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Patient Database System Secured by Smart Computing

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***Abstract*— The Swift Digitization of medical records and databases along with advanced computing techniques assures to improve health care and make it more promising than ever. Digitized medical record helps in analyzing historical patient medical data to improve health of the concerned patient. Such digitization raises concern about security of such sensitive patient health database. Hence, the idea deals with digitizing the medical records for improving diagnosis by doctors and also to secure such vital information. Here, we have considered the issues related to diagnosis of a patient with the effects of misdiagnosis. Security is the key aspect here. It may overcome the problem of misdiagnosis and improve health care.**

***Keywords*— Database, Heart Rate, Patient, RFID card.**

I. INTRODUCTION

Medical Diagnosis has come a long way since the early Greek and Egyptian physicians first started practicing medicine as we know it. A patient's past medical history plays a vital role in prescribing the appropriate medicine, in an optimum dosage. Simple enough, or so it seems.

Humans have a nasty habit of forgetting important information at the most inopportune times. We can personally relate to this emotion. So, if one forgets what medicine one is allergic to, or the side effects caused due to a particular drug, the process of diagnosis is thrown off. The doctor, through no mistake of his, can recommend the wrong medicine.

Many a times, patients give wrong information about their medical records, as well as their symptoms. Moreover, there are many people who don't know even the basic medical information about themselves, example gratia, their blood group. Also there are times when a patient has to refer to one or more doctors, here it becomes difficult to keep the record of prescriptions and test reports by one doctor for reference of the other. When one doctor gives a reference of another specialized doctor, the patient has to carry his medical reports and prescriptions with him for diagnosis. It would be highly practical and logical to have a central database wherein patient information is recorded and stored. Also the database will be accessible to other doctors.

II. OVERVIEW OF THE OLD SYSTEM

The Old system involves a long procedure. When a patient visits a doctor for medication, then he/she has to register with name and identity and then stand in queue for submitting the registration form and then visit the doctor.

The doctor then asks for the past medical history, reports, past diagnosis and prescriptions for the further treatment of the patient. The patient has to carry all the files and reports on the visit to doctor. Also he/she has to maintain all the prescriptions and files. They have to remember the medical terms in case any prescription is lost. This System is a loss-full process as a patient cannot remember all the terms every time. Also maintaining all the files, prescriptions and reports is difficult. There is a possibility of loss of papers eventually and the information needs to be maintained properly without any damage, hence the proposed solution.

III. SYSTEM PRINCIPLE

Every time a patient visits the doctor's clinic, this information is retrieved by having a unique identification system for every patient serviced by that one doctor. This is where RFID comes in. At the time of the visit, the patient is required to carry his/her RFID tag, which will be scanned by the doctor. Upon scanning, the system will receive a unique code corresponding to that patient. This code will be used in retrieving the medical records stored in the server, which will be updated by the doctor after the visit. The database may include the patient's name, age, blood group, past medical dosage etc. [1]This database can be located locally on the doctor's server/computer or on the cloud. Having the server in the cloud has many advantages. Firstly, sensitive patient information is secure. So, the privacy of the patient is respected. Secondly, in the event of patient changing his physician, the new doctor still has access to past medical data of the patient. This is highly convenient.

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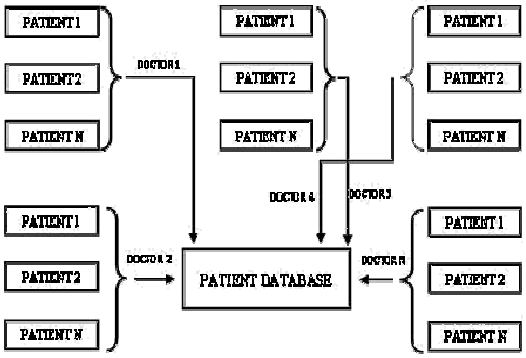


Fig. 1. System Concept Diagram

Third, presently, doctors maintain patient records in the traditional pen-paper style. Consequently, this system may override the archaic methods used by doctors. Moreover, patients do not have to carry medical reports, files, etc. every time he/she visits a doctor. Also, one needn't maintain all the reports, which reduces all the paper work.

The database can be stored on cloud as well. Along with the basic information it will also include past medical history, if the patient is or was suffering from any disease, also various reports, etc. Moreover, measurement of parameters such as heart rate, temperature, etc. can be done by using the system whenever required. The system will have parameter measurement circuit which will measure these parameters and include them in the database directly and also display them on the screen when required.

The Parameter module will measure the parameters as and when required. One or more modules can be included. These are nothing but different health parameters such as heart rate, temperature, etc. These individual parameter modules give the data or values related to their respective parameters and the corresponding value is stored into the database as a medical record of the patient. Upon RFID card scanning, the medical record corresponding to card owner patient will be displayed on the webpage, the doctor can modify the information and update the database after diagnosis of the patient. The changes are saved and retrieved upon next scanning.

IV. SYSTEM DESIGN

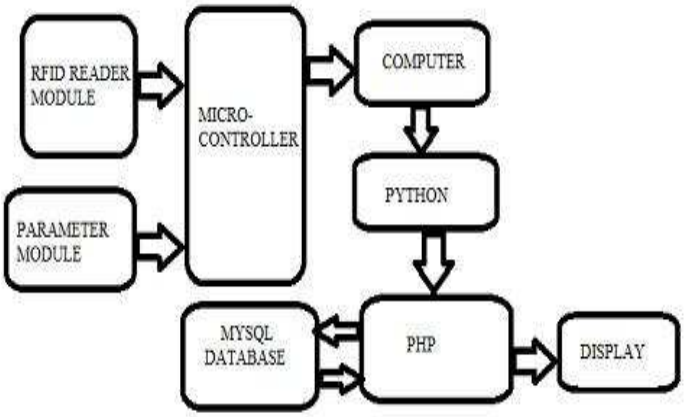


Fig. 2 Block Diagram of the Proposed System

A. Hardware Design

1) Micro-controller: The main function of the controller is to receive the unique ID transmitted by the RFID reader module. The controller is also used for accepting the information from the parameter modules and sending the same to the database via python. The controller accepts the analog signal from parameter modules and converts it to digital signal. This digital signal is displayed and stored into the database. The controller thus, controls functioning of system by receiving and transmitting the signals between different modules and by processing the signals as per requirement.[3]

2) Parameter Module: The parameter module consists of various circuits for various parameters. In this module, a number of parameter circuits can be added depending on the requirement. Here we have considered, heart rate measurement parameter using photoplethysmographic sensor[2]. The heart rate is measured through fingertip. Photoplethysmography*(PPG)* is the measurement of variation in blood volume in tissues using a light source and a detector. As the change in the blood volume is synchronous to heart beat, this principle is used to calculate heart beat.

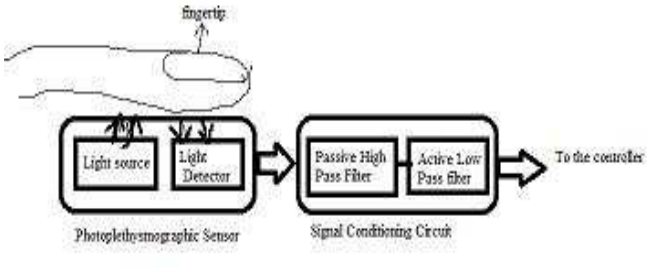


Fig. 3 Block Diagram for heart rate measurement module

The PPG sensor contains two parts, a light source and a light detector. The fingertip is placed on the sensor to measure the heart rate. The infrared light emitted by light source enters in to the tissues through the fingertip. As the pulsing of the blood varies with the heartbeat, the intensity of reflected light also varies with it. This reflected light is measured by the detector. Thus, the output of sensor is an analog signal. This signal is weak and contains DC components, hence it needs to be conditioned. This signal is then applied to a signal conditioning circuit which will suppress the DC component and amplify the weak signal carrying the information. The signal conditioning circuit consists of a passive high pass filter and an active low pass filter. High pass filter suppresses the DC component and Low pass filter amplifies the weak signal. The analog signal is then converted into pulses. The total gain is the gain of two cascade stages. The frequency of these pulses is related to heart rate, that is, beats per minute as:

Beats per minute = 60*f

This pulse is applied to the controller's digital pin or ADC for counting the number of pulses or beats per minute. Thus, we get the value of heart beat of the patient which is then stored in the database by passing it from controller to the database through python and PHP.

3) RFID Reader Module: The RFID reader transmits radio frequency when powered ON. When the tag is placed near the reader, the RFID tag will receive the radio frequency via the antenna inside tag. The radio frequency received will be converted into electrical power that is enough for the tag to transmit the data back to the RFID reader. Further, the reader will transmit the tag ID to the external device by serial communication. This module works on a frequency of 125 kHz and comes with an inbuilt antenna. Designed in accordance with the set industrial standards, this low cost RFID reader module has both weight and serial output. [4]

B. Software Design

1) *Python:* Python language acts as an interface between the controller and PHP script. The controller serially communicates with the reader module[5]. This serial port of controller is read by python and data on serial port is fetched[6]. This data is the ID transmitted by the reader. This ID is fetched by python and passed to PHP script via GET method. Python also opens the browser and the PHP page.

The algorithm for python script is as follows:

Step 1: Import web browser and serial library to open browser and fetch serial port data.
Step 2: Read tag id from serial monitor.
Step 3: Initialize serial port with Baud Rate = 9600
Step 4: If data(tag ID) is available at serial port then read the data on the serial monitor and store it in a variable.
Step 5: Pass this variable(tag ID) to PHP page using a URL of the website.
Step 6: Open the browser using URL of the website as the argument which opens the URL and passes the variable to the page.

2) *PHP*: PHP script is used to connect to MySQL database. It receives tag ID from python and it fetches corresponding information from MySQL Database[7]. PHP script displays the information fetched and we can also edit the information if required using PHP script. It is also used to upload reports and/or images to the database. PHP uses GET method to get the tag ID from python[8].
The algorithm for PHP script is as follows:

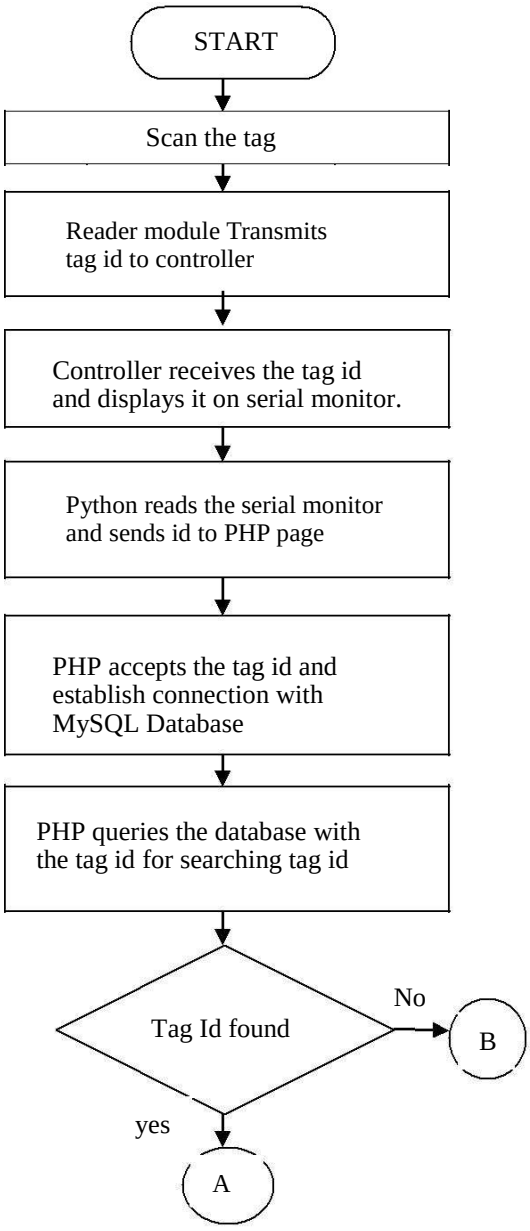
Step 1: Get the tag ID from python using GET method
Step 2: Pass the ID to the MySQL Database using POST method.
Step 3: Establish connection with the database.
Step 4: Query the database using search command for searching the ID and corresponding information in the database.
Step 5: If the tag ID found in the database, fetch the corresponding information and store all its fields in an array.
Step 6: Display the array using a loop.
Step 7: If tag ID is not found in the database, then create a new field for the tag ID and send the insert query to the database with data to be stored.
For updating the Database:
Step 8: If the needs to be edited or updated then create an 'edit' button using a form and give form action as link of edit page.
Step 9: Follow steps 1 to 5.
Step 10: Get the array and display it using a form, that is, display the contents inside the form and create an update button on the form.
Step 11: Make the required changes and press the update button.
Step 12: Get the updated information from the edit page using POST method for the tag ID and also get the tag ID.
Step 13: Send the insert query to the database with the updated information at the given tag ID.
Step 14: Close the connection to the database.

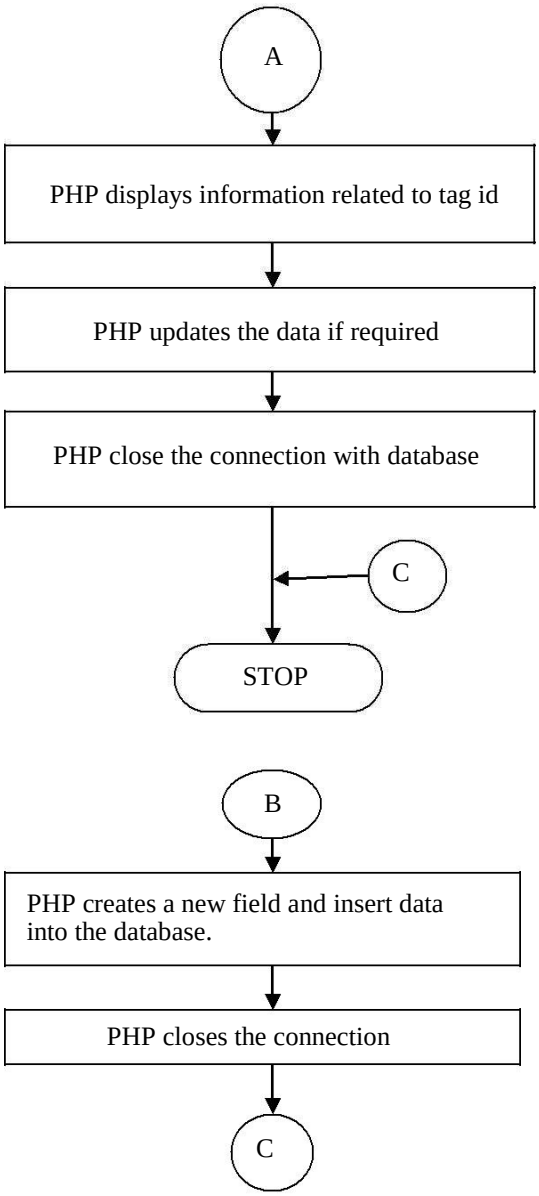
3) MySQL Database: MySQL Database is a patient medical database consisting of a table of personal basic information like name, age, gender, blood group, etc. It also contains patient past medical history and

prescription details. A number of fields can be added as per requirement. The information is stored corresponding to a tag ID. Each patient has a unique tag ID. PHP sends a query with a tag ID to fetch the information. MySQL commands to create database[9]: Step 1: Create the database.

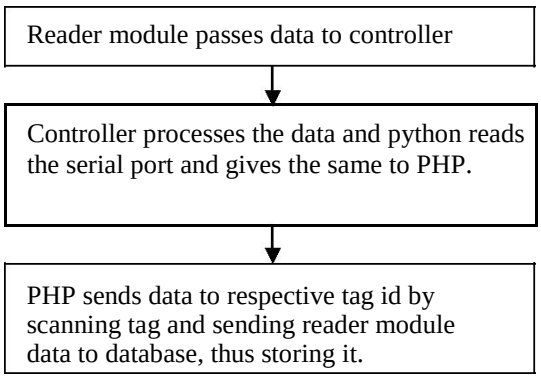
Step 2: Create a table into database for patient medical records containing different fields with corresponding tag ID.

V. SYSTEM FLOW





FOR READER MODULE:



VI. RESULTS

We successfully created a database and performed various tasks on it viz. viewing forms, creating new forms, editing various fields in the existing forms, etc. The results of the same are as follows:

Fig. 4 Insertion of a new form into the database

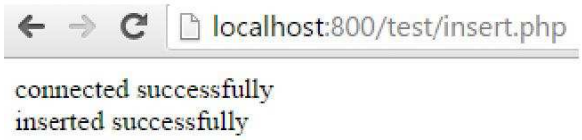


Fig. 5 Successful insertion of a new form into the database

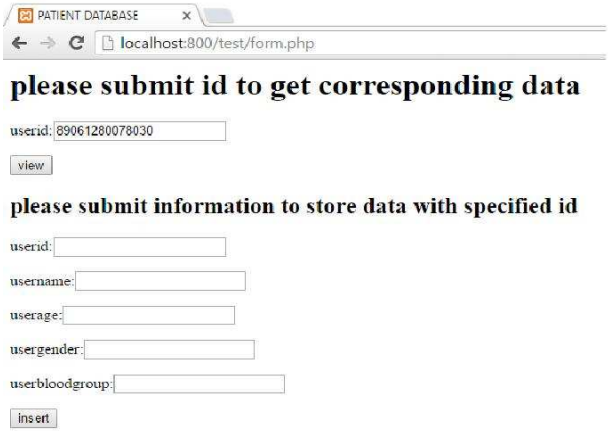


Fig. 6 Form with all the fields

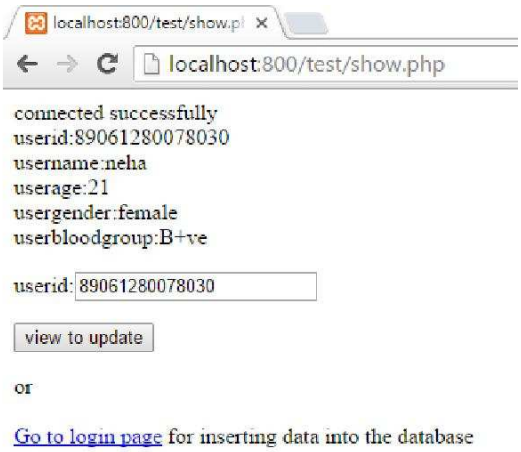


Fig. 7 Viewing of a form existing in the database

SR.NO.	userid	username	userage	usergender	userbloodgroup
1	89061280078030	neha	21	female	B+ve
2	89061286530295	tanmay	21	male	A+ve
3	89061287077159	pradnya	21	female	O+ve

Fig. 8 Database before updating a form

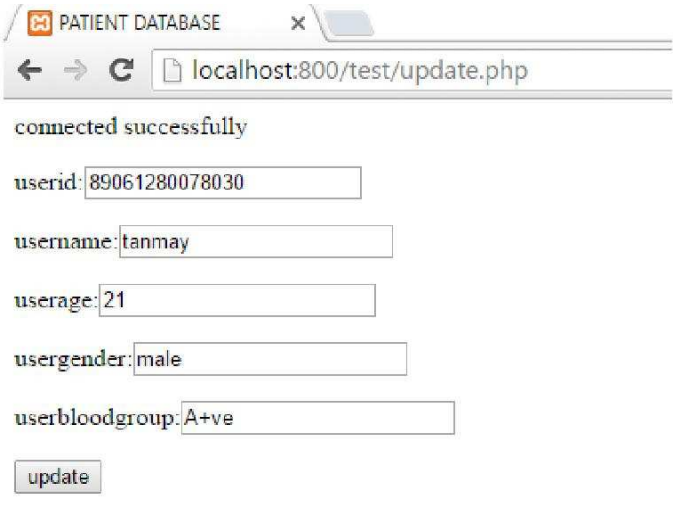


Fig. 9 Editing of a form in the database

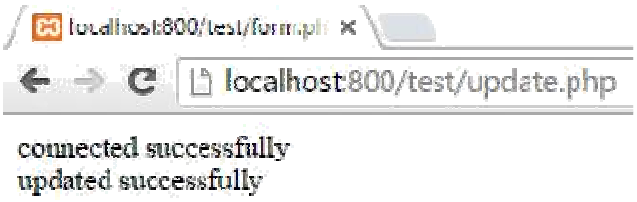


Fig. 10 Successful update of the database

Fig. 11 Display of the database after update

VII. CONCLUSION

Technology is playing a huge role in enhancing man's life.

There are plenty of opportunities where technology can have a huge impact. Our country is like a coin, having two distinct facets. Still nearly millions of people live in extreme poverty in India and face deprivation in terms of access to basic services, including education, health, water, sanitation and electricity. This means there is plenty of scope for technology to bridge the gap between the "Haves" and "Have Not's". This idea is a need

– aware kind of idea. We saw a necessity and tried to solve it using basic embedded technology. The main software component of this project is the database created in MySQL[10]. The code for MySQL is in the public domain and is thus free for use for any purpose, commercial or private. MySQL is the most widely deployed database in the world with more applications than we can count, including several high-profile projects.

We are required to make the lives of fellow humans more livable and easy. The inspiration for this idea and work was precisely this. A low cost solution for doctors which enhances their ability to render accurate diagnosis. Also the digitization of medical records for analysis and for improving security and to prevent loss is possible.

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