Design and Development of Visitor Dropbox (VDB) System

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ABSTRACT: The performance of a new VDB system was described in this study. VDB is an access control system that is accessed using an RFID card reader. VDB is widely utilised for any guests to exit the premises by putting the card into the VDB. Based on the previous model, VDB uses a PLC system and is having trouble due to magnetic field coupling that occurs when control lines are located close to lines carrying a large current, which makes it noisy, and it is using a large solenoid and a large amount of driver circuit, which makes it heavy to carry. To control the movement of the card, a Microcontroller and servo motors were used in the construction of a new system.
Keywords: *RFID card reader; Industrial automation*

1. INTRODUCTION

The purpose of this study is to develop and analyse performance for the new VDB system. The mechanical part illustrated in Figure 1 was designed using Solidworks. The system's principle is that when the card is inserted, the IR sensor detects it and shows the card that is already in VDB. Whether the card is valid or not, the RFID card reader will power on in 5 seconds. If the card is valid, it saves in the bin; otherwise, it exits and goes into the tray. The main controller is an Arduino R3, with various electrical components such as an LCD, buzzer, and red and green LEDs as output and input indicators. The movement of the card within VDB must be exact, constant, and quick. In industrial robotic automation, they must include as much automation as possible in the production line, using the lowest computing system possible while maintaining no compromise in the outcomes [1-2]. It is simple to implement in a servo system and provides high control performance in and around a certain operating point. The controller's parameters are tuned for certain operating circumstances with the assumption that the operating conditions would not vary significantly [2-3]. This project's goal is to have a cheap budget yet high-quality performance. Because of its performance, this project recommended using a servo motor [4].

2. METHODOLOGY

The hardware is made up of a main body part and a controller. As shown in Figure 2, all of the electrical components, including the RFID card reader, are connected to the body. The upper servo is connected to a 2 × 2 cm metal plate, the function of which is to actuate whether the card is valid or not. Meanwhile, the lower servo is connected to an 8 × 8 cm metal plate, the function of which is to actuate for the invalid card if the RFID card reader does not send a signal. As illustrated in Figure 3, these two servos must be connected to the controller. Figure 1 illustrates the entire system created with Solidworks software.

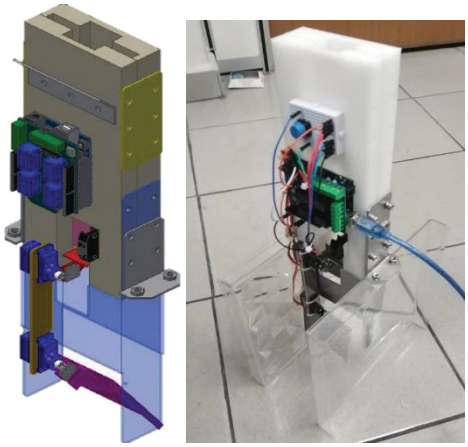

Figure 1: Full system design using Solidworks and fabrication the prototype of VDB system

Since some components require high voltage, a four-channel relay is required such as Led and Buzzer for this project used is 12V. Figure 4 illustrates the prototype circuit for VDB system.

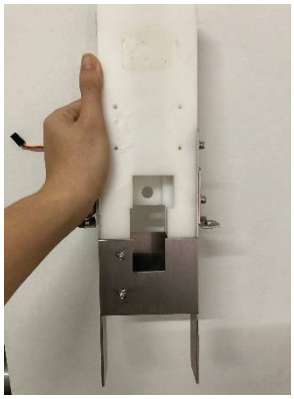

Figure 2: body part

Figure 3: Controller part

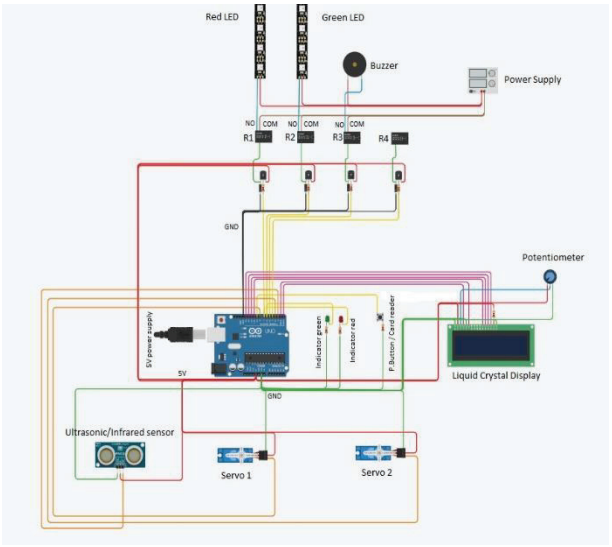

Figure 4: Electrical Circuit

2.1 Performance analysis

The servo motor is the main component used to control the system in this project. It must activate the correct angle in order to distinguish between two sorts of cards: valid and invalid. Thus, experiments for accuracy, precision, and time response need to be analysed.

3. RESULT AND DISCUSSION

After calculating average error, Table 1 shows that hardware has the best minimal error with 1.63 percent, while software has 2.65 percent error. Unpredictable changes throughout the experiment might create a random error in hardware experiments. In general, pulses with a period of 1ms correspond to a position of 0 degrees.

Table 1 shows the accuracy result comparison of hardware and software.

Entered angle(degree)	Software result(degree)	Hardware result(degree)	Software Error(%)	Hardware Error(%)
1	1.04	1	4	0
45	45.2	43	0.4	4.4
90	87.6	89	2.6	1.1
120	116.7	118	2.75	1.6
180	173.7	175	3.5	2.7

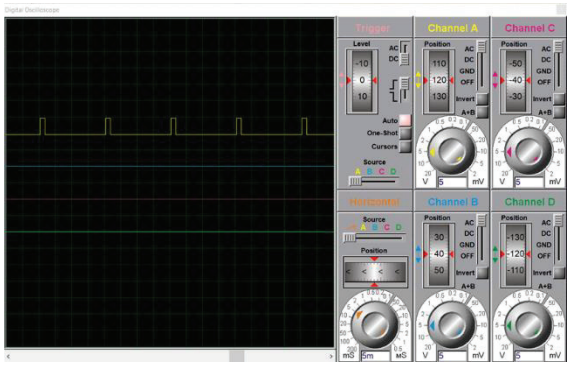

Figure 5: Graph result for precision

According to Figure 5, this experiment is carried out by programming the servo to spin 90° clockwise and then 90° anticlockwise. Channel A demonstrates that the pulses sent to the servo motor are consistent.

Table 2: Time response (valid card)

Repetition	Time (s)
1	28.6
2	28.9
3	28.4
4	28.2
5	28.6
6	28.3

This experiment uses a full system, as seen in table 2. The goal is to investigate the time required for ten visits (10 valid cards). This experiment should be repeated six times to obtain the exact value. Without any delay or error, the mean value from the table is 28.5s while performing this experiment. An extra servo is used at the card entry to prevent two or more cards from entering while the VDB is processing.

4. CONCLUSION

This project achieved all of the requirements required for the new VDB system and produced a positive outcome. The development of a microcontroller VDB with a servo motor as a controller demonstrates that it has good performance in terms of accuracy, precision, and time response.

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