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COVID19 Testing Management System

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Abstract— Nowadays, COVID19 Testing Management System is one of the most essential tools that are mostly used in Testing Lab; it is mostly used to manage COVID19 medical lab related activities. In this project we tried to develop a computerized and web based COVID19 Testing management system. Our main intention is to allow this application to be used in most retailing COVID19 labs, where a small point of customization will be required to each COVID19 lab in the implementation period. This system is designed to overcome all challenges related to the management of diagnostics that were used to be handled locally and manually.

Keywords— COVID19, Testing, Software, Management, Report.

I. INTRODUCTION

According to WHO, testing on clinical specimens from patients meeting the suspect case definition should be performed in appropriately equipped laboratories by staff trained in the relevant technical and safety procedures. National guidelines on laboratory biosafety should be followed in all circumstances. There is still limited information on the risk posed by COVID-19, but all procedures should be undertaken based on a risk assessment. Specimen handling for molecular testing would require BSL-2 or equivalent facilities. Attempts to culture the virus require BSL-3 facilities at minimum.

Hence, we needed to come up with an idea to minimize the risk associated with the testing of COVID 19 i.e. risk associated with proper transportation of the slabs, reports generation, management and also a safer way to keep the phlebotomists arranged at one place. Therefore, the COVID19 Testing Management System will help and is web based technology which brings up various diagnosis works online. Here patients are first allowed to register on the website and provide personal, test information. Once registered with their address and contact details, the patients may now see a variety of tests conducted by the lab. The patient will select the required test and book an appointment after that lab center sends a lab boy at the registered address to collect a sample. After successful sample collection, patients can track their test history using the name, order and registered mobile number. The system allows the admin to attach a copy of the report into the system and automatically shown on the user side so the user can download the report.

II. EXISTING SYSTEM

After doing a lot of research on the testing management system, laboratories from all over the world are now switching onto this Testing Management System.

Earlier, the testing of the samples was done randomly without any proper technology or software to manage the testing system. All the testing management was done on paper, this pen and paper model was creating a lot of chaos in proper management of the testing of samples. But, a lot of softwares is now in existence based on various tools and technologies.

The on-paper request system proved a major bottleneck to the COVID-19 sample flow. First, critical clinical information and contact details were often not provided, significantly delaying sample triaging and reporting, respectively. Second, because clinical information and triage categorizations were not registered into our LIS database, epidemiological and research studies were only possible after additional administrative personnel retrospectively entered those data using an ad hoc-developed structured data entry module Third, too often, preanalytical and shipping biosafety procedures (triple packaging) for suspected SARS-CoV-2-infected specimens were not strictly followed. Fourth, the paper-based order system did not allow rapid and immediate change in test ordering behavior in function of evolving criteria and scientific insight.

A. Mobile Apps

At the onset of COVID-19 pandemic, the challenge was to standardize the format of sample data from various Tests conducted across the country. ICMR designed the Specimen Referral Form (SRF) for use with every COVID-19 sample; NIC developed the RT-PCR and RATI mobile apps on Android, iOS and Windows mobiles for ICMR along with the web-portal to whitelist phlebotomists (sample collectors) for using the mobile apps and web-portal.

RT-PCR App is a handheld tool for the Medical Staff at Sample Collection Centers spread across the country. The Sample Collection Facility will be sending the sample for various types of specimen to ICMR labs conducting the RT-PCR test for confirmation of COVID-19. Advanced Intimation is being shared through the App with ICMR. On successful saving of any sample, the Collection Centre and the User can view the collection details.

Due to this system, the download facility enables Health officials, Laboratories and Collections Centres to use the SRF data in their own applications, saving data entry effort.

State-level applications are using the output for verification and genuineness of RT-PCRSRF reports.

Also, Majority of the States / UTs use RT-PCR, RATI apps to collect COVID-19 samples data.

Some of the features of this system includes, Option to enter offline data after generation of SRF-ID Configurable- Skip Patient OTP for verification and warning on multiple use of same patient mobile RT-PCR, Rapid Antigen and Rapid Antibody tests covered.

Fig.1. NIC's Mobile Application for Containment and Monitoring COVID-19 pandemic across the country

B. Web based application

Recently the UK has launched a software(web based) in order to manage the testing in UK schools.. Cloud-based coronavirus test management software, COVID-19 Test Register for Schools launched on 4 January, with the aim of removing the administrative burden of delivering coronavirus testing to schools.

Thomson Screening has adapted its Innovate UK funded COVID-19 School Screener test manager software for use by schools. The test is available immediately and claims to take an hour to set up. The software is fully NHS and GDPR compliant and results can be stored and destroyed within one month of the testing programme ending.

The platform includes an online parent portal for communication and consent, automated administration, stakeholder reports and audit.

The COVID-19 Test Register for Schools includes:

Department of Education consent forms and letters for parents

Consent and registration management

Unique Identifier search

Recording test barcode ID

Simultaneous use by staff

Filtering lists by year group, tutor group or similar categories (including children to follow up from a positive test)

Reporting at pupil level

Anonymised reporting at school level: heatmaps for clusters or other warning signs

Managing on-going testing for specific groups or pupils

Importing and exporting data via CSV file

Reporting to Public Health and other bodies, as may be required

Fig.2. School Screener COVID Manager

III. PROPOSED SYSTEM

Today also we have to go to the diagnostic center, wait in the queue to get our COVID19 test done. As Technology is growing rapidly we are also moving to a technical world where everything we want to be online. So with the help of this project we are bringing the use of technology in the field of medical diagnosis where patients can avail all the diagnosis facilities at their door steps. This project makes the diagnosis process easy and reduces the burden of patients. At the same time it helps the diagnostic center to track all their patients' details with their test reports.

The system is an online COVID19 lab manager application that brings up various COVID19 tests working online. Using this system, it will help us to record all transactions made at the daily tests; recognize all customers, employees, etc. It will manage all activities around the COVID19 lab that increases productivity and maximize profit, it will also minimize the risk of getting lost because all transactions are recorded to the system.

A. Design

Design is the first step in the development phase for any techniques and principles for the purpose of defining a device, a process or system in sufficient detail to permit its physical realization. Once the software requirements have been analyzed and specified the software design involves three technical activities - design, coding, implementation and testing that are required to build and verify the software.

The design activities are of main importance in this phase, because in this activity, decisions ultimately affecting the success of the software implementation and its ease of maintenance are made. These decisions have the final bearing upon reliability and maintainability of the system. Design is the only way to accurately translate the customer's requirements into finished software or a system.

Design is the place where quality is fostered in development. Software design is a process through which requirements are translated into a representation of software. Software design is conducted in two steps.

- a) UML stands for Unified Modeling Language. UML is a language for specifying, visualizing and documenting the system. This is the step while developing any product after analysis. The goal from this is to produce a model of the entities involved in the project which later need to be built. The representation of the entities that are to be used in the product being developed need to be designed.
- b) Use case diagrams model behavior within a system and help the developers understand what the user requires. The stick man represents what's called an actor.

Use case diagrams can be useful for getting an overall view of the system and clarifying what can do and more importantly what they can't do.

Use case diagram consists of use cases and actors and shows the interaction between the use case and actors.

Fig.3. Use case diagram for CTMS

- c) A class diagram is the description of set of objects that share the same attributes operations, relationships, and semantics
- d) The Entity-Relationship (ER) model was originally proposed by Peter in 1976 [Chen76] as a way to unify the network and relational database views. Simply stated the ER model is a conceptual data model that views the real world as entities and relationships. A basic component of the model is the Entity-Relationship diagram which is used to visually represent data objects. Since Chen wrote his paper the

model has been extended and today it is commonly used for database design for the database designer, the utility of the ER model is:

- It maps well to the relational model. The constructs used in the ER model can easily be transformed into relational tables.
- It is simple and easy to understand with a minimum of training. Therefore, the model can be used by the database designer to communicate the design to the end user.
- In addition, the model can be used as a design plan by the database developer to implement a data model in specific database management software.

B. Implementation and System Testing

The goal of the system testing process was to determine all faults in our project .The program was subjected to a set of test inputs and many explanations were made and based on these explanations it will be decided whether the program behaves as expected or not. Our Project went through two levels of testing:

a) UNIT TESTING

Unit testing is commenced when a unit has been created and effectively reviewed .In order to test a single module we need to provide a complete environment i.e. besides the section we would require:

- The procedures belonging to other units that the unit under test calls
- Non local data structures that module accesses
- A procedure to call the functions of the unit under test with appropriate parameters:

1. Test for the admin module

- Testing admin login form-This form is used for login of administrator of the system. In this form we enter the username and password if both are correct, the administration page will open, otherwise if any of data is wrong it will get redirected back to the login page and again ask the details.
- Report Generation: admin can generate reports from the main database.

b) INTEGRATION TESTING

In the Integration testing we test various combinations of the project module by providing the input.

The primary objective is to test the module interfaces in order to confirm that no errors are occurring when one module invokes the other module.

Fig.4. Admin dashboard

IV. Conclusions

COVID19 Testing Management System is very graceful and lively. Patients have to register to the portal by giving their details and then they can take appointments online with minimal effort. The Phlebotomist comes to the patient address to collect the sample. Once the test is done and the test report is generated, the patient can download the report by logging in to the portal. This system can be implemented in diagnostic labs and clinics.

- Automation of the entire system improves productivity.
- It provides a friendly graphical user interface which proves to be better when compared to the existing system.
- It gives appropriate access to the authorized users depending on their permissions.
- It effectively overcomes the delay in communications.
- Updating information becomes so easy.
- System security, data security and reliability are the striking features.
- The System has adequate scope for modification in future if it is necessary.

The main purpose of COVID19 Testing management system is to provide a platform where patients can book the test online and get their COVID19 test done at home. With the help of this project we are bringing the use of technology in the field of medical diagnosis where patients can avail all the diagnosis facilities at their door steps. Another purpose for developing this application is to generate the report automatically.

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