Improvement Development of Bill Acceptor for Laundry Application with Internet-of-Thing as Notification.

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Abstract. Nowadays, self-laundry kiosk service has been widely available in Malaysia. Although the technology has been progressing rapidly especially the technology of Internet-of-Thing, most of the system used by the self-laundry machines are outdated. One difficulty faced by the owners of the self-laundry kiosk, they need to check frequently by themselves at their cashbox machines in order to check whether the cashbox filled or emptied. This leads to inefficiency and can be addressed if self-laundry machine is integrated with Internet-of-Thing technology. Thus, this project attempts to improvise the current system by developing the bill acceptor that gives the owner to monitoring the flow of current amount inserted by customer in real time by displaying it in apps at owner smartphone. The project uses Arduino Mega as a controller, bill acceptor machine as token receiver, Wi-fi module to send the data to apps, LCD and Blynk apps to display the current amount and Bluetooth module to communicate between the Arduino and the washing machine. A checklist analysis and scenario analysis are implemented to verify the functionality of the proposed prototype. The result shows that the proposed prototype achieve all the objectives required.

1. Introduction

The self-laundry kiosk service has been growing rapidly in Malaysia. According to [1][1], this rapid growth is due to Malaysians are keen to accept and adopt the self-service technology. Most of these self-laundry machines implemented are still similar to their predecessor in early 2000s where each self-laundry machine is independent and are not connected to internet in anyway. Most of the system used by the self-laundry machines does not connected with internet. This leads to difficulty for the owners for them to access real-time information of their machines. Especially when it is dealing with the inefficiency of travelling to their self-laundry kiosks frequently in order to check manually their cashbox machines whether the cashbox filled or emptied. This inefficiency created many losses: 1) monetary loss due to downtime because the cashbox is filled therefore it cannot receive cash note anymore or emptied token because the machine can no longer convert cash note to token for the machine; 2) loss of time and increase in cost due to unnecessary travelling to check the self-laundry kiosks.

As the technology has been progressing rapidly with the term Industry 4.0 being introduced, there are increasing trend in integrating internet with all machines and devices. This trend is called Internet-of-Thing (IoT) and has shown many benefits especially in the area of notifying, reporting, and predicting.
based on the data its collected. Few examples of the implementations of IoT are: 1) in the water quality monitoring system [2] where the data of temperature, PH, turbidity and the flow values can be access by the user in real-time via internet; home automation and reporting [3]; 3) real-time health care monitoring system [4]; 4) monitoring the irrigation and tank in India [5]; 5) monitoring weather parameters [6]; monitoring air pollution [7];

Noticing the benefit of integrating real-time of notification and reporting to the current self-laundry service machine in addressing the problems mentioned in earlier chapter, this project attempts to do exactly that by employing Arduino Mega as a controller, bill acceptor machine as token receiver, Wi-fi module to send the data to apps, LCD and Blynk apps to display the current amount and Bluetooth module to communicate between the Arduino and the washing machine. The use of Arduino as the main microcontroller due to its cost and programmer-friendly where the success of its implementation can be seen in several areas: educational kit [8-10], electronic game board [11-12], can crusher [13], etc.

The remaining of this project will explain the methodology of the project, the result and discussion of the project, and conclusion of this project.

2. Methodology

This project used a 36cm X 29cm X 36cm cube black box as the main container for the prototype. Figure 1 shows the actual physical construction in the project. Noticeable at the front panel of the proposed prototype, the bill acceptor machine is on the left side which accept cash bill note from the user. A push button is located at the middle as an emergency button where the user can press if it need to alarm the owner if there is problem faced when using the proposed prototype. The top right is the liquid crystal display (LCD) which is used to display the amount inserted by the user and other menu for the user to respond by using the keypad on the bottom right of the front panel. The relationship between the components is illustrated in Figure 2.

![Figure 1: Actual physical construction of the proposed prototype](image-url)
Figure 2: Block diagram of the proposed prototype

Figure 3 shows about the flowchart of the proposed prototype. Bill acceptor will accept the notes either in RM1, RM5 or RM10. After that, sensor that located in the bill acceptor will detect the notes inserted before. When the sensors detected the present of notes, the LCD will display the amount of money. Then, the total amount of money will also be displayed in Blynk apps. If the money is equal or more than RM5, then LCD will appear new menu which is if customers choose number 1 at keypad, motor that has be set as washing machine will be activated. If customer choose number 2 at keypad, motor that has be set as dryer machine will be activated.

Figure 3: Flowchart of the proposed prototype
Figure 4 shows the schematic diagram of this project. Two motors are replacing the role of dryer and washing machine. And serial module is used to replace the Wi-fi module. This project use Arduino Mega as the microcontroller that will act as a brain for this system. Bill acceptor will be used as an input which is money will be inserted through it. After that Arduino mega will do the process to display the amount inserted at LCD and via Blynk apps. Keypad 4x4 was used to select the machine that want to be use by customer which “1” for washing machine and “2” for dryer machine.

![Schematic diagram of the proposed prototype](image)

**Figure 4: Schematic diagram of the proposed prototype**

3. Result and Discussion

A checklist analysis has been done in order to test the functionality of this bill acceptor system project. By referring to Table 1, all the expected functionality of the proposed prototype has been able to be executed on the actual proposed prototype. This shows that the proposed prototype able to function according to the expectation when employed.

| Number | Statement                                           | Expected | Actual |
|--------|-----------------------------------------------------|----------|--------|
| 1      | Accept bill RM 1                                    | √        | √      |
| 2      | Accept bill RM 2                                    | X        | X      |
| 3      | Accept bill RM 5                                    | √        | √      |
| 4      | Accept bill RM 10                                   | √        | √      |
| 5      | Accept bill RM 20                                   | X        | X      |
| 6      | Accept bill RM 50                                   | X        | X      |
| 7      | Accept bill RM 100                                  | X        | X      |
| 8      | Display amount of money inserted into the bill acceptor at LCD | √        | √      |
| 9      | Display and monitoring real time the incoming cash flow into the machine via website/apps. | √        | √      |
| 10     | Controlling washing/dryer machine from the coin changer machine. | √        | √      |

For project analysis, this project has been rigorously tested for one month in order to test the performance reliability of the project systems. Figure 5(a) below show before bill acceptor activate and after bill acceptor already activates and figure 5(b) ready to accept the bill notes. To activate the bill acceptor, user needs to press the push button at the box. This is to avoid buffer from bill acceptor if the
power is on. After that LCD will display the current total which is RM0.00 due to there still no money insert in it. Figure 5(c) below show the current money already inside the box.

![Figure 5. (a) Before Bill Acceptor Activate, (b) After Bill Acceptor Activate, and (c) Current Money Inside the Box](image)

After that user need to insert money until the RM5.00 to proceed to other menu which is menu to choose between using washing machine or dryer machine. Since this bill acceptor system can be monitored and display the amount of money inside of it in real time, the display on LCD and Blynk application need to be tally. Figure 6(a) shows the current amount of money inside the box is equivalent with the Blynk apps in Figure 6(b). Figure 6(c) shows the LCD when user insert the money to bill acceptor after reach to RM5.00. Then, new menu will display in LCD which is 1 for washing machine and 2 for dryer machine.

![Figure 6. (a) LCD Display the Current Amount, (b) Current Amount Display in Blynk Apps, and (c) New Menu to Select Laundry Application](image)
After done the selected process, LCD will display back the main menu which is displaying the default amount RM0.00 regarding the first user already done using the machine. But in the Blynk apps, the amount of money inserted before will be remain. Figure 7(a) shows Blynk apps record the amount inserted before even the first process already done. This program will keep looping until the power is off. When the power is off, all the data send to Blynk apps will also reset. Figure 7(b) below shows when the power is off, the current amount display in Blynk Apps is reset to RM0.00.

![Figure 7](image1.png)

**Figure 7.** (a) Money Inserted in First Process Remain in Blynk Apps, (b) Value in Blynk Apps Already Reset When Power is Off

Since ThingSpeak is a cloud based system for this project, so it will record all of the flow money inserted even the Blynk apps already reset when the power is off. Figure 8 below shows all of the flow that has been recorded in ThingSpeak since this system implemented.

![Figure 8](image2.png)

**Figure 8.** Data Recorded in ThingSpeak Since System Has Been Implemented
4. Conclusion

This project is focused on the development of a Bill Acceptor for Laundry Application with Internet-of-Thing as Notification. The block diagram, schematic diagram, flowchart of the proposed system has been explained concisely. The result shows the proposed prototype fulfil the expected result.

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