ionFluid: Designing and Developing A Water Level Notification System

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Abstract. The difficulties to access the information to retrieve the river’s water level status at the area of Sungai Sembrong causes the residents nearby to insensitive and complacent towards the threat of flood hazard that can occur in just in a matter of seconds and can destroy their property and also can cause the loss of life. ionFluid is an online water level notification system for Android based application that allow users to receive water level status of a river. Users can receive water level status by using mobile device either by SMS or Push Notification technology. This system will be The methodology used to develop this Android system is Evolutionary Prototyping model. Software technology used to develop this system is Ionic Framework where this technology uses web technology to develop mobile hybrid application. Database used for this system is MariaDB while programming language used to develop this system is PHP, AngularJS, HTML and SCSS. Hereby, developed system can increase the awareness of the public to be more cautious against environmental threats especially floods disaster.

1. Introduction
Flooding is a phenomenon that often occurs in Malaysia. But in recent years, flood phenomenon are often occurs and the situation is worrying some Malaysians citizens. Floods that struck Johor state in 2006 and 2007 and the East Coastal in 2014 have triggered a greatly impact to the flood management here in Malaysia (SM Bukari, 2016).

The absence of an effective flood alarm systems in providing information about the impending flood has caused many residents in flood prone areas to face the problem of property damage and loss of life oftentimes. For the present time, there is no efficient flood warning system in Malaysia where
the public can receive flood information directly through telecommunication networks. The residents also cannot access any information about floods if do not have internet connection.

This project intends to create a web based system and an android based application that could determine the water level of the river based on the input from a water level monitoring device. This project will use water level monitoring device to monitor the river’s water level and notify users by mobile device. Thus, allowing the residents who have subscribed to this system to be able to know the water level for precautionary measures. Following are the objectives of developing this system:

- To design a water level notification system using object-oriented programming method.
- To develop a web-based water level notification system by integrating mobile-based system.
- To provide a mobile-based platform for user to receive notification.

2. Related Work

2.1. Info Banjir Jabatan Pengairan dan Saliran (JPS)

Portal "Jabatan Pengairan dan Saliran Malaysia" can be achieved through http://publicinfobanjir.water.gov.my/ address. This portal provides easy to view a variety of information regarding the floods in Malaysia. This system does not provide any easy use of the system to the user, it only provides ease of use for staff. Review the website shows that it is to display information related to the floods.
2.2. Iowa Flood Information System (IFIS)

![IFIS Interface]

Figure 2. IOWA Flood Information System Interface

Portal IOWA Flood Information System can be achieved through http://ifis.iowafloodcenter.org/ifis/address. The Iowa Flood Information System (IFIS) is a one-stop web-platform to access community-based flood conditions, forecasts, visualizations, inundation maps and flood-related data, information, and applications. This is a beta version of the Iowa Flood Information System (IFIS) which is always in active development cycle with much experimental and advanced functionality.

2.3. Scottish Environment Protection Agency (SEPA) Water Level

![SEPA Interface]

Figure 3. Scottish Environment Protection Agency (SEPA) Interface

Portal Scottish Environment Protection Agency (SEPA) water Level can be achieved through http://www.sepa.org.uk/environment/water/water-levels address. This website monitor and record water levels on lochs, rivers and coastlines around Scotland, producing valuable information used by businesses, households and leisure users.
Table 1. Comparison among similar systems

| Specification       | System | JPS | IFIS | SEPA | ionFluid |
|---------------------|--------|-----|------|------|----------|
| Responsive          |        | No  | No   | No   | Yes      |
| User friendly       |        | No  | Yes  | Yes  | Yes      |
| Web-based           |        | Yes | Yes  | Yes  | Yes      |
| Mobile application  |        | Yes | No   | No   | Yes      |
| Login               |        | No  | No   | No   | Yes      |
| Reporting           |        | Yes | Yes  | Yes  | Yes      |
| Notifications       |        | Yes | No   | No   | Yes      |
| Historical data     |        | Yes | Yes  | Yes  | Yes      |
| Graphical data      |        | Yes | Yes  | Yes  | Yes      |

Table 1 above shows the comparison between the proposed system and the similar systems with respect to the scope of the system.

In the modules aspect, it can be seen that the similar existing systems are lacking some functionality which the proposed system can cater to. Such functionalities are the notification on smartphone device and also login module. These drawbacks in the similar existing systems are adopted into the proposed system to improve the efficiency and capabilities of the proposed system. All three existing similar system does not have login module for the end-user because these system are built for public users and does not charge the end-user for any data they get from the website. Meanwhile, the proposed system has a login module because this system provide notification using paid service which will be receive by the end-user through their mobile phone. This capability require login module to be installed in this proposed system so the end-user can pay online to use the service using their account.

3. Development Approach

Evolutionary prototyping strategy was chosen as the most appropriate approach for the proposed system. Evolutionary Prototyping is a lifecycle model in which the system is produced in increments so it can promptly be changed because of end-user and customer feedback. Most evolutionary prototyping start by prototyping the UI and after that evolving to a completed system from that, yet prototyping can begin with any region of the system. According to Sommerville in (Sommerville, 2007), the development starts with the parts of the system that are understood [4]. The system evolves by adding new features proposed by the customer. Evolutionary prototyping fundamental idea is to construct a robust prototype and continually enhance it.

Requirements analysis is implemented to look for the system’s needs and its functionalities. The requirements elicited for the system are documented in the form of a Use Case Diagram and Use Case Specification, Sequence Diagram and Activity Diagram for each use case and a Class diagram to represent the identified entities. In the user requirements, the components and functionalities for the proposed system were recognized. Table 2 demonstrates the user requirement for the system.

Table 2. User Requirements for ionFluid system

- User ought to have the capacity to get alert notification message.
- User ought to have the capacity to see the current and previous water level readings.
- User ought to have the capacity to enrol an account.
- User ought to have the capacity to manage channel subscription.
- Administrator ought to have the capacity to manage channel and user.
- Administrator ought to have the capacity to produce measurable chart.
4. Designing the system
An object oriented approach was used to develop the system. Therefore, the analysis is represented in the form of object-oriented diagrams such as Use Case Diagram depicted in the Figure 4 below.

The Use case outline gives a realistic review of the performing artists required in a system, distinctive capacities required by those actors and how these diverse capacities are associated. Requirements investigation is imperative with a specific end goal to set up user and system requirements. Analysis on the requirements has created the project specifications report to build up the application.

To make instinctive and user-friendly environment, aspects such as color scheme, button positions, navigation menu and many more were arranged painstakingly. In the application development, we emphasized functional design and flat layout design so as to give the user straightforward yet rich with user experience.

5. Result and Discussion

5.1. Application Development
The principle relic for this venture is the development of the application. This project is developed based on the user and system requirement specification.

Figure 5 below shows the main interface for the application. User is able to view list of water level log schedule retrieved from the server through Push Notification service. User can choose either to view the schedule by filter it by water level status or by day (maximum to past seven days). When the filter is applied, user still can receive data but the interface will show records based on the user selection.
Figure 5. Main interface for ionFluid (View Schedule)

In the View Schedule interface shows the list of schedules retrieved from server and each individual schedule item can be clicked to view the details of the records as depicted in figure 6.

Figure 6. View Graphical Data Interface

Figure 6 shows the View Historical Data interface. This interface is used by users to view historical data of water level reading for up to seven days. Users are able to view historical data through the Historical Data Activity. Here, a line chart displays reading values for the last 24 hours. The graph data is constructed according to the series of water level reading from the remote device.
Figure 7. View Graphical Data Interface

Figure 7 shows the View Graphical Data interface. This functionality is available through a mobile and web interface that is accessible to any public user. The public users are able to view live sensor readings through the ionFluid web portal.

Figure 8. Register Account Interface

Figure 8 above shows the registration account step where in this step the user requires to fill a registration form which is used to collect their details. After the user complete the form and submits it, the data would then be saved into the user’s database table on the remote database.

After the user submitted the registration form, an SMS will be retrieved containing six-alphanumeric. The user required to enter the code into a pop up dialog box to continue registration. This step validates the user information such as phone number which is required to use in this system.

Upon successful registration, the user now is able to receive schedule data from the server by Push Notification service. The example schedule is depicted in the earlier figure which is in the figure 5.
6. Conclusion and Future Work

In the end of the project, it is concluded that the ionFluid system has been successfully developed and achieved all the objectives that was outlined earlier. The system has also managed to fulfil the system and user requirements, based on the results from the user acceptance test which has been carried out earlier. Nonetheless, the system still have room for improvements.

The system can be better improved to increase its scalability and flexibility in handling larger user scope in Malaysia. The ionFluid can be improved in many ways to further enhance its functionality. Some of the identified possibilities for improvement are as follows:

i. Improve the water level monitoring device’s efficiency by replacing the power source with a solar panel for continuous power supply.

ii. Improve the system to support multiple water level status from multiple devices.

iii. Improve the system to support incoming emergency calls for any types of phone including mobile phone and home phone

Overall, ionFluid has achieved all the objectives stated earlier. Hopefully the system can be implemented at the target area so as to help the target users improve their lifestyle.

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