I.V. FLUID CONTROLLING SYSTEM

By

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Under Guidance

of

Internal Guide

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Submitted to

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Changa.

Acknowledgement

Knowledge in itself is a continuous process. At this moment of our substantial enhancement, we rarely find words to express our gratitude towards those who were constantly involved with us.

The completion of any inter disciplinary project depends upon coordination, cooperation and combined efforts of several resources of knowledge, creativity, skill, energy and time. The work being accomplished now, we feel our sincerest urge to recall and knowledge through these lines, trying our best to give full credit wherever it deserves.

We would like to thank our project guide **Mr. Jaimin Undavia, Mr. Ravi Patel** and Dean & Principal **Dr. Atul Patel** who advised and gave us moral support through the duration of our project. Without their constant encouragement we could not have been able to achieve what we have.

It's our good fortune that we had support and well wishes of many. We are thankful to all and those names which have been forgotten to acknowledge here but contributions have not gone unnoticed.

With Sincere Regards,
Saurabh Kumar Mishra (21MCA048)
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PROJECT PROFILE

Project Name: I.V. Fluid Controlling System

Type of Application: IOT Application

Project Description: Our system is an IOT application which allow controlling the "I.V. Fluid" in Hospital. Doctor manage the application.

Team Size: 2

Front End: HTML, CSS, Bootstrap

Back End: PHP, MySQL Database

Tools used: IR sensor and detector, LED light and photo detector, Load cell, Ultrasonic sensor, Node MCU, HX711 amplifier, LCD display, I2C model, MAX30102 spo2 and Bom sensor.

INTRODUCTION TO TOOLS

IR sensor and detector:

- Article [16] discusses about the development of an Intravenous Fluid measurement system by measuring the amount or number of drops that fall through the drip chamber. A Computer GUI has been developed that can display and control the flow of fluid by adjusting the drip rate through the drip chamber. If no activity is detected in the chamber for 30 s, the drip is closed and the GUI intimates the user that the fluid in the Intravenous bag is over.

- It uses an STM32F103C8T6 microcontroller as the heart of the system.

- For making of drip measurements, it uses an IR LED and a TSOP 1740 IR ReceI.V.er. For controlling the drip rate, it makes use of a servo motor. For transmitting the information to the computer, it uses an ESP8266-01 Wi-Fi Module.

Led light:

- Article [17] performs the I.V. fluid measurement with the help of light from LED and a photo-detector to detect that light. This work also focuses on controlling the flow of I.V. fluid with the help of a smartphone application. It also uses a very sensitive flow sensor in conjunction. It uses an Adriano Mega 2560 for processing the data, a HC-05 Bluetooth module for communication with a smartphone, an Android Smartphone as an entry point, a LED for light and BC-547 light detector. Again article [22] also uses visible light from a LED to make drip measurements but it uses a photo-transistor to detect that light.

Load cells:

- Article [18] uses an S-type Load Cell to continuously measure the bag weight to monitor the amount of fluid in the I.V. bag. This study aims at measuring the weight of the I.V. bag with a load cell but since load cells don't give good output, an amplifier has been used to amplify the load cell's output. It uses an Adriano (i.e. ATMega328 microcontroller based) as key engine of the system, a S-type Load Cell to measure the I.V. bag's weight, an INA125P instrumentation amplifier to amplify the load cell's readings, a Sigsbee board for data communication and a Heartbeat sensor to monitor the patient's heartbeat.

- Similarly, article [19] also uses an S-type Load Cell for measuring the I.V. bag's weight to measure the fluid level inside the bag. It also uses RFID tag to identify patients. Additionally, the data from the system is uploaded to a healthcare cloud (unspecified) for further review and analysis. The system checks if the level of fluid inside the I.V. bag is normal or abnormal. It uses a 6502 microcontroller and an Adriano, a Load Cell of 600 g maximum capacity, RFID tag, ID-20-RFID reader and a Wi-Fi module for transmitting data.

Ultrasonic sensor:

- Article [20] discusses the use of an ultrasonic sensor to measure I.V. fluid level. The ultrasonic sensor sends out an ultrasonic sound-wave which gets reflected by the other side of the drip chamber wall. The reflected sound-wave is again picked up by an ultrasonic sensor and calculates the distance by measure the arrival time of the sound-wave. When a drop is on the way, this distance is shortened and hence, a drop is registered by the system. The system also uses light in conjunction with the ultrasonic sensor. It uses an ATMega128L based microcontroller, a CC2420 based 2.4 GHz radio chip for communication, an ultrasonic sensor, a fork type light barrier with 1.5 cm diameter slot, RFID card and EM4904 RFID V1.0 RFID reader.
- Moving on to article [21], it is concerned with the development of an ultrasonic transducer using various piezoelectric materials which can measure drops in the drop chamber in the same manner as discussed above. This research has shown that acoustic characteristics of the developed transducers have an acceptable FDB of -6dB and sufficient sensitivity for being used in I.V. fluid monitoring. It uses Ultrasonic Transducer with PZT-5H 1–3 piezoelectric composite material for the

sensor, plexus-glass for mounting the sensors and a DSO7104B-based oscilloscope for visualizing the data from the sensor.

Node MCU:

- Node MCU is an open source platform based on ESP8266 which can connect objects and let data transfer using the Wi-Fi protocol. In addition, by providing some of the most important features of microcontrollers such as GPIO, PWM, ADC, and etc.

HX711 amplifier:

- The HX711 is a precision 24-bit analog-to-digital converter (ADC) that is designed for weighing scales and industrial control applications to interface directly with a bridge sensor. It is specially made for amplifying signals from cells and reporting them to another microcontroller. HX711 module is a Load Cell Amplifier breakout board for the HX711 IC that allows you to easily read load cells to measure weight.

LCD display:

- A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. LCD display responsible for displaying the result of counting drop of I.V. bags.

I2C Module:

- I2C_LCD is an easy-to-use display module, it can make display easier. We developed the Arduino library for I2C_LCD, user just need a few lines of the code can achieve complex graphics and text display features. Arduino library supported, use a line of code to complete the display.

MAX30102 spo2:

- The MAX30102 is a very versatile sensor and it can also measure body temperature other than heart rate and blood oxygen level. This is a sensor designed by Analog Devices and features two LEDs (one Infrared and one Red), a photo detector, optics, and low-noise signal processing unit to detect pulse oximetry (SpO2) and heart rate (HR) signals.

Bom sensor:

- The BOM-TS-485 is an accurate and reliable back of module temperature sensor. Designed to specifically measure the temperature of the rear of photovoltaic solar panels, the BOM-TS-485 provides key insights into panel performance. As a PV panel's efficiency is affected by temperature, measuring and understanding this information helps form a greater understanding of your panel's performance.

SYSTEM STUDY

Existing System:

- In Existing system is totally manual Nurse or Doctor has to check your I.V. regularly to be sure you're getting the correct amount of fluid.

PROPOSED SYSTEM:

- In our system admin can register doctor and nurse so we can keep data in our database.
- Doctor and Nurse can add fluid data through our application.
- Doctor can check I.V. fluid status from our application, when I.V. fluid is closed then send message for available nurse.
- Admin view report which is generated by Doctor and also view feedback which is given by user.
- Admin can manage application. Admin send notification to Doctor and Nurse.

Scope of Proposed System:

- Admin as well as Doctor/Nurse will also able to use this system affectively .It would be used on internet.
- Doctor manage their I.V. fluid status and if the fluid is closed nurse get notification from our application based on I.V. fluid status update.
- Our system is only used for Hospitals.

Aim and Objective of the Proposed System:

- It is a system design especially for Doctor (admin/nurse).
- I.V. fluid controlling system provides complete functionality to automatically manage the I.V. for service from our desktop device.

Feasibility Study:

The main objective of the feasibility study is to test the Technical, Operational and Economical feasibility for adding new modules and debugging old running system. All system is feasible if they are unlimited resources and infinite time.

- Operational Feasibility
- Technical Feasibility
- Economical Feasibility

Operational Feasibility:

Operational feasibility aspects of the project are to be taken as an important part of the project implementation.

The management issues and user requirements have been taken into consideration. So there is no question of resistance from the users that can undermine the possible application benefits.

Technical Feasibility:-

The current system developed is technically feasible. Thus it provides an easy access to the Doctor or Nurse.

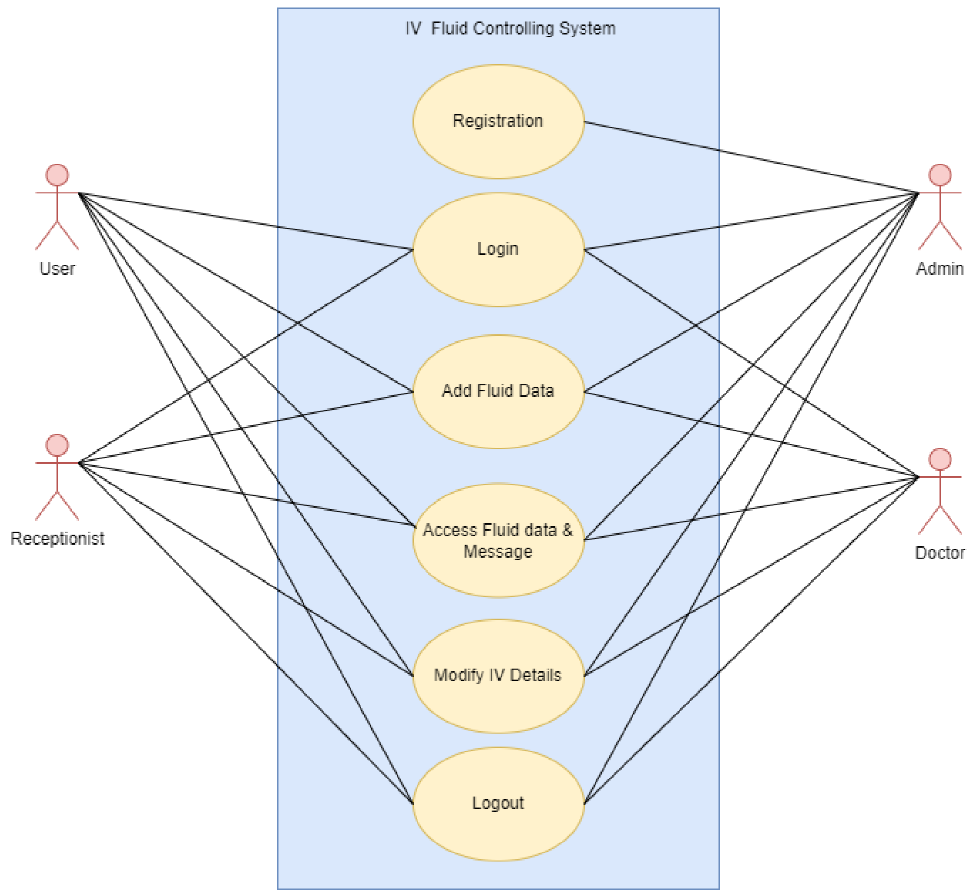
Economical Feasibility:

In the economical feasible, the development cost in creating the application is evaluated against the ultimate benefit derived from the new systems. Financial benefits must equal or exceed the costs.

SYSTEM ANALYSIS

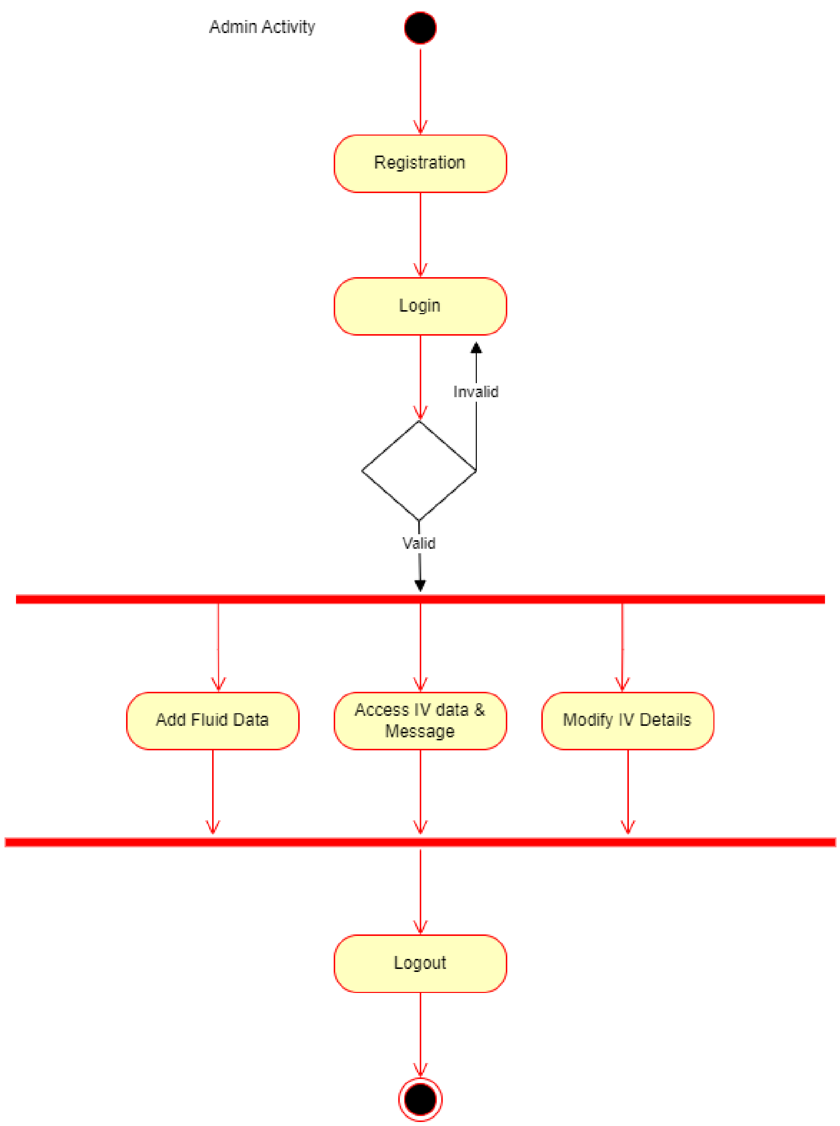
REQUIREMENTS SPECIFICATION (ALONG WITH SYSTEM MODULES):

1)Use case diagram:

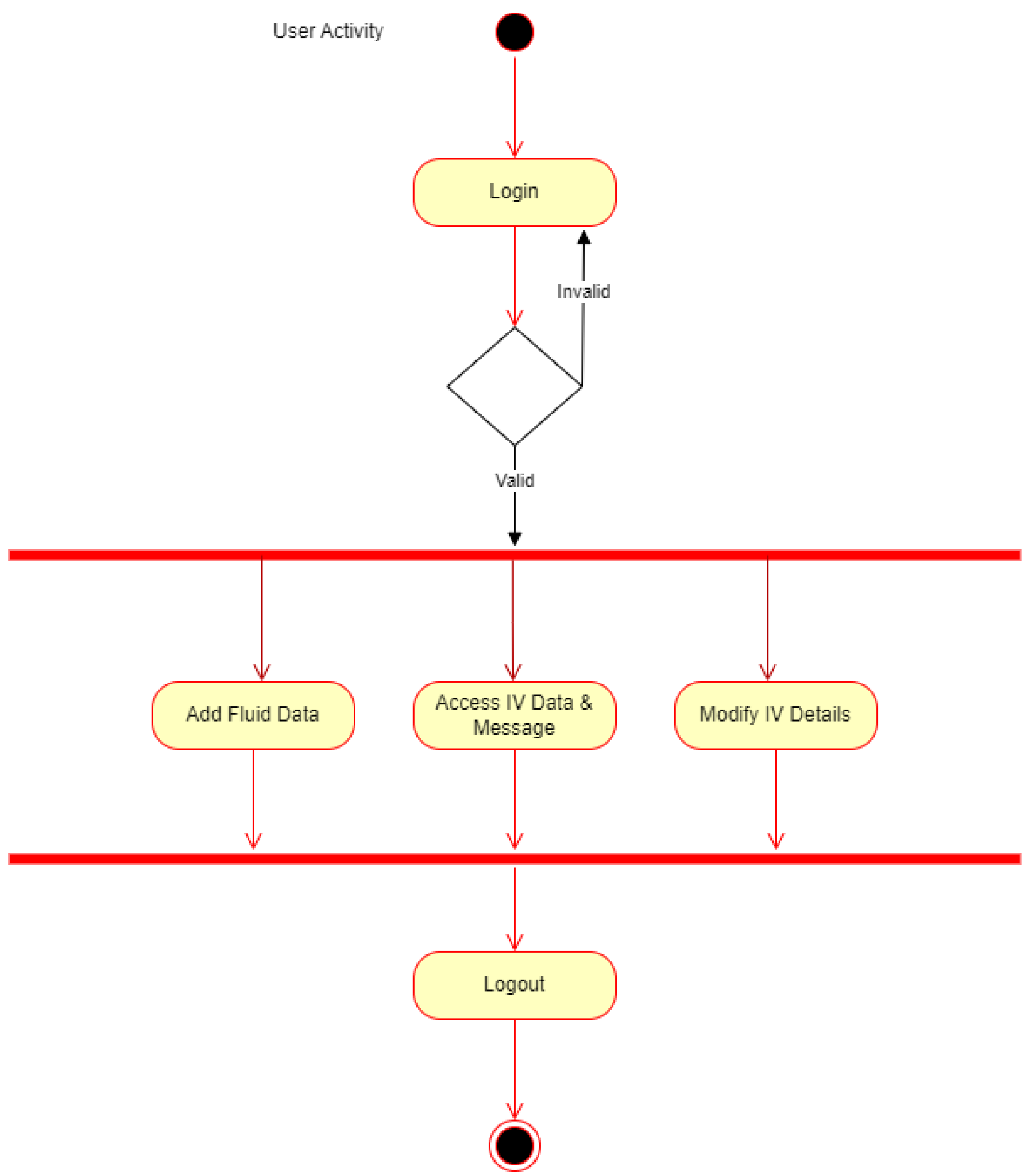


2) Activity Diagrams:

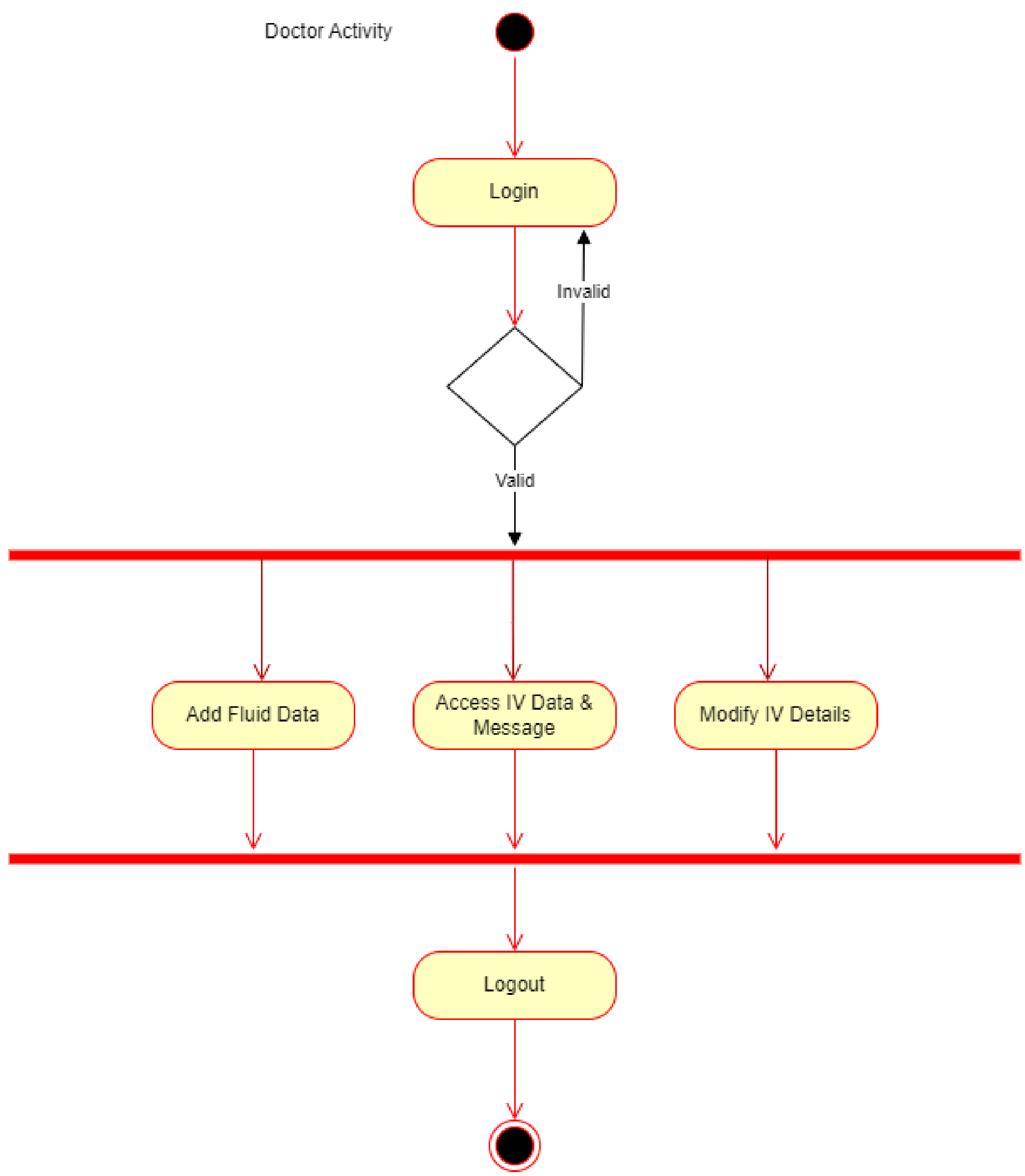
- Admin activity diagram:-



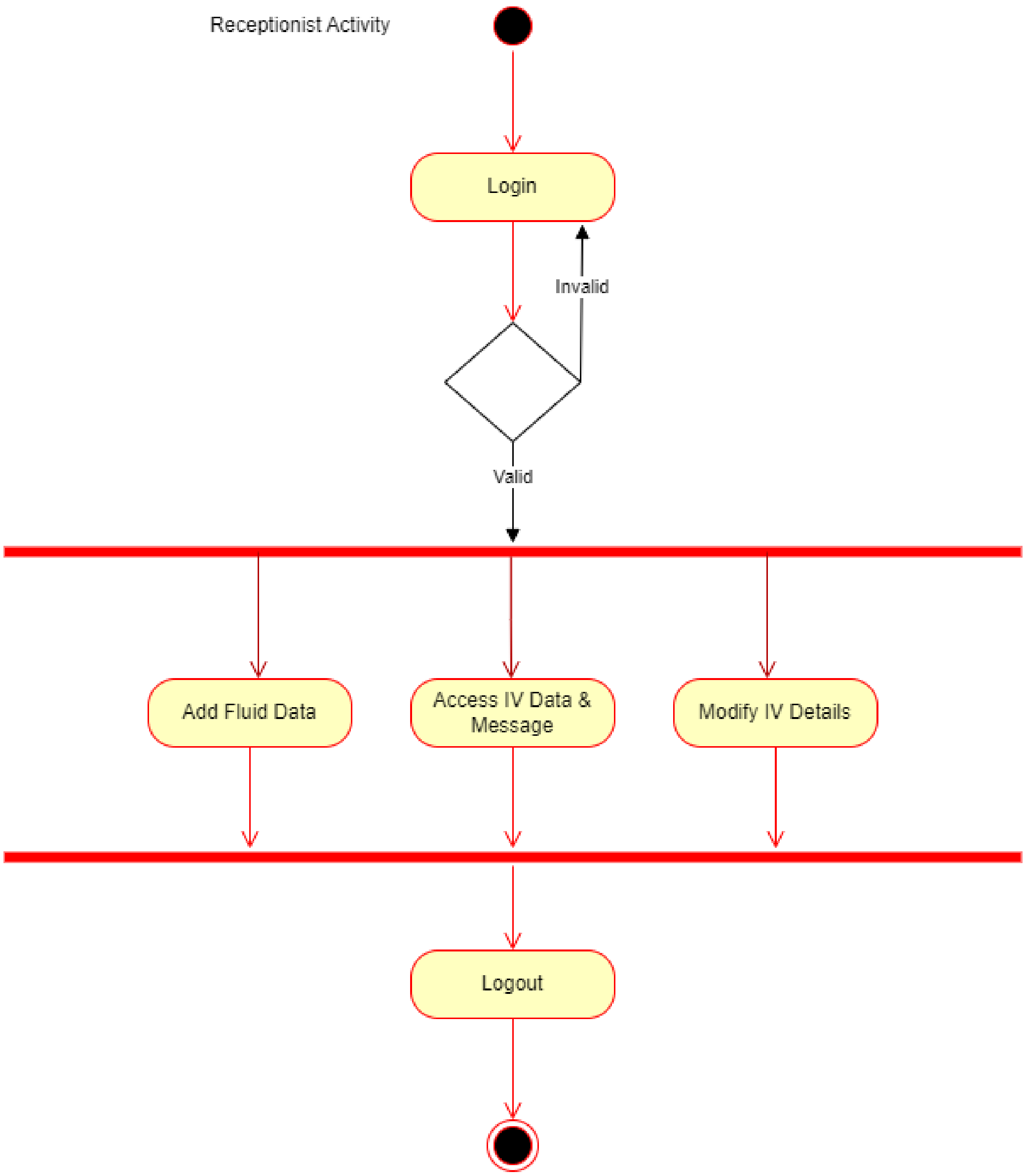
- User activity diagram:-



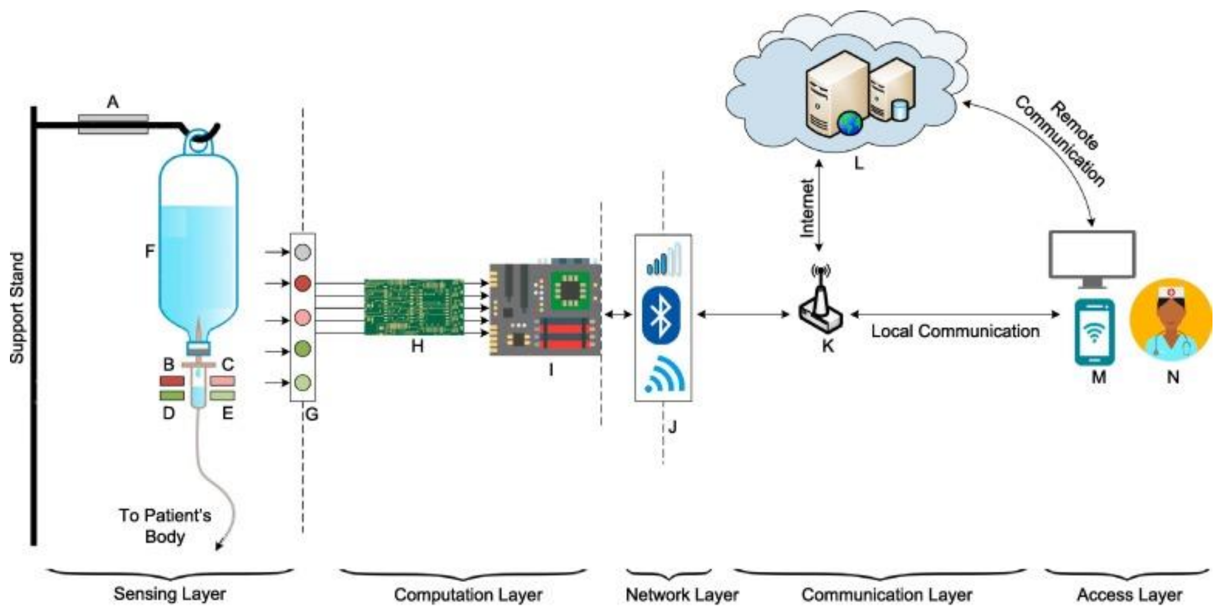
- Doctor activity diagram:-



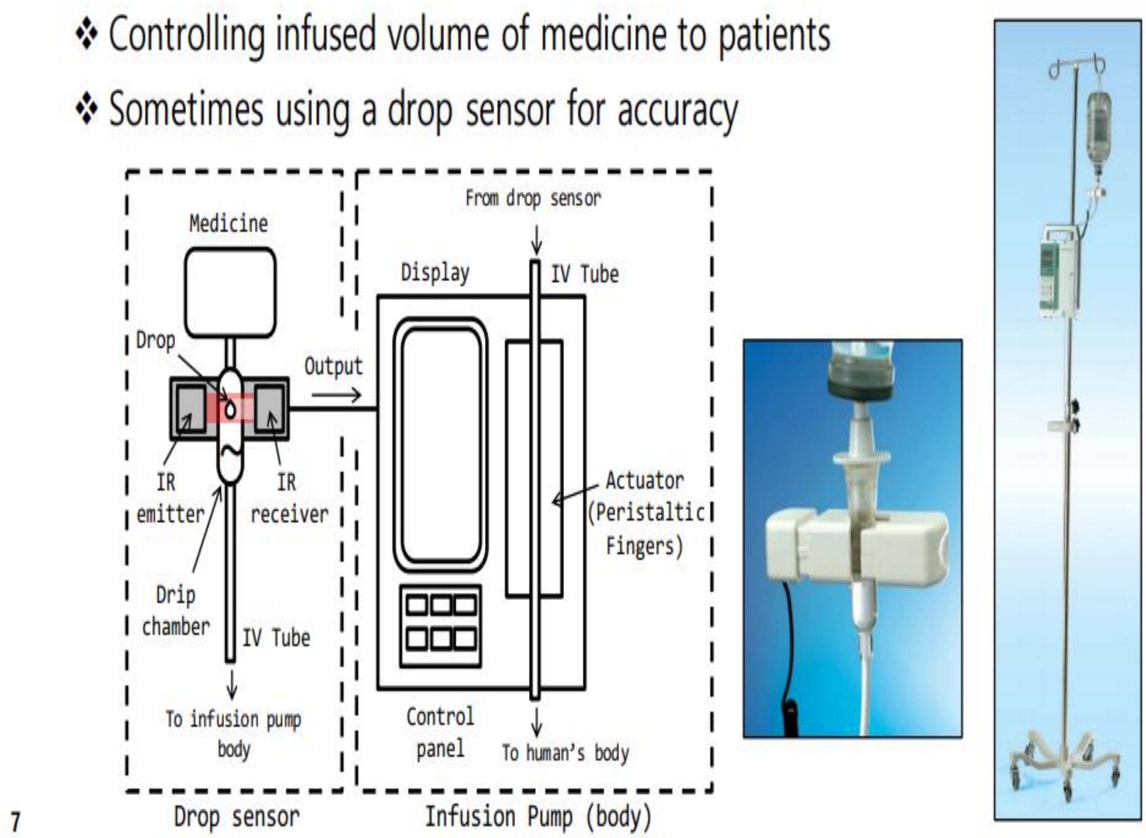
- Receptionist activity diagram:-



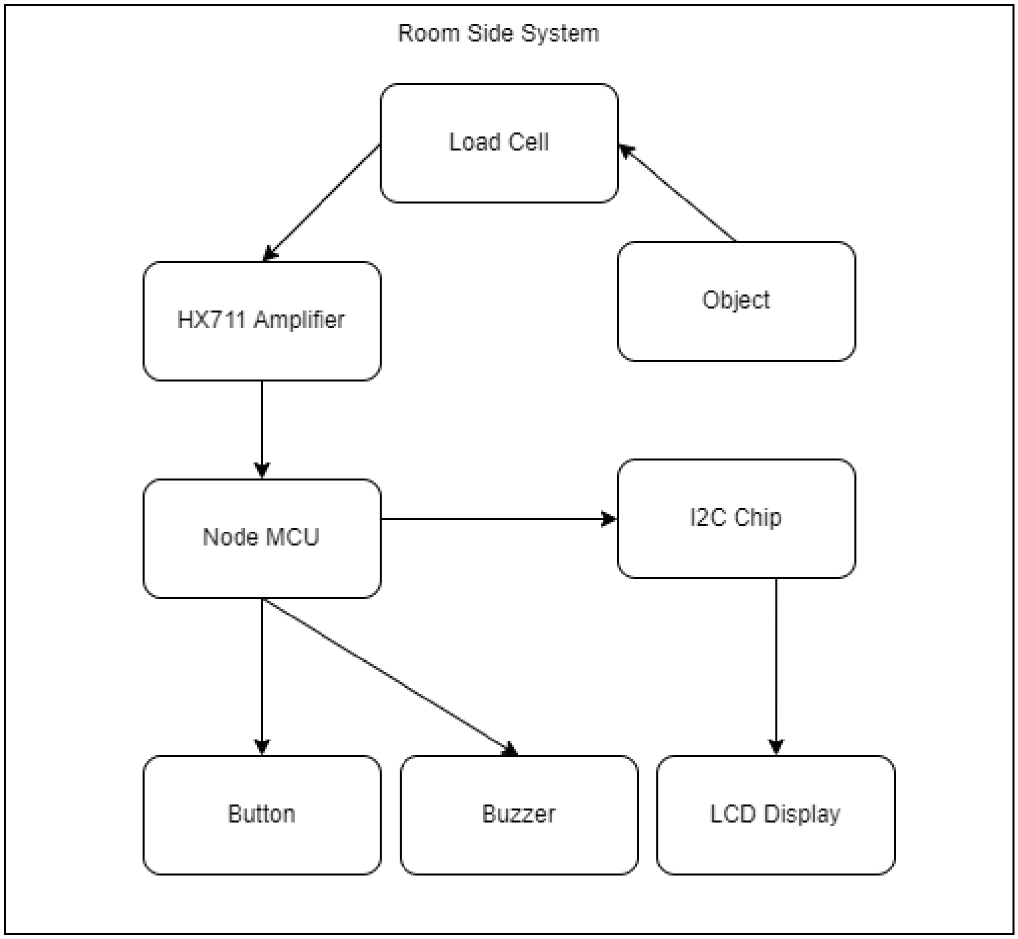
SYSTEM DESIGN



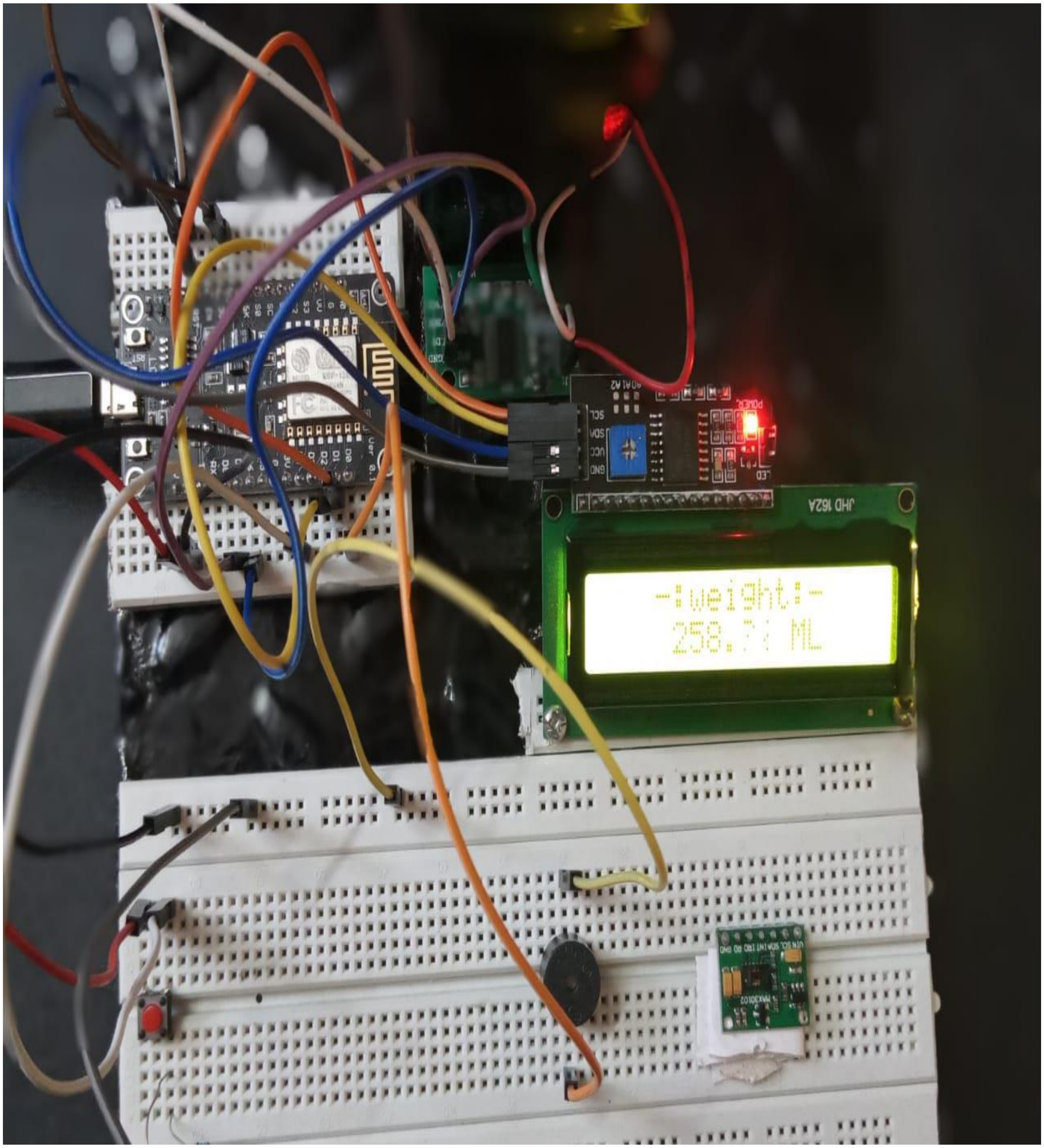
Abbreviations: A- Load Cell, B- Infrared LED or LED, C- Infrared or Light Detector, D- Ultra Sound Emitter, E- Ultra Sound Receiver, F- IV Fluid Bag, G- Sensor Data Output Terminal, H- Calibration and Amplifier Circuitry, I- Microcontroller, J- Wi-Fi or Bluetooth or 3G/4G, K- Gateway, L- Cloud Service on Internet, M- Data Reception Units (e.g. Smart Phone, PC, Tablet etc.), N- Medical Care Giver (e.g. Nurse)


❖ Controlling infused volume of medicine to patients
❖ Sometimes using a drop sensor for accuracy
Medicine
Drop
Output
IR emitter
IR receiver
Drip chamber
IV Tube
To infusion pump body
From drop sensor
Display
IV Tube
Actuator (Peristaltic Fingers)
Control panel
To human's body
Drop sensor
Infusion Pump (body)
7

Room side system



Screenshots

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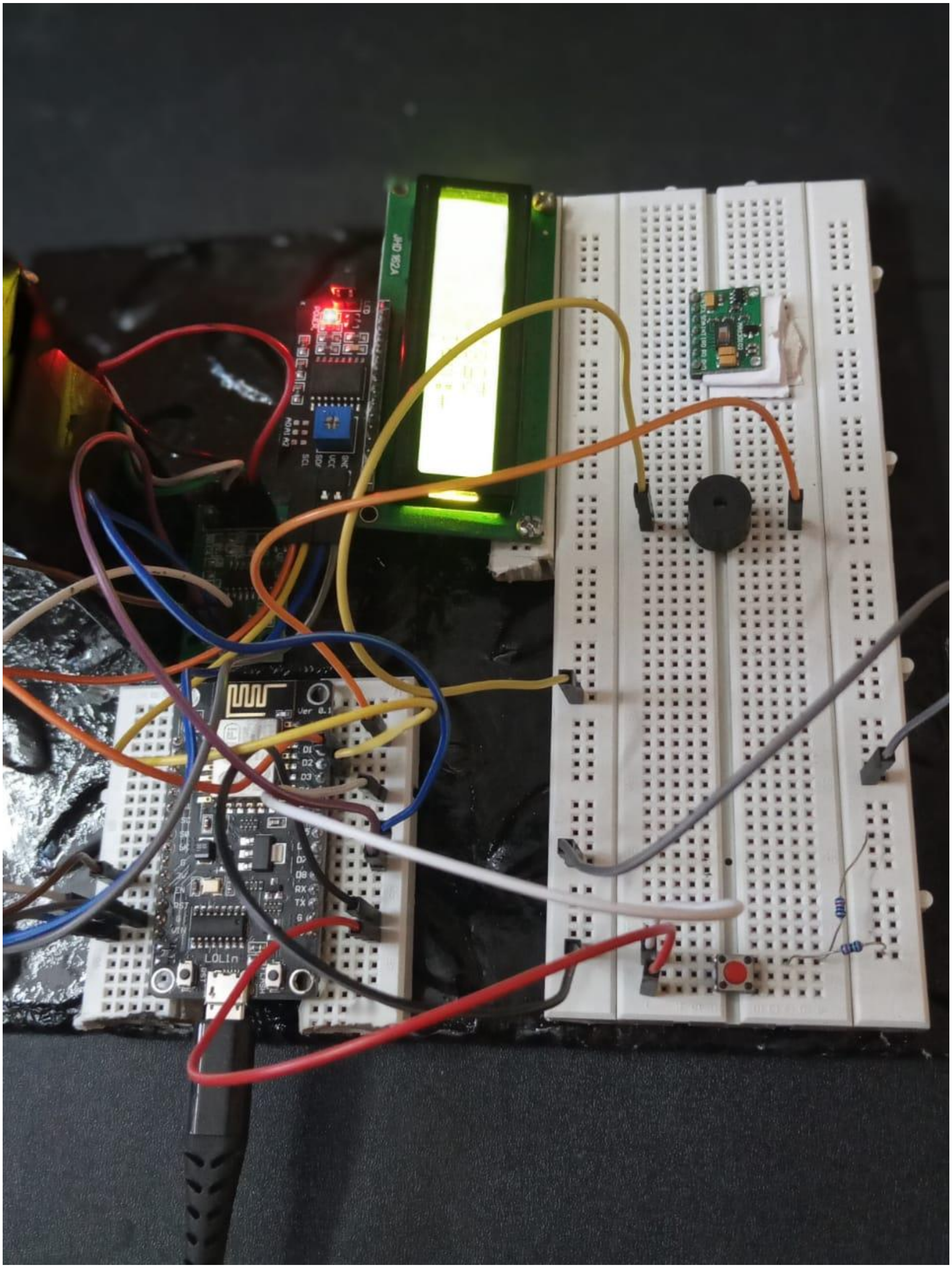
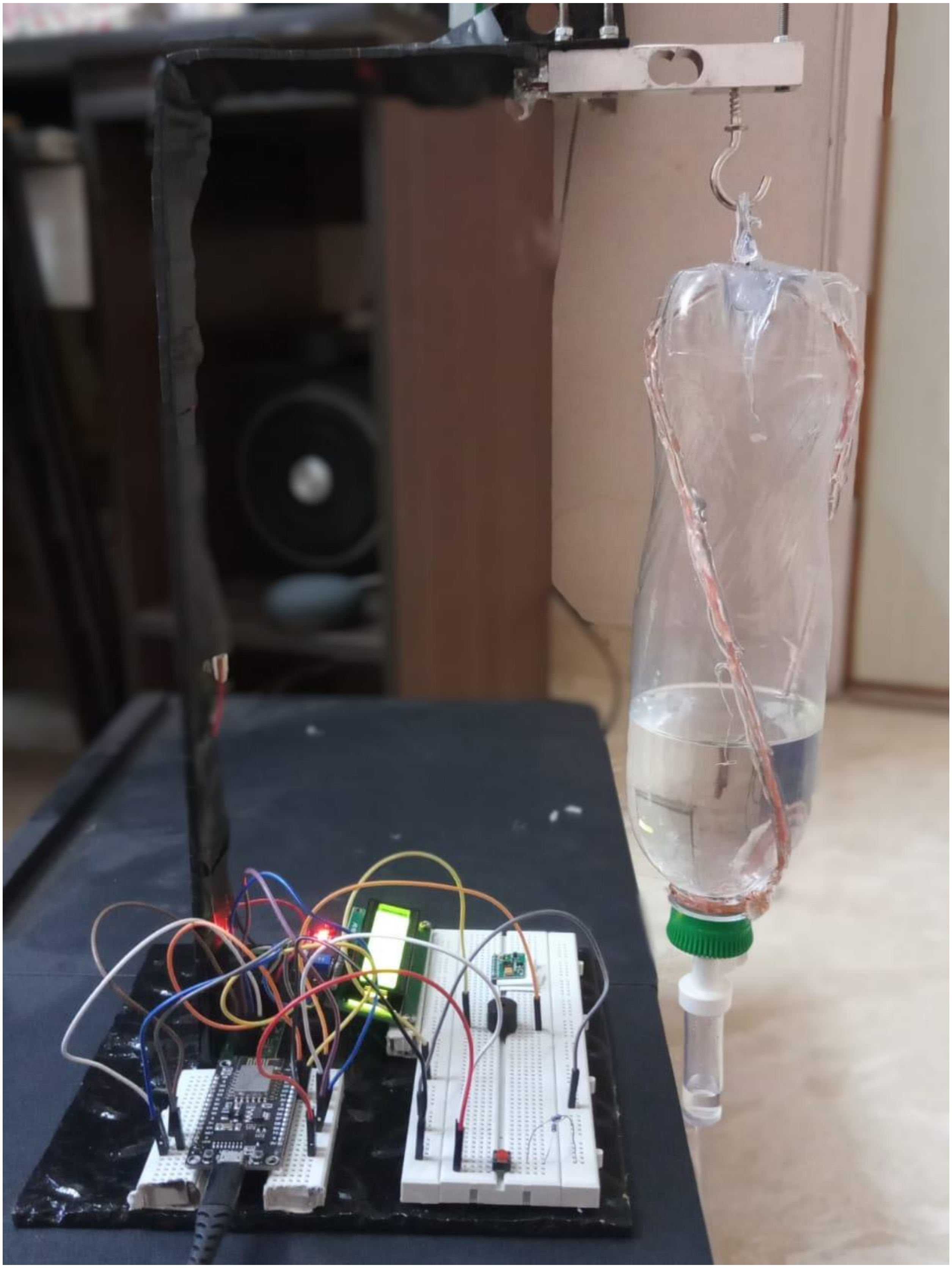
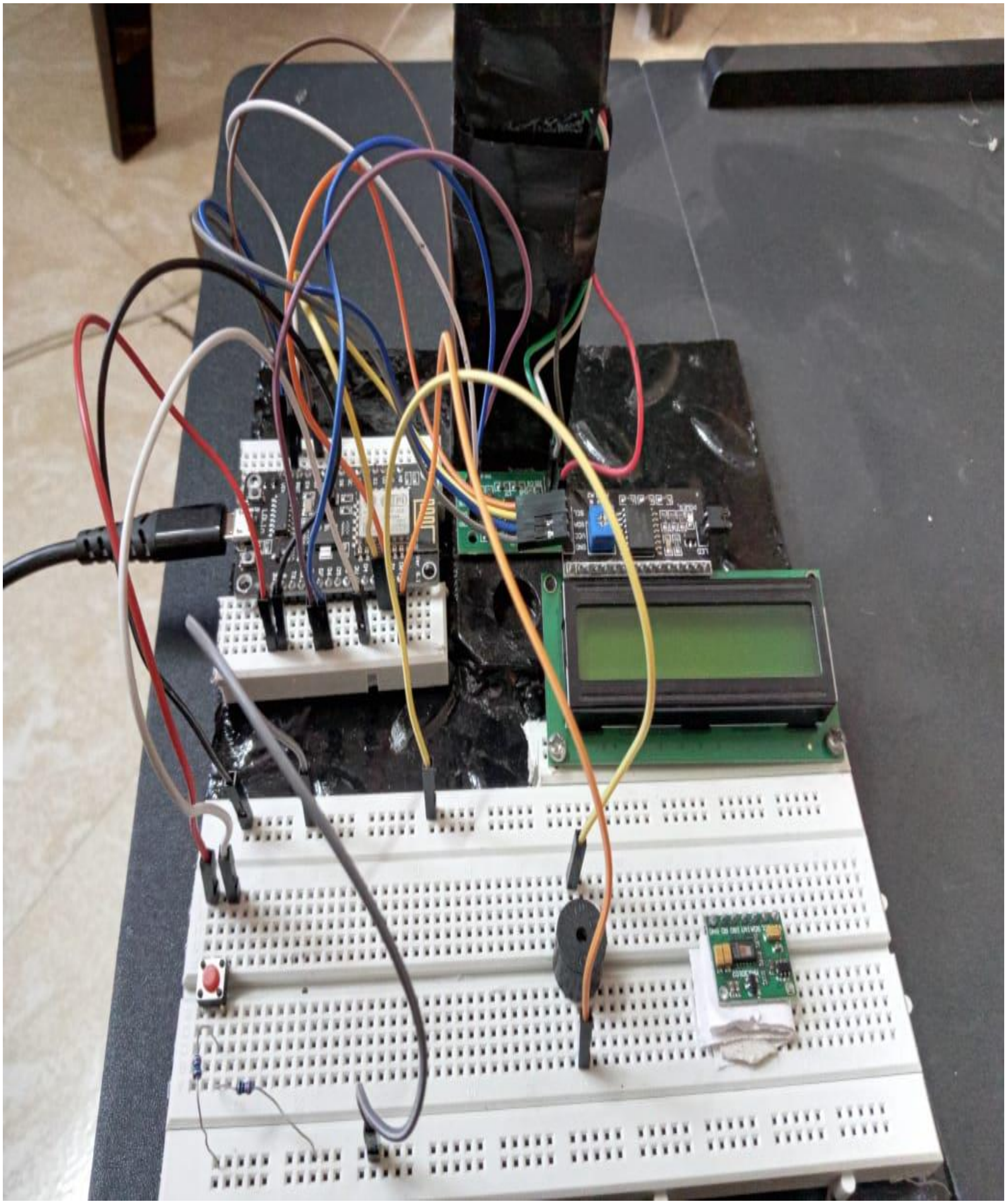
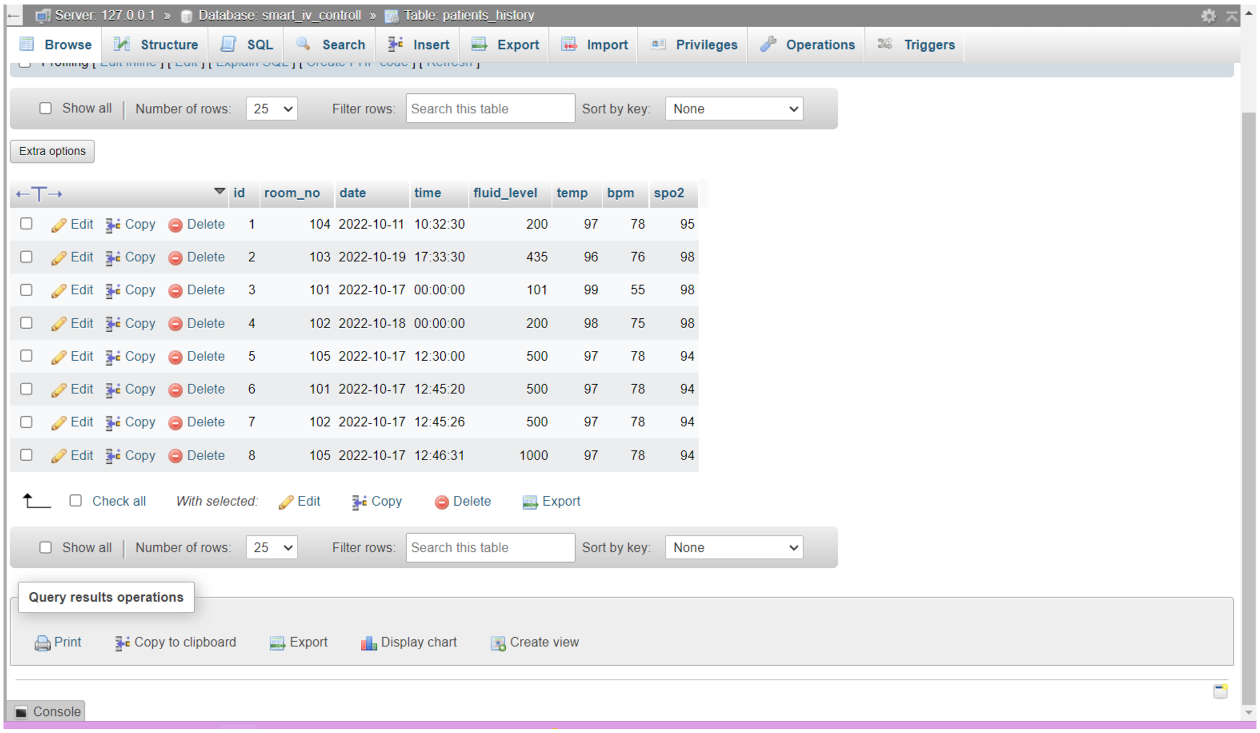






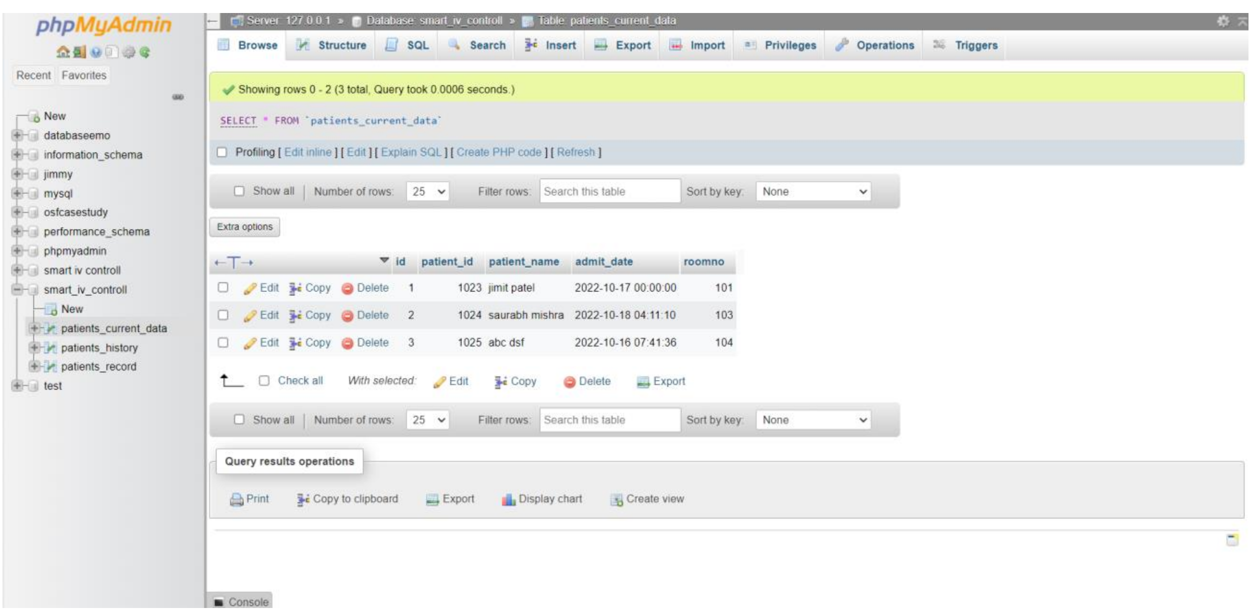
Database Tables:

Patient record:



Server: 127.0.0.1 » Database: smart_iv_controll » Table: patients_history

id	room_no	date	time	fluid_level	temp	bpm	spo2
1	104	2022-10-11	10:32:30	200	97	78	95
2	103	2022-10-19	17:33:30	435	96	76	98
3	101	2022-10-17	00:00:00	101	99	55	98
4	102	2022-10-18	00:00:00	200	98	75	98
5	105	2022-10-17	12:30:00	500	97	78	94
6	101	2022-10-17	12:45:20	500	97	78	94
7	102	2022-10-17	12:45:26	500	97	78	94
8	105	2022-10-17	12:46:31	1000	97	78	94

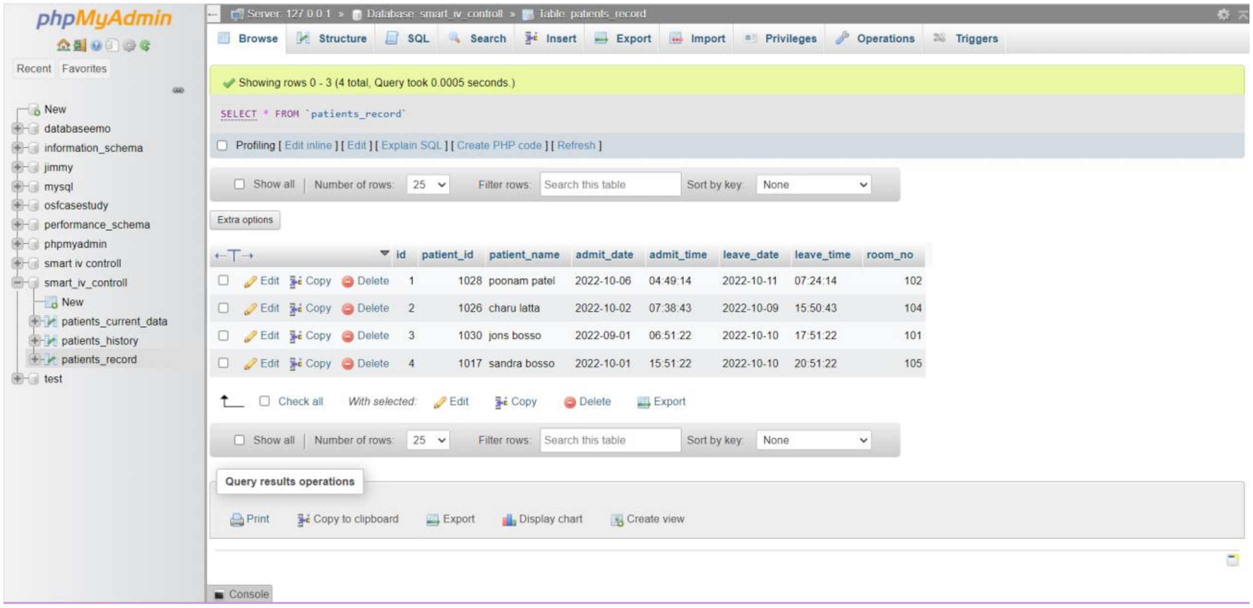


Server: 127.0.0.1 » Database: smart_iv_controll » Table: patients_current_data

Showing rows 0 - 2 (3 total, Query took 0.0006 seconds.)

SELECT * FROM `patients_current_data`

id	patient_id	patient_name	admit_date	roomno
1	1023	jimit patel	2022-10-17 00:00:00	101
2	1024	saurabh mishra	2022-10-18 04:11:10	103
3	1025	abc dsf	2022-10-16 07:41:36	104

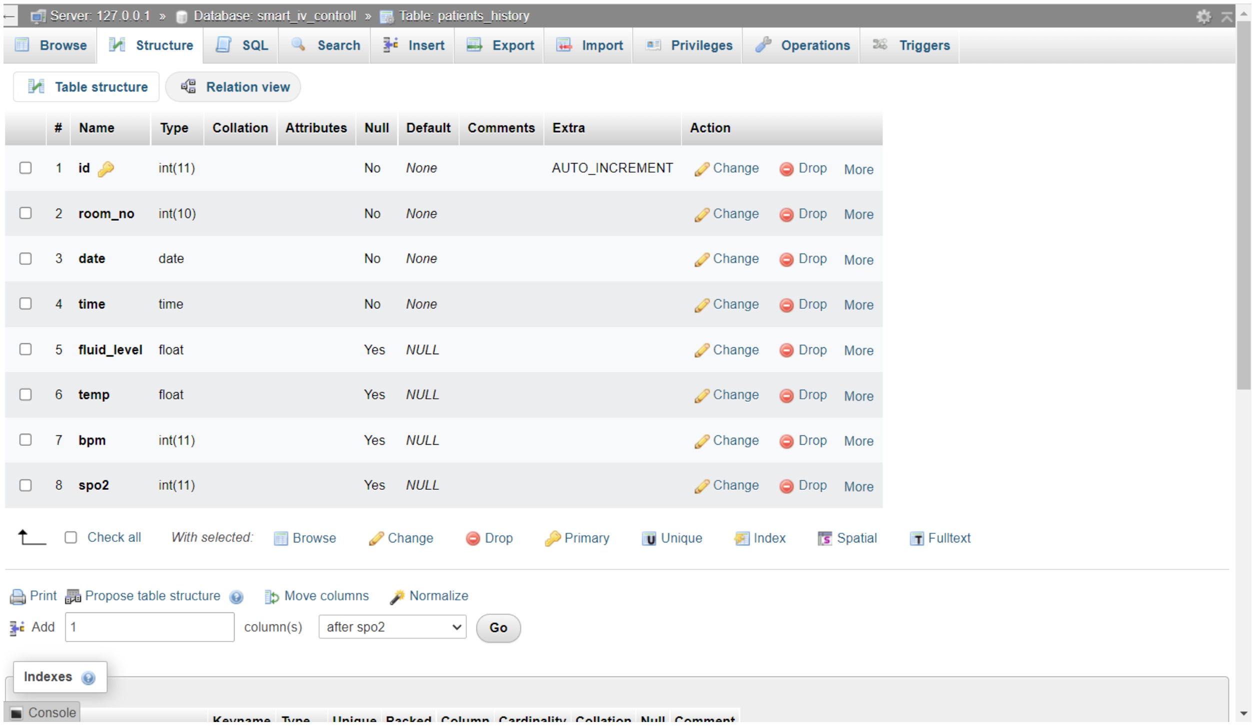


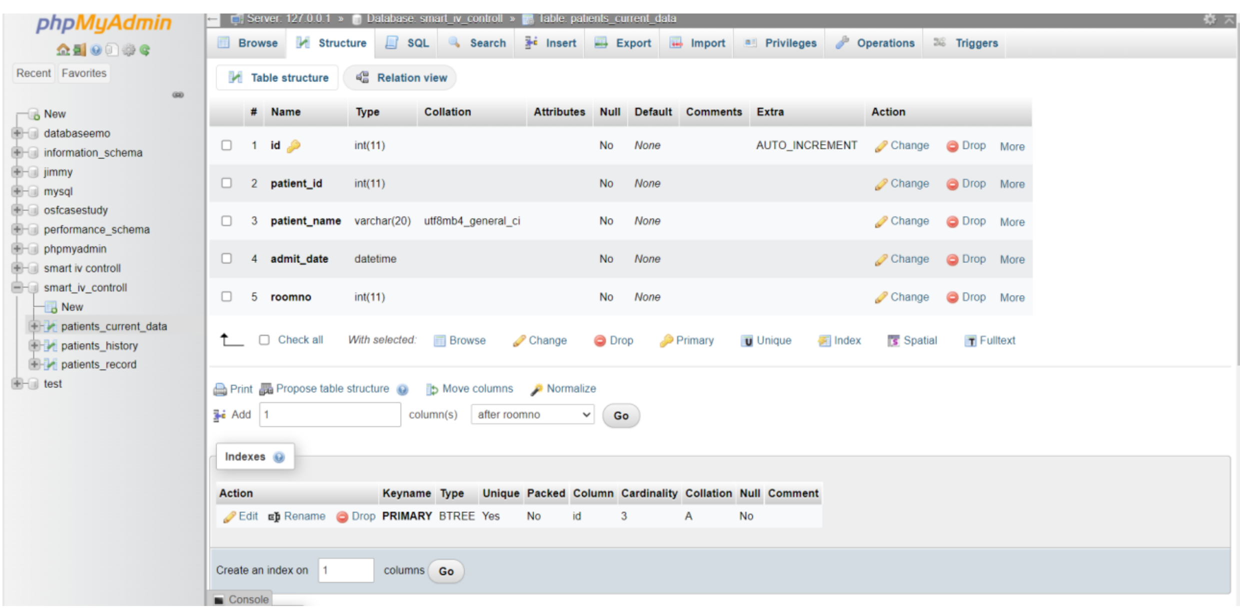
Live I.V. fluid data:

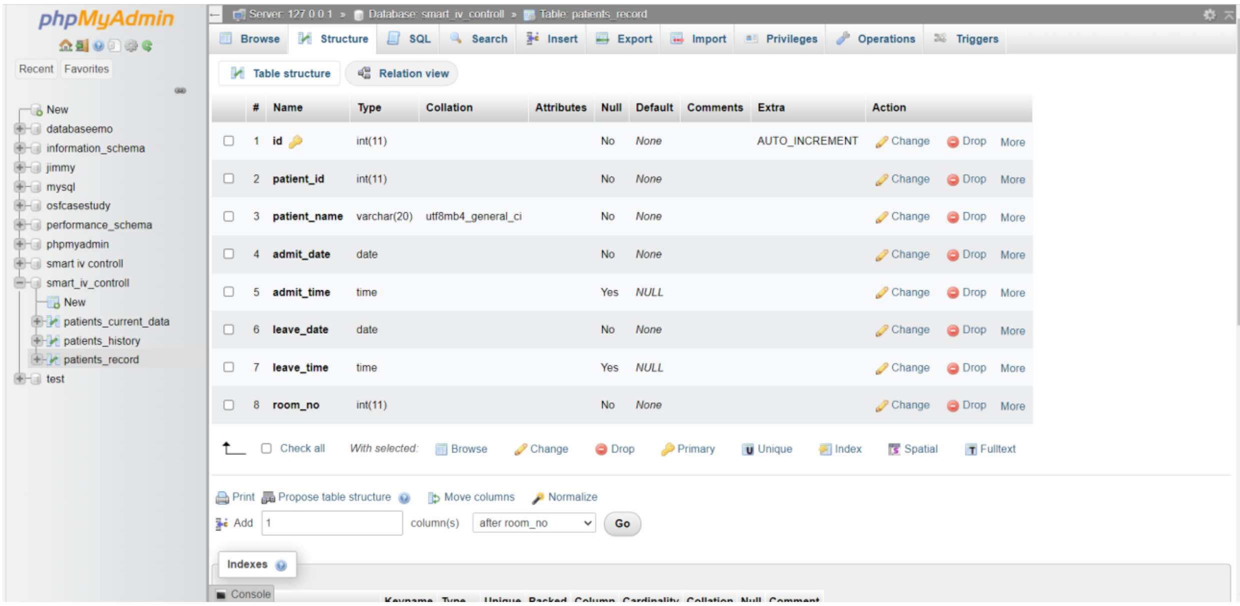
LIVE DASH BOARD

Room No	Date/Time	Fluid_level	Temperature	Heart rate	Spo2
105	2022-10-17__12:30:00	500 ML	97 °C	78 BPM	94 %
102	2022-10-18__00:00:00	200 ML	98 °C	75 BPM	98 %
101	2022-10-17__00:00:00	101 ML	99 °C	55 BPM	98 %
103	2022-10-19__17:33:30	435 ML	96 °C	76 BPM	98 %
104	2022-10-11__10:32:30	200 ML	97 °C	78 BPM	95 %

Table Structures:






phpMyAdmin
Server: 127.0.0.1 » Database: smart_iv_controll » Table: patients_record
Browse Structure SQL Search Insert Export Import Privileges Operations Triggers
Table structure Relation view
Recent Favorites
New
databaseemo
information_schema
jimmy
mysql
osfcasestudy
performance_schema
phpmyadmin
smart iv controll
smart_iv_controll
New
patients_current_data
patients_history
patients_record
test
Name Type Collation Attributes Null Default Comments Extra Action
1 id int(11) No None AUTO_INCREMENT Change Drop More
2 patient_id int(11) No None Change Drop More
3 patient_name varchar(20) utf8mb4_general_ci No None Change Drop More
4 admit_date date No None Change Drop More
5 admit_time time Yes NULL Change Drop More
6 leave_date date No None Change Drop More
7 leave_time time Yes NULL Change Drop More
8 room_no int(11) No None Change Drop More
Check all With selected: Browse Change Drop Primary Unique Index Spatial Fulltext
Print Propose table structure Move columns Normalize
Add 1 column(s) after room_no Go
Indexes
Console

SYSTEM TESTING

Testing Strategies:

- What needs to be the tested-the scope of testing, include clear identification of the will be the tested & what will not be tested.
- How the testing is going to be performed-breaking down the testing into small and manageable tasks and identifying the strategies to be used for carrying out the tasks.
- Resource needed for testing.
- The timelines by which the testing activities will be performed.
- Risks that may be faced in all of the above, with appropriate mitigation and contingency plans.

Test Cases:

- Using the test plan as the basis, the testing team design test case specification which then becomes the basis for preparing for individual test cases.
- A test case is nothing but a series of step executed on a product, using a predefined set of input data, expected to produce a pre-defined set of outputs, in a given environment.
- It describes "how" to implement those test cases.
- Test case specifications are useful as it enlists the specification details of the items.

Test case Specification	Description
Test case ID(TC_ID)	Unique ID to identify/report the bug if present in the functionality software
Test case Objective	The purpose of the test. The lists can be generated to perform intended task, for which software is developed. Results should always follow the test case objective.
Pre-requisite	This can include environment setup, supporting software environment setup. For the project, or any fields in which user will give the input. So that test

	cases can be planned accordingly.
Steps	This includes steps to be performed to give the input to the system, so what system can perform its specified task and display the result accordingly. If automated testing is used then, these steps are translated to the scripting language of the tool.
Input data	The choice of input data will be depended on the test case itself and the technique followed in the test case. For e.g. Equivalence partitioning, boundary value analysis etc.
Expected Result	It can be the user required output to be shown.
Actual Result	This step should do a comparison of the expected and actual results to highlight any differences.
Status	Whether expected results and actual result match, if it matches then PASS or else FAIL.

FUTURE ENHANCEMENT

- Using smart watch application to call nurse.
- Manage the details in RDBMS which is more relational.
- Generate report in PDF form.
- When saline I.V. bag is finished I.V. cannula is automatically closed.

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REPORTING REPORT