A
Project Report
On

“BLOCKCHAIN BASED SECURE BILLING FOR HOSPITALS”

Submitted By

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2020-21

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CERTIFICATE

This is to certify that,

Mr. Ashish Hanmant Mahadik.

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Mr. Omkar Ganpat Sonawale.

Mr. Sourabh Vishnu Jamdade.

Have satisfactorily completed the T.Y.Btech Project entitled, **“***Blockchain Based Secure Billing for Hospitals*”. This work is being submitted in partial fulfilment for the Third Year in Computer Science and Engineering of the Shivaji University, Kolhapur, Maharashtra, INDIA for the academic year 2020-2021.

Prof. A. H. Renushe.

Guide

Prof. A.N. Patil

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ACKNOWLEDGEMENT

I express my special thanks to Prof. A. H. Renushe, Project Guide for his sincere efforts and kind guidance in selecting project topic. I am very grateful to Prof. A.N. Patil, Head of Computer Science and Engineering Department, for making available all the facilities required for the fulfilment of the project.

I cannot forget to express my immense sense of thankfulness towards all the teaching and non-teaching staff of Computer Science and Engineering department, and all my friends who offered their helping hands at the time of need.

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Abstract

The today's digital world is completely depended upon the data which we have around us. And when we listen the word DATA the first thing that comes in our mind is "security". Securing our day-to-day life's data will be the very big aspect in today's IT world. Because most of the time the data that goes over the internet is sensitive.

If you have been following banking, investing, or cryptocurrency over the last ten years, you may have heard the term "blockchain," the record-keeping technology behind the Bitcoin network. Blockchain is a specific type of database. It differs from a typical database in the way it stores information; blockchains store data in blocks that are then chained together. As new data comes in it is entered into a fresh block. Once the block is filled with data it is chained onto the previous block, which makes the data chained together in chronological order.

Understanding the importance of data security in our day-to-day life, we have decided to make a small project on it. we have finalized the fields where we can use blockchain in today's era, and we the field that comes in our mind is "HEALTH CARE", since the entire world is facing that same COVID-19 issue, so many documentational related issues was coming out in television report. hence, we have decided why not to secure the patient's personal information so that nobody can ever alter it once it is entered. and we named this project as "**BLOCKCHAIN BASED SECURE BILLING FOR HOSPITALS**".

This respective project will help us to save the billing information of the patient with very secure hash algorithm that is SHA256. This respective hashing algorithm will take some unique input constraints into consideration and will generate the 64bit hash value for it. Every time even if the single byte had been changed the entire hash value generated by the SHA 256 will get changed.

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1. INTRODUCTION

1.1 Project Idea

Everything nowadays will become digital. And the data is the core key features among all of them. So as the data get involved here, hence its security does. From end of 2019 we all are facing the same problem that is COVID-19. The healthcare sector is very crucial part not only for India but also for every other country. And if we consider the India then we have already seen and heard so many frauds happening even in this pandemic situation. Frauds regarding patient's billing, frauds regarding his/her death report. Etc. so if the digital information is stored at the core of this, we have decided to overcome these frauds by giving some certain amount of security to the system.

The respective project will use the secure blockchain technology for the billing purpose as well as to store the personal details of the patients. We have seen so many cases in which those private hospitals are charging huge number of drugs prices apart from the one that the manufacture of the drug company has allotted. These small but serious issues will lead to the big money regrading frauds in patients billing system. So, the blockchain will comes into the frame. It will compile that one particular transaction of the patient (billing information) and will generate one unique reference number; we call it as HASH. The hashing algorithm that we have used here is a SHA 256. Cryptographic hash algorithms produce irreversible and unique hashes. The larger the number of possible hashes, the smaller the chance that two values will create the same hash. The algorithm here will take input of the patient's unique id, his unique bill no, the entries inside that bill no, its previous hash and the time stand at which the bill had been saved inside the database, by considering all these key inputs the output SHA 256 hash value will get generated. And this hash value will be pointed as the previous hash value of the next bill entry. And the chain will go so on.

How security is maintained here is that previous hash value will take as an input for the current row's current hash value. Hence any slight change into previous ledger will change that row's current hash value and the changed hash value is to be stored as a previous hash value for next consecutive row. But if the previous hash value of the next row is changes, we can easily find detect that some information is altered. And hence can detect the fraud. We have taken some unique and fixed key values of the patient's information database that will tell us that particular bill no is referred to that particular patient only.

1.2 Need of project

Blockchain technology provides numerous benefits to medical researchers, health care providers, and individuals. It would serve research as well as personalized medicine to create a single storage location for all health data, track personalized data in real-time and set data access permissions at a granular level Health researchers need comprehensive data sets to advance understanding of disease, accelerate biomedical discovery, track the development of drugs quickly, and design individual treatment plans based on genetics, lifecycle, and environment. By including patients of different ethnic and socio-economic backgrounds and from different geographic areas, the shared data system of Blockchain would provide a wide range of data set.

Within public health organizations the systems store a large amount of patient data every day; and this fact raises the question about how to handle all of this data. In recent years, this challenge has been met by employing a common concept the Big Data Analysis—that can be defined as a set of new approaches used in large datasets of high complexity, in which the standard architectures cannot be supported. Big Data has the potential to be applied to healthcare areas, and make the following improvements: prediction in healthcare diagnosis, analysis in magnetic resonance imaging, and other applications

A health care blockchain will likely encourage the development of a new breed of smart health care provider apps that would circumvent the latest medical research and develop customized treatment pathways. The health care provider and patient would have access to the same information and could be involved in a cooperative, educated discussion of research-based treatment options rather than intuition-based best case.

1.3 Literature survey

From the many healthcare professionals who put their own safety and well-being on the line to many others who donate their money and resources to assist in the fight, it is heart-warming to see this display of heroism and selflessness. At the same time, there are people who use a crisis, like this one, to take advantage of others who are in need. During one fraud examination I conducted, an allergy doctor was providing a treatment, which was considered experimental and therefore not approved by government health care plans or other insurance companies. With a few strokes of a pen or taps on a keyboard, the allergy doctor submitted claim forms and still got paid for utilizing the experimental treatment.

2. PROBLEM STATEMENT & SCOPE

2.1 Problem Statement

Develop a better and improved software than current Hospital Billing System that solves problems in field of security to avoid ongoing frauds in medicine sector. It is very important to maintain and handle important financial information of a hospital in a secure way. The new system will provide a secure platform for hospital bill management by using a very secure blockchain hashing mechanism.

2.2Project Scope

For future use, there are so many provisions specified with the help of which the system can also survive in the future with its excellent capacity and robustness. This can be improved adding some new module related to accounting and inventory. The scope of this project work covers design and implementation of a computerized "**BLOCKCHAIN BASED SECURE BILLING FOR HOSPITALS"**, it provides a program that will effectively handle the operations of the hospital billing system. As in our society, medical field is a very important and growing field and this makes it a venerable area for corruption. And as in past we observed and studded those frauds are increasing day by day in medical sector. So, to overcome the corruption related problems in future, we need to actively work on the problems and this makes medical sector a place to work constantly and so our project scope in future is vast to work.

In almost every health care fraud examination, Authorities found evidence that the medical provider or its facility submitted claim forms to government health care plans and/or insurance companies for services and care — that were never provided — and the corresponding patient files had no supporting documentation. It makes sense that if a fraudster would commit any of the schemes, which takes a bit of brainpower and effort, they might as well throw in some extra dates and codes on the claim forms to try to make some real easy money. There was a case where an allergy doctor was providing a treatment, which was considered experimental and therefore not approved by government health care plans or other insurance companies. With a few strokes of a pen or taps on a keyboard, the allergy doctor submitted claim forms and still got paid for utilizing the experimental treatment. She accomplished this by calling it (and coding it) something else that was covered by insurance plans and policies.

2.3 Area of project

The project undertaken is actually to develop a system that helps medicine sector and ongoing frauds in it. Requirement analysis is a software engineering task that bridges the gap between system engineering and software design. It provides the software designer with a representation of information and function that can be translated to data. A program that will be interactive whereby they must be an operator (staff) to supply patients billing data into the computer system. It covers the area where the medicines and billing system of medical sector is managed. The revolutionary trends of computerization have reached the peaks achieving global goals in all fields and sectors. The Medical Billing systems are getting computerized leading to a new and innovative way of approach to Billing and Invoicing.

This project specifically aims to the total computerization of the billing and invoicing system in Hospital, Medical stores, sales department. With the total automation of billing process, the manual dependency is minimized to a large extent. It inherits all the properties of computerizing a system which includes quick response, less processing time, non- diligence, fast recovery, robustness, flexibility, reliability, scalability. Our project offers the user to provide a secure transection in billing system which avoids the fraud happing in billing system. It is an improved system which focuses on security and integrity to overall system than previously available system.

The system includes a comprehensive product information database. It also has role – based access level control that is functionally based on whether the user is a data entry operator or a manager. With Medical Billing System Administrators can manage and track System users. To develop software application that supports the application specific to the Medical Billing Automation in an intranet to an organization there by allowing the interaction of all the sales staff pertaining to that organization.

The existing Medical Store System is manual system and is less secure. The main drawback of the existing system is easy to me misused for fraud and time consumption. There are number of records and hence a larger number of registers have to be kept to the store and which has less provided security and is it not conserved to be important. It has product/medicine details with supplier name, supplier/vendor master with all details, purchase medicine, with rate, expiry date, sale product and produce various reports like stock in hand, purchase and sale report, balance sheet.

2.4 Goals & Objectives

- Our goal is to design a system which can handle important medical billing system with maximum security. To achieve more security, we are using a new approach of Blockchain hashing technique.

- Blockchain is a **system of recording information** in a way that makes it difficult or impossible to change, hack, or cheat the system, and will help us to achieve a better security than current available medical billing systems.

- The purpose of the project is to build an application program to reduce the manual work and increase the speed and security for managing the Bills. It tracks and stores the medical data in more secure way.

- They may use improper **medical billing** to generate more profit. Often, hospitals that engage in medical billing fraud don’t stop at just one they typically commit some combination of fraud practices.

- These frauds are increasing, our goal is to make a fully secure medical billing system which will stop these frauds at its roots.

3. SOFTWARE REQUIREMENT SPECIFICATION

3.1 Software Requirements:

- **Operating System**: Windows 7, Linux, Mac OS.
- **Front End:** Python, Tkinter.
- **Back End:** MYSQL connector, Python IDE
- **Tool:** VS Code.

3.2 Hardware Requirements:

- **System:** Pentium IV 2.80 GHz, Core
- **Hard Disk:** 160 GB.
- **Monitor:** 15 VGA Color.
- **Ram:** 4 GB.

4. PROJECT PLAN

4.1 Project schedule

Month	**Activities**	**Week 1**	**Week 2**	**Week 3**	**Week 4**
May	Staffing and Planning	Team Management	Requirement Gathering	Project Scheduling	Risk Management
June	Designing Front-End	Model Creation	Model Creation	Model Testing	Model Testing
July	Deployment	Integration Testing	Integration Testing	Integration Testing	Final Review

5. PROJECT DESIGN

- **Data Flow Diagram**

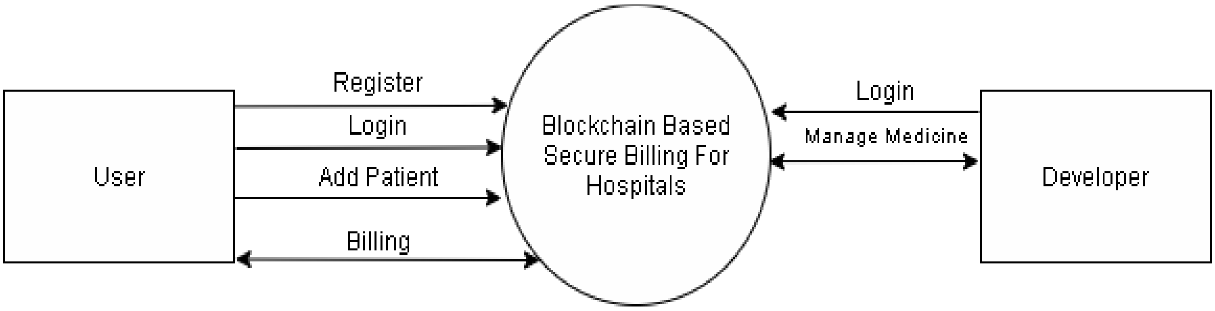

Figure 5.1: - DFD Level 0

- **Data Flow Diagram**

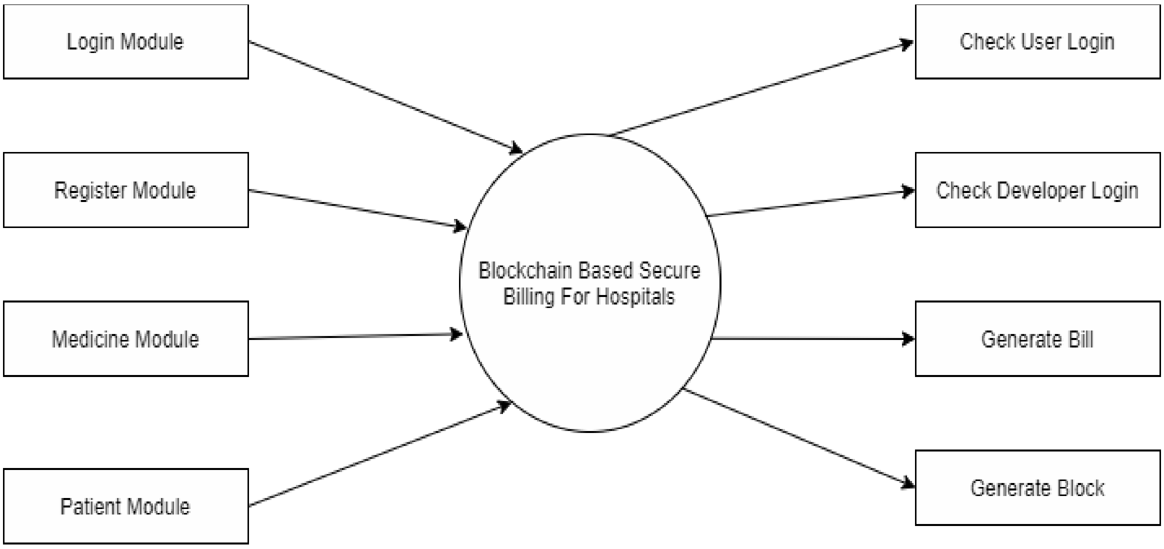

Figure 5.2: - DFD Level 1

- **Data Flow Diagram**

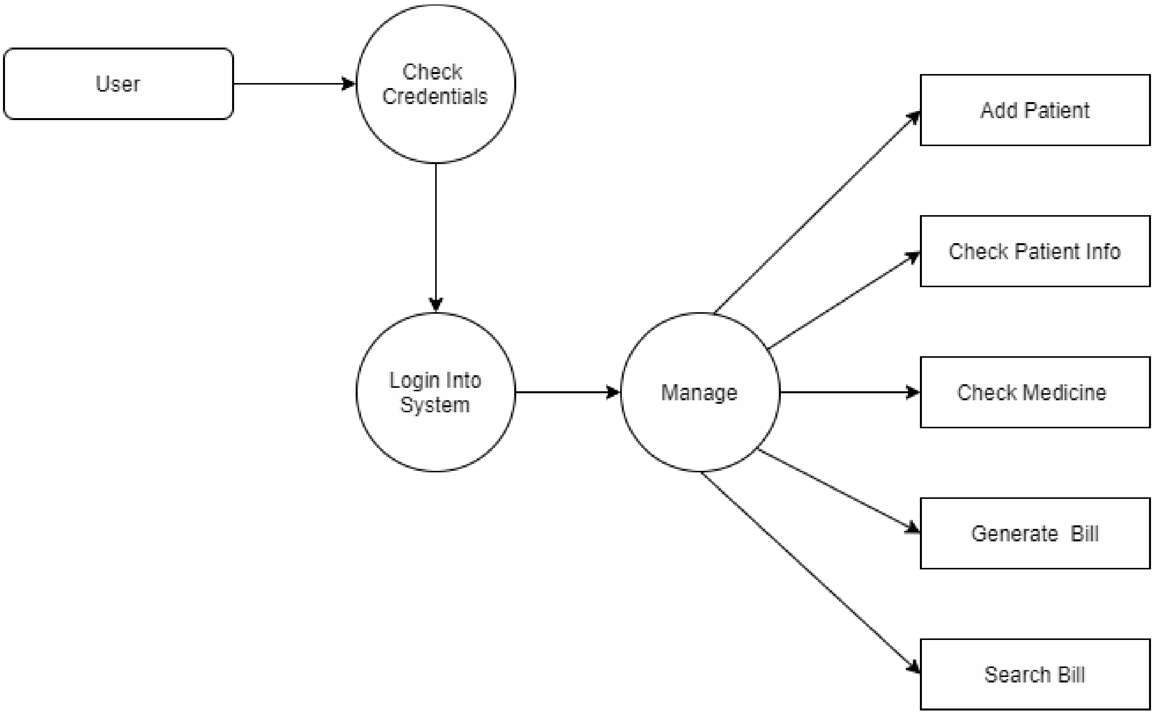

Figure 5.3: - DFD Level 2 User Side

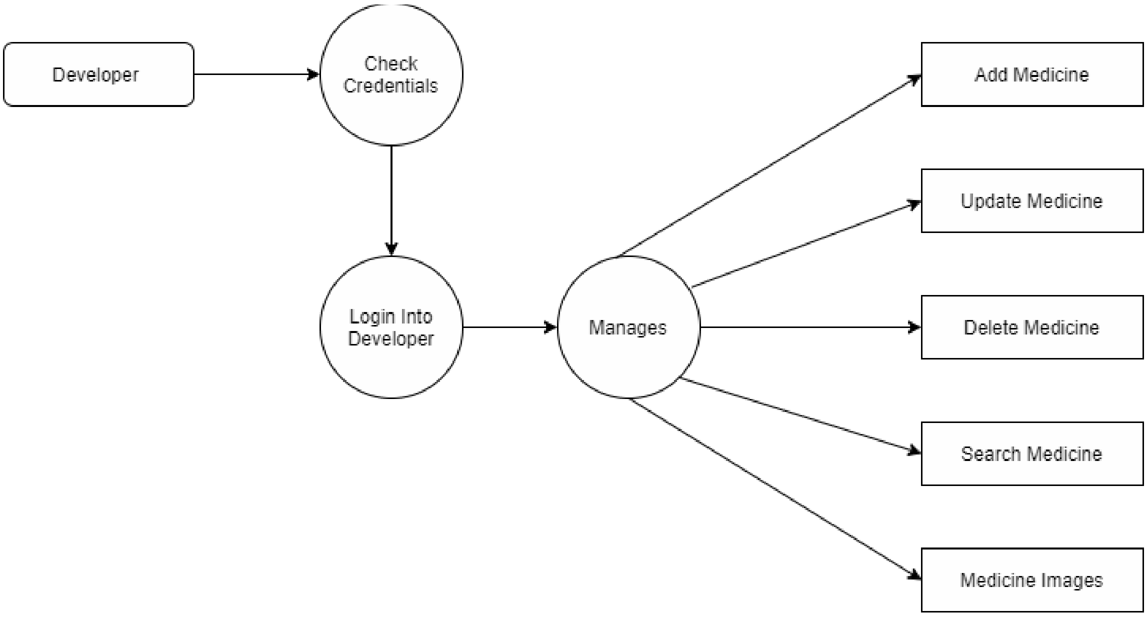

Figure 5.4: - DFD Level 2 Developer Side

- ## Flow Chart

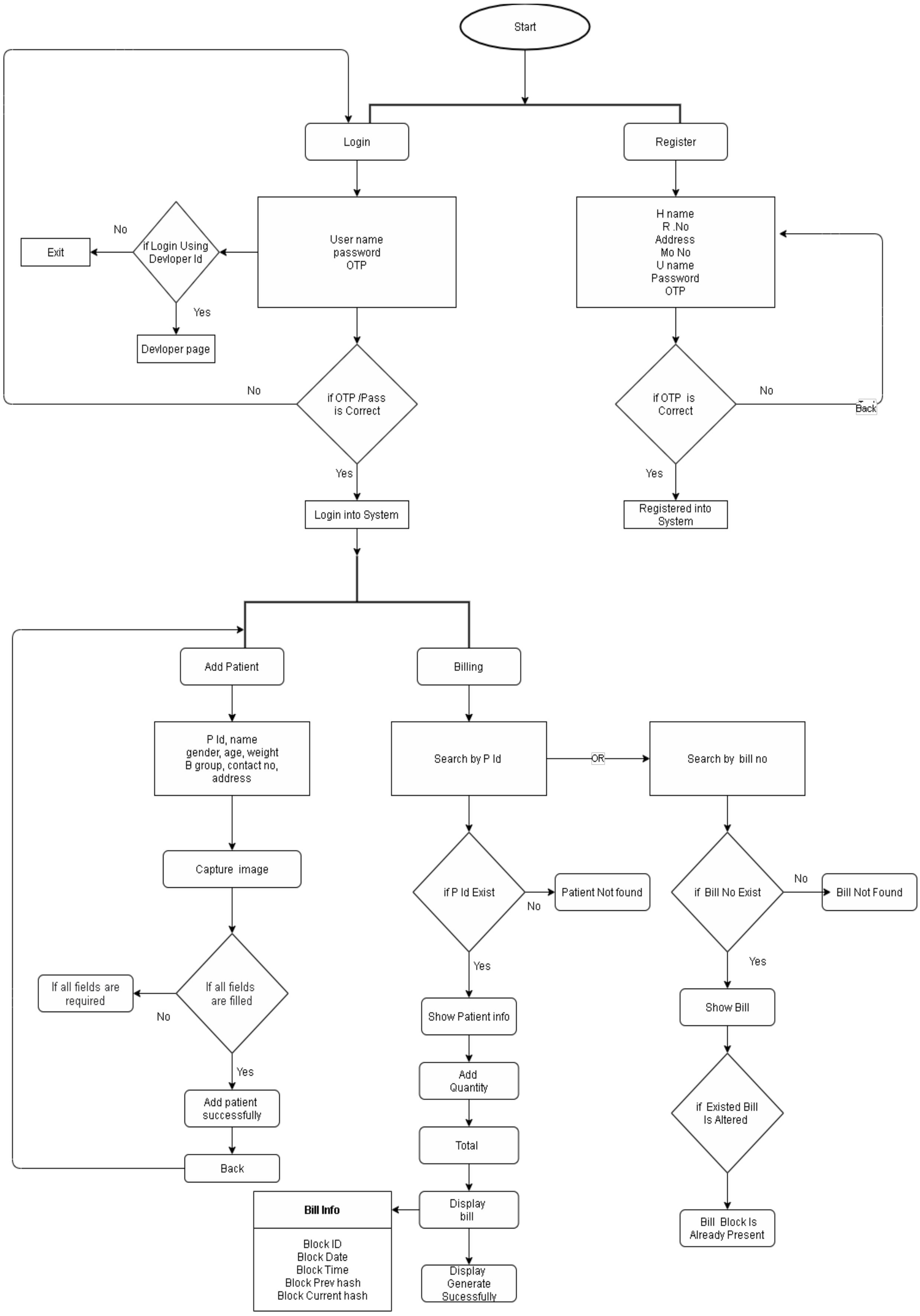

Figure 5.5: - User Flow Chart

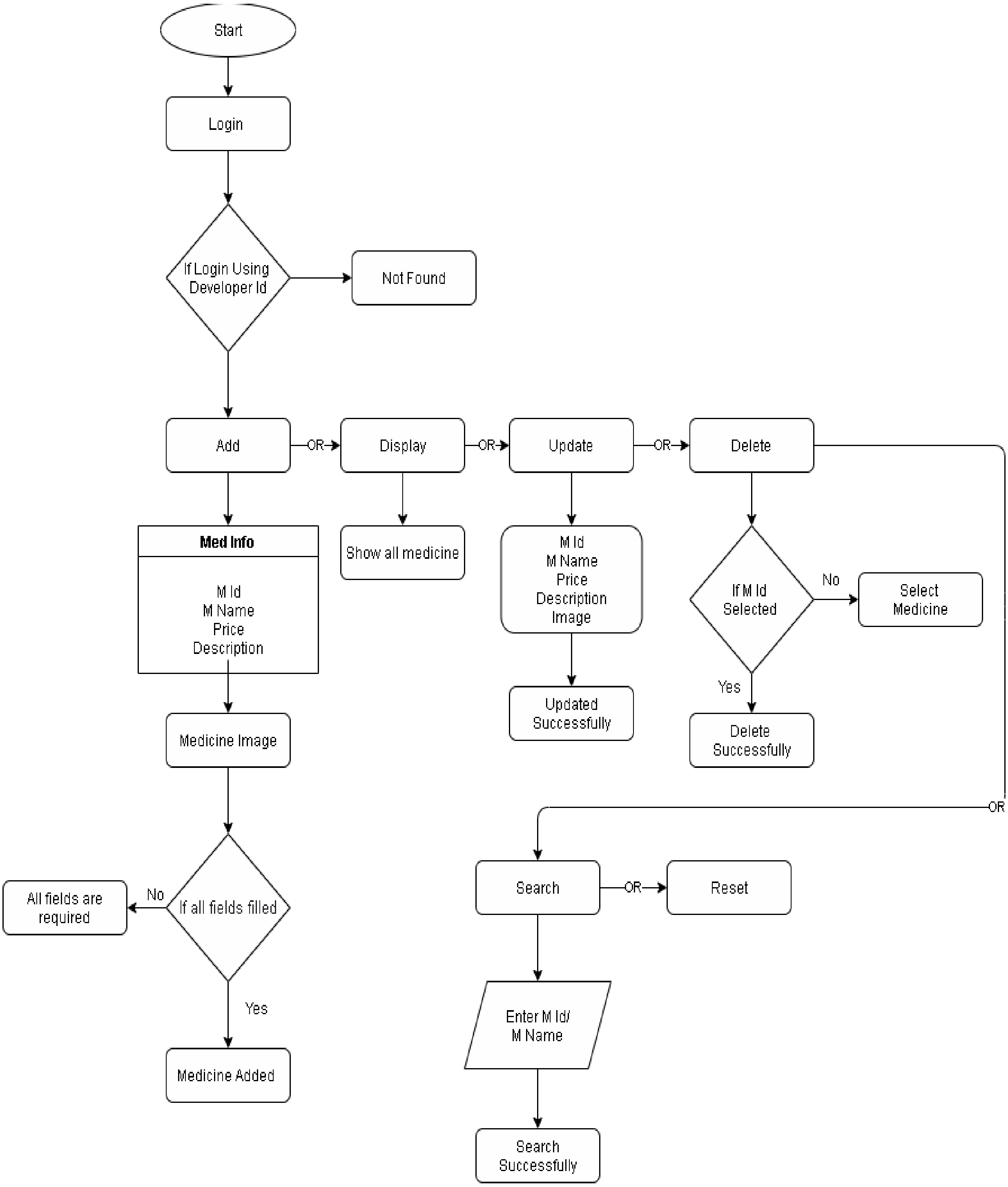

Figure 5.6: - Developer Flow Chart

- **Architecture Diagram**

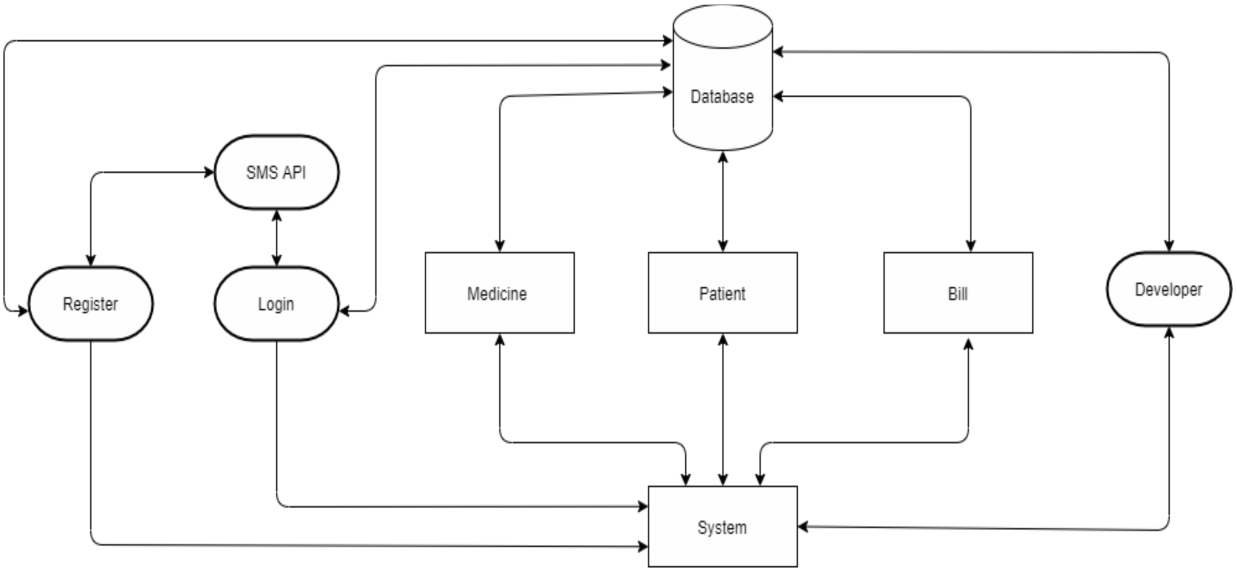

Figure 5.7: - Architecture Diagram

- **ER Diagram**

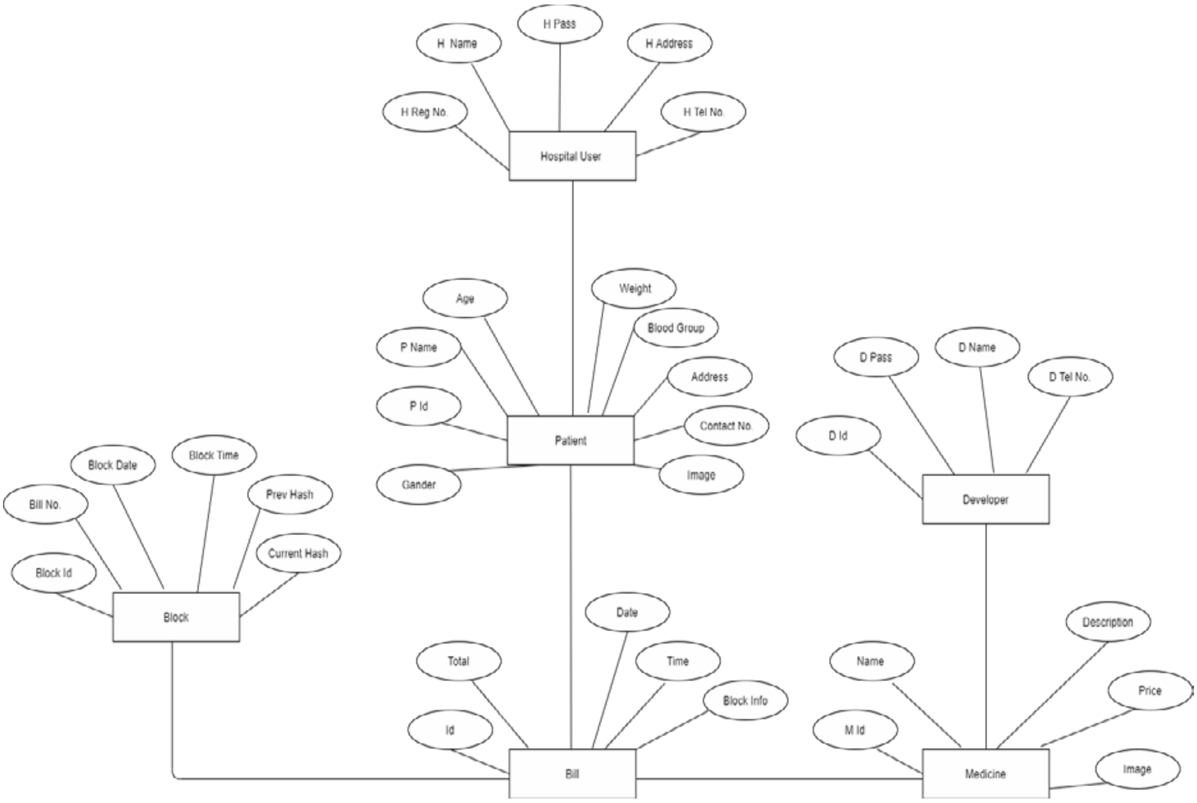

Figure 5.8: - ER Diagram

- **Database Design**

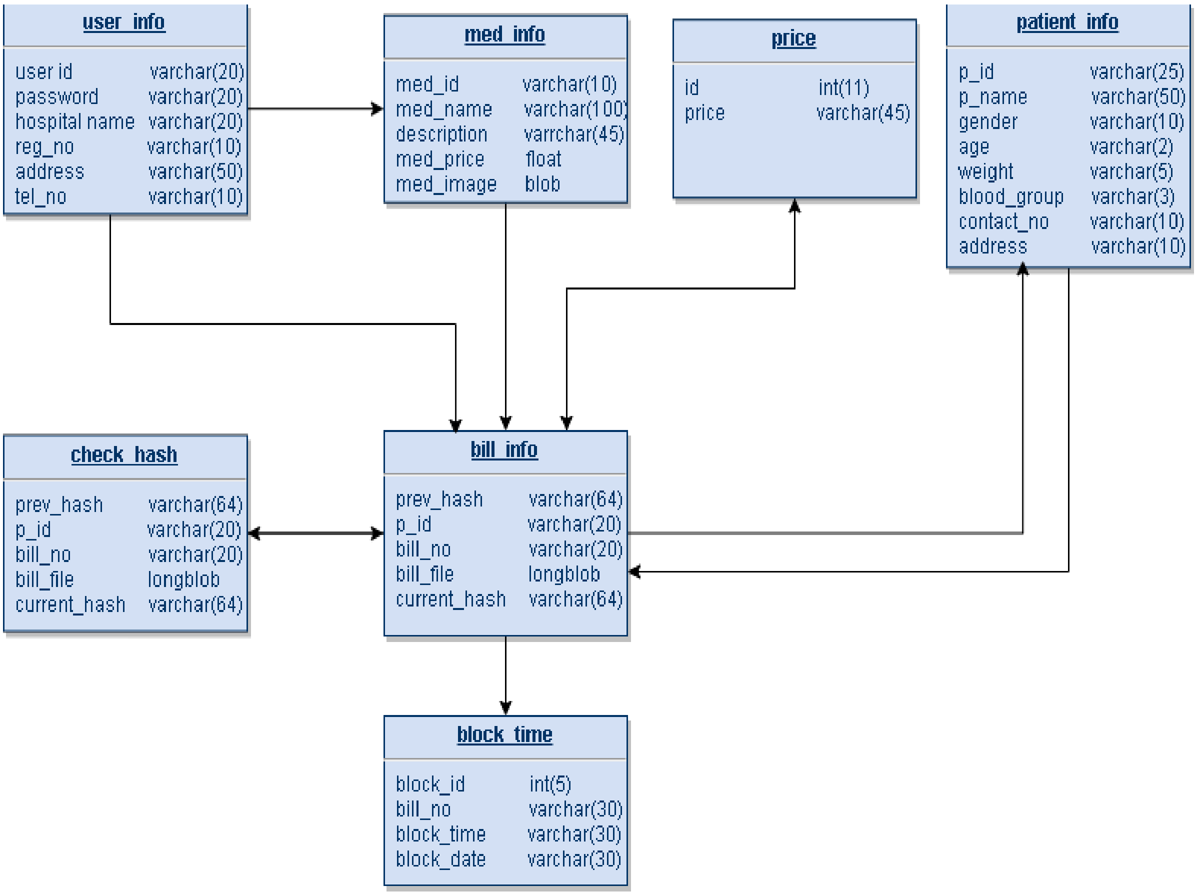

Figure 5.9: - Database Design Diagram

6. IMPLEMENTATION DETAILS

6.1 Modules and Their Functionalities:

- **Welcome Module**
- **Registration Module**
- **Login Module**
- **Developer Module**
- **User Welcome Module**
- **Add Patient Module**
- **Billing Module**

- **Welcome Module:**

  Welcome module is the entire/first module of the project, this module contains login and registration module getaway. Welcome window is a well prepared and user-friendly user interface which contain two options in which first option is login for existing users and second option is register for new users. This module is only way to login for user.

  We are using tkinter library of python, it is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter is the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task. Using tkinter we have created welcome window.

  This window is developed for every screen resolution. All the alignment are set for every display resolution. GUI is developed with relatable background and easy to recognize buttons.

- **Registration Module:**

  Registration module designed for new user, where new hospital can register and setup there individual billing system. Register module is kept convenient for new users and only essential information is taken.

  All the fields are kept compulsory as every information is necessary for keeping records for administrator. Every field has required validations and an important system is kept for false registration.

  There was a problem of false registration which could happen in future, so to overcome this problem we have implemented a verification method using the contact number, this OTP method uses cellular number where a random generated number is send to the given number via SMS and with that number only registration is possible. This number is valid for 60 seconds only. For this method we are using FAST2SMS API service. Register module helps hospital to create their individual identity with their given credentials and that credential can be used by hospital in our next module for login.

- **Login Module:**

  Login module is developed for existing users where registered user can login to their individual billing system profile where they can manage their hospital billing system.

  Login module is connected to the user’s database with a secure connection which is used for login. All the login credentials are validated using database values. Login module is properly validated. Login module has developed user friendly and professionally.

  Login module is also protected with an extra layer of OTP module as Register module. This extra layer of protection is also similarly implied as Register module and similar services and API is used.

- ## Developer Module:

Developer window is developed for administrator side. Developer module is the only side of project that can manage all the database of the project. Developer module is a well interpretation of database workstation. It is developed with a user-friendly UI where all the medicine related data can be added, deleted and replace.

Developer window has no. of options for administrator conveniences, it includes

Add, Display, Update, Delete, Search and Reset.

As in medical sector frequently new medicines are introduced and it make administrator to keep records in database and in this chase our first option of Add comes to picture. **Add option** is developed for adding new medicine and its details as medicine id, medicine name, price, description and image which works as proof of medicines details.

Second option is Display, which has functionality of displaying all the available medicines records for database. There is a special window for displaying medicine related data.

Third option is Update which is used for updating medicine details. Update option works with display window. The following cursor is called "mycursor" and it loops through a set of customer records and we are mycoursor to extract from database.

Fourth option is Delete which can be used to delete medicines records.

There is always a need to find particular medicine in records because scrolling throw whole list is a time-consuming task and this option will solve the problem. There is an always need of resting all the data entry blocks as it helps to entre new data and in this case reset option comes handy.

- ## User Welcome Module:

This window comes right after User login, and this window is gateway to user’s main two work windows which are Add Patient and Billing.

- **Add Patient Module:**

  This module is designed for adding new patient's information of hospital to database. It is an easy way to keeping records of new patients and for that task multiple fields are asked, which are Patient Id, Full Name, Gender, Age, Weight, Blood Group, Contact No, Address and at last its Patient's picture.

  All the required field are necessary and important so they properly and safely kept in database.

- **Billing Module:**

  This is the very important part of the system and it is developed with our focused blockchain technology to provide maximum security.

  Billing module is developed for finance purpose and is the key module of the project and by that mean it has multiple options as Add, Total, Generate, Preview, Print, Clear, Exit, Search, Rest and Search by Name.

  Billing Module starts with patient selection because bill can be only generated by selecting a patient and it can be done by entering patient id. After selecting patient next step is to add medicines to the bill and for this process following steps are to follow, starting with searching the medicines with "search with name" button. Search with Name entry is also works with few starting letters. After finding desired medicine in medicine window, you need to select the medicine and click the add button. After clicking add button a new window will appear where quantity of medicine is entered. After entering the quantity and adding medicine next step is to clicking on total and total amount will be calculated in the bill. Every medicine detail can be checked in medicine display window and preview of bill can be seen in bill window.

  For an extra measure to ensure authenticity we have provided an image of actual medicine where medicine price is mentioned. It adds an extra layer of proof to medicine pricing.

  After totaling the bill, bill can be generated or saved and after saving the bill no changes can be done to the bill.

  The key technology of our project which is blockchain come to picture in this module. After Generating bill all the details are stored in database and with detail a **256-bit SHA hash is generated** which represents the blockchain technology implementation in the project.

This SHA 256-bit hash is generated with current bill details and previous bill hash which automatically create a chain of blocks.

For this implementation a genesis hash is already gets created at first bill which a previous needs hash to create current hash.

For user convinces we have added print, reset and exit options too.

7. TESTING

- ## INTRODUCTION

The development of software involves a series of production activities where opportunities of injection of human fallibilities are enormous. Error may begin to occur at the very inception of the process.

Testing is the process of executing the program with the intent of finding an error. A good test case is one that which has high probability of finding an as yet undiscovered error. A successful test is one that uncovers an as yet undiscovered error.

- ## System Test

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

- ## White Box Testing

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

- ## Black Box Testing

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box. you cannot “see” into it. The test provides inputs and responds to outputs without considering how the software works.

- **Test Items**

This test plan applies to each part of our project as well as overall integration testing. For each module, the input and output will be tested on validity. This will also require that each function supporting the modules be tested similarly. After each module is tested the final project has to be tested.

- **Test Plan**

Test planning was planned as soon as the requirement specifications were prepared. Detail definition of test cases was started as soon as the design of components was finished.

The first test plan executed generally focuses on individual components, and then the focus shifts towards the larger components. Module testing will be used for each unit. An overall system test will be executed after integration.

- **Unit Testing**

Unit testing focuses verification effort on the smallest unit of software design-the software component or module. Using the component-level design description as a guide, important control path is tested to uncover errors within the boundary of module. The relative complexity of test and uncovered errors is limited by the constrained scope established for unit testing. The unit testing is white-box oriented, and the step can be conducted in parallel for multiple components.

- **Integration Testing**

Integration testing exercises several units that have been combined to form a module, subsystem or system. Integration testing focuses on the interfaces between units, to make sure the unit together. The nature of this phase is certainly ‘white box’, as we must have certain knowledge of the units to recognize if we have been successfully in fusing then together in the module.

- **Performance testing**

  In software engineering, performance testing is testing that is performed to determine how fast some aspect of a system performs under a particular workload. This phase includes testing of the entire application as whole in order to ensure that the application function successfully as a coherent unit without errors and breakup points.

- **Item Pass/Fail criteria**

  - For unit level:

    A unit level test is placed if each module satisfies the following conditions: All test cases completed: Each function returns the expected output for given input.

  - For integration level:

    All unit level plans completed successfully for all test cases. All modules integrated together gives valid result

  - For performance level:

    The monitoring application as a whole gives valid result for all possible operations. Performance results for the entire application are within acceptable limits.

Test Cases

- **Mobile No.**

Test case #	**Test case condition**	**Test Data**	**Expected Result**	**Actual Result**
1	Check results on entering Mobile No.	abc	Entry is valid.	Entry is not valid.
2	Check results on entering Mobile No.	111	Entry is valid.	Entry is not valid.
3	Check results on entering Mobile No.	9822121212	Entry is valid.	Entry is valid.

- **OTP**

Test case #	**Test case condition**	**Test Data**	**Expected Result**	**Actual Result**
1	Check results on entering OTP	abc	Entry is valid.	Entry is not valid.
2	Check results on entering OTP	1111	Entry is valid.	Entry is valid.

- **Username**

Test case #	**Test case condition**	**Test Data**	**Expected Result**	**Actual Result**
1	Check results on entering username	abc	Login Successful	User not registered.
2	Check results on entering username	1111	Login Successful	Login Successful

- **Password**

Test case #	**Test case condition**	**Test Data**	**Expected Result**	**Actual Result**
1	Check results on entering Password	pass	Login Successful	Password is not valid.
2	Check results on entering Password	Pass123	Login Successful	Login Successful

- **Patient Search**

Test case #	Test case condition	Test Data	Expected Result	Actual Result
1	Check results on entering Patient Id	2107300205	Patient Found	Patient Id is not valid.
2	Check results on entering Patient Id	1107300205	Patient Found	Patient Found

- **Bill No**

Test case #	Test case condition	Test Data	Expected Result	Actual Result
1	Check results on entering Bill no.	196011	Bill Found	Bill not found.
2	Check results on entering Bill no.	19602	Bill Found	Bill Found.

- **Generate**

Test case #	**Test case condition**	**Test Data**	**Expected Result**	**Actual Result**
1	Check results on altering bill.	Adding medicine to old bill.	This Bill is already present...!	This Bill is already present...!
2	Check results on altering bill.	Adding medicine to old bill.	Duplicate BILL BLOCKS are not allowed!	Duplicate BILL BLOCKS are not allowed!

8. SNAPSHOTS/GUI

- **Welcome Window**

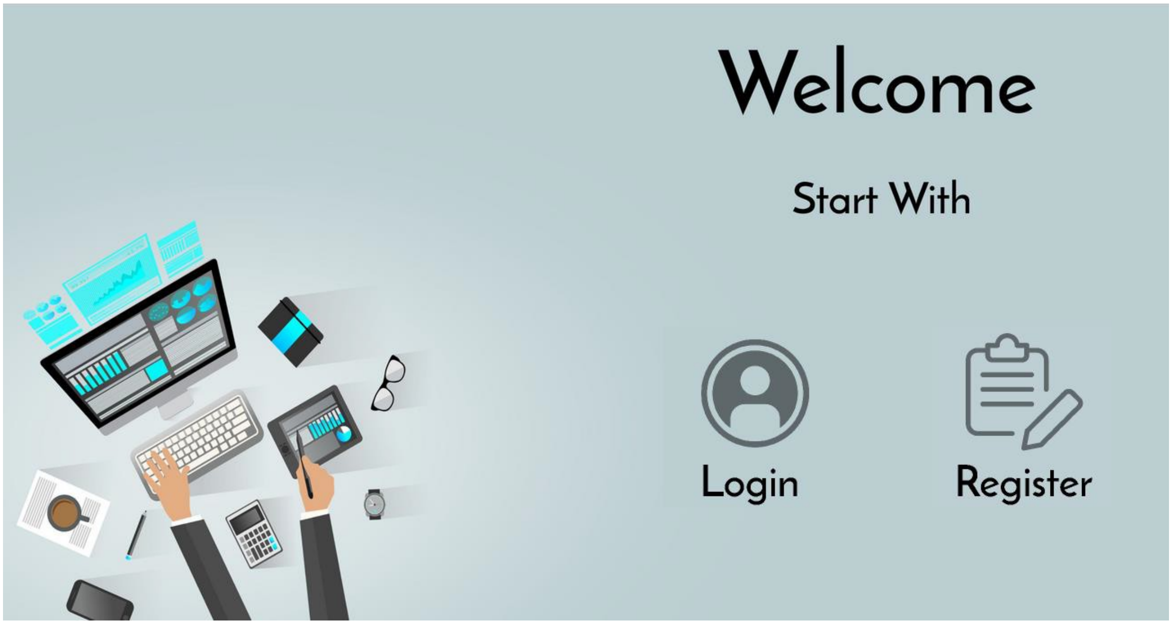

Figure 8.1: - Welcome Window

- **Login Window**

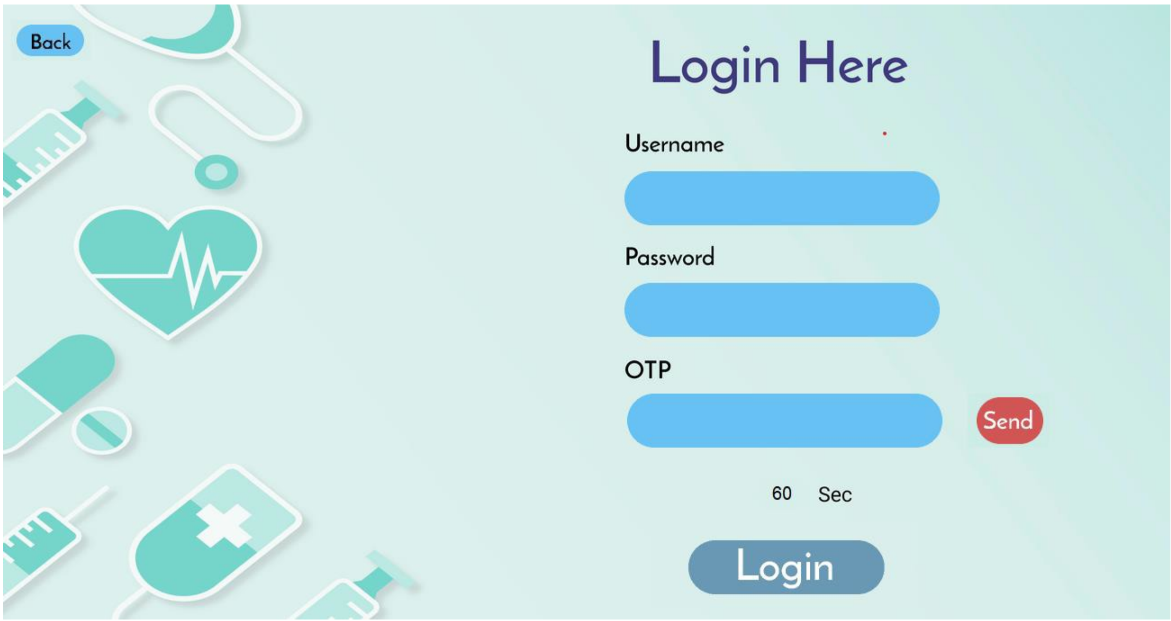

Figure 8.2: - Login Window

- **Register Window**

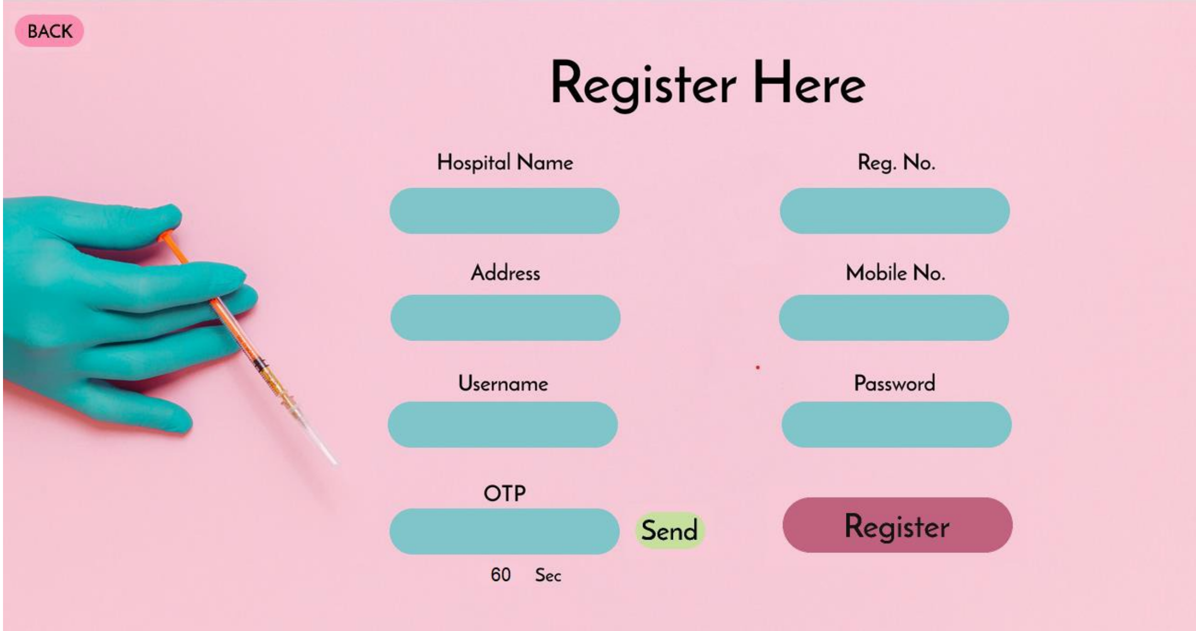

Figure 8.3: - Register Window

- **Developer Window**

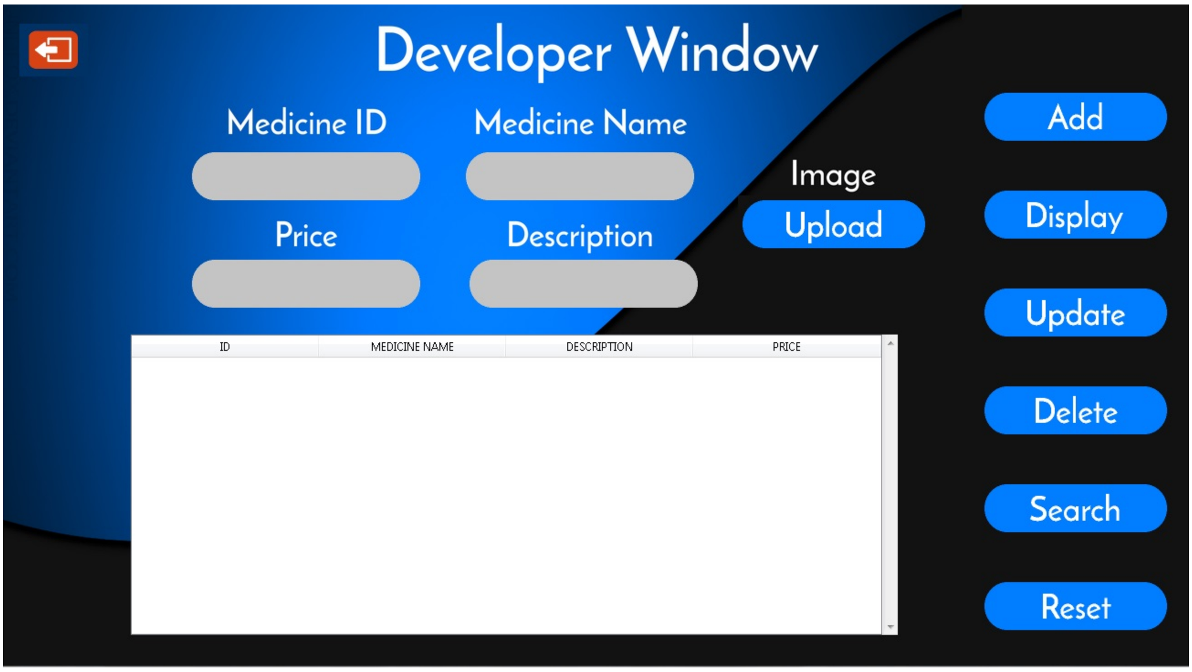

Figure 8.4: - Developer Window

- **User Welcome Window**

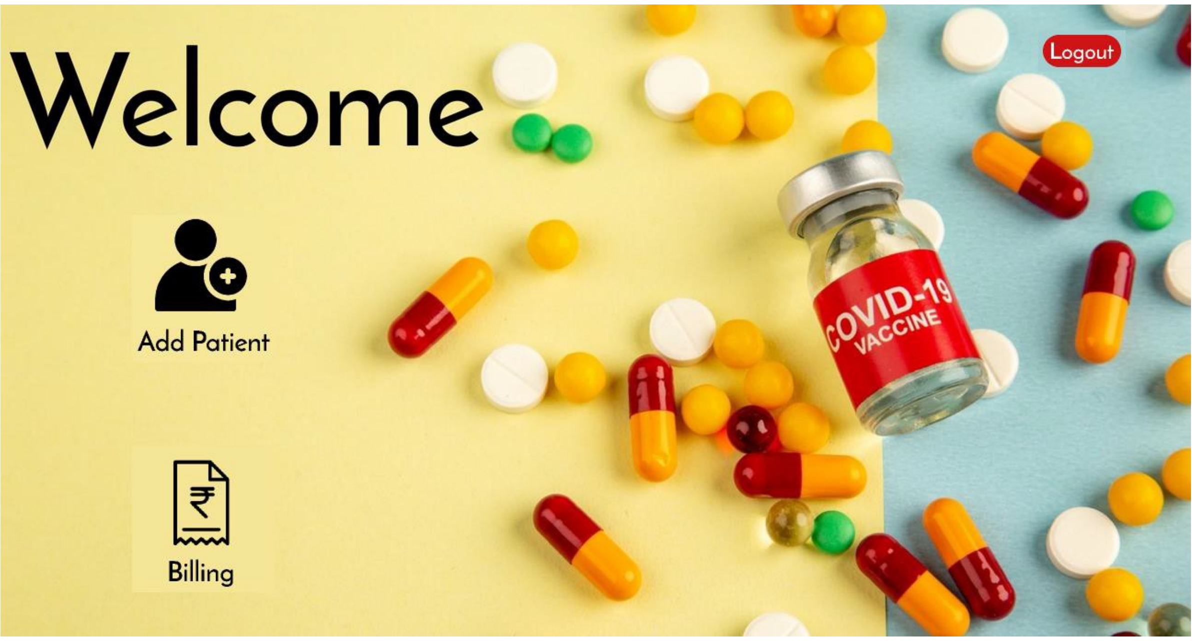

Figure 8.5: - User Welcome Window

- **Add Patient Window**

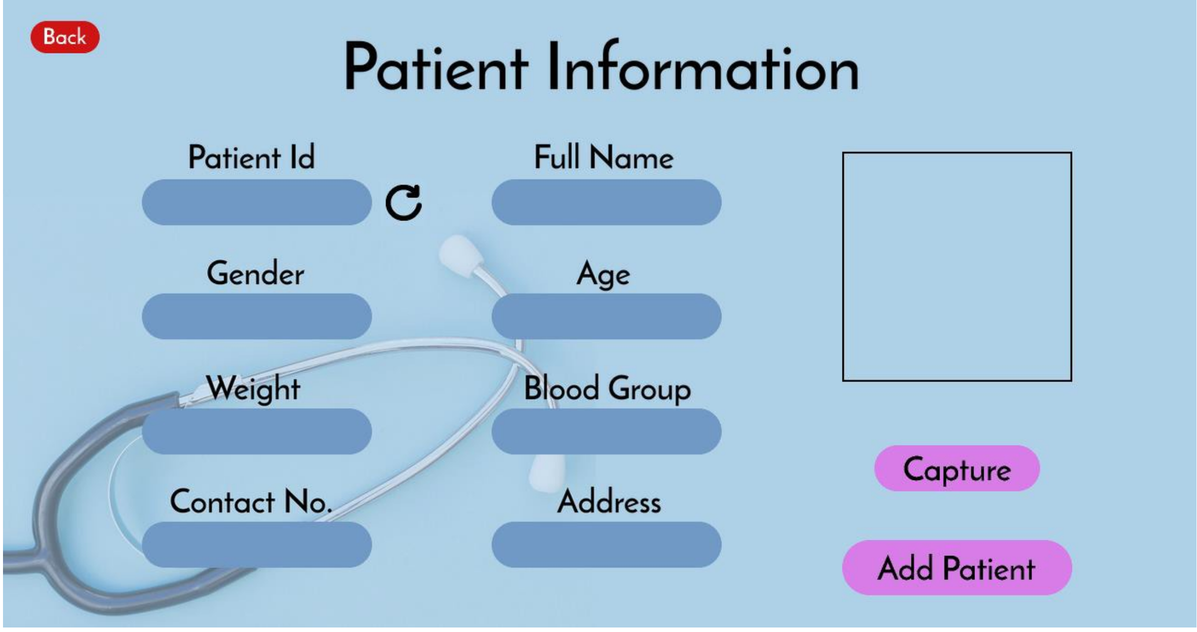

Figure 8.6: - Add Patient Window

- **Web Cam Module**

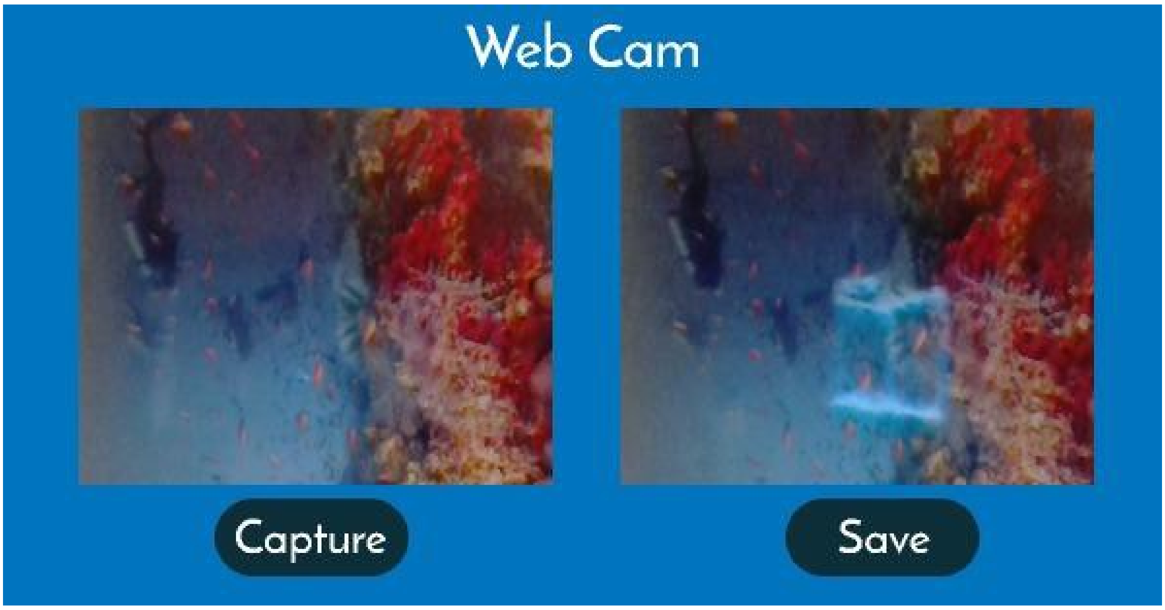

Figure 8.7: - Web Cam Module

- **Billing Window**

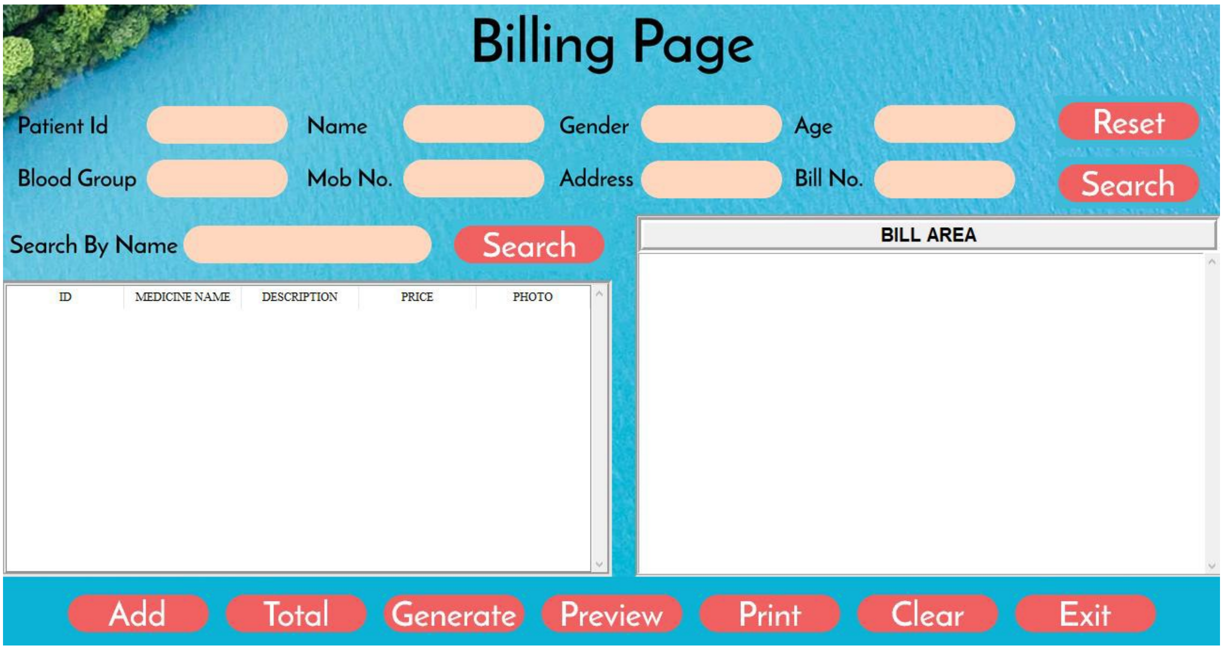

Figure 8.8: - Billing Window

9. CONCLUSION

This project has been a rewarding experience in more than one way. The entire project work has enlightened us in the following areas. We have studied new technologies like python and blockchain while working on this project. We have gained an insight into the working of the HOSPITAL BILLING SYSTEM. This represents a typical real-world situation. Scheduling a project and adhering to that schedule creates a strong sense of time management. Sense of teamwork has developed and confidence of handling real life project has increased to a great extent. Initially, there were problem with the validation but with discussions, we were to implement validations Our understanding of database design has been strengthened this is because in order to generate the final reports of database designing has to be properly followed.

10. FUTURE SCOPE

- Diagnostics billing system.
- Creating patient’s report card.
- Generating blockchain visually.
- Securing patient’s information using blockchain.

11. REFERENCES

- Bitcoin: A Peer-to-Peer Electronic Cash System white paper by Satoshi Nakamoto.
- https://www.figma.com with https://github.com/Proxlight/Proxlight- Designer.
- https://dev.mysql.com/doc/refman/8.0/en/
- https://pypi.org/project
- Core Python Programming - Covers Fundamentals to Advanced Topics By Dr.Rao R. Nageswara