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Mask Detection System with Computer Vision-Based on CNN and YOLO Method Using Nvidia Jetson Nano

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Abstract

Health is an essential aspect of life. The World Health Organization (WHO) has officially declared the Corona Virus (Covid-19) a global pandemic that has spread to Indonesia. For preventive measures against Covid-19, the Indonesian government is trying to deal with the Covid-19 pandemic with 3M health protocol aimed at community activities, such as *Memakai Masker* (wearing masks), *Mencuci Tangan* (washing hands), and *Menjaga Jarak* (maintaining distance). In this study, software and hardware design was carried out to detect mask users and immediately warn violators who do not use masks automatically and can function automatically offline by utilizing digital image processing using NVIDIA Jetson Nano using the YOLO (You Only Look Once) method. The CNN YOLOv4-tiny model is chosen to obtain measurement results for mask user detection accuracy because it has a relatively minor computational value and is faster. The best camera detection angle is obtained at a vulnerable angle of 45O-90O or in the range of 90O-135O with value confidence that the average is 99.94% and the best accuracy is at a lux value greater than 70, and a minimum camera height of 1 meter and a maximum of 3 meters. Under conditions of lux 96 (bright), the maximum distance for detecting a face object is 12 meters, and the ability of the system to output a warning sound has been successfully integrated with a relay to run the mp3 module separately from the system, so as not to interfere with the Jetson Nano computation process and the model is successfully run on the Jetson Nano with an average computation of 13 frames per second.

1. Introduction

Health is an essential aspect of life. One easy way to maintain a healthy body is to carefully wash hands and wear a mask [1]. In carrying out daily activities, hands are often contaminated with microbes

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or viruses, so that hands become an intermediary for the entry of viruses into the body when hands touch parts of the face without a mask, such as a nose, mouth, and eyes as the entry point for viruses that can cause disease, like the spread of a virus called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) or the Corona Virus (Covid-19) [2][3].

The World Health Organization (WHO) has officially declared that Covid-19 is a pandemic that has hit the world, including Indonesia. When the Covid-19 pandemic hit Indonesia, there were many affected areas. It is not only health that has an impact, but also on education, socio-cultural, and the economy. The positive cases of corona and the death rate in Indonesia are increasing daily, which indicates that the pandemic cannot be said to end soon. There have been many ways to deal with the spread of the Covid-19 outbreak and reduce the number of Covid-19 sufferers in Indonesia, which have been carried out in all regions. Among them are efforts to provide policies to limit social activities [4]–[6].

The spread of the coronavirus has made governments in all countries, including Indonesia, prohibit activities outside the home, which has an impact on weakening the economy; transportation services are reduced and regulated by stringent policies. The government even closed tourist attractions, shopping centers, and entertainment venues empty of visitors. Even work, and study was done online at home [7], [8].

To fight against Covid-19, the Government of Indonesia is trying to deal with the Covid-19 pandemic by simultaneously considering the health and economic aspects. The health protocol approach is divided into two activities, namely, 3M and 3T. The 3M health protocol is aimed at community activities, such as *Memakai Masker* (wearing masks), *Mencuci Tangan* (washing hands), and *Menjaga Jarak* (maintaining distance). Then also implemented 3T, namely Testing, Tracking, and Treatment aimed at government activities [9].

The government has appealed to the public to comply with the Covid-19 protocol, but in reality, many still do not comply with the government's call to comply with health protocols, especially not wearing masks. The government's effort to make people comply with the protocol of wearing masks is by directly reprimanding the assigned apparatus. Reprimanding health protocol violators, especially those who do not wear masks, is a massive obstacle that costs a lot of time and energy and is done continuously. So, there must be an effort to create a tool that can give direct warnings automatically and follow up on violators who still do not comply with the rules of wearing masks by automatically getting violators' data. Then, creating an innovative direct warning tool that detects the use of masks automatically and provides direct warnings in the form of warning sounds can be a solution so that people get used to complying with health protocols.

Over the past few years, quite several researchers have been interested in developing technology to minimize the spread of Covid-19 and Deep Learning (DL) as AI technology (Artificial Intelligence) which became a hot topic, and many creating a detection of objects, faces, and several other types of health innovation development. Some detectors, like Fast-RCNN, Faster-RCNN, and You Only Look Once (CNN YOLO), are a detection network that is often used and is quite significant and makes the evolution of detection precise but light in several aspects [10]–[12].

Convolutional Neural Network YOLO (CNN YOLO) is the algorithm in which the app uses a DL Convolutional Neural Network (CNN) to detect objects. The YOLO algorithm is claimed to be a fast and highly accurate architecture [13]–[15]. Although some variables can affect the accuracy of the architecture, YOLO can be a good choice for detection in real-time by zooming out the loss of accuracy. An accessible overview of YOLO, the YOLO algorithm does much detection, predicting the class created and identifying the object's location. The latest research on the YOLO CNN Algorithm is on the Identification of Mask Use Using the YOLO CNN Algorithm, utilizing the YOLO method using a minor architecture with data augmentation with the process flip, cropping, and rotation as a variation for the dataset as a reducing objective overfitting [16]. The result of data augmentation with YOLO creates detections with up to 90% accuracy, even in real-time [17]–[21].

Some studies use the technique of Deep Learning using the Facemask Net method. The study by Madhura Inamdar and Ninad Mehendale aims to test whether a person is wearing a face mask. The text presents a classification of three classes: people who wear masks or are worn incorrectly, and no masks detected. Deep Learning uses a method calledFacemasknet, which got 98.6% accuracy [22].

Other research on mask use detection utilizes learningDeep Learning Convolutional Neural Networks conducted by Amrit Kumar Bhadani and Anurag Sinha. This study describes the research process utilizing various Python libraries such as Open CV, Tensorflow, and Keras for model training.

The study results are that it can detect mask users with the built algorithm that works well according to its purpose [23].

This study will design software and hardware to detect the use of masks and directly warn violators who do not wear masks by utilizing digital image processing with minicomputers NVIDIA Jetson Nano with the Convolutional Neural Network YOLO method (You Only Look Once).

2. Literature Review

Based on the research that researchers will conduct, references from several previous studies are significant before researching to find out the relationship between the research that will be carried out and previous research to avoid duplication or similarities in the research that will be carried out. Based on the references taken, it is used as a reference in research, and the focus of research can identify and classify.

Dicki Giancini conducts the latest research on the YOLOv3-tiny CNN Algorithm regarding the Identification of Mask Use Using the YOLOv3-tiny CNN Algorithm. Research conducted by Dicki Giancini, utilizing the YOLO method using a minor architecture with data augmentation with the process flip, cropping, and rotation as a variation for the dataset as a reducing objective overfitting. By using the architecture, namely Darknet-19 with no difference multi-scale detector and for input image using YOLOv3-tiny configuration file with size network of 416 x 416. This study uses 200 datasets for the raw dataset, to 600 datasets that have been augmented by adding the option rotation, random cropping, and options flip, which is then iterated into as many as 6000 iterations. The result of data augmentation with YOLOv3 creates detections with up to 90% accuracy, even in real-time [17].

Other research regarding deep Learning is the research of Alief Wikarta, Is Bunyamin Suryo, and M Khoirul Effendi regarding the analysis of the effect of size testing data on the level of accuracy of mask-wearing detection. Then, architecture on deep learning the types used are MobileNet and MobileNetV2 by adding data augmentation. The results of the experiments show that the data augmentation will increase the value of model accuracy in Deep Learning [24].

Arham Rahmi, Kusrini, and Emha Taufik Lutfi's following research are about building models using algorithmsConvolutional Neural Network (CNN) and 1000 datasets to train the system deep Learning as well as conducting tests to obtain accuracy values from the classification results for facial images using masks and without using masks. The results of this study indicate that using epoch 50 and a dataset ratio of 90% training data and 10% test data obtains the best accuracy of 96%. So it can be concluded that the amount of training data dramatically affects the accuracy value [25].

Some studies use the technique of Deep Learning using the Facemask Net method. The study, conducted by Madhura Inamdar and Ninad Mehendale, aims to test whether a person is wearing a face mask. The text presents a classification of three classes: people who wear masks or are worn incorrectly, and no masks are detected. Deep Learning uses a method calledFacemasknet, which got 98.6% accuracy [22].

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3. Method

This research method carried out several steps, as seen in Figure 3.

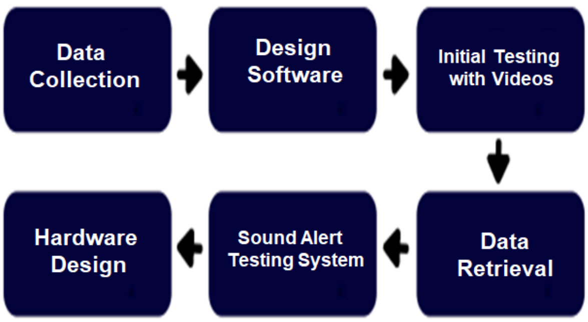


Figure 3. Steps of Research Method

3.1 Time and Place of Research

This research was conducted in the Laboratory Building of the Faculty of Engineering and the Faculty of Engineering Dean Building of the Faculty of Engineering, University of Bengkulu. This research will start with object detection programming and mask detection on objects to design hardware and tool testing in real-time.

3.2 Tools and Materials

This research mainly focuses on object-violating detection systems without masks, and the programming language uses Python as the software and Jetson Nano as the hardware. The tools & materials are as follows.

Table 1. Tools and Materials for Data Collection

	Software	Hardware
Tools	Linux Ubuntu 18.04 Python IDE 3.7.9 Visual Studio Code 64-bit	Digital multimeter Solder Screwdriver Saw Electric Drill
Materials	Model YOLOv4-tiny	Jetson Nano B01 Mp3 Sound Module V8 Full HD Webcame 1080p Camera USB Sound Card LCD Touchscreen

3.3 Work Flow of System

The process of this tool system can be seen through the block diagram, whose system can be seen in Figure 4.

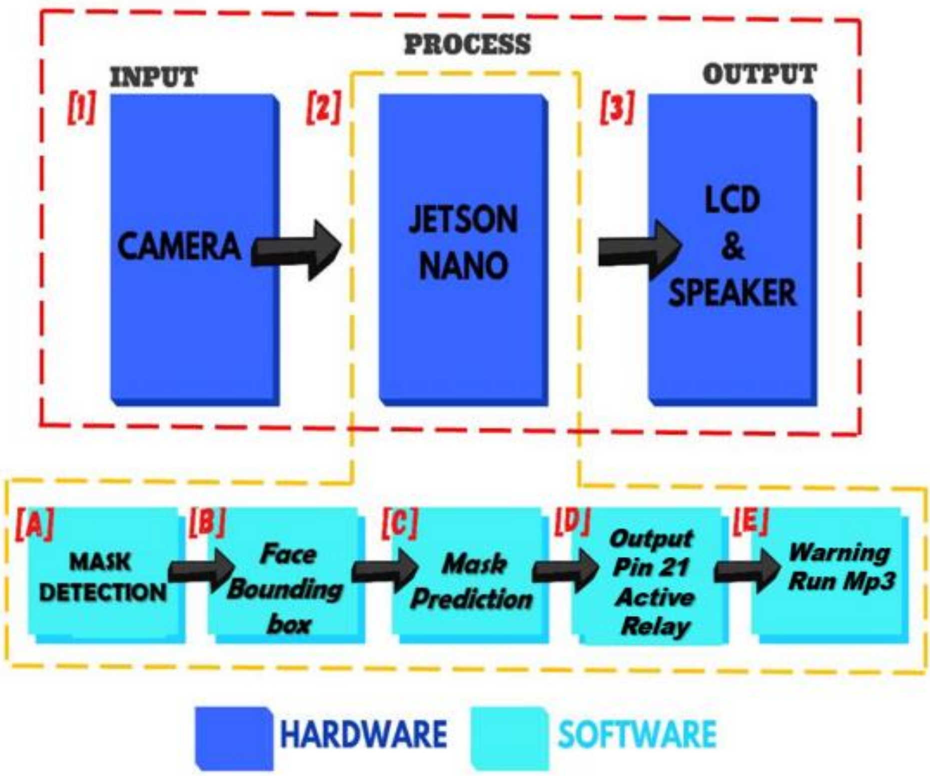


Figure 4. Diagram Block System

Based on the block diagram, the description of the explanation is as follows:

1) **Input**, a real-time camera that takes a video of facial objects, is then shipped and processed by the NVIDIA Jetson Nano on-stage process.

2) **Processing** and All data storage will be received by NVIDIA Jetson Nano and forwarded to output. An explanation of the process is as follows:
   a) **Mask Detection**, object detection with face target.
   b) **Face Bounding box**, predict and give bounding box and centroid on the face object that has been detected.
   c) **Mask Prediction**, object decision-making by comparison against the dataset and detecting whether it is an offender or not
   d) **Output Pin 21 Active Relay**, Activate the relay to run the mp3 module.
   e) **Warning**, Running the mp3 module is a live sound alert.
3) **Output**, in the form of an LCD, to display the captured video in real-time as a visual and audio alert.

3.4. Tool Software Design

3.4.1 The Model Used

Image detection of data sets in applications is essential because models are built based on data sets. The model itself results from the training used in the application image detection. The developed research uses the model created from the set of datasets for trained networks, containing 678 images of people with and without masks trained for about 2 hours over 6000 iterations. The result of the process training, i.e., The YOLOv4-Tiny model, consists of file weight, cfg files, and obj.name (object class) files. The trained YOLOv4-Tiny model was then used next for development purposes for mask user detection on Nvidia Jetson Nano model B01 4 GB RAM and Laptop HP Core i5 RAM 4 Gigabytes for comparison.

Figure 5. Dataset of Faces Without Masks and Faces with Masks (a) Figure 661st Face with Mask, (b) Figure 672nd Face with Mask, (c) Figure 576th Face Without Mask, (d) Figure 664th Face with Mask, and (e) Figure 648th Faces with Masks

3.4.2 Classes Used in Models

Three classes are obtained from the YOLOv4-tiny model in the obj.name file. Among them are:

a. Good (Face with Mask)
b. Bad (Poorly Fitted Mask)
c. None (Face Without Mask)

The obj.name file consists of classes Good, None, and Bad are three classes used in the application for mask user detection warning that will be built. Some classes will be dominant in the testing process and subsequent data collection, namely the Good class and the None class, with the aim that the test data collection does not have too many comparative parameters used in the test data collection process.

3.4.3 Detection Development

In this study, it is hoped that the system can detect violations of health protocols in the form of violations of not wearing masks. The expected result is in the form of a direct warning sound for mischievous offenders not using masks. In a detection system, the system must be able to detect violations of not using a mask and detect various types of masks. In addition, the system must also detect that one or all of the violators are not wearing masks. From the above problems, a scenario is obtained, as shown in Figure 6. As a system was created, it is hoped that it can detect violations of not using masks for indoor detection applications.

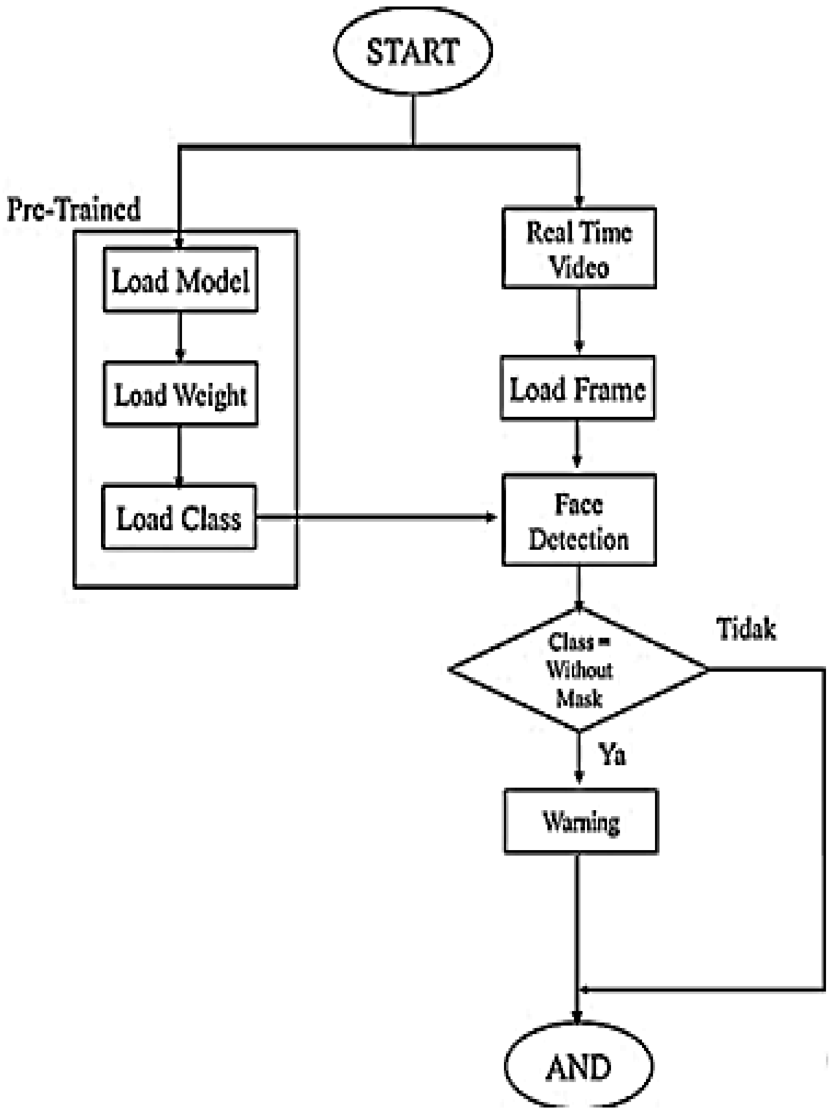


Figure 6. Flowchart Violation Detection System Does Not Use Masks

Then the following is an overview of the implementation of the physical tool and the design of work instructions. The following is an overview of the 3D design of the tool.

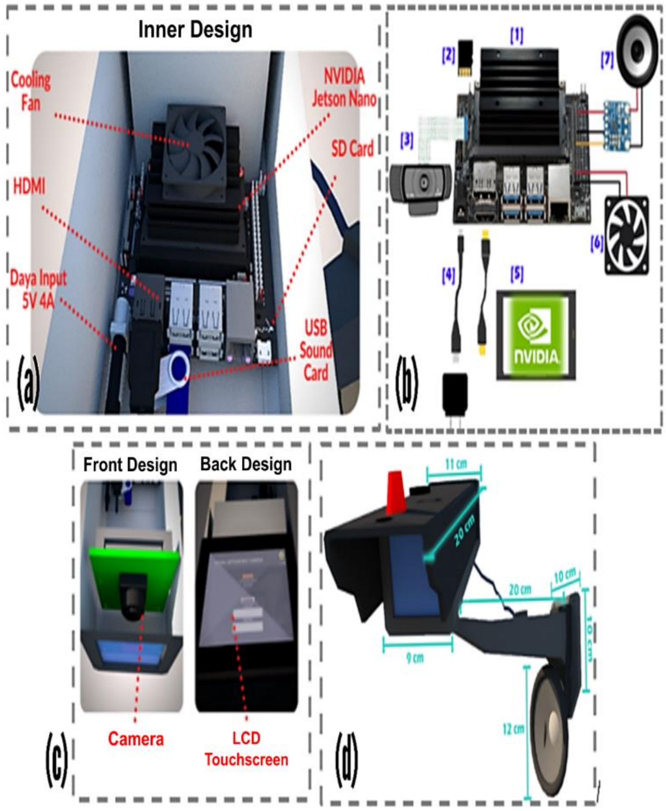


Figure 7. Design 3D Overview

Based on Figure 7. (c), it can be observed that the camera's location is behind the lens at the very front. With a shape resembling CCTV, as shown in Figure 7. (d), this tool can see widely throughout the area so that detection results are more optimal. Then based on Figure 7. (b) above, an explanation of the main components that are composed, namely:

a. **NVIDIA Jetson Nano**; minicomputer main.
b. **Memory Card**; storage, and operating system.
c. **Camera**; a device to catch objects.
d. **Input Daya**; adapter 5V-12V DC.
e. **LCD**; is used to display the tool interface.
f. **Cooling Fan;** to remove heat.
g. **Speaker**; warner

4. Results and Discussion

4.1 Testing Hardware Optimal

This test determines which hardware is optimal so that only one piece is used for the next test. The specifications of the two hardware are as follows in Figure 8.

Nvidia Jetson Nano model B01	
Parameter	Specification
Effective Resolution	1932(H) x 1088(H)
Image sensor	1/2.9
Effective Pixels	2.0 MegaPixels
Video frame rate	25FPS/30FPS
Video output	USB Video streaming
Rasio sinyal terhadap noise	>50dB
Software	UVC (tidak mengharuskan pemasangan software).
Laptop HP Core i5	
Parameter	Specification
OS Support	Windows 10
Developer Kit Size	100mm x 80mm
CPU	Quad-core Intel(R) Core(TM) i5-2520M CPU @ 2.50GHz 64-bit
RAM	4 GB
Memory	Hardisk 1 terabyte (HHD 1 Terabyte).

Figure 8. Specifications of Hardware used

4.2 Testing Detection Accuracy with Variations in Object Angle

Testing the detection accuracy with variations in the object's angle facilitates the following testing process so that not too many test parameters are carried out. The optimal angle test is carried out by varying the angle of the face object to the camera with the brightness level (Lux) and the camera distance to the object being the same (fixed).

Based on the placement of the camera position, this test will be able to analyze the best performance results hardware. The test results can be seen in Table 2 and Table 3.

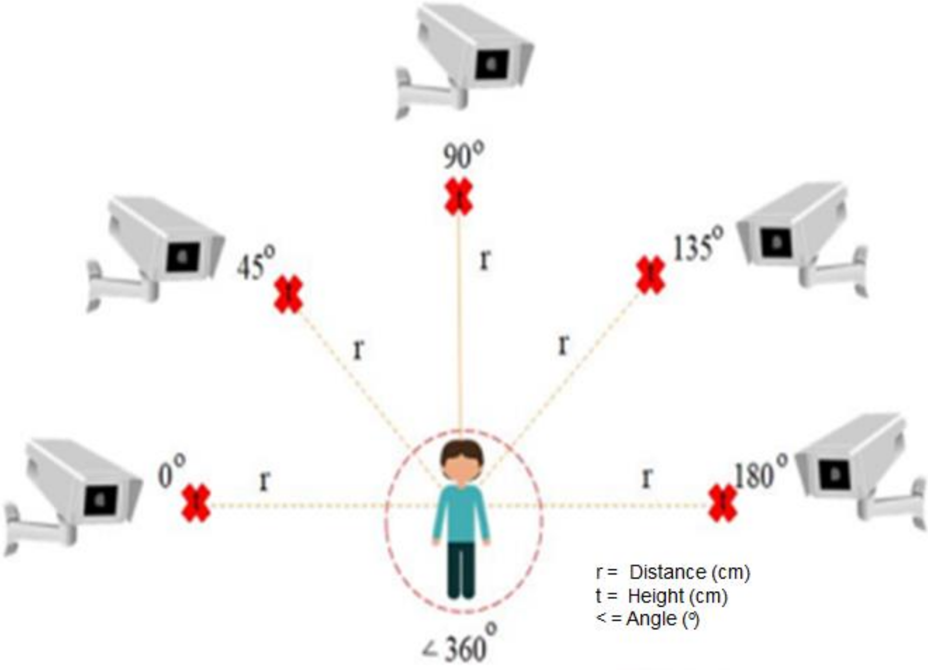


Figure 9. Testing Variations in the Angle of the Face Object Against the Camera

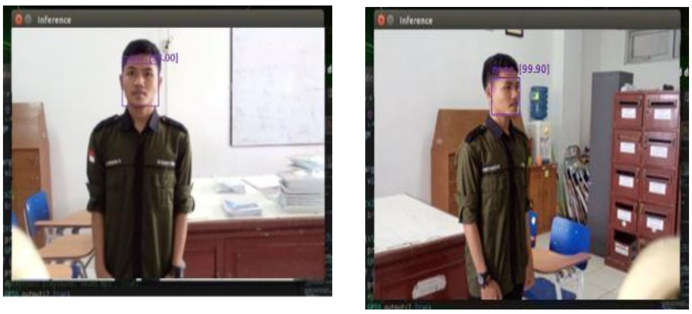
The angles used in the test process refer to Figure 9. That the system will be tested, namely the Jetson Nano. The objects that become the parameters of the test results are as follows:

a) Testing Object Angles with Masks Against the Camera
b) Testing the Angle of an Object Without a Mask Against the Camera

It is expected that the measurement of the conditions of different detection objects can analyze the best results from the parameters tested.

4.2.1 Testing the Angle of an Object Without a Mask Against the Camera

The first test is to see the detection accuracy of objects without masks. The angular variation values given are different, referring to the angular quantities used, such as the description in Figure 9.



(a) (b)

Figure 10. The Process of Testing the Angle of a Face Object Without a Mask Against the Camera
(a) Face Without Mask (Face Angle 90^{O}) and (b) Face Without Mask (Face Angle 45^{O})

Table 2. Testing the Angle of an Object Without a Mask Against the Camera

Camera Angle Position	FPS	Class Detected	Height of Camera (cm)	Distance of Camera (cm)	Average Flux Value (Lux)	Confidence (%)
Testing on Jetson Nano (Without Mask)						
0^{O}	15	none	265	220	123	74,33
45^{O}	14	none	265	220	123	99,90
90^{O}	13	none	265	220	123	99,98
135^{O}	15	none	265	220	123	99,99
180^{O}	14	none	265	220	123	94,54
Testing on a Laptop (Without a Mask)						
Camera Angle Position	FPS	Class Detected	Height of Camera (cm)	Distance of Camera (cm)	Average Flux Value (Lux)	Confidence (%)
0^{O}	3,59	none	265	219	123	99
45^{O}	3,55	none	265	215	123	100
90^{O}	3,66	none	265	219	123	100
135^{O}	3,48	none	265	223	123	99
180^{O}	3,45	none	265	218	123	89

Based on Table 2. which displays the value of the test results, shows that the test was carried out at five variations of the given face angles and then tested on HP and Jetson Nano laptops. From the best angle detection results description, it is measured by the magnitude of the value confidence (confidence level) and the FPS value (Frame Per Second). The best detection angle on the Jetson Nano is at an angle range of 45°^{O}-135^{O}and the best detection angle on testing on HP laptops is the same, namely 45^{O}-135^{O}.

4.2.2 Testing Object Angles with Masks Against the Camera

The second test is to see the detection accuracy of objects with masks. The angle variation values given are different, referring to the angle sizes used in Figure 4.2.

(a) (b)

Figure 11. Process of Testing the Angle of the Face Object with a Mask Against the Camera (a) Face with a Mask (Face Angle 90^{O}) and (b) Face with Mask (Face Angle 45^{O})

Table 3. Camera Angle Testing with Objects Wearing Masks

Camera Angle Position	FPS	Class Detected	Height of Camera (cm)	Distance of Camera (cm)	Average Flux Value (Lux)	Confidence (%)
Testing on Jetson Nano (With a Mask)						
0^{O}	15	good	265	220	123	70,23
45^{O}	14	good	265	220	123	99,90
90^{O}	13	good	265	220	123	99,99
135^{O}	15	good	265	220	123	99,94
180^{O}	14	good	265	220	123	99,77
Testing on a Laptop (With a Mask)						
Camera Angle Position	FPS	Class Detected	Height of Camera (cm)	Distance of Camera (cm)	Average Flux Value (Lux)	Confidence (%)
0^{O}	3,59	good	265	219	123	98
45^{O}	3,38	good	265	215	123	100
90^{O}	3,37	good	265	219	123	100
135^{O}	3,35	good	265	223	123	100
180^{O}	3,34	good	265	218	123	98

In Table 3. testing on HP and Jetson Nano laptops, the best detection angle on the Jetson Nano is in the 45° angle range^{O}-135^{O,} and the best detection angle in testing on HP laptops is the same, namely in the range of 45^{O}-135^{O}. The following testing stage is only on the Jetson Nano because the FPS results are much higher with reasonable accuracy.

4.3 Performance Testing Based on the Number of Faces

Based on the number of faces, the performance testing phase aims to determine how many objects the system can detect in one frame camera capture and the FPS value that works with the model used. The selected location was the Instrumentation and Control Laboratory of the Electrical Engineering Study Program, Faculty of Engineering, University of Bengkulu. The testing stage is only on the Jetson Nano because the FPS results are much higher with reasonable accuracy.

Figure 12. Test Site Conditions

Tests carried out are to see detection accuracy on multi-object no masks. The fixed measuring parameter is the given camera angle variation value of 90^{O}, with a constant Flux value of 123. Many detected facial objects are the values to be measured.

(a) (b)

Figure 13. Detection Multi-Object (a) Faces with and without masks and (b) All Faces without masks

Table 4. Detection Results Multi-Object Without Mask and With Mask

Measurement Parameters		Class Detected	Average Flux Value (Lux)	YOLOv4-tiny on Jetson Nano	
				Average of Confidence (%)	FPS
Value of faces detected	1 Object	1 good	123	99,94	11
	2 Objects	2 good		98,15	12
	3 Objects	1 good & 3 none		98,77	11
	4 Objects	all good		97,93	12
	5 Objects	all none		95,76	12

Referring to the test results in Table 4. which displays the value of the test results for detecting facial conditions, some are wearing a mask, and some are without a mask, that the light intensity (Flux) given is consistent at an average lux value of 123 has a value confidence the average for all facial objects is above 95.00% and a large FPS is rated 11 and 12. From the measurements, it can be said that the system can detect many faces with and without masks in one frame, then Jetson Nano can provide control for giving a warning because it detects a face without a detectable mask. As well as, the ability of Jetson Nano to detect multi-object is good.

4.4 Performance Testing Based on the Height Position of the Camera

The performance testing stage based on camera height aims to determine how much the value confidence on objects that the system can detect in one frame camera capture with the model used. The selected location was the Electrical Engineering Study Program Laboratory, Faculty of Engineering, University of Bengkulu. The testing stage is only on the Jetson Nano because the FPS results are much higher with reasonable accuracy.

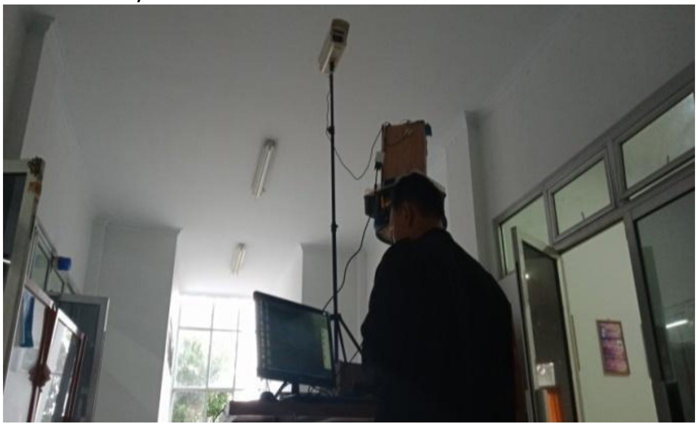


Figure 14. Location Conditions for Testing Places for Camera Height

Tests carried out are to see the accuracy of detection with variations in camera height. The fixed measuring parameter is the given camera angle variation value of 90^{O}, with a constant Flux value of 120. Value Confidence The face object to be detected is the value to be measured.

Table 5. Result of The Detection of The Camera's Altitude Test

Height Position of Camera (m)	Object Distance (m)	Class Detected	YOLOv4-tiny on Jetson Nano		Average Flux Value (Lux)
			Confidence (%)	FPS	
7	4	good	99,95	12	120
	8	good	99,91	11	
1,5	4	good	98,21	11	
	8	good	98,32	12	
2	4	good	95,25	11	
	8	good	93,67	11	
2,5	4	good	95,42	12	
	8	good	90,34	12	
3	5	good	85,75	12	
	8	good	90,60	10	
3,15	5	good	64,75	11	
	8	good	48,50	10	

The test results are in Table 5. display the value of the test results to detect the condition of the face object in real time. The amount of light intensity (Flux) given is the average Flux value, which is 120 has a value of confidence in all objects detected; a face with a mask is above 90.00%, and the FPS is large, which is greater than 11 except for the camera height at 3.15 meters which has a different value. There is a value confidence terrible for the face object with a mask at a camera height of 3.15 meters from the object to the camera 8 meters below 50.00%; This is because the higher the camera position, the lower the confidence value, the maximum detection distance, and the detection range.

The testing stage in real-time based on the place aims to find out how much value confidence in objects that the system can detect directly in the field in one frame camera capture with the model used and Jetson Nano as hardware. The location selection was the dean building of the Faculty of Engineering, University of Bengkulu.

Figure 15. Retrieval of Real-Time Test

The tests carried out were to see detection accuracy by direct testing in the field (Dean Building of the Faculty of Engineering, University of Bengkulu). The fixed measuring parameter is the value of the given camera angle variation of 80^{O}, with a constant flux value of 110 and a camera position of 8 meters from the entrance to the Dean Building of the Faculty of Engineering, the University of Bengkulu (this is the standard value as well as the best value used). The confidence value of the face object to be detected is the value to be measured because when the system makes a sound when the system detects an object without a mask, it will be a measure of the success of the system in detecting and running an mp3 file warning to warn the target to use a mask immediately.

Direct testing on employees and the Faculty of Engineering community consisting of teaching lecturers, faculty guests, students, and employees. The testing time was from 07:30 WIB until 11:00 WIB, so the test results were obtained in real-time and entered in Table 6. the data from the experiments carried out.

Table 6. Test Detection Results in Real Time

Object Condition	Face Value	Class Detected	Average Distance of Objects (Cm)	YOLO-v4-tiny on Jetson Nano		Speaker sound output
				Confidence (%)	F P S	
With Mask	1	good	250	90,00	12	Off
No Mask	-	-		-	-	Off
With Mask	-	-	100	-	-	Off
No Mask	1	bad		90,02	1	On
With Mask	2	good	200	90,20	12	Off
No Mask	1	none		98,01	1	On
With Mask	3	good	300	88,00	11	Off
No Mask	-	-		-	-	Off
With Mask	-	-	200	-	-	Off
No Mask	2	none		90,05	1	On

The test results are in Table 6. which displays the value of the detection test results for various face conditions in real-time. The data shows that the system can adequately detect faces with masks with value confidence (%) average above 88.00%. Then the face object without a mask can also be detected and emits a warning sound to wear a mask and wear a mask correctly.

5. Conclusion

The Planning results software with Python 3.9.0 against the darknet framework in testing the NVIDIA Jetson Nano can work properly because the GPU is successfully activated. As well as the results of testing and designing hardware Using a Jetson Nano Mini Computer Model B01 RAM 4GB Quad-core and laptop Intel(R) Core (TM) i5-2520M CPU @ 2.50GHz Ram 4GB, Webcam camera Full HD 1080P resolution and other system support components were successfully carried out. The model's accuracy level, namely YOLOv4-tiny, has good accuracy on the Jetson Nano Model B01 Mini Computer. The best camera detection angle is obtained at a vulnerable angle of 45O-90O or the range 90O-135O with a confidence value above 90.90%. So according to the measurement results, in conditions of a lux value of 90-110 (bright), the maximum detection distance is 12 meters, the best accuracy is at a Flux value that is greater than 70, and the camera height is at least 1 meter and a maximum of 3 meters. The results of detecting facial objects without masks using an algorithm image detection YOLOv4-tiny computed on NVIDIA Jetson Nano Model B01 is excellent feature performance, with massive computational FPS above ten and value confidence that the average is 99.94%. At the condition of Flux value greater than 78 and detection distance at 220 cm, which is a good value in standard computing image detection. The system's capability to provide output warning sound has been successfully carried out by utilizing the pin digital output Jetson Nano for the relay system to run the mp3 module separately from the system to not interfere with the computation process.

References

[1] D. Arianto and A. Sutrisno, “Kajian Antisipasi Pelayanan Kapal dan Barang di Pelabuhan Pada Masa Pandemi Covid–19,” *J. Penelit. Transp. Laut*, vol. 22, no. 2, pp. 97–110, 2020.

[2] A. Tafrikhatin, “Penerapan Kran Otomatis Guna Pencegahan Covid-19 untuk Masjid Jami Al-Istiqomah di Kelurahan Setrojenar, Kecamatan Buluspesantren, Kabupaten Kebumen,” *JURPIKAT (Jurnal Pengabdi. Kpd. Masyarakat)*, vol. 1, no. 2, pp. 48–59, 2020, doi: 10.37339/jurpikat.v1i2.306.

[3] Y. Yuliana, “Corona virus diseases (Covid-19): Sebuah tinjauan literatur,” *Wellness Heal. Mag.*, vol. 2, no. 1, pp. 187–192, 2020, doi: 10.30604/well.95212020.

[4] N. R. Yunus and A. Rezki, “Kebijakan Pemberlakuan Lock Down Sebagai Antisipasi Penyebaran Corona Virus Covid-19,” *SALAM J. Sos. dan Budaya Syar-i*, vol. 7, no. 3, 2020, doi: 10.15408/sjsbs.v7i3.15083.

[5] R. Jayapermana, A. Aradea, and N. I. Kurniati, “Implementation of Stacking Ensemble Classifier for Multi-class Classification of COVID-19 Vaccines Topics on Twitter,” *Sci. J. Informatics*, vol. 9, no. 1, pp. 8–15, 2022, doi: 10.15294/sji.v9i1.31648.

[6] J. Jumanto, M. A. Muslim, Y. Dasril, and T. Mustaqim, “Accuracy of Malaysia Public Response to Economic Factors During the Covid-19 Pandemic Using Vader and Random Forest,” *J. Inf. Syst. Explor. Res.*, vol. 1, no. 1, pp. 49–70, 2023.

[7] F. Firman and S. Rahayu, “Pembelajaran Online di Tengah Pandemi Covid-19,” *Indones. J. Educ. Sci.*, vol. 2, no. 2, pp. 81–89, 2020, doi: 10.31605/ijes.v2i2.659.

[8] S. Mishra, S. Yadav, M. Aggarwal, Y. Sharma, and R. Muzayanah, “Developed an expert system for analysis of Covid-19 affected,” *J. Soft Comput. Explor.*, vol. 4, no. 1, 2023.

[9] “6_.”

[10] W. Fang, L. Wang, and P. Ren, “Tinier-YOLO: A Real-Time Object Detection Method for Constrained Environments,” *IEEE Access*, vol. 8, pp. 1935–1944, 2020, doi: 10.1109/ACCESS.2019.2961959.

[11] R. K. Chandana and A. C. Ramachandra, “Real time object detection system with YOLO and CNN models: A review,” *arXiv Prepr. arXiv2208.00773*, 2022.

[12] S. Sakib, T. Tazrin, M. M. Fouda, Z. M. Fadlullah, and M. Guizani, “DL-CRC: deep learning-based chest radiograph classification for COVID-19 detection: a novel approach,” *Ieee Access*, vol. 8, pp. 171575–171589, 2020.

[13] J. Redmon, A. F. ön baskı ArXiv:1804.02767, and U. 2018, “Yolov3: Artımlı bir gelişme,” *Arxiv.Org*, 2018.

[14] R. L. Galvez, A. A. Bandala, E. P. Dadios, R. R. P. Vicerra, and J. M. Z. Maningo, “Object detection using convolutional neural networks,” in *TENCON 2018-2018 IEEE Region 10 Conference*, 2018, pp. 2023–2027.

[15] W. Zhiqiang and L. Jun, “A review of object detection based on convolutional neural network,” in *2017 36th Chinese control conference (CCC)*, 2017, pp. 11104–11109.

[16] Y. Al-Smadi *et al.*, “Early Wildfire Smoke Detection Using Different YOLO Models,” *Machines*, vol. 11, no. 2, p. 246, 2023.

[17] D. G. Arwindo, E. Y. Puspaningrum, and Y. V. Via, “Identifikasi Penggunaan Masker Menggunakan Algoritma CNN YOLOv3-Tiny,” *Pros. Semin. Nas. Inform. Bela Negara*, vol. 1, pp. 153–159, 2020, doi: 10.33005/santika.v1i0.41.

[18] D. M. Montserrat, Q. Lin, J. Allebach, and E. J. Delp, “Training object detection and recognition CNN models using data augmentation,” *Electron. Imaging*, vol. 2017, no. 10, pp. 27–36, 2017.

[19] S. Wen, Y. Tao, and J. Chen, “Defect Detection for Mobile Phone Cases Based on Improved Yolo Model,” in *2021 7th International Conference on Computing and Artificial Intelligence*, 2021,

pp. 28–38.
[20] P. Wu, H. Li, N. Zeng, and F. Li, "FMD-Yolo: An efficient face mask detection method for COVID-19 prevention and control in public," *Image Vis. Comput.*, vol. 117, p. 104341, 2022.
[21] A. Kumar, A. Kalia, A. Sharma, and M. Kaushal, "A hybrid tiny YOLO v4-SPP module based improved face mask detection vision system," *J. Ambient Intell. Humaniz. Comput.*, pp. 1–14, 2021.
[22] M. Inamdar and N. Mehendale, "Real-Time Face Mask Identification Using Facemasknet Deep Learning Network," *SSRN Electron. J.*, 2020, doi: 10.2139/ssrn.3663305.
[23] A. K. Bhadani and A. Sinha, "A FACEMASK DETECTOR USING MACHINE LEARNING AND IMAGE PROCESSING Engineering Science and Technology , an International Journal A FACEMASK DETECTOR USING MACHINE LEARNING AND IMAGE PROCESSING," *Eng. Sci. Technol. an Int. J.*, no. November, pp. 1–8, 2020.
[24] A. Wikarta, B. Suryo, and M. Khoirul Effendi, "Analisa Pengaruh Ukuran Testing Data dan Data Augmentation pada Tingkat Akurasi Deteksi Pemakaian Masker oleh Pengemudi Kendaraan menggunakan Deep Learning Influence," *Sent. 2020*, no. November 2020, pp. 20–24, 2020.
[25] A. Rahim, E. T. Luthfi, M. T. Informatika, and D. Learning, "Convolutional Neural Network Untuk Kalasifikasi," pp. 109–115, 2019.