The Design of IoT Dengue Alert Supervisions System with RFID Access

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Abstract. This research presents a development of a patient's Dengue Alert Supervisions (DAS) System. The system is designed adaptively to alert patients and can be monitored over the Microsoft Windows Interfacing Applications system. The purpose is to alert patients on dengue attacks if they are possibly infected with dengue. Problem identifies that patients are difficult and hard to go for regular medical check-ups especially to the hospital. They face issues like long queues and long waiting times at public hospitals and it takes time to diagnose the dengue attacks. The objective of this system is to design a handy system for dengue detectors and to accurately warn the patients so that, they are being treated properly. The elements designed in this system comprised of a temperature sensor and blood dengue kit which is combined with push buttons as a tool to determine the condition of blood cells. This system used Radio-Frequency identification (RFID) access card to detect personal details. The database is directed to Windows applications on the DAS system. Results present the value of the blood level of infected dengue and body temperature in an online graph. The data can automatically send to hospitals online and access by medical officers on current situations. The system is beneficial to society as it is an essay system that can provide the user with simple and timely feedback. It would also be a significant invention to medical officers in diagnosing patients with much easier and quicker collection data using the Internet of Things (IoT).

1. Introduction

Dengue fever virus is a common disease that happened all around the world these days. Estimates of the global incidence of dengue infections per year have been increased drastically in both tropical and subtropical countries [1]. This disease is transmitted when the mosquitoes that are called Aedes mosquitoes, which live in dirty places like unclean water or vases that carry the virus and attack humans[2]. Dengue is among the most important mosquito-borne diseases, with more than half of the world's population at risk of infection in dengue endemic countries. Environmental management, which includes any activities that involve environmental modification, environmental manipulation and changes to human behaviour have been used to mitigate the risk of dengue transmission[3]. The disease began to multiply in the number of cases from year to year and country to country. From 2009 to 2011, the disease began to infect humans in Brazil as the incidence were 205.5, 530.3, and 400.5 per 100,000 persons[4]. In Malaysia, the fatality rate has increased month per month due to the disease. Adulticiding using permethrin, deltamethrin, and malathion and larviciding with temephos and Bacillus thuringiensis isrealensis(Bti) are the main methods used to control the dengue vector in Malaysia. The scientist asserts that two types of species occur in Malaysia which are aegypti that found in areas that are developing
rapidly with less vegetation and *albopictus* that prefers conditions with more vegetation and more exophilic[5].

The dengue disease was firstly reported in 1902 and the first outbreak happened in 1962 at Georgetown, Penang, and followed by Kuala Lumpur in 1973 in Malaysia. Subsequently, the outbreak of the disease happened in both the urban area and rural area [6, 7]. Hence, the infected area where there is a breeding ground for mosquitoes within 100 meters to 200 meters or quarantine an area experiencing an outbreak of dengue has been studied. The transmission of the disease on specific also depends on the mosquito's growing period[8]. For every person infected with dengue, there are different levels for different ages. According to the past research, there were 128 subjects which involved extensive experiment on dengue disease including 80 males and 48 females from various sages who clinically suspected to have this disease and were referred for ultrasound scanning for both abdomen and thorax [9, 10]. Humans which have been infected with dengue disease will have common clinical manifestations like fever, severe headache, retro-ocular pain, pain in the muscles and joints, and purpuric spots on the body [11].

There are two general types of dengue fever, which can be considered as the most severe which are Dengue Hemorrhagic (DHF) and another one is Dengue Shock Syndrome (DSS) [12, 13]. According to research mosquitoes were strictly associated with standing water, with the belief that mosquitoes must have water to lay their eggs. They figured out by analyzing the vulnerability of water which is associated with health hazards. Dengue virus would be active in the patient's body for about 3-14 days or on average the symptoms are usually detected on the 4th to 6th day. The patients infected by dengue would experience sudden fever that would later be followed by a variety of signs and symptoms that are not specific. This is because the blood of the patients is not stable and low volume of platelet[14]. The sign that indicated the dengue fever are sudden high fever and persistent, red spots on the skin, severe pain in bones, joints, muscles, eyes, and head, bloody body, nose and mouth, loss of appetite, vomiting, stomachache, bitter taste on the tongue and weak and also feeling of listless. There are several ways for the infectious dengue fever virus to be transmitted, such as dengue fever germs carried by Aedes mosquitoes, the healthy person is bitten by mosquitoes, dengue fever patients with dengue germs in his body and Aedes mosquitoes bite dengue patients.

The advancement in modern technology devices has driven the users to incorporate the electronic devices to perform their daily tasks and improve the basic operation of the device [15]. Therefore, this system is developed and implemented in Windows 10 Application, enabled the interactive control panel for monitoring the dengue system. Nowadays, the IoT has grown to become the most preferred system that utilizes the local area networking and global area networking to user details [16]. IoT can access out the range that localhost used. The application is suitable to use by using with Graphical User Interface (GUI) on the Windows 10 device. The system also provides an interface that allows users to explore every detail of this software [17]. The webpage localhost is developed by using the XAMPP software. XAMPP is an Apache distribution package that is small, portable, and contains the common web development technologies in its set. This is a very effective tool to develop and test applications in PHP and MySQL database [18]. The Windows 10 applications are developed by using the Microsoft Visual Studio Community and Arduino.

2. Methodology
This research comprises of three main phases which are the design phase, development phase, and testing phase of the hardware and software system for the Dengue Alert and Supervision System.

2.1 Flowchart
Figure 1 shows the project flowchart of the Dengue Alert Supervisions (DAS) System. Both hardware and software evaluations were made to analyze and characterize important parameters to be used in the system's design. The hardware used in this project were microcontroller Arduino Uno, USB 2.0 Cable Type A/B, Radio Frequency Identification (RFID) RCC 552 with RFID Card, Temperature Sensor LM35, 3 components 6x6x8mm push button that linked with Dengue Kits. The software used in this project
was Microsoft Visual Studio, Operation System Windows 10, and XAMPP Server by Online Database. Both hardware and software need configure to access the database and serial port. It will automatically be connected after the configuration database and serial port. The user connects the card to the RFID sensor and the value of integers as user ID display in Microsoft Visual Studio Applications. The user ID which has already been stored in the database can access the system else patients failed to access the system. New users need a new user ID which the patient needs to fill in their details into a new form register account. After the system allows access, the patient also can check their blood by using Dengue Kits. The result on Dengue Kits links with level blood needs to click push buttons. Each push buttons have a blood condition level. Temperature sensors detect human body temperature. Users need to click the push button while holding the temperature sensor. The value of both blood condition level and human body temperature load Microsoft Visual Studio Applications. Finally, both values were recorded and saved into the database.

![Flowchart of the DAS System](image)

**Figure 1.** Flowchart of the DAS System

### 2.2 Block Diagram

This project used some chemical kits that are needed to complete this system. Dengue Kits is one of the required tests in the system to check the user's blood sample. It was combined with push buttons to indicate the level that the user can refer to have used. There are three levels, indicating that the Dengue kits provide three-level blood condition. Since dengue tests can be easily be checked using the human
body's temperature, there is a sensor that is specifically used to check the body's temperature. The sensor is LM35 which is expertly used to detect body temperature. Another more advanced system, RFID RC552 sensor used as well, and the user has to log in and provide their details which are saved in a secured database. All data is controlled by one microcontroller which controlled the system. For this project, Arduino Uno is used since it is more suitable and easier to configure in terms of the coding for the three mains sensors input. The codes in Arduino is read by Microsoft Visual Studio Community 2015 using Visual Basic Interface. The condition and output of the program will be displayed on the Visual Basic Interface.

![Figure 2. Block Diagram of the System](image)

Figure 2 shows the functional block diagram of the system. Three of the components are the input of this system which is RFID Sensor with Card, Temperature Sensor, and Dengue Kits and Push Button. Data from the three components are captured and are processed by the Arduino Uno. Finally, the result is displayed on the Windows application. Most of the common Windows application used is Visual Basic Interface. Visual Basic is a program similar to another language that more to Windows Interface that is suitable for computers and linked with Arduino through serial Port.

3. Results and Analysis

Results show the successful functions of the developed system on windows application Interface for DAS System. Since the project is a system application, the application is called DAS System (DAS). Figure 3 shows the combined hardware and software DAS System with Dengue Kits. Figure 3 shows the result of the hardware and software that was being developed and produced. The hardware is connected to the device by Serial Port Cable and linked with Visual Studio. Before initiating the system, both hardware and software need to be connected. The devices require internet access Wi-Fi or Lan Cable. The Visual Studio Application was run with the connected hardware. Figure 4 shows the displayed Windows Application.
The Windows applications is displayed when the Visual Studio is run. The patients that have already registered in this system would need to click the connect button, and If they have not, click the Create Me button. After connected then the next form is shown. Figure 5 shows how the patients were briefed about the configuration on this system and the connection between Arduino Uno and Visual Studio using Serial Port and Visual Studio with Database Online using MySQL server. There are two configurations before initiating this application. First, the selection process for serial port to find a suitable device, either PC or Laptop. It is automatically shown that one serial port can be used by the PC. Only one port depends on the PC or Laptop. Click until the Timer display ON. Next step, click "Connect Database". A network of this device is connected. Figure 6 shows the patient database.

There are two conditions after the device is being connected to this application and database. The success of database online already setup has shown a MessageBox that displayed “Connection Successful” else “Connection Lost” or “Reading the stream fail” is displayed. The RFID in the hardware has completed the setup process and it is ready to be used after the two configurations are completed. RFID card needs to be scanned by RFID RC552 on this hardware to login into this system. It is automatically displayed ID numbers depending on the registered RFID card. Login through this system and all the details that have been saved in the database can be displayed and filled into all textboxes and data table. After the data about patients displayed, the patients can do a checkup on the blood level and body temperature. Before starting, the patient needs to check the blood manually using the provided Dengue Kit. In the Dengue Kits, 3 levels need to be updated into this system. Level 1 shows one indicator and the patient needs to click push button number one. This means that the patient does not have dengue. Level 2 shows two indicators and the patient needs to click push button number two which means the patient has dengue for the first time and needs to be checked by a doctor. Level 3 shows three indicators and the patient needs to click push button number three. This level is critical and the patient is required to be quickly treated by a doctor.
Patients have to click and hold the temperature push-button temperature to detect the value of body temperature. Both value temperature values and push-button value will be sent to the textbox as shown in figure 7. Patient click "New Record" and data table updated as similar with database updated. The patient can log out and exit for this application. All the data is recorded and saved into the online database.

![Figure 7. Value of Temperature Sensor detects and Blood Level.](image)

Figure 8 shows an online database that has collected all data about the patients’ body temperature by LM35 as human body temperature and saved into the database. Blood level and condition were checked by Dengue Kits and click the button on hardware will be displayed in Windows application. The database is updated securely in the online database. All data recorded into one form of Windows applications that displayed the result from the data collected.

![Figure 8. Online Database](image)

Figure 9 shows the collected data from selected patients. In this form, there are two chart graphs, each display about body temperature, blood condition, and the date when the data was recorded. This data shows the balanced and manipulated data of blood and temperature.
Figure 9. Data that was recorded.

Figure 10 shows the data for Blood Level and Body Temperature. The system checked the condition of the patient. Both blood level and temperature are displayed in a condition that is suitable to patients if the blood level and temperature are varying in condition. Figure 11 illustrated the actual condition of the patient. The patient is considered as infected with Dengue disease but no fever if the blood level is higher and the temperature is normal. If the blood level is normal and the temperature is higher, it indicates that the patients only have a high fever. The data is automatically tracked by a recorded database and it is submitted to the doctor if the condition is critical and high fever. The data can be sent to Government hospitals for them to act in treating the patient or quarantining the location of the patient's living location. The system used Arduino Uno as the main component for the system hardware and was used as the controller of the whole system. Arduino was connected to the Microsoft Visual Studio Community by the installation of some add-ons for configuration purposes to both hardware and software. Since this system consists of hardware and software applications, it is suitable to be developed by using the Windows Basic Interface. Microsoft Visual Studio has a wider range of programming language which can easily be used. As a Windows application, Visual Basic is easy to work with, by simply selecting some form or event that needs to be displayed as the user interface. The codes that used to connect to the database has use localhost and global network, as it is easier since Visual Basic as many language styles to configure it from VB.net until Visual Basic 2015. Microsoft Windows 10 is a suitable running application of Microsoft Platform Interfaces without crashing. Connecting Visual Basic to the Database is also convenient and a high uplink to both software and hardware. Since this project requires software, the hardware part also had to be completed for this system. Figure 12 shows the connection of all input to the one microcontroller Arduino Uno. The inputs that are required are RFID Sensor RC552, Temperature Sensor LM35, and Push-button. The combination of inputs has been fed to the controller that saved the data acquired into the database. All processes from input to output were controlled by one microcontroller. All data will be connected and linked up with the database and saved on each table in the database.
Figure 10. Graphs about Date Record, Blood Level, and Body Temperature.

Figure 11. Data Temperature and Blood Level

Figure 12. Connection all input sensors with Arduino Uno.
4. Conclusion
In a conclusion, this DAS System on Windows Platform using Arduino Uno that had been developed is a great alternative to the traditional time-consuming approach easy to use by anyone. The combination of chemical kits and electronic components has been designed in the system that able to explore very deep and more suitable ways of recognizing the condition of the blood. This system had utilized the Microsoft Platform like Windows 10 and Visual Basic Interfacing wand was designed to run on laptops or desktops. As the connection with the IoT, all the measured data has been recorded in the database provided, which is easy to store and upload. Furthermore, Windows 10 application like Visual Basic made it easier for the users to connect and control this application with high security without bugs and system crashes either in its hardware or software.

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