Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th February 2025. Vol. 4. No. 2; e-ISSN: 2808-4519

Book Detection System At Bogor Library Using Teachable Machine

Mohamad Ridwan Apriyadi [1], Eka Kusuma Pratama[2*]

[1]*Universitas Bina Sarana Informatika*
[2]*Universitas Bina Sarana Informatika*

eka.eem@bsi.ac.id[2*]

Abstract

This research aims to develop a book detection system at the Bogor Library using Teachable Machine technology, focusing on improving efficiency in automatically searching and identifying books. The system is designed to replace the barcode-based search method, which is considered less flexible, especially since users often experience difficulties in returning books to their original places after reading. Through the application of machine learning, users can detect books based on their cover images with high accuracy, without needing to adjust the barcode's position. This research involves collecting book data by capturing images from various angles to train the machine learning model. The developed model was tested under various conditions, with results showing detection accuracy above 80%, meeting the research targets. The application was developed using Flutter, with an interface designed to facilitate users in accessing book scanning and search features. The test results show that the system can detect books with high accuracy and provide information about the location of books in the library, such as shelf numbers and floors. This system is expected to improve the efficiency of book management in the library and assist users in finding and returning books to the correct location.

Keywords: *Book Detection, Teachable Machine, Machine Learning, Flutter, Bogor Library*

1. Introduction

The library is one of the important facilities in supporting educational and research activities. A library that has a good collection of books and management makes it very easy for users to find and identify the books they need. At the Bogor Library, there is already a barcode-based scanning system to obtain book information[1]. However, this system has limitations because users are not always free to scan[2], considering that barcodes are often small in size and require proper adjustments in order to be scanned correctly. This makes the scanning process sometimes slow and inefficient, especially when it comes to adjusting the position of the barcode[4]. In addition, users often have difficulty remembering the location or bookshelf after finishing reading, as they have to manually search for books to return them to their original place[8]. This problem can happen to anyone, not just the elderly, especially when users read in a long time and forget where they took the book. To overcome this problem, a more flexible and automatic system is needed in detecting books, such as through book cover images, which do not require position adjustment like in barcodes. Therefore, this research aims to develop a Teachable Machine-based book detection system[11], which allows users to detect books more easily and visually through book covers, while helping users find the location of books more efficiently without relying on barcodes.

Baihaqi stated that "The Machine Learning process is carried out on a computer to identify image data as a result of classification in the form of predictions" [3]. This technology allows the system to recognize objects based on images and can be used to identify books quickly and accurately[5]. With this Teachable Machine-based book detection system, it is hoped that the library can provide faster and more efficient services, both for staff and library users. This system not only speeds up the book search process, but can also minimize errors in book retrieval and improve the effectiveness of library collection management.[7]

Ningsih stated that "Models in Machine Learning have a function in determining the position, detecting and identifying or clarifying many objects, which is still the main challenge in computer vision" [6].

2. Research Method

This research involves several components used in the creation of the Book Detection System at the Bogor Library Using a Teachable Machine [9], [10], [12]. These components include software and hardware

2.1. Research Design

The application's wireframe displays several main pages with key elements. On the home page, the top displays the app's logo as a visual identity, followed by a welcome message that introduces the app's basic functionality. Furthermore, there are main navigation buttons, such

as the "Open Scanner" button that directs users to a page to scan images. Users can choose two methods of uploading images, namely through the "Take Photo" option to take a picture directly using the camera, or "Select from Gallery" to upload an image that has been stored on the device.
In addition, there is an "Information" page that contains details about the app's version, its purpose, and its functions. There is also a "Books" page that allows users to view a list of books in the Bogor library, with the option to read books online. Finally, the "About Me" page contains information about the creator of this app.

2.2. Research initialization

After the shooting process is complete, the images of the books are grouped by the name of their respective books. Each book has its own folder containing a collection of photos from different angles, making it easy to organize data for the model training stage in Teachable Machine. With this grouping, the model training process becomes more structured and allows the model to more easily recognize and classify each book according to a predetermined category. In addition, there is an “Information” page that contains details about the app’s version, its purpose, and its functions. There is also a “Books” page that allows users to view a list of books in the Bogor library, with the option to read books online. Finally, the “About Me” page contains information about the creator of this app.

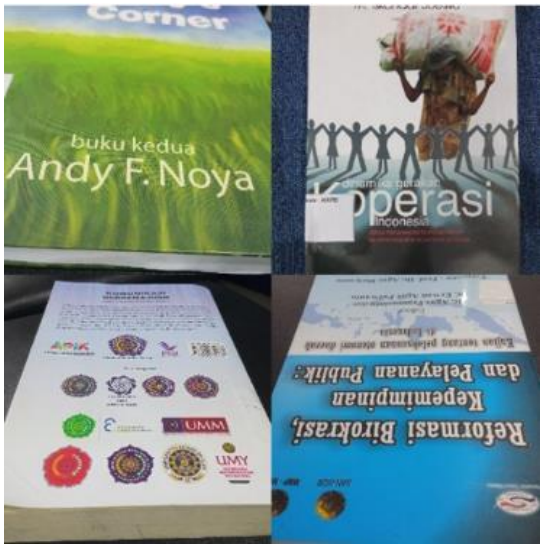

Fig. 1: Photos of the book

2.3. Dataset Creation

Once all the books have been photographed and grouped by class, the next step is to create a dataset using the Teachable Machine. The images that have been grouped are put into the Teachable Machine according to their respective classes, namely based on the name of the book. In this process, each class represents one different book, with a total of 16 classes or 16 books sampled. After all the images are entered according to the class, the dataset is trained on the Teachable Machine to generate a model that is able to recognize the books. The resulting model is expected to have good classification capabilities based on images from various angles that have been provided in the dataset.

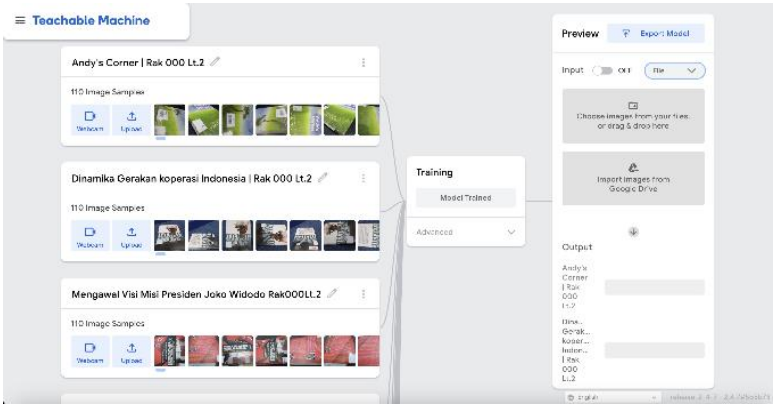

Fig. 2: Dataset creation process

The model training process was carried out with 50 epochs, a batch size of 16, and a learning rate of 0.001. This arrangement aims to improve the accuracy of the book detection system and maintain learning stability during the model training process.

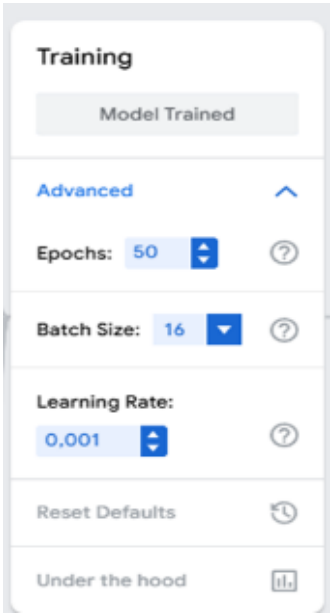

Fig. 3: Advanced Teachable Machine

2.4. App Creation

Once you've finished creating the dataset and training the model, the next step is to build the app. This application was developed using Visual Studio Code (VSCode) as its programming environment. In this stage, the trained model is integrated into the application to enable the recognition and classification of book images according to pre-built datasets. VSCode was chosen as a development tool because it provides a wide range of features that make the process of coding, debugging, and testing applications efficient

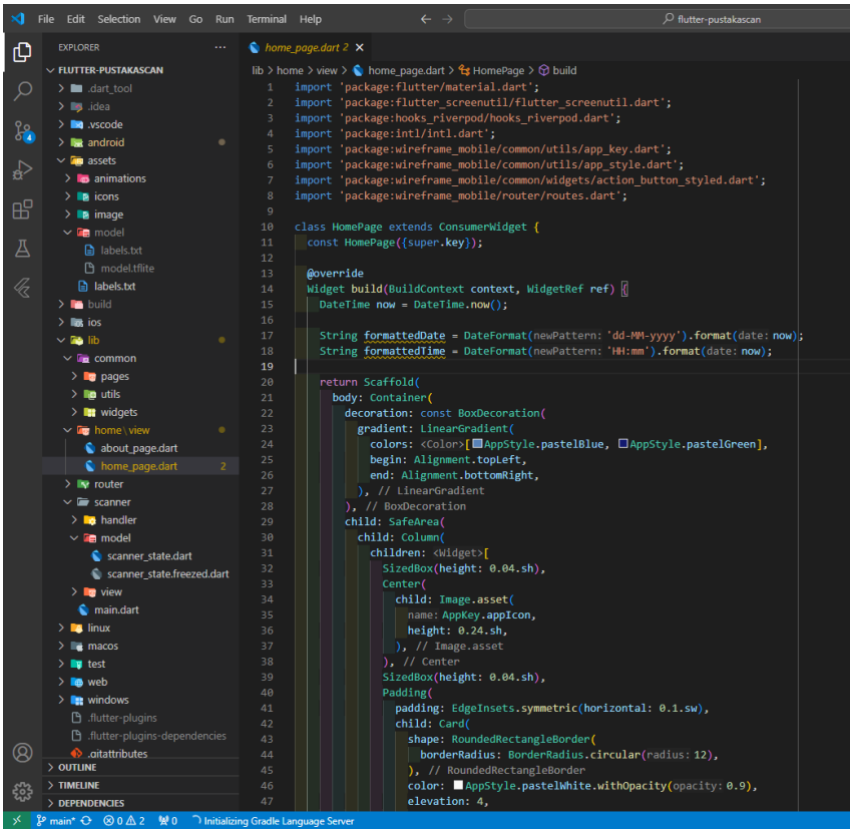

Fig. 4: Code homepage

In the development of this application, Flutter technology with the Dart programming language is used to build a modern and responsive user interface. The app is designed specifically for the Android platform, so the features and interface are tailored to the needs of Android users. The main view of the app includes a home page that contains options to open the scanner feature and provide information related to the app. This home page design is built using Scaffold, Container, and Card and Image elements to create an intuitive and accessible layout. The colors and design styles are tailored to AppStyle, providing an engaging and consistent visual experience.

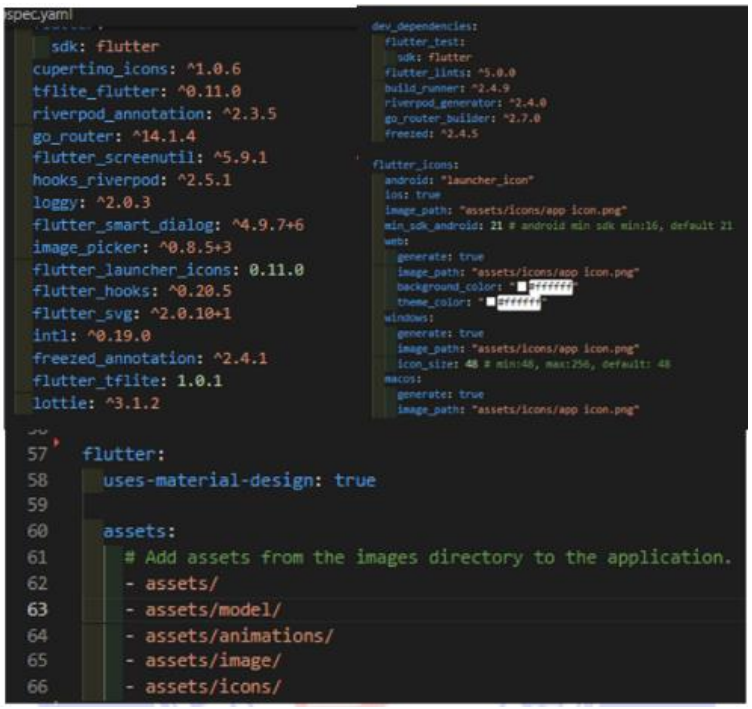

Fig. 5: Pubspec.yaml

The development of this application involves adjusting the pubspec.yaml configuration file to support the application's functionality and aesthetics optimally. Various important dependencies are added, such as image_picker to allow taking images from the user's device, flutter_launcher_icons to set the application icon, and intl which is useful in setting the date format. In pubspec.yaml, the application icon and background color are also configured according to the desired interface design. In addition, a data model is inserted into the application structure to manage data efficiently, which is then called in the main code section. The use of this model helps speed up feature development and makes it easier to manage data in the application. The asset folder containing icons, images, and model files is also organized in pubspec.yaml to ensure easy accessibility in various interface display components.

3. Result and Discussion

This research resulted in a Teachable Machine-based book detection system for use in the Bogor Library. This system was developed to make it easier to search for books through image recognition, which provides information about recognized books with high accuracy, close to or more than 80%

3.1. Accuracy Per class

In the model training results displayed on Teachable Machine, each class has a level of accuracy that shows the extent to which the model correctly recognizes images for each category. The model achieved 100% accuracy in most classes, which means the model was able to recognize images from that category precisely in all existing test experiments.

Fig. 6: Accuracy Per Class

3.2. Confusion Matrix

The confusion matrix in the results of this model training shows the success rate of the model in classifying each category. Each row represents the actual class, while each column shows the predictions generated by the model for that class. The diagonal value indicates the number of correct predictions for each class, most of which are "2", indicating that the model successfully recognized two samples accurately in those classes.

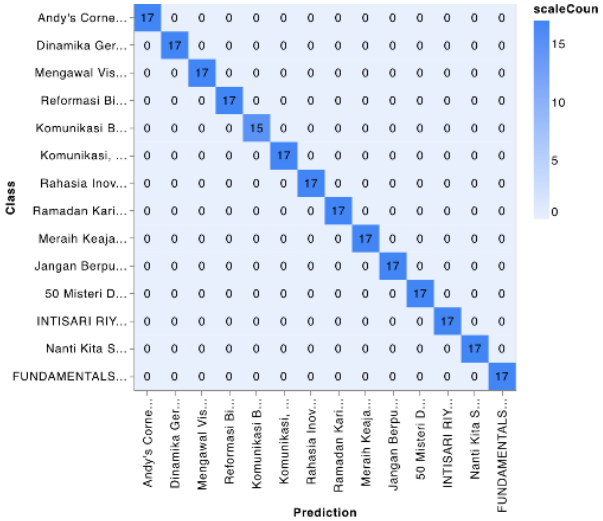

Fig .7: Confusion Matrix

3.3. Test Results

The results of this test use a mobile application that has been developed to evaluate the accuracy level of key features. Testing is carried out directly through the application to ensure that the system is able to provide prediction results or responses that suit the user's needs. The data obtained will be analyzed to assess the extent to which the application can provide accurate output in various usage scenarios, so that it can meet the expected accuracy standards.

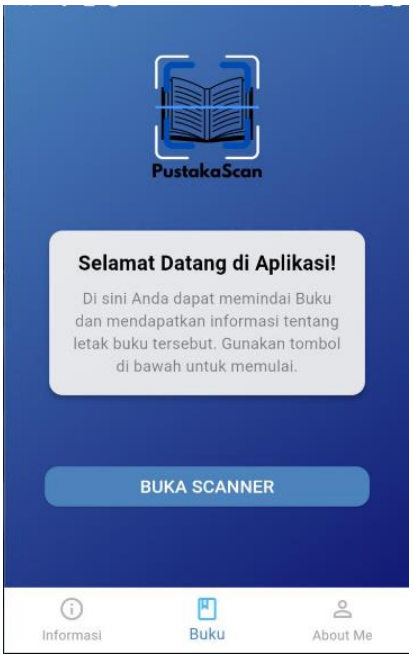

Fig. 8: home pustakascan

From the 4 (four) feature buttons in the initial display, each feature is:

1. Logo and name of the app; The display of the PustakaScan logo and name at the top helps users to identify that they are using the correct application for the purpose of scanning books in the library.
2. Initial Information; A welcome message that includes brief information about the main functions of the scanner app helps users understand firsthand the purpose of the app and the features they can use.
3. Open Scanner' Button; This button is the main feature that allows users to immediately start scanning books, which is the core of this application, so that users can get information about the location of books.

4. Menu Navigation (Information, Books, About Me); The menu at the bottom makes it easy for users to access various parts of the app, such as additional information, a list of books, and about the app developer, which enriches the overall user experience. These features are designed to provide ease of navigation and use of the app for users who want to take advantage of library services.

3.3.1. Testing using images in the "Select from gallery" dataset

The scan results show that the validation system successfully detected and identified two book titles and their locations with high accuracy. The first book, Dynamics of the Indonesian Cooperative Movement, is located on Shelf 000 2nd Floor and is detected with 100% accuracy. The second book, Andy's Corner, is also on Shelf 000 2nd Floor.

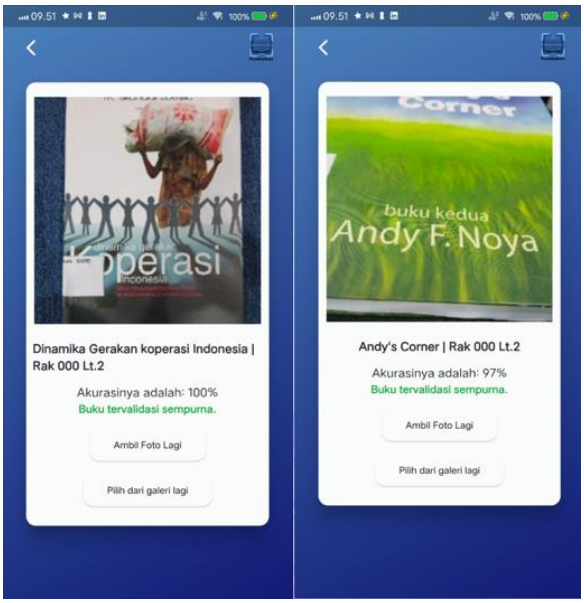

Fig. 9: Pustakascan result

3.3.2 Testing using "Take Photo"

The scan results showed that there was a variation in accuracy in the scanned books, namely 100% and 99%. This difference in accuracy indicates that the shooting angle affects the scan results, so the optimal shooting position and angle is important to achieve higher accuracy.

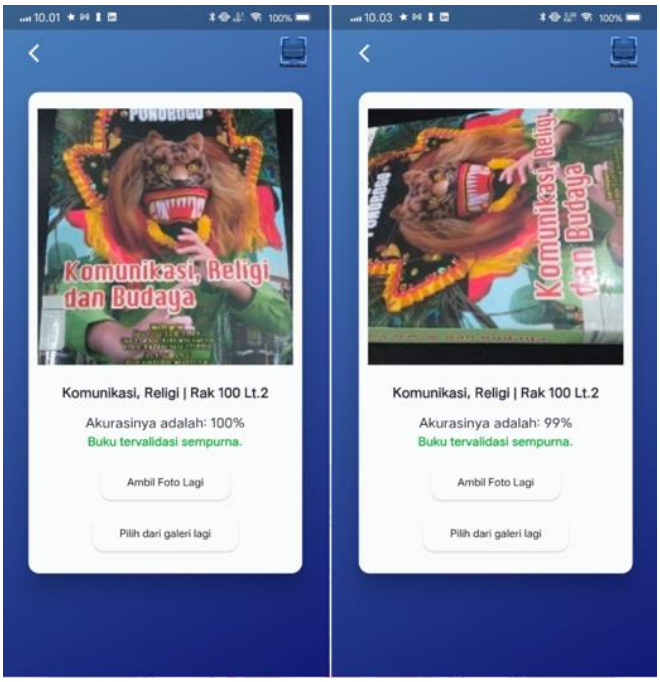

Fig. 10: Pustakascan result

In this test, images that are not included in the training dataset are used to assess the model's ability to recognize new objects. The results show that these images are considered undetectable with 0% accuracy, as the model only recognizes objects from the training dataset. Detection below 80% accuracy is automatically declared as undetected, indicating the model's limitations in generalizing data that was not previously trained.

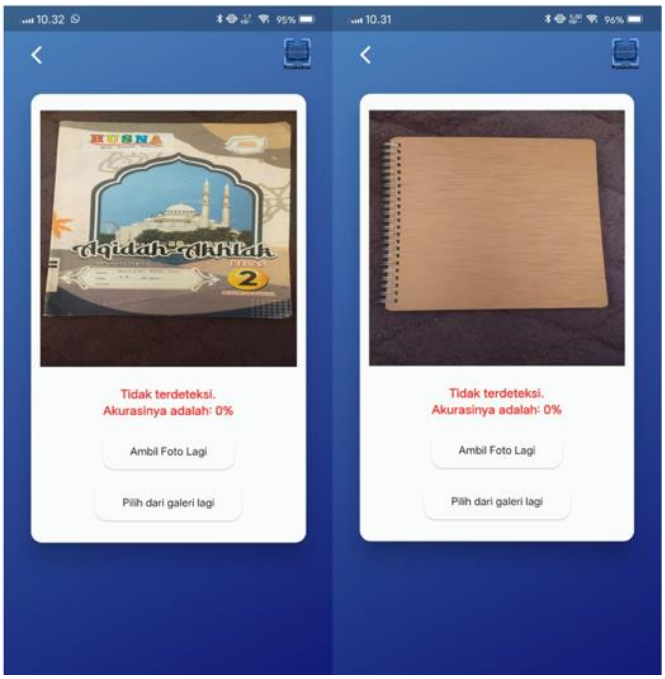

Fig. 11: Pustakascan result

The results showed that both H0 and H1 were answered, with a Teachable Machine-based book detection system that achieved an accuracy of over 80% on the training data. This proves the effectiveness of the model in identifying books that have been included in the dataset according to the needs of the library.

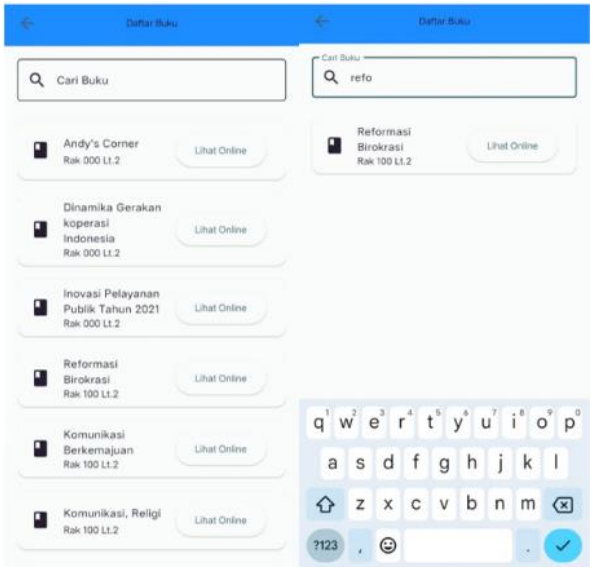

Fig. 12: Results of the Library Scan of Book Pages

Testing of the "Books", "About Me" and "Information" features shows that all three are working well. On the "Books" page, users can search for various collections of books available in the Bogor library as well as online. This feature is equipped with a search bar, where users only need to enter keywords in the form of book titles, and search results will appear automatically.

4. Conclusion

This study shows that the developed system is able to detect objects included in the training dataset with a good level of accuracy. However, the system has limitations in recognizing new objects that are not included in the training dataset, as evidenced by the low or 0% accuracy results for these images. This limitation is due to the model's reliance on training data and the existence of an accuracy threshold of 80%,

where accuracy below this value is considered undetectable. These results show that the model needs further development to improve the generalization ability of data that has never been trained before.

Acknowledgement

The authors would like to thank the Bogor Library and the Faculty of Engineering and Informatics of Bina Sarana Informatics University for supporting this work

References

[1] Adella Eka Ridwanti. (2024). Pengertian Sistem Informasi – Sejarah, Fungsi, Tujuan, Kelebihan, Kelemahan, dll. Dianisa.Com.
[2] Admin. (2023). Pengertian, Fungsi, Dan Jenis Sistem Operasi. Pengertian, Fungsi, Dan Jenis Sistem Operasi.
[3] Kualitas Dari Biji Kopi Berbasis Android Fadli Kamil, M. (2023). Pengolahan Citra Digital Menggunakan Metode Yolo Untuk. In Jurnal Artificial Inteligent dan Sistem Penunjang Keputusan (Vol. 1, Issue 1). https://jurnalmahasiswa.com/index.php/aidanspk
[4] Maulana, F. F., & Rochmawati, N. (2020). Klasifikasi Citra Buah Menggunakan Convolutional Neural Network. Journal of Informatics and Computer Science (JINACS), 1(02), 104–108. https://doi.org/10.26740/jinacs.v1n02.p104-108
[5] Muharram, R. F. (2021). Implementasi Artificial Intelligence Untuk Deteksi Masker Secara Realtime Dengan Tensorflow Dan SSD Mobilenet Berbasis Pyton. JRKT (Jurnal Rekayasa Komputasi Terapan), 1(03). https://doi.org/10.30998/jrkt.v1i03.5832
[6] Nabila Fauziah. (2022). Bahasa Pemrograman Dart – Pengertian, Sejarah, Fitur, dan Contoh Aplikasi. Alterra Academy.
[7] Ningsih, P. T. S., Gusvarizon, M., & Hermawan, R. (2022). Analisis Sistem Pendeteksi Penipuan Transaksi Kartu Kredit dengan Algoritma Machine Learning. Jurnal Teknologi Informatika Dan Komputer, 8(2). https://doi.org/10.37012/jtik.v8i2.1306
[8] Nurul, H. (2022). Visual Studio Code: Pengertian, Fitur, Keunggulan dan Jenisnya. Dewaweb.Com, 1.
[9] Rahmia, K. (2021). Rancang Bangun Sistem Identifikasi Penggunaan Masker Menggunakan Arduino. UPB Repository, 1–46. http://repository.upbatam.ac.id/1166/1/cover s.d bab III.pdf
[10] Saretta, irene radius. (2023). Flowchart: Pengertian, Fungsi, hingga Simbolnya. Https://Www.Cermati.Com/.
[11] Suparman, M., Rosada, M., Lutpi, M., Kamaliya, P., Sabaniah, F., Alfian, R. H., Ramadhan, F., Alfaro, I., & Rosdiana, M. (2023). Mengenal Aplikasi Figma Untuk Membuat Content Menjadi Lebih Interaktif di Era Society 5.0. Abdi Jurnal Publikasi, 1(6), 552–555. https://jurnal.portalpublikasi.id/index.php/AJP/article/download/283/191#:~:text=Figma adalah salah satu tools,pelaksanaan PKM berbagai desain lainnya
[12] Triwidianto, A., & Musyaffa, N. (2021). Perancangan Aplikasi Penanganan Kargo Udara Berbasis Android Menggunakan Metode Waterfall. Simpatik: Jurnal Sistem Informasi Dan Informatika, 1(1). https://doi.org/10.31294/simpatik.v1i1.125.