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Application for data collection and monitoring of COVID-19 patients in Sukorame Community Health Center

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Abstract: The significant increase in COVID-19 cases in Indonesia in May-July 2021 overwhelmed health workers. One of the efforts to monitor the spread of COViD-19 disease is collecting data on patients and proper monitoring. For example, the Sukorame Community Health Center, Mojoroto Kediri, does not yet have an application to record and monitor COVID-19 patients. Data collection is currently done manually by writing in books and excel. This study designed and built a data collection and monitoring application for COVID-19 patients to help Puskesmas staff obtain more accurate patient data and monitor the related patient data. This study implements the waterfall method, including system requirements, design, implementation, verification, and maintenance. The results of this study are the applications that can help and facilitate Community Health Center in collecting data on COVID-19 as a form of effort in overcoming and preventing the spread of COVID-19 in the work area of Sukorame Community Health Center, Kediri City. Based on the user satisfaction questionnaire results, 75% of users consisting of staff and heads of community health centers were helped by this application.

Keywords: COVID-19 applications, community health center, web application

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Introduction

COVID-19 (Coronavirus Disease 2019) is a disease caused by a new type of coronavirus (SARS-CoV-2) which began to spread in early 2020 [1]. This virus was first discovered at the end of December 2019 in Wuhan, China, and then infected approximately 217 countries worldwide with a total of 218,946,836 [2]. Meanwhile in Indonesia, based on data from the COVID-19 Task Force as of September 2, 2021, there were 4,116,890 confirmed cases, 3,813,643 recovered and 134,693 deaths [3]. On September 2, 2021, there were 8955 confirmed cases, according to data from the covid19.go.id website. The distribution of covid 19 is primarily on the island of Java, particularly in the provinces of DKI Jakarta and West Java, as indicated in Figure 1.

Common symptoms in people infected with the virus are fever over 38 degrees Celsius, dry cough, and shortness of breath. COVID-19 is spread from an infected person when coughing, sneezing, talking, singing, or breathing through small particles through the nose or mouth. These liquid particles vary in size, from larger airway droplets to smaller sprays. The virus can enter the mouth, nose, or eyes, most likely when having direct or close contact with a distance of less than 1 meter with an infected person. Aerosol transmission may occur indoors, crowded, poorly ventilated areas where infected people spend more time with others. So on reducing the spread of the virus by applying the 3M Sanitary Protocol, namely, wearing a maker, maintaining distance, and washing hands properly and cleanly.

Figure 1. The spread of COVID-19 in Indonesia, on September 2, 2021
(Source: https://covid19.go.id/peta-sebaran-covid19)

Based on the Decree of the Minister of Health of the Republic of Indonesia Number HK.01.07/MENKES/413/2020 concerning Guidelines for the Prevention and Control of Coronavirus Disease 2019 [4] the operational definition of COVID-19 cases used in the practice of collecting data on COVID-19 cases is Suspected Cases. Probable Cases, Confirmed Cases, Close Contacts, Travelers, Discardedm Completed Isolation and Death. For Suspected Cases, Probable Cases, Confirmed Cases, Close Contacts, the terms used in the previous guidelines are People Under Monitoring (ODP), People Without Symptoms (OTG) Patients Under Monitoring (PDP).

1. Suspected Case
   A person who has one of the following criteria:
   a. Persons with Acute Respiratory Infections (ARI) and in the last 14 days before the onset of symptoms have a history of travel or living in a country/territory of Indonesia that reports local transmission
   b. People with one of the symptoms/signs of ARI and in the last 14 days before symptoms appeared had a history of contact with confirmed/probable cases of COVID-19.
   c. People with severe ACI / severe pneumonia require hospitalization and no other reason based on conclusive clinical features.
2. Probable Case
   Suspected cases with severe ARI/ARDS/died with a convincing clinical picture of COVID-19 and no RT-PCR laboratory results.
3. Case Confirm
   A person who has tested positive for COVID-19 in an RT-PCR laboratory test. The approval cases are divided into :
   a. Confirmed cases with symptoms (symptomatic)
   b. Confirmed asymptomatic cases (asymptomatic)
4. Close Contact
   Persons who have been exposed to possible or confirmed cases of Covid-19. Relevant contact history includes:
   a. Personal/surroundings contact with possible or confirmed cases within a radius of 1 meter and 15 minutes or more
   b. Direct physical contact with possible or confirmed cases (eg, handshaking, holding hands)
   c. Persons directly managing potential or confirmed cases without the use of standardized PPE
   d. Other situations indicating exposure are based on a local risk assessment carried out by the local epidemiological investigation team (explanation attached).
      In possible or confirmed cases that are symptomatic (symptomatic) to find close contact, the exposure time is calculated from 2 days before the onset of symptoms and up to 14 days after symptoms. In finding close contacts in confirmed asymptomatic cases, the contact period was calculated from 2 days before and 14 days after the sampling date from the confirmed case.

5. Traveler:
   A person who has entered the country from abroad or traveled within the country in the last 14 days.
6. Discarded
   It will be dropped if it meets any of the following criteria:
   a. Suspect with negative duplicate RT-PCR results for two consecutive days> 24 hours
   b. A person in close contact who has completed 14 days of quarantine
7. End the insulation
   Complete insulation if it meets any of the following criteria:
   a. Confirmed asymptomatic (asymptomatic) cases without RT-PCR observation with an additional ten days of self-isolation since diagnostic confirmation sampling.
   b. Probable / confirmed cases with symptoms (symptomatic) that RT-PCR did not monitor were ten days from the start date plus at least three days after no fever symptoms and respiratory distress.
   c. Possible / confirmed cases with symptoms (symptomatic) with adverse 1X RT-PCR monitoring plus at least three days after the absence of fever and respiratory problems symptoms.
8. Death
   COVID-19 deaths for surveillance purposes are confirmed/probable cases of COVID-19 who died.

One way to handle COVID-19 in Indonesia is by finding cases at the entrance and in the region. Case finding activities at the entrance are aimed at identifying the presence or absence of cases through state entrances, either through air/seaports or border areas (checkpoints). Meanwhile, case-finding activities in the region can be carried out at the first level of health services as well as in the community. What is meant by "region" is the administrative area of the province and district/city [5].

Sukorame Public Health Center is one of the leading healthcare providers in Kediri, striving to provide public health and critical individual health efforts, prioritizing advocacy and prevention efforts to achieve the highest levels of public health in Kediri. Sukorame Health Center is involved in community management and settlement in the Kediri district. Hemorrhagic officials will review, report, escalate and respond to any evidence of Covid-19 that requires an immediate response. The response to control is by identifying and tracking contacts, sending, communicating, and breaking the transmission chain.

In handling cases, if probable or confirmed cases are found, the health center or known as "puskesmas" will dig up information by tracing people who have close contact with probable and confirmed patients. The close contact period is calculated based on the provisions of the Minister of Health Decree that has been described previously. From the results of tracing the close contacts obtained, the health center officers will collect data and monitor for 14 days on residents with close contact status and will change the status based on the development of conditions during observation.

From the analysis of the situation that has been described, there are problems faced by Sukorame Community Health Center, namely the absence of a computerized system that can assist health center officers in recording and monitoring [6] the operations of COVID-19 cases. The Puskesmas still uses the conventional method by using stationery and excel applications in collecting data on COVID-19 cases. So that the data collection process is not systematic and inefficient in terms of functionality and time.

Several studies that have relevance to the development of the COVID-19 Application include the research with the title "Creating a Covid-19 Patient Reservation Application At Muhammadiyah Hospital Bandung" [7]. This study aims to develop an online registration application; The results of this application indicate a change in the Covid-19 patient registry. What originally led patients to go to the hospital for registration became online, through electronic devices connected to the Internet. Meanwhile, Erni Rihyanti conducted research in 2020 entitled "Development Of Android-Based Mobile Learning Applications For Covid-19 Patients ". This study aims to The Mobile Learning Application for the Help of Covid-19 sufferers aims to make it easier for anyone to learn about the Aid of Covid-19 Patients. This application can be used using mobile devices anytime and anywhere [8]. There is research related to data collection and monitoring

titled "Web and android-based application for monitoring tuberculosis (TB) patients in Kediri City" to collect data of TB patients and monitor its medication [9].

Methodology

1. Data Collection Methods
   The method of collecting data or information used in this study is as follows :
   a. Interview
      The interview method is carried out by asking questions to related parties. In this case, the speakers were the Sukorame Community Health Center's head and staff. Based on the interviews that have been conducted, it can be concluded that currently, the health office needs an effective system to collect and monitor COVID-19 data, and can be accessed anytime or anywhere using internet technology. The system that is currently running is still using the manual method, namely recording treatment information on paper. This is considered less effective and efficient if we look at the availability of existing technology. That is why it is necessary to create an application to collect and monitor COVID-19 patients' data that can increase effectiveness and efficiency.
   b. Literature Review
      A literature study is a method of data collection carried out by searching, reading, and collecting documents as references such as books, articles, and final project literature related to selected topics related to the object of research. So it gets a useful theoretical overview helps analyze and design as well as write this report.
2. System Development Methods
   This study implements the waterfall method [10], which consists of several phases as shown in Figure 2, including system requirements analysis, system design, program code writing, program testing, and program implementation and maintenance, which are explained below:

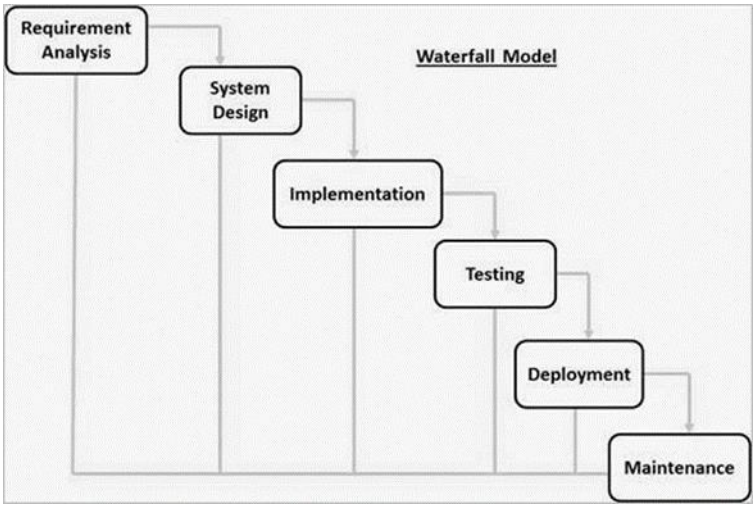

Figure 2. Waterfall model

   A. System Requirements Analysis
      At this stage, an analysis of the system requirements is performed. Data were collected through interviews or bibliographic studies. Interviews were conducted with several people, namely the Sukorame Community Health Center officials. In addition, they conducted a bibliographic study as described in previous studies. In this phase, a user requirements document is created, or it can be said that it is data related to the user's preferences when creating the system. Finally, this document serves as a reference for the analysis system to be translated into the programming language.
   B. System Design
      The design process will translate the requirements into a software design that can be estimated before coding is made. This process focuses on data structures, software architecture, interface representations, and procedural details (algorithms). The system

design stage will produce a document called a software requirement. Programmers will use this document to carry out system creation activities.

C. Writing Program Code
Coding is the translation of designs into a computer-recognized language by a programmer who translates user transactions. This phase is the actual phase of working with the system because it maximizes computer usage. An application has been developed in a website for an administrator, a Community Health Center employee, and the Director of the Sukorame Community Health Center. Tests are performed on the previously created system when the coding is complete. The purpose of testing is to find design flaws and then correct them.

D. Program Testing
This stage is the final step in making a system. After analyzing, designing, and coding the system that has been used by the user. In this case, system testing is carried out by Community Health Service Officers, and The Head of Sukorame community health center.

E. Maintenance
Software that is difficult to deliver to customers will change. These changes may be related to errors because the software needs to adapt to the environment (new peripherals or operating systems) or because the customer needs functional development.

3. Functional Requirement
Functional requirements are system process requirements that run according to the user functions of the system. For the web application, this system has three users, namely system administrator, community health center officer, and The Head of Sukorame community health center.

Table 1. Functional requirement

User	Requirements
System Administrator (web)	- Manage District, Sub-district, and Medical Facilities Data
Community Health Center Officer(web)	- Submit and manage patients' data - Manage report data
The Head of Sukorame Community Health Center (web)	- See report data of the patient - See recapitulation data of the patient

4. System Architecture
In this research work, we develop a web-based application for collecting and monitoring COVID-19 patients which has a system architecture as shown in Figure 3. The application is divided into web applications and mobile applications. There are three user levels in the web application namely; The System Administrator, the Community Health Center Office, and The Head of Suko-rame Community Health Center.

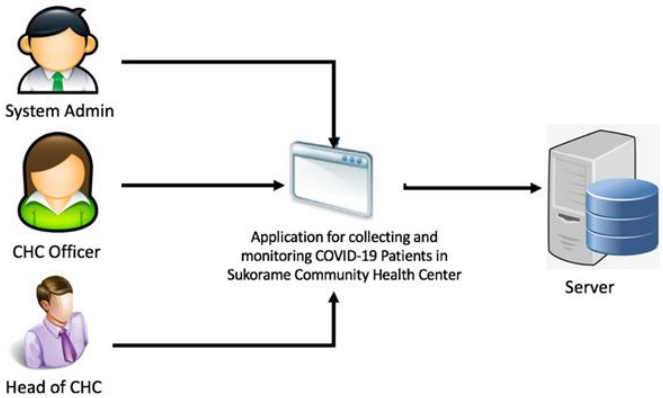

Figure 3. System architecture

For the system architecture, the head of the health center view patient reports from the database server, admins can manage data to be displayed by the system, officers can input patient data into the system.

5. Use Case Diagram
In this COVID-19 patient data collection and monitoring application, there are 3 main users, namely the system admin user who has the authority to add master data, the officer (CHC Officer) user who has the authority to add COVID-19 patient data, and the head of CHC user who has the authority to view the data patient report as illustrated in Figure 4.

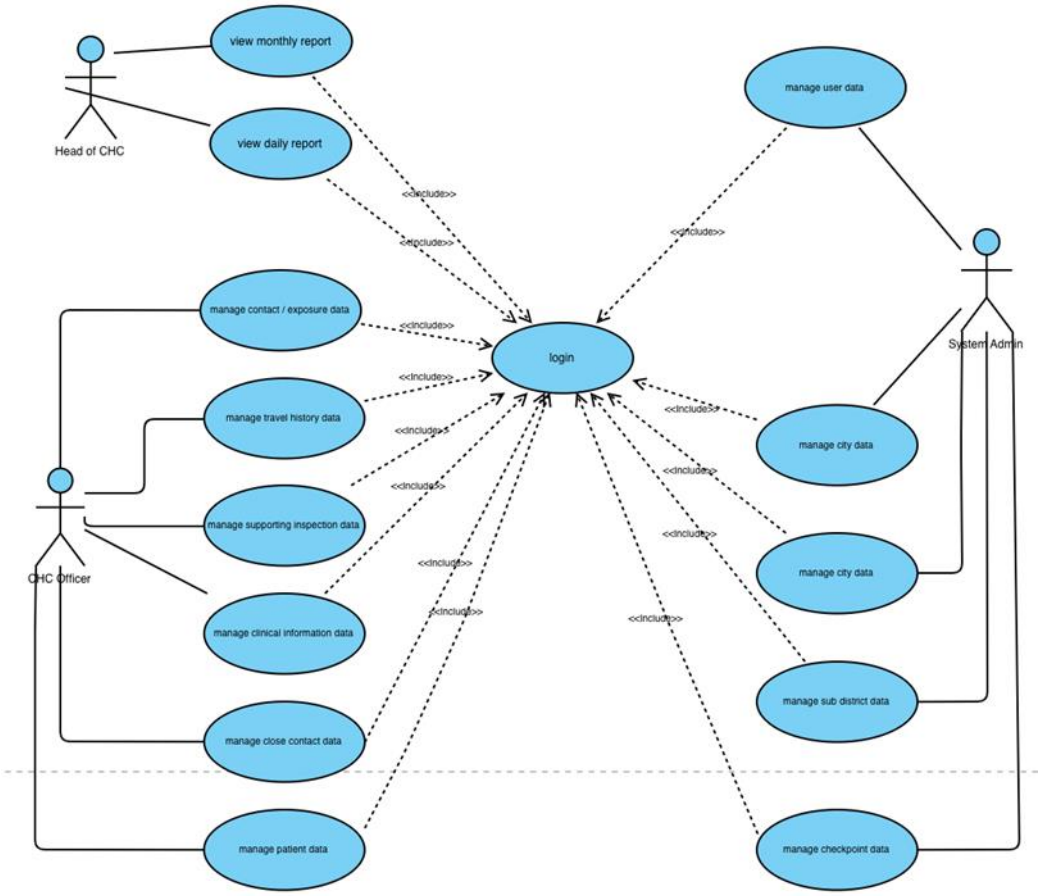

Figure 4. Use case diagram

6. Entity Relationship Diagram
In an application, ERD is the underlying structure of a database system and is used to illustrate the data model concept that happens to the system that is being built. Figure 5 illustrated the relationship between the tables, which provides an overview of each system's related processes.

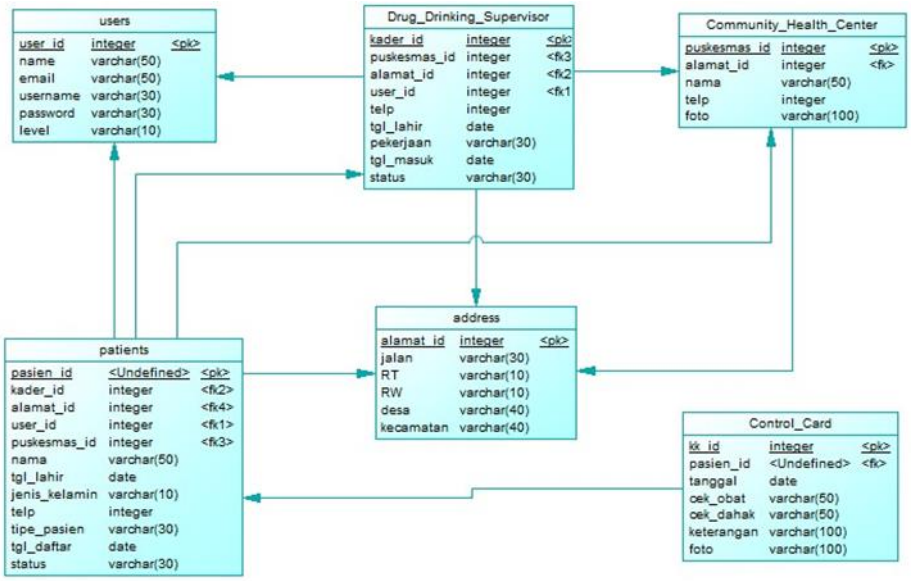

Figure 5. Entity relationship diagram of an application

The relationship between the tables describes a database that is useful for storing data needed to build applications. Here's a more complete explanation.

a. The city table has the city_id attribute as the primary key, city_name.
b. The sub-district table has the kec_id attribute as the primary key, district_name.
c. The kelurahan table has the kel_id attribute as the primary key, kelurahan.
d. In the user table has the attribute peng_id as the primary key, name, email, username, password, photo, level.
e. In the patient table, the attribute nik is the primary key, name, parent_name, date of birth, age, age_b, gender, occupation, address, rt, rw, no_telp, longitude, latitude, kat, note.
f. The p_support table has the penj_id attribute as the primary key, tgla, tmpa, hsla, tglb, tmpb, hslb, tglc, tmpc, hslc, tgld, tmpd, hsld, tgle, tmpe, hsle, tmp, jng, hg, tmpg, hslg.
g. In the examination_place table has the tmp_id attribute as the primary key, place_name.
h. In the clinical table it has the clinical_id attribute as the primary key, date of symptoms, fever, fever, status, cough, runny nose, throat, breath, head, weakness, muscle pain, nausea, abdomen, diarrhea, others, pregnancy, diabetes, heart disease, hypertension, malignancy, g_immunology, G_kidney, g_liver, COPD, others2, diag_1, diag_2, diag_3, diag_4, diag_5, st_rs, nama_rs, log-in_rs.
i. In the table r_perj1 has the attribute perjl1_id as the primary key, status, country, city, date_perj, date_arrival.
j. In the table r_perj2 has the attribute perjl2_id as the primary key, status, prov, city, tgl_perj, tgl_tiba.
k. In the table r_perj3 has the attribute perjl3_id as the primary key, status, prov, city.
l. In the table r_perj4 has the attribute perjl4_id as the primary key, status, name, address, relationship, initial date, end date.

Results and Discussions

The results of the development of a web-based data collection and monitoring of COVID-19 patients in Sukorame Health Community Center application are described in the section below.

Results

Administrator Page

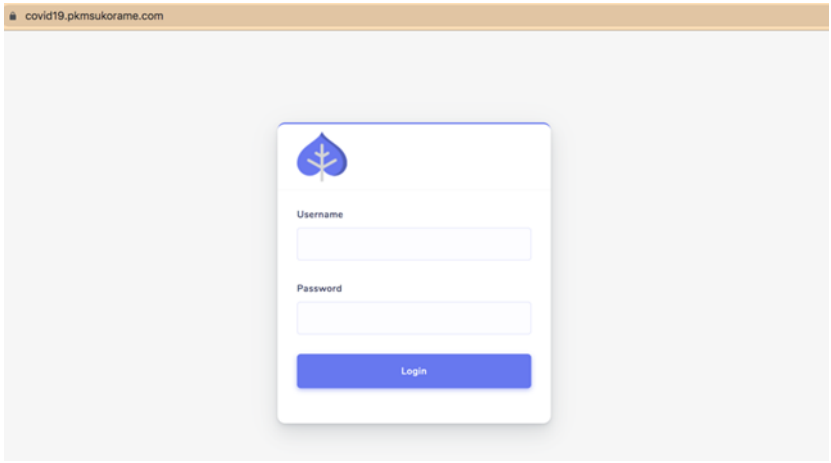

Figure 6. Login page

The display of the initial login page for all user levels is shown in Figure 6. When the username and password are wrong, it will display a warning.

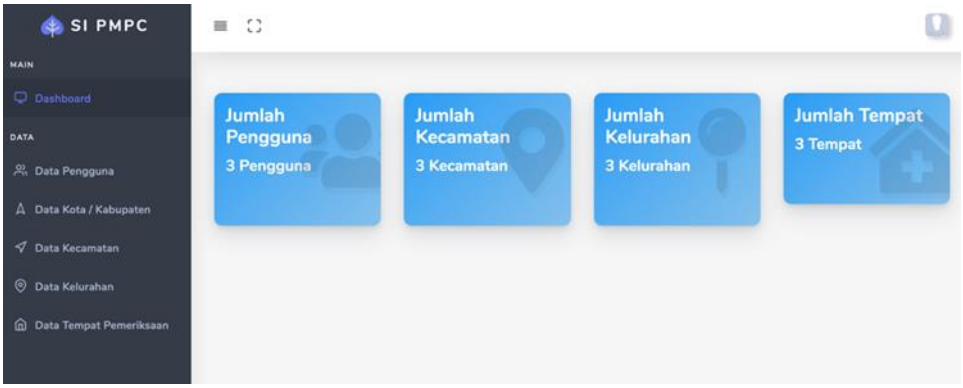

Figure 7. Home of administrator page

Figure 7 shows the dashboard of the admin. The page will be displayed when successfully logged in as admin. As illustrated in the figure there is some menu to manage user data, city, district, sub-district, and medical facilities data.

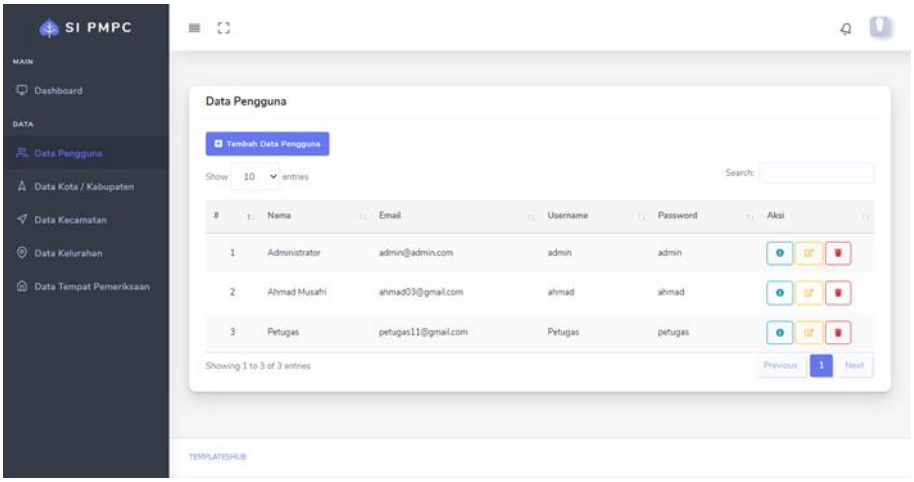

Figure 8. User data page

In this menu, the user data page is a page to display user data. Admin can add data in the form of name, email, username, password. On the user data page, there is an edit data action, view data, and delete data, which is shown in Figure 8.

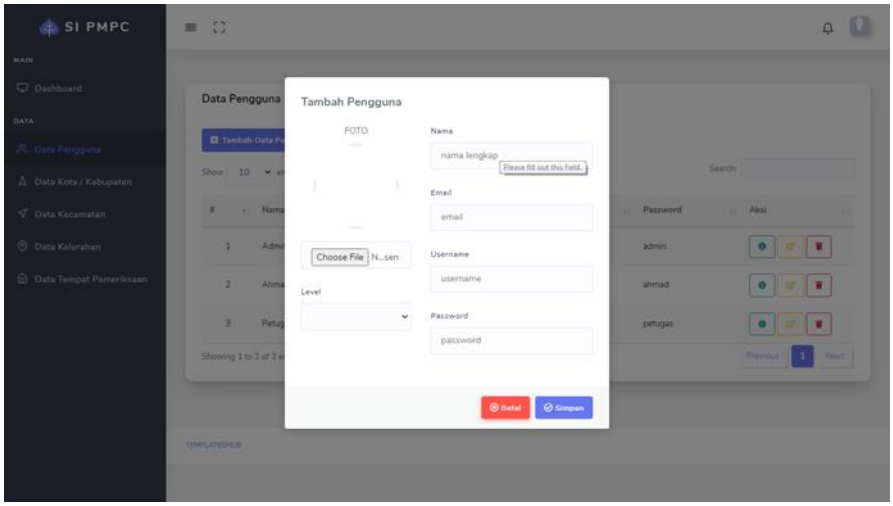

Figure 9. Add user data

The page for adding user data is shown in Figure 9. On this page, the admin can add data by filling in the data, when it is finished and saved then click the save button, if not click cancel.

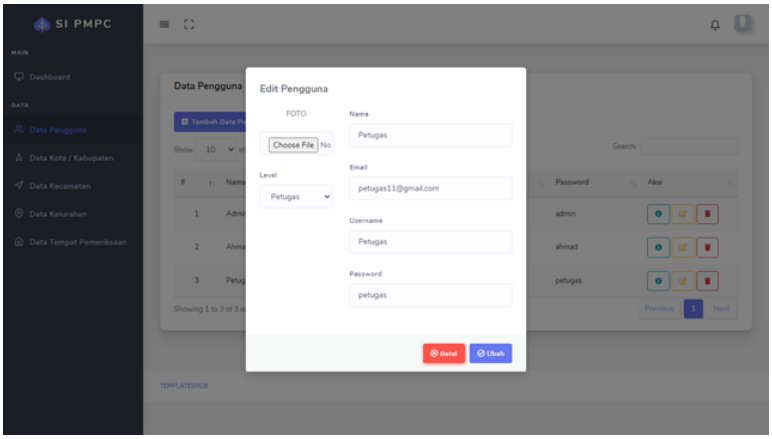

Figure 10. Edit users data

Figure 10 shows the page to edit user data. On this page, the admin can edit user data when there is a data change.

Sukorame Community Health Center Officer Page

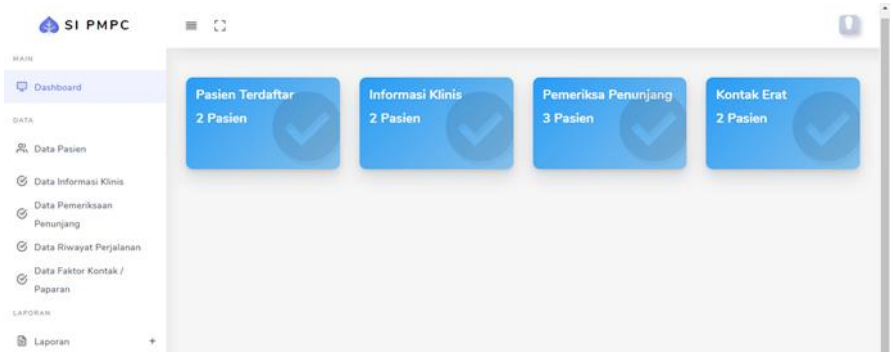

Figure 11. Community health center officer dashboard

The officer dashboard is a page to display the number of patients, patient clinical information, supporting examinations, and close patient contacts which are illustrated in Figure 11.

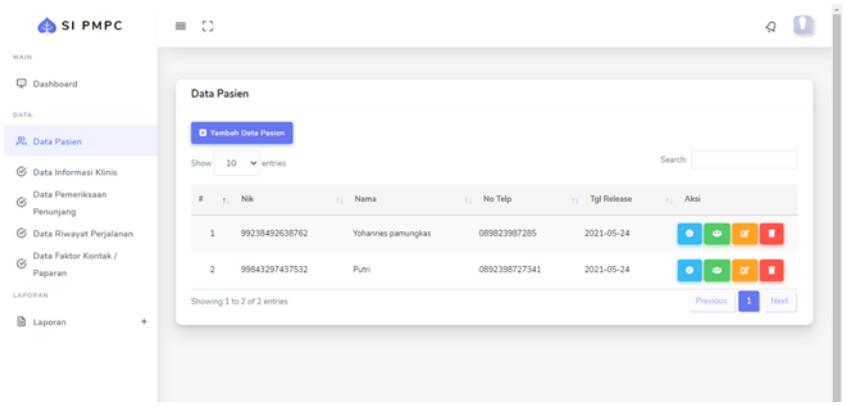

Figure 12. Patients data page

Figure 12 is a page to display patient data. Officers can add data that contains some details of the patient's profile. On the patient data page, there is an action to edit data, view data, and delete data.

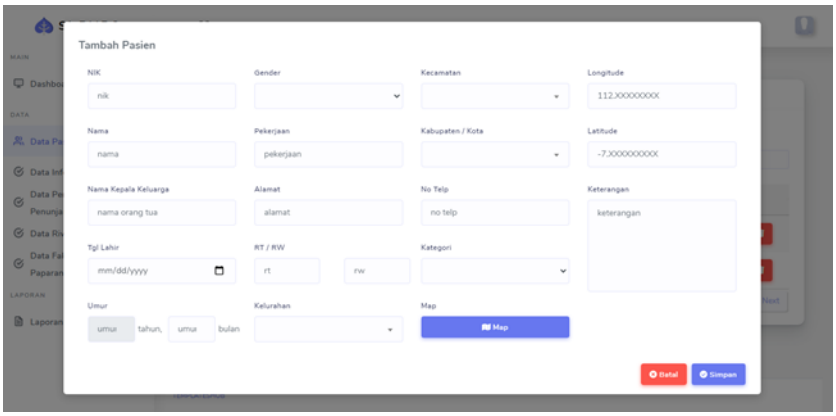

Figure 13. Add patient data

Figure 13 shows the page to add patient data. On this page, the officer can add data by filling in the data, when it is completed and saved then click the save button, if not click cancel.

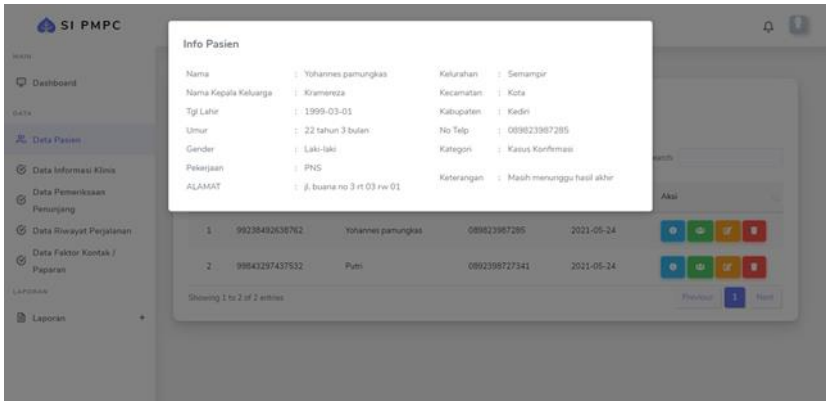

Figure 14. Show the detail of patient data

On this page, officers can view patient info, to view details of the patient's profile, this process is illustrated in Figure 14.

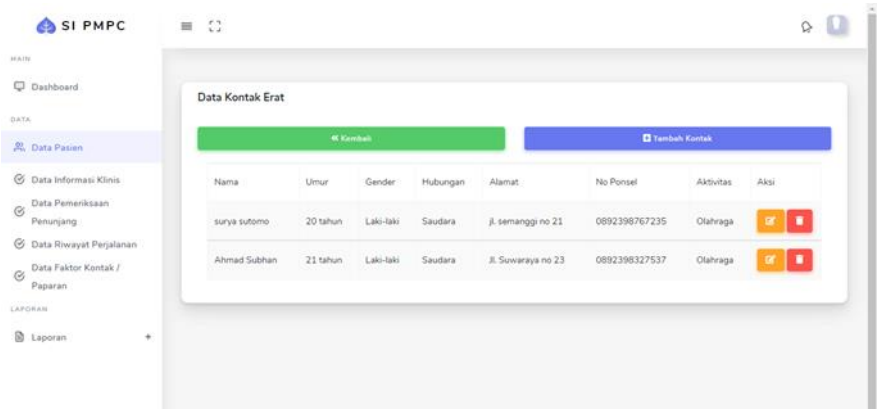

Figure 15. Close contact data page

Figure 15 displays Close contact data page is a page to display close contact data for each patient. Officers can add data that contains several details of patient profiles exposed from previous patients. On the close contact data page, there is an edit data action, view data, and delete data.

Discussions

Black box testing is used to determine whether the application features are well developed or not by trying all the available features, as shown in the table below:

Table 2. Blackbox testing result

No	Scenario	Expected Result	Valid / Not Valid
1	Open the web application	The application shows the login screen	Valid
2	Show Administrator Dashboard	Administrator Dashboard successfully displayed	Valid
3	Show District dan Sub-District Data	Menu District dan Sub-District successfully displayed	Valid
4	Delete District dan Sub-District Data	The selected data can be removed from the database.	Valid
5	Show Community Health Center Staff Menu Dashboard	Community Health Center Staff Menu Dashboard successfully displayed	Valid
6	Show Patient Data	The application shows the patient data	Valid
7	Add, edit and Delete patient Data	Successfully add, edit or delete patient data.	Valid
8	Show report data	The report data successfully displayed	Valid

As we can see in the table, all functional requirements can be fulfilled in the application and run well, for example, the essential functions of patient data management where the community health center staff can add, edit and delete the details of patient data.

Conclusion

This research was successfully built as an Application for collecting and monitoring COVID-19 Patients in Sukorame Community Health Center. The website application has three user levels: ad-min, Community Health Center officer, and The Head of Community Health Center. All the

functions of the application are running well and fulfilled user requirements. Based on the results of the user satisfaction questionnaire, 75% of users were helped by this application to monitor COVID-19 patients.

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