IJEEE: Indonesian Journal of Electrical Engineering and Electronics
| Vol. 3 | No. 2 | Pages 29 - 35
[August] [2026]

Design and Construction of a Safe Viewing Distance Detection Tool for Laptop Screens Using the HC-SR04 Ultrasonic Sensor

Liemalasintasari, Afriansyah Putra, and Muhamad Mirza Alfarisi

Teknik Elektro, Universitas Pembangunan Nasional Veteran Jakarta
2210314040@mahasiswa.upnvj.ac.id

Received 31st December 2025 **|** Revised 10th August 2026 **|** Accepted 10th August 2026

ABSTRACT

Prolonged laptop use with an excessively close viewing distance can cause eye discomfort, such as dry eyes and visual strain, commonly experienced by students. This article presents the design and development of a laptop monitor safe-distance detection device to assist users in maintaining an appropriate viewing distance. The system utilizes an Arduino Uno R3 microcontroller and an HC-SR04 ultrasonic sensor to measure the distance between the user and the laptop monitor. The measured distance is classified into three conditions: danger, warning, and safe, based on predefined thresholds. Distance information and system status are provided through traffic light LEDs, an LCD with an I2C module, and a buzzer as an alert. Test results indicate that the system is able to detect distance changes accurately and generate appropriate output responses. The device is expected to improve user awareness of proper viewing distance during laptop use.

Keywords: *viewing distance, laptop monitor, Arduino Uno, ultrasonic sensor, microcontroller-based system.*

1. INTRODUCTION

Using laptops as the primary medium for students' academic activities increases the intensity of user interaction with the screen for relatively long periods. One common habit is using a laptop at too close a viewing distance, especially when working on assignments or activities that require intense concentration. This condition not only impacts visual comfort but also has the potential to cause eye health problems.

Using screens at close range can increase the workload on the eyes and accelerate tear evaporation, thus triggering dry eye complaints and visual impairment (Chairiah, Basri, & Sakdiah, 2022). In the context of computer use, this complaint is known as Computer Vision Syndrome (CVS), which is a visual impairment that arises from the activity of continuously viewing a Visual Display Terminal (VDT) screen (Putri & Mulyono, 2018). The distance from the eyes to the screen is one parameter that influences the severity of CVS.

Several studies have shown that computer use at a viewing distance of less than 50 cm carries a higher risk of developing vision problems compared to longer viewing distances.

Therefore, it is recommended that the viewing distance between the eyes and the laptop or computer screen be between 50–70 cm to reduce the risk of eye problems during long-term use (Rohmawati & Budiono, 2025).

Although viewing distance recommendations have been widely discussed, in practice, many users are unaware of or unable to maintain a consistent viewing distance when using a laptop. This situation highlights the need for a technology-based assistive system that can monitor the user's distance from the screen and provide a warning when the distance falls below the recommended limit. This study focused on monitoring the user's viewing distance from the laptop screen as a preventative approach, without directly analyzing eye conditions.

2. MATERIALS AND METHODS

2.1 System Functionality Overview

The designed system is a microcontroller-based device for detecting a user's safe distance from the laptop screen. This system works by monitoring the distance between the user and the laptop screen while the system is active, then processing this distance data to determine the user's viewing distance (ADITYA, DARLIS, & ARMI, 2021).

The user's distance from the screen is measured using an ultrasonic sensor. The resulting data is then processed by a microcontroller to be compared with a predetermined distance limit. Based on the comparison, the user's viewing distance is classified into three conditions: dangerous if the user's distance from the screen is less than or equal to 40 cm, alert if the user's distance is more than 40 cm to less than 50 cm, and safe if the user's distance is more than or equal to 50 cm.

Distance classification results are displayed through visual indicators in the form of LED traffic lights and an information display on an I2C module-based LCD. The system is also equipped with a buzzer as an audible indicator that activates at certain distances. The combination of visual and audible indicators allows users to quickly and clearly determine visibility conditions.

Overall, this system is designed as a tool to help increase user awareness in maintaining viewing distance from the laptop screen to stay within the recommended limits.

2.2 Main Components

Main components of this work are Arduino Uno R3, HC-SR04 ultrasonic sensor, 5V buzzer, Light Emitting Diode (LED), and Liquid Crystal Display (LCD). The Arduino Uno R3 is an ATmega328P-based microcontroller board widely used in small to medium-scale embedded systems (Husain, B, Khairah, & Akbar, 2022). This board provides digital and analog input/output pins that can be used to connect various sensors and actuators. The Arduino Uno R3 is supported by the Arduino IDE software, which simplifies the programming and system testing process. In this tool, the Arduino Uno R3 functions as the main controller that processes distance data from sensors and determines system output based on predetermined conditions.

The HC-SR04 ultrasonic sensor is a proximity sensor that uses ultrasonic waves to detect objects in front of it. This sensor measures distance based on the time difference between the transmission and reception of reflected waves. The HC-SR04 has trigger and echo pins connected to a microcontroller for distance measurement (Mardhalena & Nathasia, 2022). In

this device, the ultrasonic sensor is used to detect the user's distance from the laptop screen as a basis for determining viewing conditions.

A 5V buzzer is an electronic component that functions as an audible indicator by converting electrical energy into sound energy (Husain, B, Khairah, & Akbar, 2022). The buzzer operates when given a voltage signal from the microcontroller and produces a sound as a warning. In the designed system, the buzzer is used as an audio warning when the user's distance from the laptop screen is dangerous. The use of the buzzer helps increase user alertness without having to constantly pay attention to visual indicators.

A Light Emitting Diode (LED) is a semiconductor component that emits light when an electric current flows through it (Mardhalena & Nathasia, 2022). Traffic light LEDs come in three colors: red, yellow, and green, which are used to indicate system conditions. In this device, a red LED indicates a danger zone, a yellow LED indicates a warning zone, and a green LED indicates a safe zone. The use of color-coded LEDs makes it easy for users to quickly understand visibility status.

A Liquid Crystal Display (LCD) is a display device used to display information in the form of text and numbers (Mardhalena & Nathasia, 2022). An LCD equipped with an I2C module allows communication with a microcontroller using fewer pins. In this device, the LCD is used to display the measured distance value and the user's distance status. The LCD display serves as an information interface between the system and the user during device operation.

2.3 Tool Design and Assembly Methods

This research was conducted through several stages to realize a safe distance detection tool for laptop screens. The methods used were structured in stages so that the designed system could operate according to predetermined specifications. The stages of the research method are shown in Figure 1.

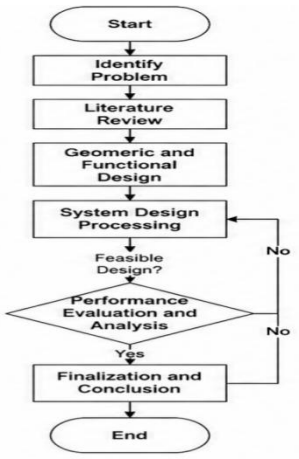

Figure 1. Flowchart of Research Method Stages

1. Identification of Problems
   The problem identification phase was conducted based on observations of students' laptop usage habits. This phase identified that laptop use at too close a viewing distance was still common and potentially causing visual discomfort. Therefore, a system was needed to monitor the user's viewing distance from the laptop screen.

2. Literature Study
   A literature study was conducted by reviewing references related to Computer Vision Syndrome (CVS), recommendations for safe viewing distances for laptop screens, and the operating principles of microcontroller- and ultrasonic-sensor-based systems. The results of the literature study were used as the basis for determining distance parameters and system design (Lonteng, Gunawan, & Rosita, 2020).
3. Schematic and Flowchart Design
   At this stage, a circuit schematic and system flowchart are designed. The circuit schematic is designed to illustrate the relationships between the device's main components, while the flowchart is used to explain the system's working stages in detecting and classifying the user's distance from the laptop screen. The working process of the laptop screen safe distance detection system is displayed in a flowchart that illustrates the stages of distance reading to determining the output conditions, as shown in Figure 2.

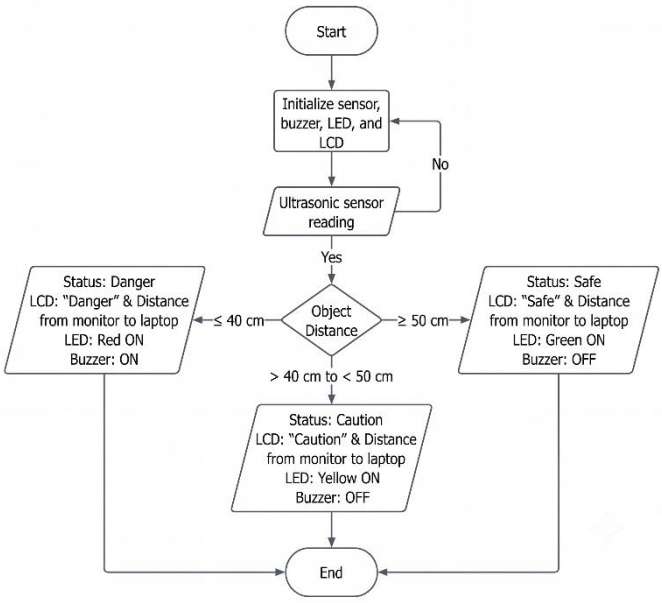

Figure 2. Flowchart System

4. System Design and Programming
   The software was designed using the Arduino IDE (Musthafa, Utama, & Syahrin, 2020). The program was designed to allow the system to perform repeated distance readings, process measurement data, determine the user's viewing distance, and control output indicators based on the detected conditions.
5. Testing System
   System testing is conducted to ensure that the program logic and system processes are running smoothly. At this stage, the system's ability to read distance data and classify visibility conditions is tested according to the design (Safitri, Putri, Pranata, & Sahertian, 2023).
6. Hardware Assembly
   Once the system is functionally functioning properly, hardware assembly is performed by connecting all components according to the designed schematic. The components are assembled into a single prototype device ready for testing.

7. Tool Testing and Data Collection
   The tool was tested to determine the prototype's performance in detecting the user's distance from the laptop screen. At this stage, distance measurement data was collected and the system's output response was observed for each distance condition.
8. Evaluation and Conclusion
   The final stage of the research is an evaluation of the tool test results. The evaluation is conducted to assess the suitability of the tool's performance to the design objectives, and conclusions are then drawn based on the results.

3. RESULTS AND DISCUSSION

3.1 Design Results

The design results in the form of a prototype of a user's safe distance detection tool from the laptop screen, which was realized in accordance with the system design. The prototype consists of an Arduino Uno R3, an HC-SR04 ultrasonic sensor, an LED traffic light, a buzzer, and an LCD with an I2C module as a display medium for distance and system status.

The system's circuit schematic is shown in Figure 3, which shows the relationships between the main components and their connections to the Arduino. All components are assembled according to the design to form a unified system that is ready for operation.

The physical form of the prototype device is shown in Figure 4. The ultrasonic sensor is mounted on the top of the laptop screen, near the camera, and facing the user to detect direct viewing distance. The indicator components, including an LED, buzzer, and LCD, are housed in an acrylic box placed to the right of the laptop, so they are easily observed without disrupting user activity.

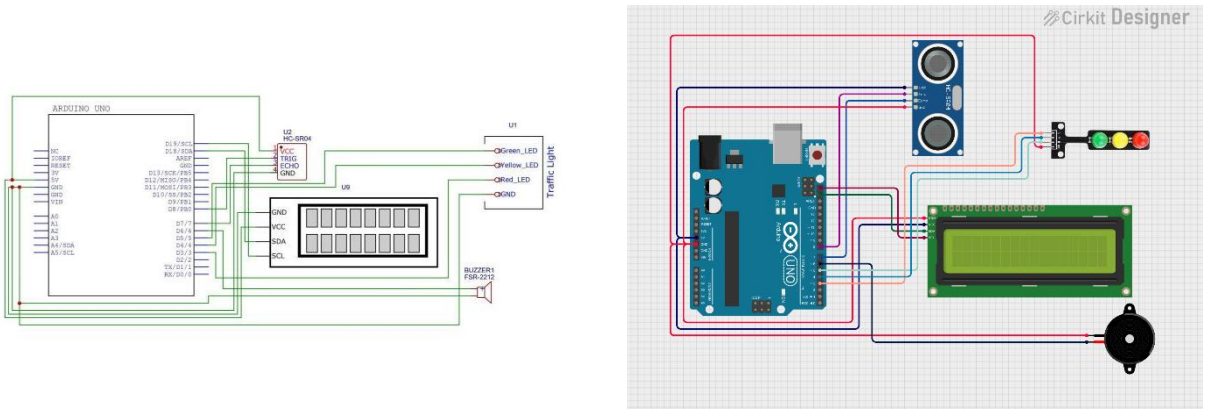

Figure 3. Tool Schematic Circuit

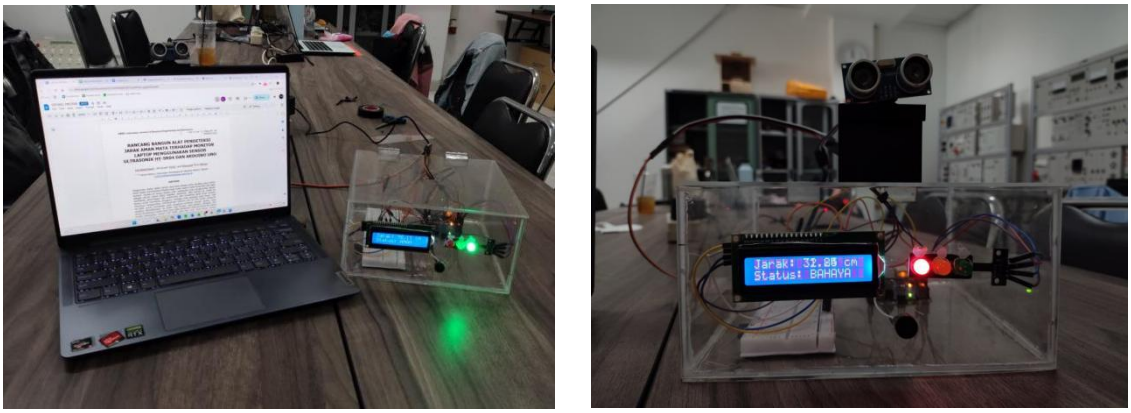

Figure 4. Prototype

3.2 Device Function Testing

Device function testing is performed to ensure the system performs as intended. Testing involves varying the distance between the user and the laptop screen, then observing the system's response, including light indicators, sound indicators, and information displays on the LCD.

Table 1. Test Results of the Laptop Screen Safe Distance Detection Tool

No	Distance (cm)	Light Indicator	Sound Indicator	Information
1	1 - 10	Red	On	Danger
2	11 - 20	Red	On	Danger
3	21 - 30	Red	On	Danger
4	31 - 40	Red	On	Danger
5	41 - 50	Yellow	Off	Alert
6	51 - 60	Green	Off	Safe
7	61 - 70	Green	Off	Safe

3.3 Discussion

3.3.1 Distance Detection System Performance

Based on test results, the system is capable of repeatedly measuring the user's distance from the laptop screen throughout its operation. Changes in user distance are accurately detected, allowing the system to update the output conditions accordingly.

3.3.2 System Indicator Response

The light and sound indicator response indicates compliance with the set distance conditions. The LED traffic light provides clear distance information through color differences, while the buzzer serves as an additional warning in dangerous distance conditions. The combination of light and sound indicators makes it easy for users to recognize visibility conditions without having to constantly pay attention to the LCD display.

3.3.3 Distance Limit Compliance

The distance limits applied to the system can be implemented well, indicated by changes in the output status that follow the variation of the user's distance according to the design parameters. This indicates that the system works according to its function as a tool to improve visibility awareness. The system's limitations lie in the use of ultrasonic sensors that rely on wave reflection, so they are affected by the position and orientation of the object. Further development can utilize camera-based sensors such as ESPcam or Lidar sensors to obtain more specific user position information..

4. CONCLUSION

A laptop screen safety distance detector was successfully implemented and functions according to its design objectives. The system is able to detect the user's distance from the laptop screen and provide appropriate output responses through light indicators, sound indicators, and distance information and status displays. This tool can help users recognize and maintain an appropriate viewing distance when using a laptop, potentially reducing the risk of eye problems caused by using a laptop at too close a distance.

ACKNOWLEDGEMENTS

The author would like to thank the lecturer in charge of the Integrated Project course for the guidance and direction provided during the design and prototype development of this tool. Thanks are also extended to the Faculty of Engineering and the Electrical Engineering Study Program of the Veteran National Development University Jakarta for facilitating the design and development of the tool. Furthermore, the author would like to thank the previous researchers whose work served as references in the preparation of this article, as well as all parties who have been involved and provided support so that this activity can be carried out properly.

LIST OF REFERENCES

Aditya, M. I., Darlis, A. R., & Armi, N. (2022). *Implementasi Sistem Deteksi Jarak Kendaraan Menggunakan Sensor Ultrasonik*. 1–11.

Atmega, A. U. N. O. (2022). Parking sensor system untuk mendeteksi jarak aman kendaraan menggunakan sensor ultrasonic berbasis arduino uno atmega328. *JIPI (Jurnal Ilmiah Penelitian Dan Pembelajaran Informatika)*, *07* (04), 1391–1400.

Chairiah1, Saiful Basri2, S. 1. (2022). *Hubungan Penggunaan Gadget dengan Gejala Sindrom Mata kering pada Mahasiswa Psikologi Universitas Syiah Kuala*. *5* (4), 22–30.

Fildzatul Rohmawati, N. D. P. B. (2025). DURASI DAN JARAK PENGGUNAAN KOMPUTER HUBUNGANNYA DENGAN KELELAHAN MATA PADA PEKERJA DI PT. PETROKOPINDO CIPTA SELARAS DURATION. *Journal Health & Science*, 109–118.

Husain, N. P., Khairah, M., & Akbar, M. (2022). RANCANG BANGUN PENDETEKSI JARAK AMAN DENGAN LAYAR MONITOR TELEVISI BERBASIS ARDUINO UNO. *Jurnal Teknologi Komputer*, *02* (02), 184–189.

Imanuel Yosua Lonteng, Gunawan, I. R. (2020). RANCANG BANGUN SIMULASI ALAT PENDETEKSI JARAK AMAN ANTAR KENDARAAN MENGGUNAKAN SENSOR ULTRASONIK. *JEECOM*, *2* (2), 22–26.

Laptop, K. A. (2018). *Kendali jarak aman penggunaan perangkat (gadget) komputer atau laptop*. *3* (1), 11–17.

Monitor, T. (2018). HUBUNGAN JARAK MONITOR, DURASI PENGGUNAAN KOMPUTER, TAMPILAN LAYAR MONITOR, PENCAHAYAAN DENGAN KELUHAN KELELAHAN MATA. *The Indonesian Journal of Occupational Safety and Health*, *7* (1), 1–10.

Musthafa, A., Utama, S. N., & Syahrin, M. A. (2020). Rancang Bangun Alat Pendeteksi Jarak Aman, Intensitas Cahaya, dan Waktu Ideal Pengguna Laptop. *REPOSITOR*, *2* (8), 1055–1066.

Safitri, L. I., Putri, D. R., Pranata. (2023). IKITIPI : Rancang Bangun Alat Pendeteksi Jarak Aman Televisi. *Prosiding Seminar Nasional Teknologi Dan Sains Tahun 2023*, *2*, 363–368.