

An Assistive Tool for Blind Students in Taking Exams Based on Microcontroller and RFID

Ari Jodiansyah Fijrianto, Stevent Hogan, Massus Subekti
Automation Engineering Technology Study Program, Faculty of Engineering
State University of Jakarta
Email: ari_jodiansyah@naver.com, masus@unj.ac.id

Abstract—This final project aims to create a tool that serves as an alternative system for SLB A schools (schools for the visually impaired) to make it easier for blind students and to make use of students' sense of hearing when working on exam questions. The results of the tests that have been carried out show that this tool has run in accordance with the program that has been developed. The results obtained show that an RFID tag, used as a participant card, can be tapped to log in; after that, students can immediately begin working by pressing the navigation buttons, which will play audio through the DFPlayer; and when the finish button is pressed, the student's answers are sent to a database, which is later processed by the teacher for grading.

Index Terms—RFID, Arduino Mega 2560, Ethernet Shield, DFPlayer, Speaker.

1. INTRODUCTION

Persons with disabilities hold the same status, rights, and obligations as members of society without disabilities. As part of Indonesian citizens, it is only proper that persons with disabilities receive special treatment, intended as an effort to protect them from human rights violations. This special treatment is viewed as an effort to maximize the respect, protection, and fulfillment of universal human rights.

Persons with disabilities form a diverse group within society, including those with physical disabilities, mental disabilities, or a combination of physical and mental disabilities. These conditions may have only a minor impact on a person's ability to participate in society, or they may have a significant impact requiring support and assistance from others. Among persons with disabilities, those who experience the most difficulty are the visually impaired (Tunanetra) [1].

In the educational environment, visually impaired students have so far studied using a special script, namely Braille, and tape recorders. However, when taking exams, schools still use paper printed with Braille, unlike regular schools that have begun to use CBT (Computer Based Testing). As a result, visually impaired students experience difficulty during exams because reading Braille characters takes a longer time.

Therefore, an assistive tool is needed that can serve as an alternative for the exam system at SLB A schools, one that can make it easier for visually impaired students to work on exam questions by engaging another sense that remains normal, namely hearing. This tool can be developed by utilizing Arduino Mega 2560 microcontroller

technology and RFID, together with a question chip in the form of a microSD card, with speaker or headset output connected to a localhost database.

Students will be given a participant card in the form of an RFID tag, which will be used to log in. Students only need to tap the card on the available device so that they no longer need to fill in personal data again. After that, students can begin working on the questions by listening to the questions being read aloud and selecting an answer using the buttons provided.

This tool is not only an aid for visually impaired students, but is also useful for teachers, since with this tool teachers only need to record their voice using the Google Voice Assistant and load it into a microSD chip. The exam results completed by students will be entered into the localhost database via Ethernet, allowing the teacher to directly process the students' answers.

2. METHOD

This tool was created to assist visually impaired students in working on exam questions more effectively and efficiently. This tool uses RFID as the participant card, which is integrated with an online database, so that teachers can easily manage the answers of students taking the exam. The system block diagram is shown in Fig. 1.

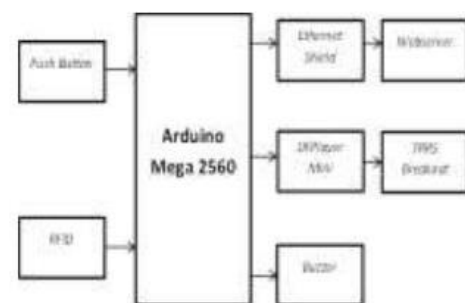


Fig. 1. System Block Diagram

To operate this tool, a power supply of approximately 5–9 volts is required. After tapping the RFID tag, the RFID reader forwards the data to the Arduino Mega 2560, and once the buzzer sounds, the participant can begin working on the exam questions. The system flowchart is shown in Fig. 2.

This tool has several buttons for operation: the next button to change the question, the repeat button to repeat the question, and the play/pause button to start listening to the question or to stop it. The questions to be heard originate from the DF Player module, which has been

Table 1 explains the test results for all input buttons. From this table, it can be seen that the button condition when not pressed has an average voltage of 4.67 volts, while pressing the button produces an average voltage of 7 millivolts. The Serial Print output for the input buttons is shown in Fig. 3.

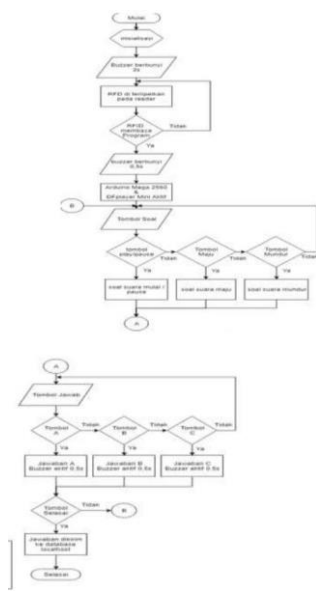


Fig. 2. System Flowchart

3. RESULTS AND DISCUSSION

Data collection for the method used in this microcontroller- and RFID-based assistive tool for visually impaired students taking exams was carried out through observation of each part of the equipment, with measurements taken on each system or component used.

3.1 Input Button Testing

TABLE 1. INPUT BUTTON TESTING

Condition	Not pressed (V)	Pressed (V)	Serial Monitor note
Prev button	4.8	10 mV	Plays audio backward
Next button	4.6	4.3 mV	Plays audio forward
Play/Pause button	4.7	9.7 mV	Plays/pauses audio
Button A	4.8	7.9 mV	Input answer A
Button B	4.6	8.8 mV	Input answer B
Button C	4.6	7.8 mV	Input answer C
Finish button	4.6	7.1 mV	Ends exam; sends answers to database



Fig. 3. Serial Print of Input Buttons

3.2 DF Player Testing

TABLE 2. DF PLAYER TESTING

Trial No.	Condition	Notes
1	Question no. 1 is read aloud	Plays file 0001.mp3
2	Question no. 2 is read aloud	Plays file 0002.mp3
3	Question no. 3 is read aloud	Plays file 0003.mp3
4	Question no. 4 is read aloud	Plays file 0004.mp3
5	Question no. 5 is read aloud	Plays file 0005.mp3
6	Question no. 6 is read aloud	Plays file 0006.mp3
7	Question no. 7 is read aloud	Plays file 0007.mp3
8	Question no. 8 is read aloud	Plays file 0008.mp3
9	Question no. 9 is read aloud	Plays file 0009.mp3
10	Question no. 10 is read aloud	Plays file 00010.mp3

Table 2 explains the test results for the DFPlayer module. From this table, it can be seen that the DFPlayer plays the voice file corresponding to the number of the question to be read aloud. The Serial Print output is shown in Fig. 4.



Fig. 4. Serial Print Reading Questions No. 1–10

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

At the conclusion of the design and construction of the Assistive Tool for Blind Students in Taking Exams Based on Microcontroller and RFID, several conclusions can be drawn:

1. This assistive tool for visually impaired students taking exams, based on a microcontroller and RFID, uses RFID as the student participant card. In addition, RFID is also used to log in to the answer database.
2. This tool also uses push buttons that have been modified as navigation buttons for answering the questions being read aloud by the DFPlayer.
3. The microcontroller used is the Arduino Mega 2560 with an Ethernet Shield, programmed using the Arduino IDE application.
4. This assistive tool uses a buzzer and an audio jack as sound output, so students can choose to use either a speaker or a headset, according to their preference.
5. This tool uses an Ethernet Shield module as a bridge between the Arduino Mega 2560 and the localhost database to transfer the data from the students' answers.

4.2 Suggestions

From the results of the research and testing that have been carried out, there are still shortcomings in various aspects. To make the research more complete, the following points should be considered:

1. The use of the DFPlayer is still fairly difficult because many commands are not yet available in the libraries circulating on the internet, so the indicator still uses a buzzer sound rather than a sound from the DFPlayer.
2. The answers sent to the database should directly display a score so that the invigilator or teacher can process the students' scores more easily.
3. The database should be accessible online so that parents can easily monitor their children's scores.
4. A box-shaped push button should be used so that the Braille characters do not rotate.

REFERENCES

- [1] Supartinah, "The visually impaired" (in Indonesian), December 2013. [Online]. Available: <https://idtesis.com/pengertian-tunanetra-menurut-para-ahali-adalah/>.
- [2] D. Hallahan, *Special Education*, Routledge, 2018.
- [3] Bisamandiri, "Teaching techniques for visually impaired children" (in Indonesian), October 2014. [Online]. Available: <https://bisamandiri.com/blog/2014/11/teknik-pembelajaran-untuk-anak-tunanetra/>.
- [4] I. D. Ramdani, "Educational services for low-vision blind students" (in Indonesian), vol. 9, p. 8, 2017.
- [5] A. G. Putra, "Learn English by using speech recognition on Google Voice" (in Indonesian), p. 11.
- [6] Z. Yulias, "Arduino Mega 2560" (in Indonesian), 26 September 2013. [Online]. Available: <http://blog.famosastudio.com/2013/09/produk/arduino-mega-2560/531>.
- [7] D. Ardan, "DFPlayer Mini: Serial Mp3 Player" (in Indonesian), July 2016. [Online]. Available: <http://belajarduino.com/2016/07/dfplayer-mini-serial-mp3-player-module.html>.
- [8] Elektronika Dasar, "Understanding and components of Radio Frequency Identification (RFID)" (in Indonesian), 13 June 2019. [Online]. Available: <http://elektronikadasar.web.id/pengertian-dan-komponen-radio-frequency-identification-rfid/>.
- [9] Immersa Lab, "Understanding the Ethernet Shield and how it works" (in Indonesian), 8 February 2018. [Online]. Available: <http://www.immersalab.com/pengertian-ethernet-shield-dan-cara-kerjanya.htm>.
- [10] Catherine, "Definition and function of a speaker" (in Indonesian), 25 March 2015. [Online]. Available: <https://www.audioengine.co.id/pengertian-fungsi-speaker/>.
- [11] "Understanding MySQL" (in Indonesian), 12 June 2016. [Online]. Available: <http://edel.staff.unja.ac.id/blog/artikel/Pengertian-MySQL.html>.
- [12] Andre, "Definition and function of PHP in web programming" (in Indonesian), 22 July 2019. [Online]. Available: <https://www.duniailkom.com/pengertian-dan-fungsi-php-dalam-pemrograman-web/>.