The Implementation of Content Planner Application with MobileNetV2 Classification for Hashtag Automation

Bevan Christian[*] and Trianggoro Wiradinata[*†]
Universitas Ciputra, Surabaya, INDONESIA

Abstract

Social media has become the most common communication channel in the 21st century. This progress opens up job opportunities for content developers, especially social media users who want their content to be managed professionally. A content developer handles several types of social media simultaneously for several clients that must be managed. Data shows that social media content developer workers experience fatigue because they have to manage a lot of content, thus sacrificing post quality if there are no tools that make their work easier.

This study aims to design and develop a content planner application with the feature of making automatic hashtag creation. Identification of app features was made through interview processes with several content developers. Among the interview results, it was found that they expressed difficulties when using applications that were not directly integrated with several popular social media, in addition to complaints about the difficulty of determining captions and hashtags for each post on social media.

This research created an application that helps content developers manage social media posts with helpful features such as implementing image classification using MobileNetV2 for hashtag automation with 72% accuracy. The direct test results found that the content planner application with the automatic hash feature helps content developers to manage posting content easier.

Key Words: Mobile application, iOS framework, social media, image classification, CNN, mobilenetv2.

1 Introduction

Indonesia's social media users have increased rapidly during the last five years. According to Digital 2022: Global Digital Insights, of 277.7 million Indonesians, 191.4 million use social media. Therefore, it can be concluded that the penetration rate is about 68.9% [5]. Having identified the significant potential of social media, some of their benefits to a company are wide scope of communication, minimal fees, brand awareness, and increased sales [4, 8, 10]. Even though many companies have Which translates to an increase in company expenditures. It is realized the benefits of social media, however, managing social media-related activities internally require time from employee social media developers who, although expensive, if done right, may be worth the investment [8].

Such demands give rise to new job positions such as Social Media Managers, Social Media Advertisement consultants, Social Media Celebrities known as Celebgram, TikTok-ers, and many more. Alongside the growing job opportunities is a growing workload challenge for content creators. They are tasked with handling various social media platforms, finding accurate SEOs, handling and avoiding copywriting issues, and creating feed and relevant hashtags. Studies conducted by Laucuka [9] concluded that hashtags cause the public to perceive something as bigger and more versatile.

Handling multiple social media platforms simultaneously means that the content created needs to be adjusted accordingly, which takes up valuable time. This overwhelms content development due to the enormous amount of administration work, including scheduling [6]. Several studies have shown that employees working in the social media area work more than their coworkers from other fields and plan to leave their job in two years due to fatigue [2]. This condition needs dire attention. An app to assist in finishing administrative and scheduling activities is needed by content developers so that they can focus more on creating content.

2 Literature Review

Newspapers and magazines are examples of content platforms that regularly publish a few items on their respective social media accounts and advertise some of them with tailored content (TCA). By publishing articles, content platforms can expand their social media followings and make money from impressions generated by clicks on links in social media posts. To schedule social media posts and TCA in a way that would optimize profitability, content platforms must decide what to post, when to post it, and whether and how much to spend on TCA. Social media managers bemoan this complexity, and the academic literature provides little help [4]. This study is interested in knowing the effects of content scheduling.

Another study by Rokhana, et al. [12] suggests using MobileNetV2 architecture as the basic model for a multi-class image classification that can identify when a face mask is being used correctly. This study also provides a trainable head model for the network, which consists of two fully connected layers, a depthwise convolution layer, and a strong classification

---

* School of Information Technology,
† Email: twiradinata@ciputra.ac.id.

performance. The experimental findings demonstrate the proposed system's high multi-class classification ability, with accuracy, precision, recall, and F1-score values of 97%, 97%, and 97%, respectively. This study suggested an example of object identification implementation in a real-time application due to its lightweight network architecture.

2.1 Terminology

1) iOS

A mobile operating system developed by Apple, iOS, runs software on devices such as iPhone, iPad, and iPod touch. It was earlier introduced as iPhone OS, but was changed to iOS with the introduction to iPad. Since 2019, iPad has its own OS, called iPadOS [1].

2) Swift

Swift is a robust and intuitive programming language created by Apple to develop applications for iOS, Mac, Apple TV, and Apple Watch. Swift alone could be used to develop games, machine-learning-based applications, and much more [7].

3) Core Data

Apple's macOS and iOS operating systems include Core Data, an object graph, and a persistence mechanism. It debuted in iOS with iPhone SDK 3.0 and Mac OS X 10.4 Tiger. It enables the serialization of data from the relational entity-attribute model into XML, binary, or SQLite databases [3].

4) Core ML

Core ML builds a model by applying a machine learning algorithm to a training data set. Making predictions based on fresh input data requires the usage of a model. A wide range of tasks that would be challenging or impractical to write in code can be carried out using models. With just a few lines of code, developers may use Core ML's four dedicated machine learning APIs to take advantage of machine learning capabilities. The first of these APIs is the Vision Framework, which uses computer vision techniques including object identification, image classification, and activity categorization to analyze photos and videos. (2) The Natural Language Framework can assist developers in the analysis of natural language content, the division of that material into paragraphs, phrases, or words, and the tagging of information about those segments. (3) The Speech Framework allows users of various languages to benefit from speech recognition on real-time or recorded audio. (4) Sound Analysis Framework, used to categorize noises like highway noise or singing birds, analyzes audio [11].

5) MobileNetV2

One of several phone-based Convolutional Neural Network (CNN) Architectures that can accommodate more computing power is MobileNetV2. The most recent version is MobileNetV2. In general, the use of convolution layers distinguishes the MobileNetV2 Architecture from the CNN Architecture. MobileNetV2 uses depthwise separable convolutions, which greatly reduce the number of parameters when compared to convolution layers generally, as seen in Figure 1.
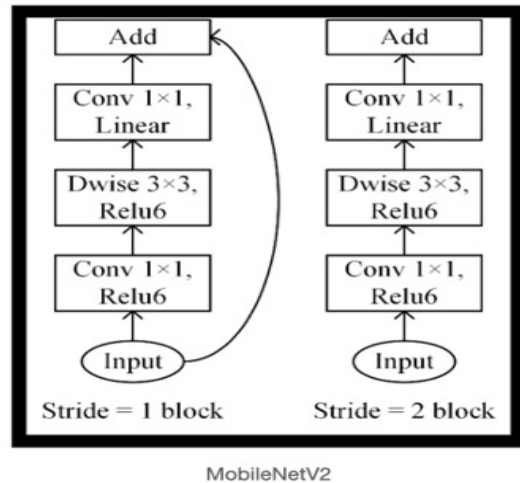

Figure 1: MobileNetV2 architecture

Depending on the input image's thickness, the MobileNetV2 convolution layer applies the appropriate filter thickness. MobileNetV2 makes use of linear bottlenecks, pointwise and depth wise convolutions, as well as shortcut connections between bottlenecks [13].

Furthermore, using the MobileNetV2 has the following benefits:

1. Less memory and power consumption.
2. Transfer learning allows the trained model to be used with a new dataset, hence saving time.
3. Up to 75% accuracy is deemed high.
4. It is perfect for devices with lower-level technology due to its compact model size.
5. MobileNetV2 beats sophisticated real-time detectors in the construction of models for object detection using COCO dataset in terms of accuracy and complexity by 10 times less calculations.

3 Design & Analysis

3.1 Analysis of the Problem

Interviewing content creators to understand the difficulties they encountered at work is the first step in analyzing the application. To find comparable existing applications, the analysis proceeds with a survey of similar apps on the App Store.

Content creators must pay attention to several factors while

managing social media, including the date and time the post was made, the description, hashtags, and even the type of content (either video or image). The above are arranged using spreadsheet tools based on the researcher's personal experience. The drawback of this approach is that image files are saved separately from the spreadsheet, taking time to locate and manually submit the image file from wherever it may be. Three content developers with at least six months of experience managing social media were then questioned to acquire more information on the previously described problem.

The purpose of the content developer interview was to learn more about:

1. The scheduling tools utilized for content.
2. Daily routines.
3. Drawbacks related to employing current tools.

Several things could be inferred from the interview's findings, including:

1. Three main tools are used to schedule content. a TikTok draft, Microsoft Excel, and a calendar application.
2. Most content developers rely on two key tools. The first is a calendar application that can just serve as a reminder when material needs to be submitted. The content developers utilize Microsoft Excel to store the information, captions, and hashtags.
3. Content developers must manually copy and paste data from Microsoft Excel.
4. Other schedules and content scheduling are combined by using a calendar program.
5. Content developers frequently overlook posts that were late or hadn't been uploaded.
6. To correctly target consumers based on each social media site, content developers must differentiate the captions, hashtags, and when a post should be published.
7. Hashtags have grown in importance as a means of boosting content popularity but coming up with the best ones may be time-consuming.

A few applications for content scheduling were discovered. There is an app that offers the ability to post and preview feed content automatically. Still, it cannot propose hashtags and requires a relatively high price to enjoy the full features. Another app was found with the capability of content post-time planning. However, it has been discovered to be unreliable regarding timely content scheduling. Finally, there is another app with complete features for content developers, except proposing hashtags.

3.2 Analysis of Needs

Content developers need an application with the following functionalities based on business-related issues:

1. Informs the creator of the material to post in accordance with the content schedule.
2. In order to eliminate the need to switch between applications, one application houses all media content.
3. The capacity to store image and video files.
4. The ability to provide a video or image file preview.
5. The ability to post content with a single click eliminates the requirement for manual posting.
6. A preview feed that is sorted according to social media networks
7. Shows overdue contents.
8. A hashtag generator that automatically creates hashtags based on image recognition.

3.3 Application Architecture

The application architecture diagram is depicted in Figure 2 below. Users first visit a view, often known as the "Home" display, where data is given to the view model for processing each input the content developer adds. For Create-Read-Update-Delete (CRUD) processing, some essential operations will start at the view model and continue in the model or local database. Then, as feedback, either a success or an error some data will be returned. The MobileNetV2 method can be used by the view model to request classification labels for automatic hashtag generation. The findings are returned to the view model to be processed into hashtag suggestions as soon as the categorization process is complete.

Data from the *model* that is sent to the *view model* is handled in accordance with each view rather than being sent directly to the view.
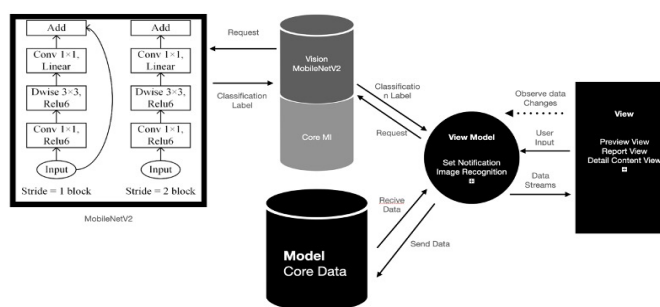

Figure 2: Application architecture

3.4 Usecase Diagram

The content developer, can perform one of the two main activities, as seen in Figure 3. The first is to create content, and the second is to examine post scheduling report data. CRUD operations could be utilized to process the creation of content, particularly in Create User where hashtags are generated automatically and in Read User where content can be disseminated straight to selected social media.

3.5 Application and Design Flow

Based on results from interviews, research, and application comparison, the content will be divided based on social media and for each social media platform, a preview of the feed and the feature to add new content (video / image-based) with *captions* and automatically generated hashtags based on *image recognition.* Another page is dedicated to reporting content that is on track and overdue concerning the content schedule as shown in Figure 4.
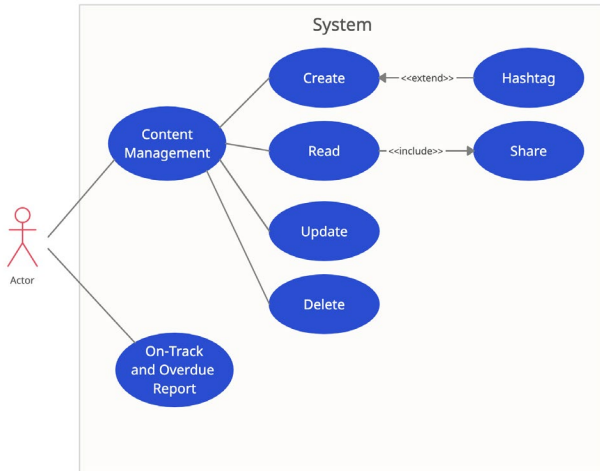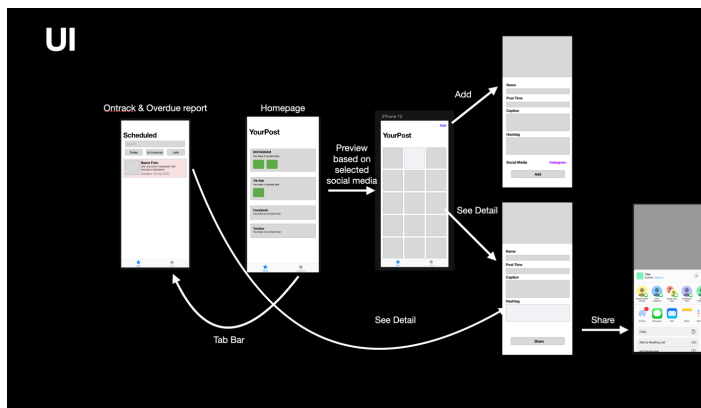

Figure 3: *Use case* diagram

Figure 4: Application flow

4 Implementation

4.1 Automatic Hashtag Generation

To generate automatic hashtags, a deep learning model, in this case an image recognition model, needs to be initialized with the following method.

```
let model = MobileNetV2()
```

Afterwards, carefully selected content will be identified as either video-based or image-based to generate the appropriate hashtag.

```
func append(item: PhotoPickerModel) {
    itemsContentPicOrVid = item
    if  itemsContentPicOrVid.mediaType
== .photo {
        clasifyImage()
    } else {
        clasifyVideo()
    }
}
```

4.2 UI Display

1) Home page

Four social media platforms chosen for the home page based on their level of popularity are listed based on the interview. Instagram, Tik-Tok, Facebook, and Twitter are the available channels as displayed in Figure 5. Content developers may simply determine how much of their content is past due, thanks to this application's homepage.
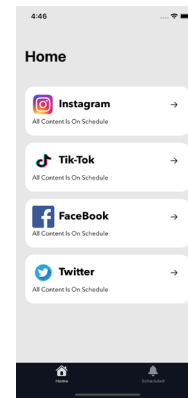

Figure 5: Homepage

2) Preview Feed

The *preview feed* page (Figure 6) is used by content developers to get a preview before posting their feed on social media and which content comes next. Pages could be displayed and ordered based on posts criteria.

3) Adding content.

On this page, (Figure 7) content developers can add new content. From adding an image or video-based content to *captions,* setting when to post, when to be notified, and acquiring an auto-generated hashtag based on the image or video-based content they uploaded and the level of accuracy.
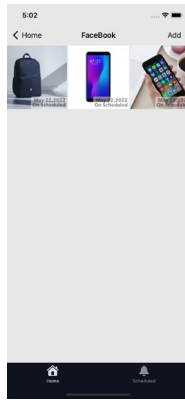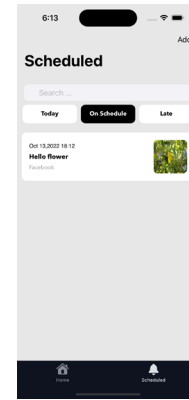
Figure 6: Preview feed page

Figure 8: On-track & overdue report display

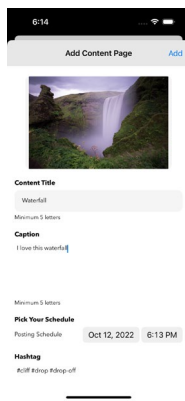Figure 7: Add content page

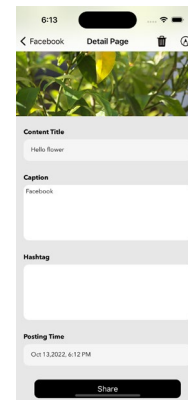Figure 9: Content detail page

4) On-track & Overdue Report

On this page, content developers can track contents that are overdue, on time, or due that day (Figure 8). This page also allows content developers to add content with the *add* button at the top right and do searches.

5) Content Detail

The caption, image or thumbnail of the video, and hashtags are among the additional information about the posted content that is displayed on this page (Figure 9). The user can share anything on this page to any social media site.   The *UIActivityViewController* will be called by this action later to establish a connection with the specified social media. The caption and hashtags will be preserved in the device's clipboard when the content creator shares content, saving time by eliminating the need to redo them.

5 Results and Discussion

User Acceptance Testing (UAT) was chosen as the application testing approach in this study, in the direction of the content developer who created a user persona based on the testing scenario. As a result, the testing scenario has also been modified to reflect the unique traits and environment of each user persona. Additionally, depending on the outcomes of the interviews, the user persona attributes were established. Here are three different types of user personas that were chosen for this study.

5.1 User Persona & Test Case

User persona 1 is an *influencer* who struggles with following the content schedule and posting on time and must manage various social media to support the influencer's work in Table 1.

User persona 2 is business owners responsible for handling business operations, including their businesses social media. This persona struggles with time constraints, handling multiple social media at the same time and posting dense content as shown in Table 2.

Last is *user persona* 3 (Table 3), the *Content Manager* who struggles with determining hashtags for their content and scheduling content.

Table 1: Influencer user persona

Persona Type: *Influencer*		
Pains	**Goals**	**Task**
Handling much content	Ease of sharing content	Sharing video on social media.
Not following content schedule	Enables the user to remember the content schedule easily and receive notification.	Track the content that must be posted on said day and receive notification.
Handling varieties of social media.	Enable the user to manage content folders and scheduling.	Post content on 3 different social media platforms.

Table 2: Business Owner User Persona

Persona Type: *Business Owner*		
Pains	**Goals**	**Task**
Time constraint	Able to save and share content quickly.	Add video-based content and share to desired social media, without writing any captions.
Handling various social media	Easily handle multiple social media at the same time.	Updating and deleting available content.
Personal files mixed with work files.	Able to separate personal files from content for social media.	Add content to various social media.

Table 3: Content manager user persona

Persona Type: Content Manager		
Pains	**Goals**	**Task**
Difficulty creating hashtags and captions	Easily create hashtags	Uploading content to generate hashtags.
Difficulty scheduling content.	Easily schedule content.	Able to interpret schedules in on-track and overdue report.

5.2 Test Results

Table 4: Influencer user persona

Task	Preconditon	Postcondition	Result
Add 3 content for different social media types at different times.	1. User grants access to their gallery. 2. User inputs necessary input for completing content. 3. User presses *add*	User can easily add content without difficulty and free from error.	Passed
Track content that needed to be posted today, overdue, and on-track content.	1. Content has been added beforehand. 2. Three types of content must be added. One to be uploaded today, the second to be posted sometime in the future and the third preceding today.	User can see and understand *segmented control* easily and can interpret in accordance with their respective *segmented control.*	Passed
Sharing a video to social media	1. Video-based content has been added beforehand. 2. Presses one of the social media to be distributed.	Easily share video-based content to social media.	Passed
Receiving notifications on schedule.	1. User has previously saved content. 2 User did not open the app on scheduled day.	A notification will appear according to schedule along with the video / image attachments. Subsequentially the social media destination can be selected.	Passed

Table 5: Business owner user persona

Task	Preconditon	Postcondition	Result
Add video-based content.	1. User grants access to their gallery application. 2. Gallery has a video for selection.	User can add video-based content easily.	Passed
Sharing video to intended social media.	1. User had saved content in video form. 2. User owns social media, capable of sharing videos on their platform.	User could easily share content, captions and hashtags to target social media platforms.	Passed, a suggestion to put the share button at the top.
Add as much content as possible and successfully do CRUD related processing.	1. Grant access to the gallery app. 2. A video is available in the gallery for selection.	User can easily change or erase data.	Passed
Adding image-based content to various social media at the same time.	1. User gives access to gallery application. 2. Gallery contains an image to be uploaded.	User could share pre-made content, captions, and hashtags consistently across social media platforms.	Passed, suggestion to add navigation title based on which social media platform is being accessed and swipe down to refresh feature.
Share image or video - based content without *captions*	1. Has a video file. 2. Captions and hashtags are inputted correctly.	User could easily share content without having to rewrite captions.	Passed

	3. Has previously selected a target social media platform.		

Table 6: Content manager user persona

Task	Precondition	Postcondition	Result
Adding content to automatical-ly generate hashtags.	1. User grants access to gallery application. 2. Has selected a video or image file.	User could effortlessly receive hashtag recommendations based on available content.	Passed, Suggestion to make social media selection consistent with results.
Able to compre-hend the content schedule made.	1. Has previously added content. 2. Three types of content must be added. One to be uploaded today, the second to be posted sometime in the future and the third one preceding today.	User can see and understand *segmented control* in the on-track & overdue view easily and can interpret it in accordance with their respective *segmented control.*	Passed, Suggestions to add time in on-track and overdue reports, a cancel button in the search bar, and adding a haptic touch feature to preview content details.

Out of 11 successful tasks, four tasks received valid suggestions that have been implemented, such as:

1. Adding a cancel button for the search bar.
2. Swipe to refresh the feature
3. Social media selection options have been made consistent.
4. Addition of time in on-track & overdue report.
5. Navigation titles that reflect the social media platform we are currently working on.

The results from UAT align with the previous study by Kanuri et al. [4], in which time was a significant factor in influencing impression and content effectiveness, as evident in the content developer's request to add time in the on-track and overdue report. It was also found that the hashtag generation process

relies on objects provided by MobileNetV2, which has an accuracy of 72% over 1000 objects. It leaves the possibility of improperly generating hashtags due to MobileNetV2's limited image recognition capabilities.

6 Conclusion

6.1 Conclusion

The design and development of a content scheduler and reminder app that automatically generates hashtag recommendations were intended to help plan and develop a content scheduling app. The first step was researching related apps and conducting interviews, which revealed content developers struggle with handling content scheduling, content creation, automating hashtag creation, and un-integration with other systems. The next step was utilizing MobileNetV2's classification capabilities to recognize objects in the image posting. Finally, acceptance testing was done with three kinds of user persona in their respective environment. Through this research, a content scheduling and reminder tool that automatically generates hashtags using MobileNetV2's classification skills were developed to assist content developers in managing content with minimal hassle.

6.2 Future Studies

Advice for future studies and app development is listed as follows:

1. The development of this is expected to be more complex and integrated directly with the API from each social media platform to automatically upload content.
2. The development of this application is expected to use a better *image recognition* model than MobilNetV2 with a level of accuracy surpassing 72% and 1000 objects to automatically generate better hashtag recommendations with the aid of alternative *libraries*.

Reference

[1]   S. Costello, "The History of iOS, from Version 1.0 to 16.0," *Lifewire*, Jul. 2022. https://www.lifewire.com/ios-versions-4147730, accessed Aug. 21, 2022.

[2]   M. Distaso and T. Mccorkindale, "The Career Path of a Social Media Professional," 2020. [Online], Available: https://instituteforpr.org/wp-content/uploads/Challenges-of-a-Social-Media-Professional-Report-v7.pdf, Accessed: Aug. 15, 2022.

[3]   P. Hudson, "How to Combine Core Data and SwiftUI - A Free Hacking with iOS: SwiftUI Edition Tutorial," *Hacking with Swift*, May 12, 2022. https://www.hacking withswift.com/books/iosswiftui/ how -to-combine-core-data-and-swiftui, accessed Aug. 21, 2022.

[4]   V. K. Kanuri, Y. Chen, and S. H. Sridhar, "Scheduling Content on Social Media: Theory, Evidence, and Application," *Journal of Marketing*, 82(6):89-108, Oct. 2018, doi: 10.1177/0022242918805411, 2018.

[5]   S. Kemp, "Digital 2022: Indonesia," *DataReportal – Global Digital Insights*, https://datareportal.com/reports/digital-2022-indonesia, accessed Aug. 15, 2022.

[6]   N. Kesaris, "New Study Finds Many Social Media Managers Work More Than Their Colleagues and Plan to Leave Their Positions in Less Than Two Years," *Institute for Public Relations*, 2020. https://instituteforpr.org/new-study-finds-many-social-media-managers-work-more-than-their-colleagues-and-plan-to-leave-their-positions-in-less-than-two-years/, accessed Aug. 15, 2022.

[7]   C. S. Kwang, "What is Swift Language and Advantages and Disadvantages?," *Towards Dev*, 2022, https://towardsdev.com/what-is-swift-language-and-advantages-and-disadvantages-eb8bb57735cb, accessed Aug. 15, 2022.

[8]   S. O. Lagrosen and K. Grundén, "Social Media Marketing in the Wellness Industry," *TQM Journal*, 26(3):253–260, 2014, doi: 10.1108/TQM-12-2013-0129/FULL/XML, 2014.

[9]   A. Laucuka, "Communicative Functions of Hashtags," *Economics and Culture*, 15(1):56-62, Jun. 2018, doi: 10.2478/JEC-2018-0006, 2018.

[10] G. Meikle, "Social Media: Communication, Sharing and Visibility," *Social Media: Communication, Sharing and Visibility*, pp. 1–170, Feb. 2016, doi:10.4324/9781315884172, 2016.

[11] M. P. Recke and T. G. Pereira, "Core ML Explained: Apple's Machine Learning Framework," Jun. 16, 2021. https://www.createwithswift.com/core-ml-explained-apples-machine-learning-framework/, accessed Aug. 21, 2022.

[12] R. Rokhana, W. Herulambang, and R. Indraswari, "Multi-Class Image Classification Based on MobileNetV2 for Detecting the Proper Use of Face Mask," *International Electronics Symposium 2021: Wireless Technologies and Intelligent Systems for Better Human Lives, IES 2021 - Proceedings*, pp. 636–641, Sept. 2021, doi: 10.1109/IES53407.2021.9594022 2021.

[13] M. Sandler, A. Howard, M. Zhu, A. Zhmoginov, and L. C. Chen, "MobileNetV2: Inverted Residuals and Linear Bottlenecks," *Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, pp. 4510-4520, Jan. 2018, doi: 10.48550/arxiv.1801.04381, 2018.

Bevan Christian is an iOS Developer at Kumparan, a collaborative news media platform. He is an alumnus of the School of Information Technology at Universitas Ciputra Surabaya, as well as an alumnus of Apple Developer Academy. His research interest is in Clean Code, Reactive Programming, and Pattern Architecture. Currently, Bevan has published three applications in Apple's App Store.

Trianggoro Wiradinata is a researcher at the School of Information Technology at Ciputra University. He received a Bachelor's degree in Electrical Engineering (major in Computing) from Petra Christian University, Indonesia, and a Master's degree in Computer Science from University of New South Wales, Australia and completed his Ph.D. program in Information Technology from Assumption University of Thailand. His main research interests are data science, software engineering, technology adoption, and technology-based entrepreneurship. He was actively involved in many large-scale enterprise software development projects before joined as researcher at Ciputra University, Surabaya, Indonesia. Assoc. Prof. Dr. Wiradinata is currently a. member of Association for Computing Machinery (ACM) and Association for Information Systems Indonesia (AISINDO).