient Management	Both computerized systems were used in parallel with existing	Improves efficiency in clinic processes. Reduce patients’ clinic	Didn’t entirely cover the aspect of improvement of quality of care received

nt and Clinician Order Entry Systems in a PMTCT Clinic in Uganda. (2011)	paper-based systems.	attendance time.	by patients
The Recommender System for a Cloud-Based Electronic Medical Record System for Regional Clinics and Health Centers in China(2017)	A notion utilizing is used to associate on rules to find the relations between certain diseases & drugs	The system aims at recommending the widely used drugs to the manager of stock via analysis.	The database is still in the testing phase, it can't support such a large amount of data.
Automated clinic record management system(2015)	Qualitative research was adopted.	Investigate ways of providing a standard record storage & management system.	Does not do away with paperwork completely. Problems in data collection
Advanced Hospital Database Management System(2016)	Data distribution from hospital to hospital and ability to access records by patients.	To computerize working in the hospital. Provide easy & effective storage of information.	The pharmacist is not added to this database as he is a key person in the hospital system.
The Role of Information System in Hospital Management and its Developing Process(2014)	Describes how the quality of the implemented information system influences the management	The management of the hospital can be done in a highly effective way.	When incorrect information is used in the process, it may result in a bad product

	ent of the hospital.		of this process.
Automated Hospital Clinic Maintaining System for Government Hospitals in Sri Lanka (2020)	The methodology used is a qualitative & quantitative base survey. The online review flowed through email.	To explore the regression of the existing system for maintaining hospital clinics. To upgrade existing systems to automated systems.	Based on only one aspect of the government hospital system.
Clinics management system (CMS) based on patient centric process ontology(2006)	Patient-centric process ontology has been adapted in the development.	To provide a more secure and flexible environment to all the participants.	Not a completely automated system, associated with the manual based existing system.
A Clinic Ontology Construction Method in Distributed Hospital Information Systems(2013)	The semi-automatic ontology constructing method is adopted in clinic ontology development.	To recognize the equivalent concepts in different databases.	Complex to be built.
Intelligent and Convolutional-Neural-Network based Smart Hospital and Patient Scheduling System(2020)	Information driven prototypical model is built dependent on process discovery, patient arrival rate analysis, and service time analysis	Formed to help patients to be relaxed while coming to the clinic without any hardness to consult a doctor for their respective needs.	

RFID-Based Hospital Real-Time Patient Management System(2015)	Uses Web service interfaces to support standard electronic health records.	To create standards-based secure access to patient's data and medical records.	Prohibitive costs, technological limitations, and privacy concerns.
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### III. METHODOLOGY

The first step is targeted to automate the diabetic clinic. The proposed methodology is; When a patient is admitted to the hospital or a patient comes to the outpatient department, if that patient is detected with diabetes, should be examined, and treated regularly, those diabetic patients are registered to the diabetic clinic at the hospital. Patients' profiles are created on the web while registration. National ID numbers are used for the authentication process. The clinic patients' fingerprints are also captured at registration to use in case of an emergency like; when a diabetic clinic patient is admitted to the hospital due to a sudden severe condition without bringing the clinic ID, instead of bothering the patient for clinic details, by scanning a fingerprint, patient's clinic information can be retrieved quickly from the web and can quickly start and continue treatments easily and efficiently.

After the registration at the diabetic clinic, they are given a clinic ID card and it contains a barcode. This barcode is used for quick identification and authentication of patients. And, that ID card contains the months, dates, and times for the clinics for a year. The ID card is supposed to annually update as it contains clinic dates and times for a year only.

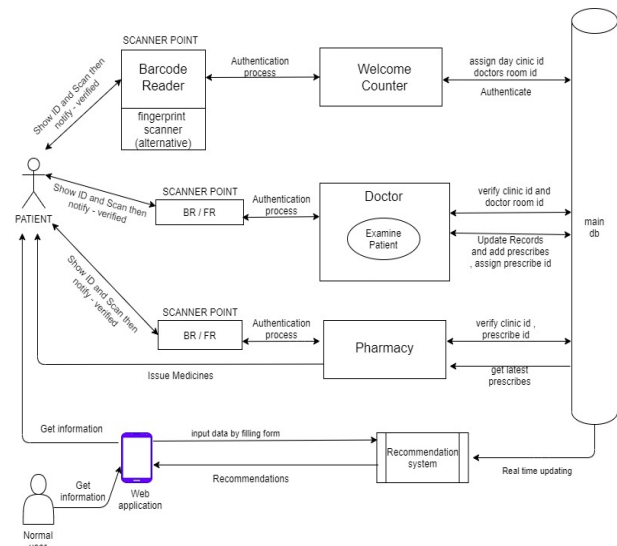


Figure 1: Methodology of the System  
Source: Author

This system has a multi-user type of login. The admin panel is the hospital staff. They are authorized to view, retrieve, or update patients' profiles. Hospital staff also have their profiles in the system. They are authorized to update general clinic details, relevant clinic dates, times, and hospital staff details. Diabetic clinic patients are another level of users. At their registration to the clinic, they are given a paper printed with URL, their username & password to log in to the web. Clinic patients can view and retrieve their clinical records, reports, or doctors' prescriptions also by log in to their profiles using the given username & password. And others are normal users. Normal users mean any person who wishes to use this. They can log in to the system after the registration. They can obtain general details about the hospital, clinics, and doctors. And through this web, they can request to register at the diabetic clinic of the hospital, and the hospital staff is in charge to work on such requests. And there is a recommendation system that includes diet plans, exercise schedules and lifestyle suggestions for users under categories diabetic, pre-diabetic and non-diabetic. Both clinic patients and normal users can use this diabetic prediction system and the recommendation system.

### IV. RESULTS AND DISCUSSION

As Sri Lanka is still a developing country, the hospital clinical procedure is still a manual



process, and it contains many issues. The research aims to automate this manual procedure to save time and make it efficient. The following is the proposed clinic patient's ID card issued at registration which includes the clinic dates and time for a year and a barcode that would be used for the authentication process. This ID card is supposed to annually update.

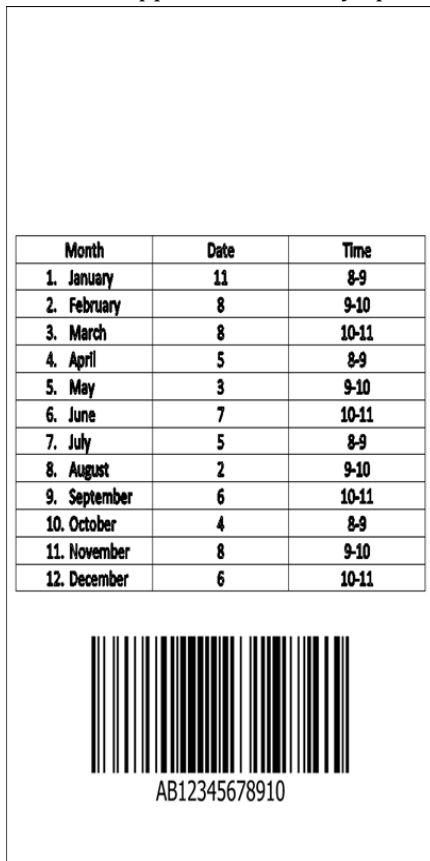


Figure 2: The proposed clinic ID card  
Source: Author

Following is the top-level architecture diagram, and it depicts the architecture that would be used in developing the proposed clinic patients' management system.

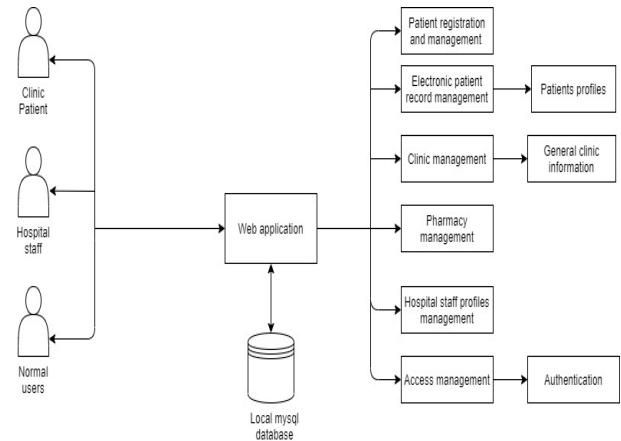


Figure 3: Top Level Architecture Diagram  
Source: Author

There are 3 main user types in this system as clinic patients, hospital staff and normal users. These users have separate access types to the system. All the user types are authorized to access general details on the web. Diabetic clinic patients and hospital staff are only authorized to access patients' profiles. Patients' profiles are managed under the task, electronic patients' record management. General clinic information is maintained under the task, clinic management. Authentication is handled by task, access management. When a patient is registered at the diabetic clinic their profiles are created.

The following shows some user interfaces of the web system.

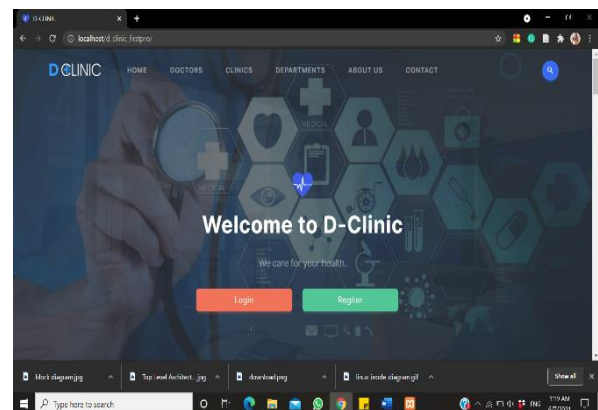


Figure 4: The user interface of the system  
Source: Author

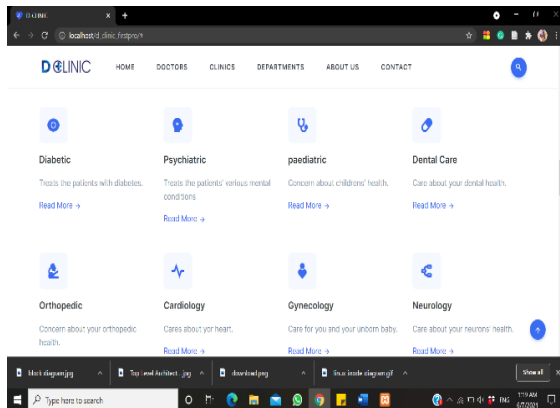


Figure 5: The user interface of the system

Source: Author

## V. CONCLUSION & FUTURE WORKS

Could identify diverse types of solutions proposed at diverse types of matters that arise in hospital clinic patient's management systems by using the literature review. Government hospital clinics are delivering huge invaluable service that is benefited by many folks. However, there are many issues related to this manual clinic process. This analysis primarily aims to create this in progress method associate with economical well-functioning. There are various kinds of issues within the hospitals concerning clinic patients' management from different views. The main drawback captured is that the time wastage. As a special step within the clinic patients' management system, propose to introduce a smart patient ID card rather than manual record books and an automatic management system that can be straightforward for the clinic patients and the hospital staff. This proposed system will be highly beneficial for doctors in the process of examining clinic patients and keeping records because with this automated system it will be extremely easy to update or retrieve patients' records in real-time. And at a sudden admit of a clinic patient, without bothering the patient for clinic details, by scanning the patient's fingerprint, clinic details can be easily retrieved from the system and can continue quick and efficient treatments. This automated system will be a better substitution for the ongoing manual clinic process. And both clinic patients and normal users can get huge benefits from the recommendation system which contains diet plans, exercise schedules and lifestyle

suggestions for the levels diabetic, pre-diabetic and non-diabetic.

As the future continuous development of this project, it is proposed to add a new feature a diabetic prediction system to this web application that could be used by both clinic patients and normal users by log in to the system. If this system is compatible with the users, it is proposed to improve this for the rest of the clinics also.

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