Integrated Real Time Monitoring System as an Effort to Reduce Children's Eyestrain in the Online Learning Process

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Abstract. The pandemic condition forces us to do physical distancing, and this has an impact on the child's learning system. Children learn at home using assisted technology. The impact that occurs is that children's screen time becomes longer, and the results of the study show that eye complaints in children are increasing. Based on this, the purpose of this study is to propose a real time system that can monitor the distance between the eyes and the screen, besides that this system can monitor the intensity of light in the children's study room when online learning takes place. This system is also designed to be able to monitor the duration when children are in front of the monitor. The experimental results show that this system can work well in real time. It is hoped that this system can reduce children's eye complaints caused by long screen time.

Keywords: Monitoring System · Online Learning · Reduce Children's

1 Introduction

The pandemic condition has finally forced us to do physical distancing to prevent the spread of the virus. This has an impact on learning systems that occur around the world. Learning is carried out in their homes online [1]. This has both positive and negative impacts.

The negative impact of online learning for children is disturbed sleep, boredom, irritating behavior, anxiety, depression, mood swings [2] [3]. Another negative impact is learning loss and socio-emotional immunity [4]. Some researchers mention other negative consequences are pain syndrome, metabolic disorders and obesity, hypodynamia [5].

Some of the positive impacts are that parents will be more aware of home-based learning as long-term education [6]. The impact of online learning is that children and parents are forced to improve their Information Technology skills [7]. Although education is not carried out in schools, online learning can improve communication between teachers and parents [8] [9].

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One of the impacts of online learning is that children have to study in front of a monitor or gadget for some time. The worrying thing is that children's eye health is feared to be disturbed. The results of the study stated that the impact of screen time is 55.23% of parents complain of ocular symptoms / complaints that occur in their children's eyes [10] [11].

The above underlies the purpose of this study. This study aims to propose a children's eye health monitoring system in the form of a real time embedded system. When children use computers or are screen time sensors will monitor the distance between the eyes and the screen. In addition, it also pays attention to the intensity of light where children learn online to comply with the provisions. Furthermore, the length of time the children are in front of the screen is also monitored by time counter. When the time has reached 2 h, there will be a warning.

2 Method

This research stage consists of hardware design, software, system integration, and system evaluation stage. The design stage is to identify all the hardware requirements needed in accordance with the desired specifications. This software is needed to implement the algorithm used in this embedded system. The system integration process is needed so that the system can work in harmony between hardware and software. In order to know the performance of the system, an evaluation process is carried out.

The hardware circuit in this study is depicted in Fig. 1. This system is equipped with an ultrasonic sensor [12] HCSR04 which is expected to be able to monitor the distance of the computer or the distance of the gadget from the child during the online learning process. This ultrasonic sensor has been commonly used for distance measurement [13] [14]. The minimum distance that meets is 25 cm, so this system is designed to be 25 cm as the minimum distance that must be met. One of the important things in maintaining eye health is the level of light intensity that must be considered. The sensor used in this research to measure light intensity is LDR Type 5539 5mm Photoconductive Resistance. Many applications have used LDR to measure light intensity [15]. This system time duration is set using an algorithm uploaded in the embedded system.

Figure 1 shows that the ultrasonic sensor HCSR04 and LDR Type 5539 5mm photoconductive Resistance are connected to the Arduino Uno. Ultrasonic will provide information on the distance between the child and the computer to Arduino, while information on light intensity will also be sent to Arduino. If the distance is less than 25 cm, the system will give a warning. The system will also provide lightening when the intensity in the room is less than 500 lx. In addition, a buzzer is also used as an alarm when the actual conditions are not in accordance with the design and algorithm that has been set.

The algorithm of this system is depicted in Fig. 2. The algorithm used is if there is a condition where the distance between the child and the gadget is less than 25 cm and the light intensity is less than 500 lx, the system will give a warning. This is important because sometimes children do not realize that eye health must be maintained in accordance with the ideal distance and light intensity. If the duration of online learning reaches 2 h, a warning will be given and children are advised to do a distant view for a few minutes.

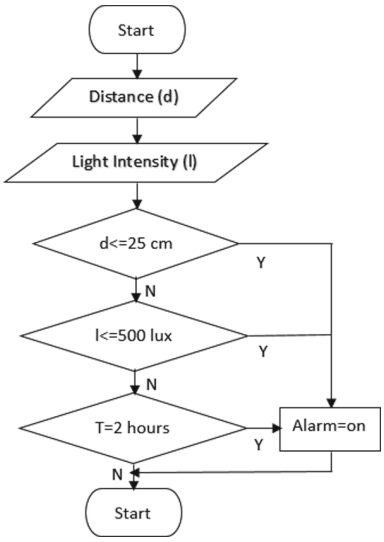

Fig. 1. System circuit design

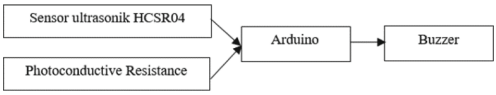

Fig. 2. System algorithm

The evaluation is done by testing the performance of each variable. The distance evaluation will be evaluated and compared with the actual data (groundtruth). Performance evaluation in measuring the level of light intensity is done by comparing it with a standardized lux meter. Further testing the measurement of the duration of online learning compared to the actual time (for every 2 h will give a warning).

3 Results and Dicussion

The implementation of the system that has been implemented is depicted in Fig. 3. This embedded system is placed in an area near the monitor so that the distance between children and the screen is monitored, besides the light intensity is also monitored by the presence of an LDR sensor.

The results of the test on the computer distance variable to children are described in Table 1. The results of the test process on the distance variable yield 100% accuracy. In addition, alerts can work according to the designed algorithm.

The experimental results on the light intensity variable in the online learning place are described in Table 2. Based on the experimental results, the light intensity read by the system is not exactly the same as the value generated by measurements using a reference lux meter. This happens due to the calibration process. However, the warning

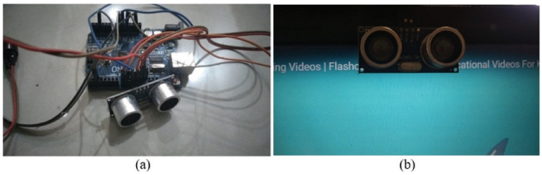

Fig. 3. System circuit design: (a) Integrated real time monitoring System circuit (b) Implementation of integrated real time monitoring system on the screen

Table 1. The results of testing process on the variable distance of screen to children

Nu	Distance (cm)	Groundtruth (cm)	Alert	Status
1	10	10	on	T
2	15	15	on	T
3	20	20	on	T
4	21	21	on	T
5	22	22	on	T
6	23	23	on	T
7	24	24	on	T
8	25	25	on	T
9	26	26	off	T
10	27	27	off	T
11	28	28	off	T
12	29	29	off	T
13	30	30	off	T

results generated by the system are in accordance with the expected conditions. The system will give a warning if the intensity in the study room is less than 500 lx.

Figure 4 shows that the reference light intensity value (groundtruth) is higher than the light intensity value generated by the system. This happens because the calibration process is carried out. Even so, the difference in intensity values is not too significant because the.

The test results for the time duration variable when online learning takes place are described in Table 3. The test results show that the specified time duration can be executed by the system. When the duration of online learning reaches 120 min, the system will give a warning, indicating that children take a short break to reduce the impact of radiation. When the children have rested a few minutes online learning can be resumed.

The evaluation of the performance of the integrated system during online learning is described in Table 4. Based on Table 4 it can be explained that the system has been well integrated, and in real time this system can work according to the algorithm that has been previously set. If the distance between the monitor and children is less than

Table 2. The results of testing process on the variable intensity of light

No	Light intensity (lux)	Groundtruth (lux)	Alert	Status
1	150	152	on	T
2	205	220	on	T
3	303	315	on	T
4	351	355	on	T
5	403	413	on	T
6	455	460	on	T
7	505	512	off	T
8	550	552	off	T
9	600	610	off	T
10	720	732	off	T
11	790	800	off	T
12	800	812	off	T
13	1000	1020	off	T
14	1500	1500	off	T
15	2000	2000	off	T

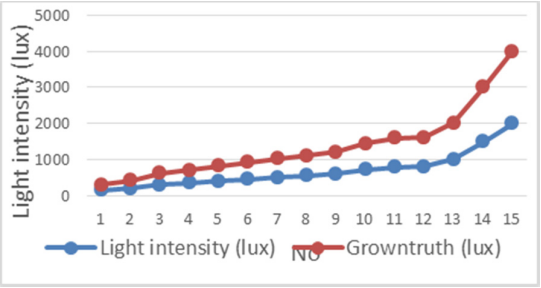

Fig. 4. Real time monitoring system to maintain children's eye health during online learning

25 cm, the alarm will sound. Likewise, the light intensity of the study area, if it is not in accordance with the provisions, the alarm will warn the children. If the duration of time for children to learn online has reached 120 min, then there is a warning so that children immediately rest their eyes.

This system can not only be used to monitor when children are doing online learning but can also monitor children's activities when playing in front of the monitor. This system is very important if children's activities are monitored, then eye disorders in children can be resolved and avoided early on.

Table 3. Testing process results on the time duration variable

No	Distance (cm)	Groundtruth (cm)	Alert	Status
1	50	152	off	T
2	60	220	off	T
3	70	315	off	T
4	80	355	off	T
5	90	413	off	T
6	100	460	off	T
7	110	512	off	T
8	120	552	on	T
9	130	610	on	T
10	140	732	on	T

Table 4. Integrated system performance evaluation during online learning

No	Light intensity (lux)	Groundtruth (lux)	Alert	Status
1	10	150	50	T
2	15	205	60	T
3	20	303	70	T
4	21	351	80	T
5	22	403	90	T
6	23	455	100	T
7	24	505	110	T
8	25	550	120	T
9	26	600	130	T
10	27	720	140	T
11	28	790	110	T
12	29	800	100	T
13	30	1000	90	T
14	33	1500	80	T
15	35	2000	70	T

4 Conclusion

The experimental results show that the system has been able to work well. System testing carried out on ultrasonic sensors can work 100% accurately in accordance with

predefined designs and algorithms. Measurement of light intensity can also work well, and the alarm also runs according to the algorithm. While system integration can also work by accommodating data from sensors, actuators can work according to the expected conditions. This system can be applied to monitor children when online learning takes place. In addition, it is also applied when children are active in front of screens or gadgets.

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References

1. Schleicher, A. The Impact Of Covid-19 On Education Insights From Education At A Glance 2020. OECD.
2. Chahal, N. Psychological Effects of Pandemic COVID-19 on Children and Adolescents Worldwide- A Case Study. 021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT), 2021 (pp. 1–6). Kharagpur, India: IEEE. doi: https://doi.org/10.1109/ICCCNT51525.2021.9579832.
3. T. Singla, S. T. Impact of Covid-19 on Education System. 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), 2021. IEEE. doi: https://doi.org/10.1109/ICRITO51393.2021.9596401
4. Mrinal Mukherjee, C. M. Impact of Disaster on Underprivileged Children in Covid-19 Pandemic: Policy Response for Emergency Education. UTAMAX Journal of Ultimate Research and Trends in Education, 3(3). doi: https://doi.org/10.31849/utamax.v3i3.7430
5. Mukhametzyanov, I. Screen Time and Health of Children and Adolescents. 2021 1st International Conference on Technology Enhanced Learning in Higher Education (TELE) (pp. 252–255). Lipetsk, Russia: IEEE. doi: https://doi.org/10.1109/TELE52840.2021.9482573.
6. S. Suzanna, S. S. Exploration of Technology Home-based Learning Guidance for Parents and Students during the Covid-19 Pandemic. 2020 9th International Congress on Advanced Applied Informatics (IIAI-AAI) (pp. 122–127). Kitakyushu, Japan: IEEE. doi: https://doi.org/10.1109/IIAI-AAI50415.2020.00033.
7. Sumitra Pokhrel, R. C. A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. Higher Education for the Future. doi: https://doi.org/10.1177/2347631120983481
8. Stoiljković, Č. The Impact of the Covid-19 Pandemic on the Educational Work of Kindergarten Teachers. International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE), 8(3). doi: https://orcid.org/0000-0002-9499-1225
9. Logan, N. O. Parent Voices: Suggestions for Remote Learning during COVID Pandemic and Beyond. Journal of Ethnic and Cultural Studies, 8(4), 1–17. doi: https://doi.org/10.29333/ejecs/850
10. Swati Agarwal, S. B. Increase in ocular problems during COVID-19 pandemic in school going children- a survey based study. Indian Journal of Ophthalmology. doi: https://doi.org/10.4103/ijo.IJO_2981_20
11. Chaitra Jayadev, P. S. Commentary: Impact of the COVID-19 pandemic on digital eye strain in children. Indian J Ophthalmol. doi: https://doi.org/10.4103/ijo.IJO_3028_20
12. Minchev, A. D. Ultrasonic sensor explorer. 2016 19th International Symposium on Electrical Apparatus and Technologies (SIELA) (pp. 1–5). IEEE. doi: https://doi.org/10.1109/SIELA.2016.7542987.

13. C. Gearhart, A. H. Use of ultrasonic sensors in the development of an Electronic Travel Aid. 2009 IEEE Sensors Applications Symposium (pp. 275–280). IEEE. doi: https://doi.org/10.1109/SAS.2009.4801815.
14. Kai-Tai Song, C.-H. C.-H. Design and experimental study of an ultrasonic sensor system for lateral collision avoidance at low speeds. IEEE Intelligent Vehicles Symposium, 647–652. doi: https://doi.org/10.1109/IVS.2004.1336460.
15. G. Kilari, R. M. Automatic Light Intensity Control using Arduino UNO and LDR Automatic Light Intensity Control using Arduino UNO and LDR. Automatic Light Intensity Control using Arduino UNO and LDR2020 International Conference on Communication and Signal Processing (ICCSP), 2020, (pp. 0862–0866). doi: https://doi.org/10.1109/ICCSP48568.2020.9182238.

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