Development Innovation to Predict Dengue Affected Area and Alert People with Smartphones

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Patsaraporn Somboonsak
Chandrakasem Rajabhat University, Bangkok, Thailand
patsaraporn.s@chandra.ac.th

Abstract—Dengue remains a significant problem that needs to be addressed urgently in Thailand. Although Thailand has spread the dengue fever for more than sixty years, however, it is still found dengue patients in every province and spread to various areas. There is also a variable pattern of disease occurring each year, so it is necessary to have tools to help forecast area to allow the related organization and the people in the area plan to prevent dengue fever that may occur next year. This research aimed to create innovation for predicting dengue fever regions, namely ThaiDengue, by collecting data from dengue patients in Chatuchak District, Bangkok, Thailand, from January 2014 to December 2018. There was a total of 358,524 dengue patients from the Bureau of vector-borne diseases applied to the prediction of patients in the next year with the ARIMA model (1,1,0) (1,1,0). It is predicted that in 2019, Thailand will have dengue patients around 95,000 cases, which has the number of dengue patients close to the year 2018. In the next step, application development and database on fog computing. Fog computing is an evolving technology that brings the benefits achieved by could computing to the periphery of the network devices for faster data analytics. It is better suited than cloud computing for meeting the demands of numerous emerging applications such as self-driving cars, traffic lights, smart homes. While the ThaiDengue consists of the main menu: how to use, forecast, surveillance calendar, notification, disease map, notify patients, contact the Bureau of vector-borne, knowledge information, and scan the QR code. After that, the result of the development, the researcher has the Bureau of vector-borne disease of Thailand used to forecasts, create a GPS map of dengue outbreaks, and create a calendar for dengue monitoring. After that, send a message to alert the people in the area of dengue via a smartphone and send additional emails. The results from using the application found this application can be used as a tool to help the Bureau of vector-borne diseases, to plan dengue fever control and alert the people in the risk areas of dengue outbreak and users are very satisfied with the use of the application.

Keywords—Prediction, alert, dengue, application, smartphone, fog computing, cloud computing

1 Introduction

Dengue (DEN) is the most important disease that is spread by the geographical area of the country, caused by a mosquito-borne viral infection. For over a decade, the incidence of dengue fever has increased by 30 times, while new diseases are estimated at 50-100 million times per year in over 100 countries (Africa, America, the Mediterranean, East Asia, Southeast Asia, and the Western Pacific region; America and the West Pacific) with epidemics every year, there are hundreds of thousands of severe cases, including 20,000 deaths [1]. While the outbreak of dengue in each country has various impact factors such as temperature, rainfall, behaviors, knowledge of dengue, and others. Although Thailand has encountered an epidemic of dengue for more than 50 years. Until dengue fever continues to spread in all provinces and unable to control without disease outbreaks. Especially in cities that are slums with the dengue epidemic situation in Thailand, 2014 – 2019, there were 90,670 dengue patients, 115 deaths [11]. Although the World Health Organization has discovered the dengue vaccine in 2016, it still has restrictions on the use of vaccines and no specific treatment, which patients always do not have medication to treat according to each patient. However, early detection of patients is effective in controlling the spread of the disease, which requires forecasting tools, and alert the people about the outbreak in the area as well as providing knowledge behavior to avoid dengue effectively [2]. Due to the advancement of emerging technologies such as the Internet of Things, cloud computing, mobile computing and fog computing, enabling application control and prevent dengue outbreaks that can accurately predict the occurrence of the disease and can be used to plan the surveillance of diseases in each area in order to effectively reduce the incidence of dengue. We have seen the increased importance of solutions that make it possible to optimize the operation of mobile devices. Among these solutions, the Mobile Cloud Computing (MCC) concept plays an important role, which enables tasks and services to be sent from the mobile device to the cloud and the result to be returned to the mobile device.

Mobile applications have been used to benefit widespread today. Especially in the medical field, patients or those who need help can use the app for a quick consultation. Also, applications can be used to forecast outbreaks from the cloud database. This makes it possible, among other things, to reduce the time of task and service performance and to reduce the power consumption of portable devices [3, 4].

2 Related Works

Dengue has become a health problem that has increased in patients all over the world [8]. Which is now an essential pathogen due to more deaths. Dengue (DEN) is the most prevalent mosquito-borne viral disease in humans. It is caused by the dengue virus infection (DENV), which is found in four serotypes, including DENV-1, DENV-2, DENV-3, DENV-4 belonging to the genus Flavivirus family Flaviviridae [9-13]. Dengue fever can spread the virus in tropical countries, generally due to favorable conditions such as high rainfall, temperature, and humidity slum or urban communities that are densely populated, affecting the control of mosquitoes in urban areas. The rapid spread of such infection is due to climate change, the inability to control the breeding of mosquitoes [14]. Dengue virus infection occurs when humans are infected by female Aedes mosquitoes [15]. After virus incubation for 4–10 days, mosquitoes infected with the virus spread the infection to other organisms [3]. These viruses have an external incubation period of approximately 3-14 days, which occurs within the Aedes mosquito and have an incubation period within human of 3-14 days after viremia 2-10 days [1, 16]. Dengue patients, in general, will have a high fever, headache, joint pain, vomiting, rash, nausea, back pain, and swollen eyes for 2-7 days after the incubation period [17]. However, no specific antiretroviral treatment and vaccines are accepted to be used in hospitals. There are also risks associated with the treatment of patients, which is caused by antibody-dependent effects (ADE) [18].

2.1 Dengue epidemic

According to the study of epidemics of diseases caused by insects found that the World Health Organization, dengue fever is the second most serious mortality rate of the population after malaria [19]. Recently, Thailand has an epidemic of dengue fever very seriously. In addition, there are many other countries, such as in the country Brazil, El Salvador, Guatemala, Panama, Venezuela, and three other countries in Southeast Asia, Cambodia, Malaysia, Bhutan, Brunei, East Timor, Indonesia, Myanmar, Philippines, Singapore, and Vietnam. Moreover, Taiwan [19]. Previous studies of dengue outbreaks associated with various predictions such as population (density and urbanization), environmental attributes (transportation and water sources), temporary features (time, season), and climate features (temperature, humidity, and precipitation). Some researchers focus on living conditions habitat and individual behavior, including in terms of geography and as well as looking at the height from sea level as well as being a relevant factor. The recurrence of dengue fever is caused by many factors such as social change population growth being a crowded city society change of environment and the traveling of the population that goes between countries [20]. Even the appearance of El Niño affects the pathogenesis of pathogens that rely on water as a breeding ground [21]. Geography is one of the factors that affect the outbreak of dengue as well as climate change resulting in more dengue populations [22].

2.2 Dengue prediction

Formulation of policies or measures to prevent dengue from the Bureau of vector-borne disease thus reducing the risk of the spread of dengue throughout the allocation of disease prevention equipment and informing the Ministry of Public Health to arrange doctors Nurses to take care of patients in the area on time can reduce the spread of dengue. Previously, there were many ways to predict the outbreak of dengue. Therefore, forecasting the occurrence of dengue in strict advance can be used to help plan the control of dengue from the study of relevant research there are many researchers interested in using time series methods to predict the occurrence of dengue [23]. Traditional methods for forecasting time series such as Box-Jenkins or ARIMA this method allows us to adjust the seasonal moving averages (SARIMA) of automatic ANN non-linear dengue fever. Predictions have long been a domain of linear statistics, the methods for predicting time series such as the Box-Jenkins method or ARIMA [24-28].

Regressive integrated moving average (ARIMA) method is a time series model that is widely used in linear data structures.

While the ARIMA method artificial neural network simulation works well with data that is no missing in the time series and when a fixed time series [29]. The use of dengue incidence data from Guadeloupe, French West Indies, time [26]. In the process of capturing general data, both linear and non-linear time series is a popular method applied to display the outstanding features of the data. According to the study of related literature, there is very little research that uses the hybrid of ARIMA-ANN [29, 30]. For forecasting the spread of disease with temperature and humidity, there is a negative association with rainfall. This creates a model using forecasting weather conditions, suitable for use in forecasting migration [31]. Seasonal autoregressive integrated moving averages (SARIMA) models based on annual and combined climate data are independent variables to predict the outbreak of dengue outbreaks [27]. Poisson regression method compared with the seasonal autoregressive moving average process (SARIMA) and seasonal automatic autoregressive moving averages (SARIMA) with external regression methods [31]. Predictions using weather produce robust evidence for the use of such models in mitigation [23]. Using descriptive statistics and creating a binomial, negative effect model for predicting the number of patients with dengue from the number of people traveling from countries with dengue outbreaks [32]. Innovations created to solve dengue fever forecasting with a new combination of ARIMA and NNAR models [33].

2.3 Mobile medical application

Modern medical services require a large amount of information and innovation technology that can interact with patients [23]. mHealth application is a mobile device for supporting medical services, including health advice disease counselling. How to take care of yourself at home, initial symptom observation, providing knowledge about diseases and others. With a smartphone can be quickly exchanged between patient and health care provider and even connect the patient monitoring device to a healthcare provider. Doctors are incorporating them to monitor specific aspects of their well-being. Therefore m-health is a phenomenon that is here to stay and is expected to rapidly progress in its evolution in the years to improve health care. The mobile information and communication technologies in the healthcare sector have created a variety of new opportunities to deliver healthcare service to the patient. In the further, the average interaction of humans with a mobile device has increased while the interaction with a personal computer has reduced at the same time. This trend has opened the opportunities for the developer community the capture consumer attention with new innovative applications. Sine phone is a personal device and is expected to stay with the same person almost all the time, therefore, is it much easier to provide access to the information or monitoring related services through the same device [2]. Currently, various devices, such as smartphones, appliances, traffic lights, wearable devices, vehicles, and industrial sensors, are including smart cities, e-healthcare, intelligent transportation, and disaster response [2, 5, 33, 34].

2.4 Mobile cloud computing

The concept of Mobile Cloud Computing in creating a network that provides services to mobile devices is the most effective. Cloud computing is considered to be a number of advantages, such as battery life and increased storage space. One crucial challenge must be addressed. To be able to be used widely and the expansive range of cloud computing. These challenges include security, privacy and reliability, bandwidth and data transfer, data management and synchronization, energy efficiency, and diversity [35]. Cloud computing is a new paradigm used for hosting and services via the internet. It is attractive to business owners as it eliminates the requirement for users to plan for large and small organizations to be ready for work. It will be used to increase resources when there is more user service demand [30]. Since the rapid growth of mobile applications and the emerging cloud computing concept, the mobile computing cloud (MCC) has been presented as a potential technology for mobile services.

2.5 Fog computing

Fog computing is a new concept that extends the cloud computing model to the edge of computing networks, provides computation, data storage, and application service to end-user [7]. Fog computing is one of the new technology disruptors that has emerged and made entrances recently [7]. It provides computing and data analytics service more immediately and closes to physical devices that generate such data, i.e., at the edge of the network. MCC combines cloud computing with a mobile device environment and overcomes (performance perspective, e.g., battery life, storage space, and bandwidth) environment (e.g., scalability, and availability) security perspective (e.g., reliability and privacy) which will be discussed in mobile computers [35].

With fog computing that is different from cloud computing, which is close to the user, dense geographical distribution, and support for mobility [36]. The hierarchy of a fog computing system is illustrated in Fig. 1, where the vehicular fog is a part of the whole system [36]. To resolve the limitations of cloud computing and mobile edge computing, a new paradigm known as fog computing arose. Fog computing is built to extend cloud computing and services across the network [37].

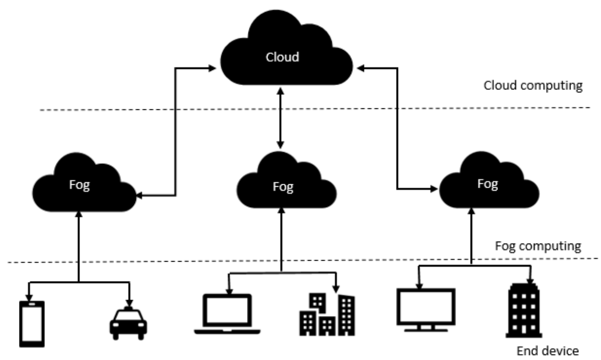


Fig. 1. An illustration of three-layer Fog computing

3 Material and Method

3.1 Study Area

The study was conducted in Chatuchak District, Bangkok, and the capital of Thailand. Chatuchak is located on the east bank of the Chao Phraya River, with 5 canals, including Khlong Lat Phrao, Khlong Nam Kaeo, Khlong Sue, Khlong Prempachakorn and Khlong Bang Khen. With a total area of 32,908 square kilometers. Divide the administration into 5 districts such as Lat Yao, population 47,590 people, Senanikhom population 21,047 people, Chatuchak population 25,772 people, Chomphon population 29,937 people and Chandrakasem population 38,492 people, total 162,838 people. A number of houses of 113,553, a population density of 4,738.14 people per square kilometer. The map of Chatuchak, Thailand, has shown in Fig. 2.

Fig. 2. Research area, Chatuchak District, Bangkok, Thailand

3.2 Survey instrument

From a survey of 162,838 people living in Chatuchak, the researcher used multi-stage sampling. The researcher selected the sample size calculation method from the Taro Yamane formula [38]**.** The sample was 400 people consisting of 117 people in Lat Yao district, 52 people in the Senanikom district, 63 people in Chatuchak district, 74 people in Chomphon district, and 94 people in Chandrakasem district. After that, a questionnaire was created, which consisted of three parts: 1) population characteristics; 2) knowledge of dengue fever; and 3) actions to prevent dengue fever. Finally, take the questionnaires to fifteen experts (In the field of information technology five people, in the field of application development five people and doctors in the field of dengue fever five people) to check the quality and then use to survey the sample.

3.3 Data collection

Collecting data for forecasting dengue fever events, the researchers collected data from the Bureau of vector-borne diseases for a period of 5 years. Thailand has a dengue epidemic in Chatuchak District, Bangkok, Thailand from January 2014 to December 2018, there were a total of 358,524 dengue patients, of which 81,489 were dengue patients in Bangkok, and in the year 2018, a total of 7,816 people, 107 people died. The patient data from the past 5 years in table 1. We are applied to the prediction of patients in the next year with the ARIMA model.

Table 1. Several patients and deaths in Chatuchak, Thailand, between 2014 – 2018

Number of patients	Year				
	2018	***2017***	***2016***	***2015***	***2014***
Sick	81,489	50,914	60,964	127,726	37,431
Die	60	60	139	40	133
Sick rate per hundred thousand	123.36	77.82	221.36	63.15	240.44
Illness Percentage Rate	0.13	0.12	0.10	0.10	0.10

3.4 Methods

The research process is a combination of both quantitative and qualitative. For quantitative use of surveys collected data from the questionnaire and area survey in terms of quality, use in-depth interviews. We conducted a survey to obtain data that caused dengue fever in the Chatuchak area. In the next step, a mobile application was developed and implement base on the results derived from the survey instrument. After that, successfully developing the application. We have taken to test for the quality of the tools by try-out with 100 users of the application. When getting quality applications, we deliver to the Bureau of vector-borne disease to use to alert the population. Finally, the usability of the mobile app was evaluated and distribute questionnaires for the satisfaction of 400 samples.

3.5 Development

In this section, we show the development of apps on the network. Fog computing with forecasting and dengue alert, we show examples of various menu applications in advanced applications. In finally, we present the results of the study of user satisfaction and an overview of the control of dengue fever when using the application found that dengue fever has decreased from the previous year. Developed applications can be used to predict areas that are expected to occur and alert the public about the occurrence of bleeding in the area. In addition, the public can send information when the patient is found to report to the Bureau of vector-borne diseases, send a doctor, nurse, or spray to get rid of the mosquito breeding area. The application supports the use of smartphones, PDAs, tablets installed with the android and iOS operating systems. In the screen design, it consists of nine menus, which divide users into two groups:

- Bureau of vector-borne disease set rights by encrypting the security for accessing the database on the network. forecast, notification calendar, alert, to prepare and alert people in area
- Users (citizens or community leaders) or individuals who install the ThaiDengue application can use the menu disease map, inform the patient, contact the Bureau of vector-borne diseases, knowledge and read the QR code can be shown in Fig. 3.

3.6 ThaiDengue application

The proposed ThaiDengue can be utilized to differentiate and discover specific mosquito-borne diseases and generates alert or notification in case of emergency to prevent the outbreak. Create and develop innovations for predicting dengue fever outbreaks on the cloud network as a tool for the Bureau of vector-borne disease to predict the occurrence of dengue fever and alert people through smartphones. Which consists of 9 menus, how to use, forecast, calendar, notification, disease map, notify, contact, knowledge, and QR code as shown in Fig.3a. Prediction and Alert Thai dengue fever developed for use in predicting the occurrence of dengue fever. Issued by creating a time series model after obtaining a useful forecast model and then create an application for bringing to the Bureau of vector-borne disease to alert people in areas that have spread the dengue fever according to the predicted results, as shown in Fig. 3.

a) Main menu b) Forecasting c) Notification calendar

Fig. 3. Prediction, and Alert Thai Dengue Application

In forecasting, the risk of dengue fever uses the information collected together with the weather forecast, which this research uses the time series analysis Autoregressive Integrated Moving Average (ARIMA) forecasting model. Forecast menu showing a graph forecasting dengue fever patients. The Emergency alert center (Bureau of vector-borne diseases) collects patient data for the past 5 years and then predicts it to be displayed in the graph of the real patient, and the patient who is forecasting can be shown as Fig. 3. B.

We are creating a surveillance calendar by the Bureau of vector-borne diseases, creating a calendar to alert, starting from the date of notification to send to the public. After that, a checkmark will be displayed, indicating the successful creation of the calendar can be shown in Fig. 3. C.

The architecture design of the ThaiDengue application starts with data from the Bureau of vector-borne disease over the past 5 years. Next, develop the application of fog computing to collect data through the fog computing. Forecasting the disease area with ARIMA model (1,1,0) (1,1,0), then take the results from the forecast to create a calendar for dengue fever monitoring next year, including creating a map of dengue fever occurred in the research area.

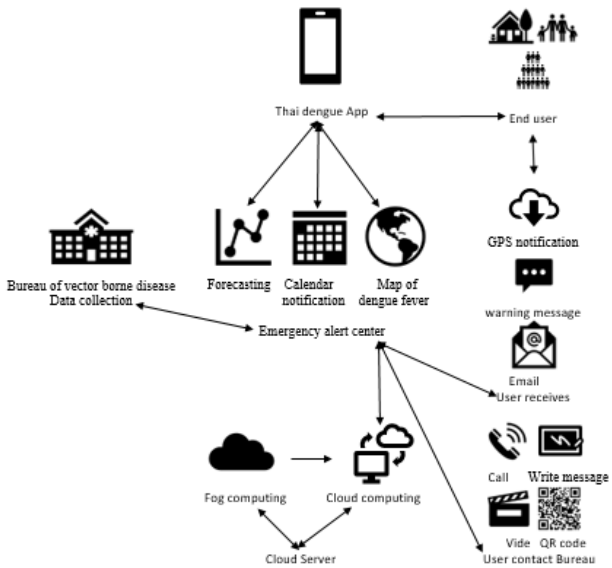


Fig. 4. An illustration of application architecture, Prediction, and Alert Thai Dengue

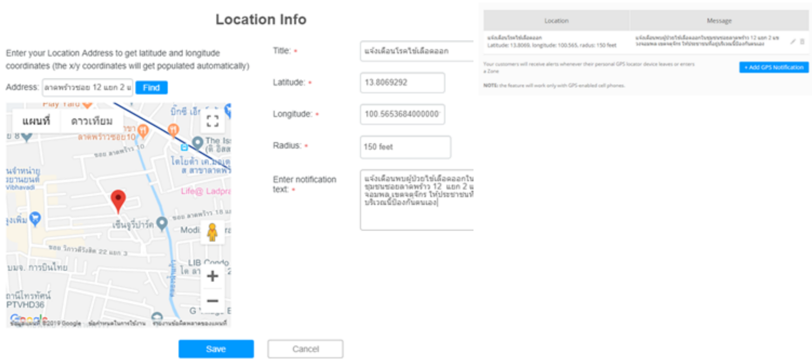
In the area of application, users in the research study area will receive GPS notification, warning dengue alert messages, and email. In addition, users of the application can make phone calls Department for Medical Delivery, the nurse came to check the patients or injecting controls to prevent the spread and send pictures of patients found in the research study area to the Bureau of vector-borne disease. Finally, users can learn how to avoid dengue infection through video or scan the QR code to see information about dengue patients and knowledge about dengue from the department, as shown in Fig. 4.

4 Results

The surveillance calendar is a menu that the Bureau of vector-borne disease uses to create a calendar to monitor the occurrence of dengue fever. It prepares mosquito spraying, arranges vaccines, etc. The test results of the application after creating a surveillance calendar set by the Bureau of the vector-borne disease determine the creation of a notification calendar by specifying the date and time of notification sent to the public. Which has a sign indicating the successful creation of the calendar.

4.1 GPS notification

Notifications for alerting citizens via smartphones and showing GPS locations in dengue alerts by the Bureau of the vector-borne disease can access the public with searching for addresses. When found, the area will show a map, position, latitude, longitude, and radius, fill the notification subject to the public and send a message. After that, people in the area will receive a message via smartphone. There are four steps: 1. search for locations starting with typing the name of the place in the address box, such as Ladprao Soi 12. In the next step, click the find button the map appears with a pin showing the location or a satellite map. 2. In the location info section (* means you have to fill out the information, do not leave blank). 3. Title type text into squares such as disease alerts latitude applications automatically retrieve latitude information. 4. Longitude applications will automatically retrieve longitude information. 5. Radius applications will automatically retrieve the radius. 6. Enter notification text type the message to be notified, such as notification, find dengue patients in the Phrayawek community, Soi Ladprao 12 Yak 2, for people in the area to protect themselves from dengue fever as shown in Fig. 5. A-B.



a) GPS Notification b) Add GPS location

Fig. 5. The Emergency alert center locates the area of dengue fever and types a notification message.

The Emergency alert center adds GPS location in the area; want to alert dengue by sending a notification message with 1. Add GPS notification button, 2. Select the phone system you wish to notify, 3. Click the phone system that needs notification, 4. Select the android or Apple operating system, 5. Create a message to send a notification (create notification message), such as a notification of an outbreak of fever, selected in Soi Ladprao 12, intersection 2. We can see the notification message is sent from preview Fig. 6. After that, click send notification message (send).

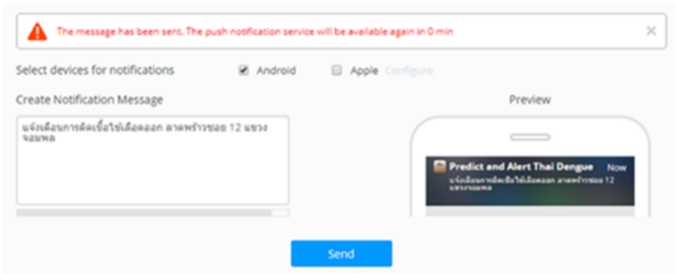


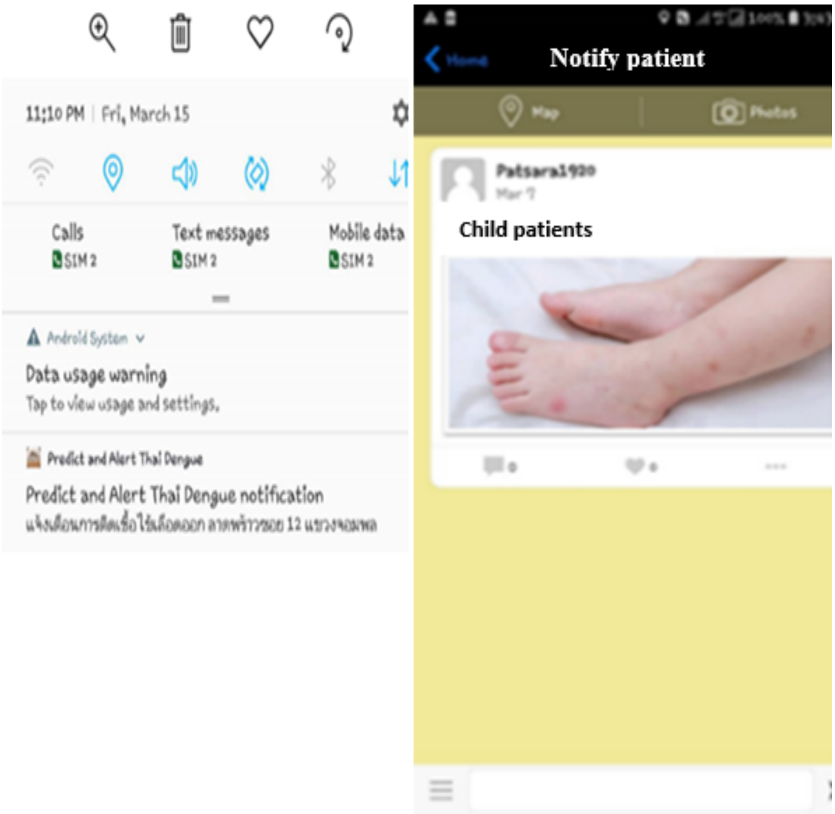
Fig. 6. Send dengue warning messages according to the area

4.2 Notification

The most critical component of an intelligent system is to control the spread of mosquito-borne diseases at the initial period itself. Once the smart system predicts the density of mosquito and risk-prone region, it automatically generates the alert messages or precautionary measures to the registered users through e-mail or mobile SMS repetitively regarding health information. It can also be sent to primary health centers, nearby hospitals, and government agencies based on the GPS location of the infected user's mobile phone to provide first aid. Once the registered user is diagnosed with the infection, an instant alert message is sent to the user's mobile phone. The alert message says that whether the user is diagnosed as possibly infected or uninfected.

If the user is categorized as infected, then continuous monitoring is essential. Thus, an awareness message is sent to take precautionary measures and medication in order to control the spreading of infection. Notification results when the Bureau of vector-borne disease sends notification messages according to the area or when dengue patients are found enabling users of the application to receive messages via smartphone, such as messages sent from Predict and Alert Thai Dengue, "Meet dengue patients in Soi Ladprao 12, Chomphon Subdistrict, Chatuchak District" as shown in the Fig. 7. A.

Application test results when users receive a warning message from the Emergency alert center, create a calendar to monitor dengue fever via smartphone notification. The user sent a photo to the Emergency alert center when dengue patients were found or carriers of the disease, as shown in Fig. 7. B.

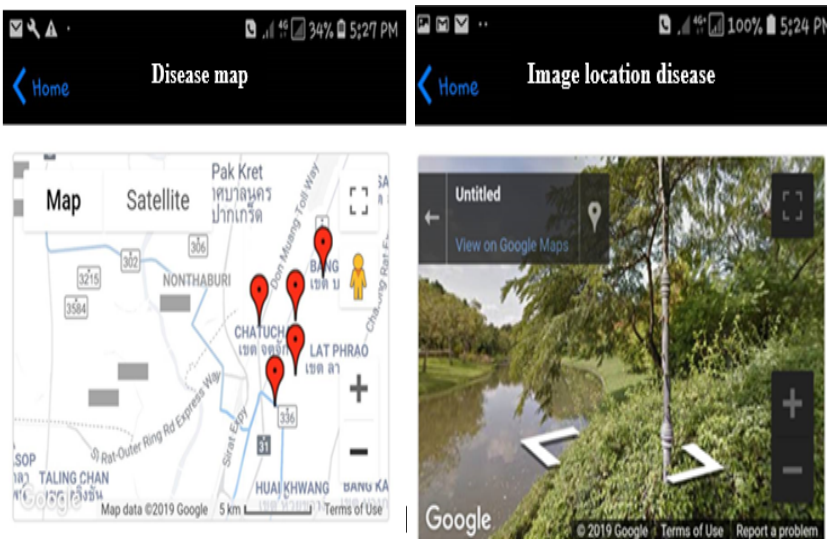


a) Receive results b) User sent photo

Fig. 7. The users receive results of dengue fever notification, and user sent a photo

4.3 Map dengue

Using disease map by the Emergency alert center determines the location on the map by filling the district information into the map area, the result is a red pin every point with the outbreak of dengue fever or displayed as a satellite image map showing the location of dengue fever shown in Fig. 8. A. The result received when clicking on the actual location of the dengue fever shown in Fig. 8. B. The map menu is used to display maps to know the area of dengue fever. The map display red spots are the area where dengue fever found in the area which users use click on the red dot, look at the overview of the map, (+) mark to increase the map size, (-) to reduce the map size and click the symbol to see the actual location shown in Fig. 8



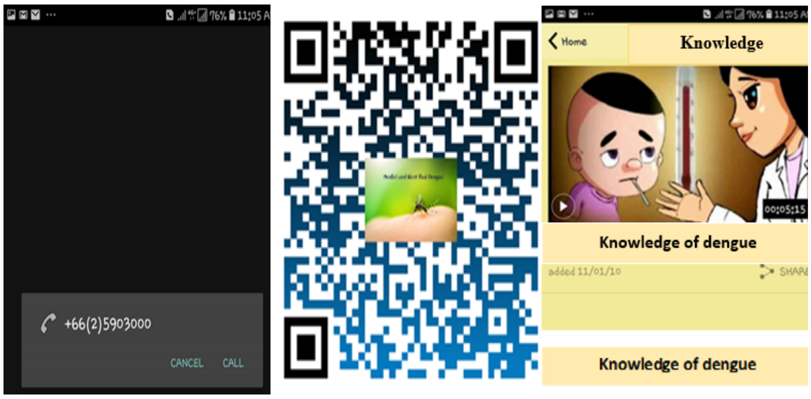
a) Map showing the location of dengue fever

b) The result of the actual location

Fig. 8. Map showing the location where dengue patients are found and pictures of actual locations of dengue fever

4.4 Contract and scan QR code

The results obtained from the application call the center or scan the QR code to see the statistics of dengue patients. In addition, users can watch videos for educating dengue and how to take care of themselves. Testing the phone application, contact the Bureau of vector-borne diseases, can press the contact button to call immediately, as shown in Fig. 9. A. When users enter the menu, scan QR code and click to read the QR code will appear in the browser. The user knows the situation of dengue fever from the Bureau of the vector-borne disease each year and the website of the Bureau of vector-borne diseases, as shown in Fig. 9. B. Dengue knowledge. Results of the knowledge menu. Users can access the dengue knowledge video and how to behave correctly, as shown in Fig. 9. C.



a) Contact b) QR Code c) Dengue knowledge video

Fig. 9. Contact read QR code and watch knowledge videos about dengue.

4.5 Application satisfaction survey results

The results of application development and database on the cloud which consists of the main menu: how to use, forecast, calendar, notification, disease map, notify, contact, knowledge, and QR code. The result of the questionnaire on the satisfaction of using applications in the amount of 400 people consisting of dengue patients, doctors, nurses, Emergency alert centre staff, community leaders in the study area. The results from evaluating the satisfaction of use 4.13, an average mean of content quality is 4.14, conventional way of design is 4.15, overall, the satisfaction with the application usage is 4.14 and a standard deviation of 0.76. Based on the consequences of the research, it could be concluded that applications developed by the researcher can be applied to the Bureau of vector-borne disease to monitor dengue fever in the area and alert the public to a high level.

4.6 Questionnaire survey results

The results of the questionnaire consist of most dengue patients who were female, 56.49%, and 61 years of age, mostly 35.06% of primary school, 29.22% were employed. Monthly income was below 10,000 baht, 43.51% had knowledge of dengue fever 4.27 points from the full score of 10 points, 16.88% received of dengue alert messages on smartphones. The results of the questionnaire on self-protection practices the dengue fever of average score 1.02 with standard deviation 0.77, the lowest score 0 points, and the highest score of 4 points from 10 points.

5 Discussion

In the research on innovation, development to predict the area of dengue fever and alert people with smartphones is an application for monitoring and GPS tracking the occurrence of dengue fever developed with the fog computing system with a service model that supports users at anytime, anywhere with a function The work that covers. the most usage and use are beneficial facilities for current smartphone users. Fog computing is a new technology disruptor could compute with limited by solving the problem of the edge of computing networks, provides computation, data storage, and application service to end-user [7]. It is a new paradigm known as fog computing arose. Fog computing is built to extend cloud computing and services across the network [35]. While modern medical services require innovation to facilitate patients who are able to receive news and information at all times via smartphones, such as the mHealth application [23]. Precise prediction of dengue fever can be used to help plan the control of dengue fever. According to a study of related works, many researchers are interested in using time series methods to predict the occurrence of dengue fever. A prediction has long been a domain of linear statistics. Time series prediction methods such as Box-Jenkins or ARIMA [24-28].

6 Conclusion

The development of innovations that use dengue prediction and alert people via smartphone. Start with, forecast the areas at risk of spreading dengue disease from collecting data from dengue patients from the Bureau of vector-borne disease for five years. In the next phase, the ThaiDengue application development consists of the main menu, how to use, forecast, calendar, notification, disease map, notify, contact, knowledge, and QR code. The new technology used to develop applications with fog computing. After that, a questionnaire was created and taken to fifteen experts to check the quality of the application. Finally, we gave the application to Bureau of vector-borne disease, this app can be used to help and monitor dengue activity and the most important can be used for planning and the government will allocate resources such as medicines, doctors and nurses to help dengue patients.

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9 Author

Patsaraporn Somboonsak Information Technology, Faculty of Science, Chandrakasem Rajabhat University, Bangkok, 10900, Thailand

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