Hyperautomation in Marketing: Transforming Social Media Strategies with AI

Huikun Chen
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
huikun.chen@tum.de

Berk Güler
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
berk.gueler@tum.de

Ege Güler
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
ege.gueler@tum.de

Erik Kiessig
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
erik.kiessig@tum.de

Osman Enis Özsezginler
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
osmanenis.oezsezginler@tum.de

Robin Reichel
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
robin.reichel@tum.de

Miloš Šolaja
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
milos.solaja@tum.de

Vladislav Vintaykin
TUM School of Computation, Information and Technology
Technical University of Munich
Munich, Germany
vladislav.vintaykin@tum.de

***Abstract*—Automation is an important component in current business processes, reducing workloads. This practice is expanded upon by hyperautomation, which enables the automation of automation, allowing complex use-cases to scale effectively while requiring less supervision. In this paper, the concept of hyper-automation is used to hyper automate the creation and posting process of social media content.**

***Index Terms*—hyperautomation, content generation, social media, automation, hyperautomation in marketing, self improvement, ranking, web scraping**

I. Introduction

Hyperautomation is a key idea for every business whose goal is scaling fast and efficiently using AI [1]. It is a true digital transformation using advanced techniques such as Robotic Process Automation (RPA), Machine Learning (ML), and Artificial Intelligence (AI) [2]. This concept automates complicated business processes, even where topic specialists were formerly needed [3]. This is an expansion of the processes of traditional business-process automation. Hyperautomation allows automation to do virtual tasks normally performed by people by merging AI technologies with RPA. It takes dynamic detecting and generation of automation processes to the next level. This allows companies to combine business intelligence systems, undertake complex needs, and automate basic human tasks, providing them the opportunity to pursue more relevant goals and increase the efficiency of the overall business [2]. Although use cases for hyperautomation can be found in almost every business model and can be useful in almost all business departments [4], this paper is going to focus on a use case of hyperautomation in one specific business area: Marketing.

Therefore, the focus of this paper is to first present and afterwards evaluate our novel Hyperautomation Marketing approach that generates social media content based on the data from a company's website.

Section II discusses current Hyperautomation solutions in Marketing and Section III explains the motivation behind this paper and our work. Section IV gives a brief overview of the components and technologies used in the solution whereas section V explains how they are combined together to create and publish posts on social media. Finally, section VI presents the test cases, including a survey and a prototype with an exemplary use case to evaluate the effectiveness of this approach.

II. Current technologies available for Hyperautomation

There are few research examples which focus on using automation in content generation to aid in creating social media. In [5] the authors use APIs such as Microsoft Face API, Google Image Search, remove.bg API, ASAHIShimbun Media Lab Text Summarizer API to generate YouTube Thumbnails. Based on their evaluation, their creations outperform the thumbnails set by YouTube but are inferior to the thumbnails set by YouTubers. Their method is limited to videos that feature people because the frame for the thumbnail is selected based on faces with the most emotionally rich expressions. Additionally, the approach is only applicable to the Japanese market, as the used Summerizer API only supports Japanese. More importantly, the approach lacks hyperautomation. First, manual code execution for summarizing text and picking an image on Google is required. Second, no parameter is tracked to automatically improve the thumbnail, and no input parameters are altered to have variation and try out different thumbnails.

However, there are commercial solutions available for aiding social media management with automation, but only few can generate content.

Lately.ai [6] can automatically post long-form content, such as newsletters, blogs, and interviews, on different platforms by simply pasting the link into the Lately.ai generator. The auto-generated posts are then ready to be edited, added hashtags, and published as scheduled. However, Lately.ai does not automatically summarize the content and generate images from the content.

Jasper [7] can generate images and text for blogs, stories, social media, etc., but the image and text generators work independently. Jasper needs a short content description for text generation, which automatically generates a unique, plagiarism-free long text. A short description of the desired image is required for image generation, after which an image is automatically generated. However, Jasper does not offer auto-posting functionality for social media channels. Thus, users need to post the created content manually.

III. Motivation

In recent years, social media has become an integral part of many people's lives. A study by Hootsuite (2022) [8] found that the average person spends 2 hours and 27 minutes per day on social media and that the average number of posts per day on social media platforms has increased by 60 percent in the last 5 years.

For businesses, social platforms have become an influential communication channel where companies can foster relationships and constantly interact with customers. [9] Such a presence can help companies stand out in the crowded space and keep up their customers with quality content output. At the same time, constant integration of the audience's feedback regarding previous posts could additionally help businesses grow and thrive.

Already available solutions showed that recent AI models are capable of performing individual specific tasks, such as text generation (GPT-3/4, Lately.ai Content Writer, Jasper.ai text module), image generation (Dall-E, Stable Diffusion, Jasper.ai Art) and keyword/hashtag generation (Lately.ai, Jasper.ai, Yake!), but an automated pipeline for social media posting, to our knowledge, has not been developed yet. We have seen this as an opportunity to combine these models to automate the entire process of creating and posting social media content.

At the same time, the importance of visual perception and the attractiveness of social media posts is more stressed than ever before. Since people perceive up to 80 percent of all impressions by means of their sight [10], one of the main factors of consumer attraction in the modern world is undoubtedly the color. [9]

In this paper, we propose a hyper-automated pipeline for social media marketing that generates and posts unique social media content with text, images, and hashtags based on articles from a company's website. Additionally, the system constantly learns from the audience's feedback and improves the attractiveness of future posts. A self-improving color ranking algorithm selects the most appealing color for the next image based on the past performance of the color on the company's social media page. This solution helps companies make their social media presence stand apart from competitors, save time, and reduce costs. Also, it is, to our knowledge, a novel hyperautomation solution for marketing purposes.

IV. Prerequisites for the solution

Our proposed solution for automated content generation for social media consists of several preexisting components that are combined together. The core of the solution comprises two models for generating content: Stable Diffusion for Image Synthesis [11] and Facebook BART [12] for text summarization. This section contains a brief explanation of all the necessary components.

1) Stable Diffusion: Stable Diffusion is a deep learning, text-to-image model released in 2022. It is primarily used to generate detailed images, conditioned on text descriptions, that resemble the data they were trained on. [13] [11]

Stable Diffusion uses a so-called latent diffusion model [13]. It works by destroying training data through the successive addition of noise. Afterwards, it learns to recover the data by reversing the noising process and gradually improving the quality of the image until a realistic one is created. [14] [15]

Stable Diffusion was trained on the LAION-Aesthetics v2 5+ dataset, a subset of 600 million captioned images. [13] The publicly available model enables users to set different parameters for their prompts, such as input prompt, negative prompt, number of denoising steps, or a specific image size.

2) BART: The BART model is a denoising autoencoder for pretraining sequence-to-sequence models developed by Facebook Research. It can be used to fine-tune models for different text-to-text applications like text generation, machine translation, or keyword extraction. The pre-training process of BART is unique with its denoising autoencoder approach, where the model is trained to reconstruct the corrupted text by predicting the original text given the corrupted version. We use a pre-trained BART model to create text summarization in our implementation. [12]

3) YAKE!: YAKE! (Yet Another Keyword Extractor!) is a lightweight unsupervised keyword extraction technique that relies on text statistical features to select the most important keywords from long-form content and rank them by importance. It uses an unsupervised approach, which makes it possible to extract keywords without any previous training or external knowledge, such as dictionaries, thesauri, or corpus. There are many possibilities to customize the solution, as YAKE! supports many settings, such as changing the processing language from the English default option to any needed language, changing the number of keywords, and tweaking the deduplication algorithm and threshold. [16]

4) Instagram Graph API: Instagram Graph API allows users with Instagram Professional accounts to connect their app to Instagram's features and functionalities, such as publishing content, managing comments, and so on.

A limitation the Instagram Graph API has is a restriction that only 25 API-published posts can be released within 24 hours. [17]

5) Newspaper3k: Usually, web scrapers search for predefined HTML tags. But not every web page uses the same HTML tags for their articles. This makes it complex to create a scraper useful for any website. The open-source Python 3 library Newspaper3k can deal with a wide range of tags and is capable of scraping multiple articles from a base URL. It also includes built-in support for caching and multi-threading to improve performance. Therefore, it is a useful tool for scraping news articles and other Internet documents, especially in large volumes. [18]

6) MongoDB: MongoDB is a NoSQL database, that handles complex and rapidly changing data. MongoDB's document-oriented approach, which stores data as documents within collections, provides greater flexibility than traditional SQL databases. It is well-suited for large and scalable projects, as it can be distributed across multiple computers and easily integrated with cloud environments. Thus, MongoDB was selected for its ability to handle dynamic information in a flexible manner. [19]

7) API: In the proposed solution, we make use of APIs that enable efficient and fast implementation. If enough computing power is provided, the whole prototype can run locally on a single machine as well. At the same time, there are publicly available APIs for all used models. Due to the limited resources provided in our case, these are primarily used within our running prototype.
MongoDB API is used to interact with a cloud database. Stable Diffusion is run on Replicate [20], which offers different machine learning models as cloud-based APIs. Bart is run on Huggingface [21], which also offers similar services through their Inference APIs. We can successfully post content on Instagram thanks to the Imgur API and the Instagram Graph API.

V. Implementation of the proposed solution

Our solution pertains to an architectural approach of microservices, in which a single application is composed of many loosely coupled and independently deployable smaller components, or services. These services have their own technology stack and are developed independently in the beginning, to be merged in the aggregation phase later. This approach shortens development cycle time and is well known for a significantly smaller error rate, benefiting the overall solution. It also allows us to expand horizontally rather than vertically, since our solution is based on multiple computationally intensive models.

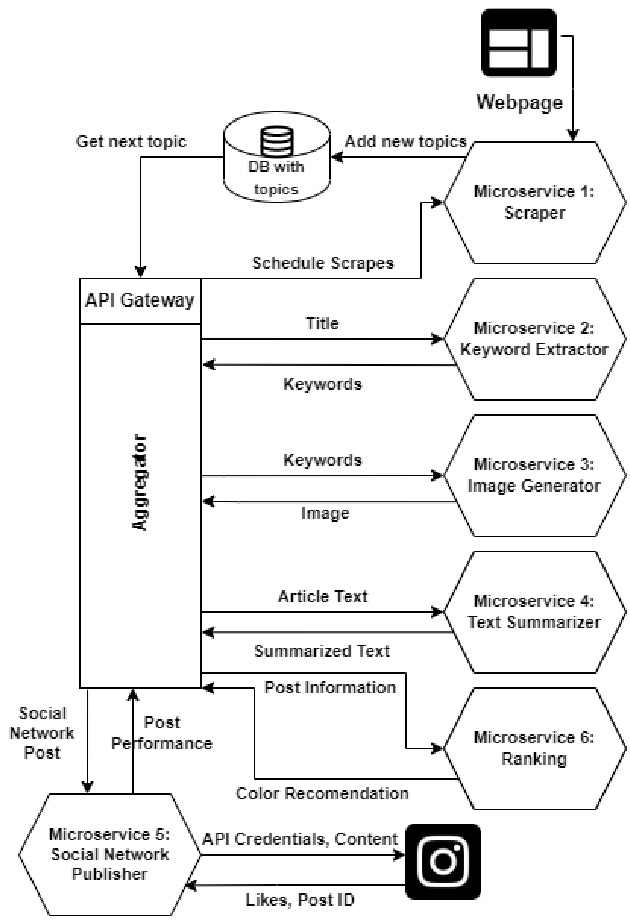

Fig. 1. Architecture Diagram

The architecture of our solution, presented in Figure 1, consists of the following microservices explained in detail in this section:

- Web-scraping
- Database
- Keyword Extractor
- Image Generation
- Summarization
- Color Ranking
- Posting and feedback from social media
- Aggregator

A. Web-scraping

Web scraping is a technique for extracting data from a website. In our proposed solution, the article content such as text, author name, article language, and date information are extracted from the desired website. The user enters a base URL without any queries. Then the scraper, in our case the Newspaper3k library IV-5, collects the links to all the articles on the website and downloads them by sending an HTTP request. Subsequently, the downloaded content is divided into title, text, author, link, language and date.

B. Database

The scraped data is stored in our MongoDB database with an article and a posted collection. Before the content is published, the articles are stored in the articles collection. This collection stores seven attributes of each article: Text, Title, URL (to Article), Author, Language, Date (Publishing Date) and Short Link. URLs are shortened to a uniform length called "Short Link" so that the description limits of social media platforms are not exceeded.

After each scraping iteration, new articles are persistently stored in the article collection. In this way, temporary errors that could occur during scraping are bridged with saved articles. After an article has been posted, it is moved from the articles collection to the posted collection. The posted collection has two additional fields, posting color and Instagram media-id, that provide information for the color ranking microservice V-F. These two separate collections are used to keep track of saved and posted articles and to avoid the same article being parsed or posted again. The flow of our database-usage can be seen in Figure 2.

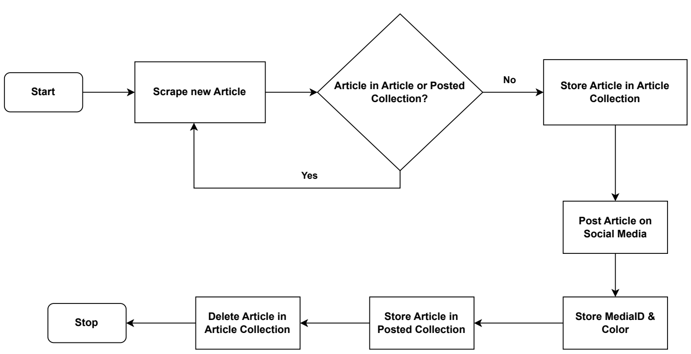

Fig. 2. Database Flowchart

C. Keyword Extractor

The keyword extractor microservice is used to get short and precise information in the form of keywords from the previously scraped text. These keywords are then used for image generation and hashtags. To generate them, we use YAKE! (IV-3). As English articles are scraped, we use the following settings: language: en, ngram size: 1, and the number of extracted keywords is set to 5. The deduplication algorithm and the threshold remain at their default values. This setting gives us five keywords with the most relevance, each containing one word.

We chose these settings after testing the impact of the parameters. Using ngram sizes larger than 1 negatively affected image generation by including non-essential words in the input, resulting in lower-quality images. To ensure coherence and precision in the generated images while maintaining flexibility and excluding less important text, we selected a moderate number of keywords. Additionally, this number was the best for creating aesthetically pleasing hashtags.

D. Image generation

To generate images for our posts, we use the extracted keywords as prompts for the image generator. We explicitly exclude keywords such as "text" and "license plate" as negative prompts because it is difficult to produce meaningful text with Stable Diffusion. Additionally, the color determined by Color Ranking is appended to the input prompts to give the generated image a specific color.

E. Summarization

The caption for the post is created by summarizing the original article text using a pre-trained BART model. This specialized model has been trained on news articles from CNN and the Daily Mail for creating summaries. The generated text adheres to a limit of 2.200 characters to comply with Instagram's caption character limit. Finally, the summary is combined with relevant keywords generated in V-C to create hashtags and form the post's description.

F. Color Ranking

Our initial approach consisted of comparing any given score of a post to the average ranking score; this, however, proved to not account for fluctuating interest in posts well, which led to more volatile and less correlated ranking results. Because of this, we switched to a sliding window-based approach, allowing any given score to be more reasonably compared to its predecessors. To achieve this, a dictionary is created, where dictionary keys represent colors, which in our case was a palette with 4 predefined colors (pink, blue, green, and red). The values of each color hold the current score of that color as well as references to up to the last 10 posts of said color and their individual performances, for which the Instagram like-count was chosen.

After a post was made and given time to be seen, the post is then sorted into one of six possible areas divided between two cases, shown in Figure 3. It is done depending on the average color performance compared to the average total performance, as well as the performance of the post in question compared to these two averages.

In case 1, where the color average is higher than the total average, a post either performed better than both averages (Area A), increasing the ranking of the color in question by a normal amount, performed better than the total average but worse than the color average (Area B), decreasing the ranking a bit based on performance worse than the expected color performance, or falls bellow both averages (Area C),

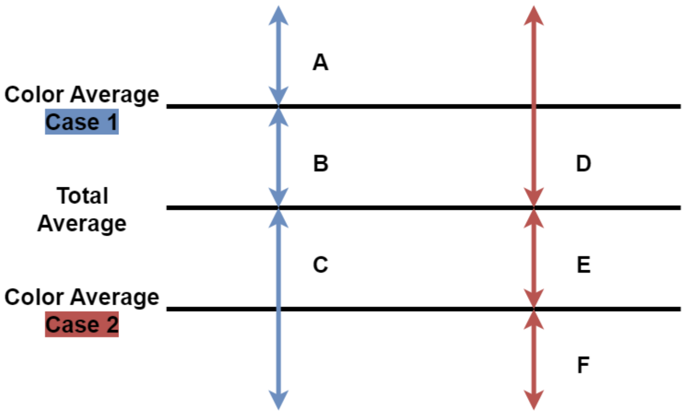

Fig. 3. Ranking Scheme for the Color Ranking algorithm

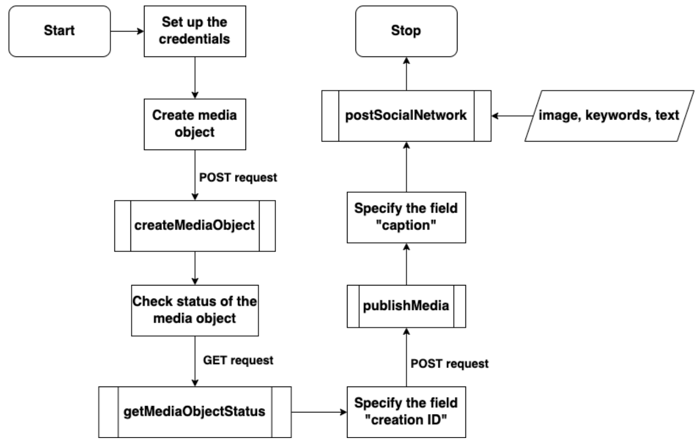

Fig. 4. Social Media Publisher

drastically decreasing the ranking of the color for unexpected under-performance, possibly hinting at a shift away from the color in current trends.

The other option, case 2, is that the color average is worse than the total average, where the post can once again fall into three similar groups: a higher performance than both color and total average (Area D), vastly increasing the ranking for an unexpected over-performance possibly hinting at a new trend, performance better than color average but worse than total average (Area E), leading to a slight increase in the ranking based on a better performance of the color than expected, or results worse than both color and total average (Area F), lowering the ranking for an already under-performing color.

Further, to ensure that all colors remain available, a minimum score is always guaranteed. Lastly, it offers a way of suggesting the color for the next post by adding the scores in order and generating a uniform random number in the interval [0,Sum). This number is then reduced each step by the current ranking score of the color until it is smaller than the ranking score, determining our chosen color.

G. Social Media Posting and Feedback Gathering

The generated image from "Image generator" V-D, the hashtags from "Keyword Extractor" V-C and the summarized text from "Summarizer" V-E are posted on Instagram using the Instagram Graph API.

To enable publishing content on Instagram via the GraphAPI, the Instagram account must be set up as a professional account and linked to a Facebook page. Additionally, an Access Token with Instagram specific rights for posting and retrieving post data needs to be generated. [17] With the Access Token and the Instagram Account ID in place, the image and caption can be posted on Instagram. For that to work the image is first uploaded to Imgur and the caption is build from the summarized text and keywords.

The flow of this process can be found in Figure 4

H. Aggregator

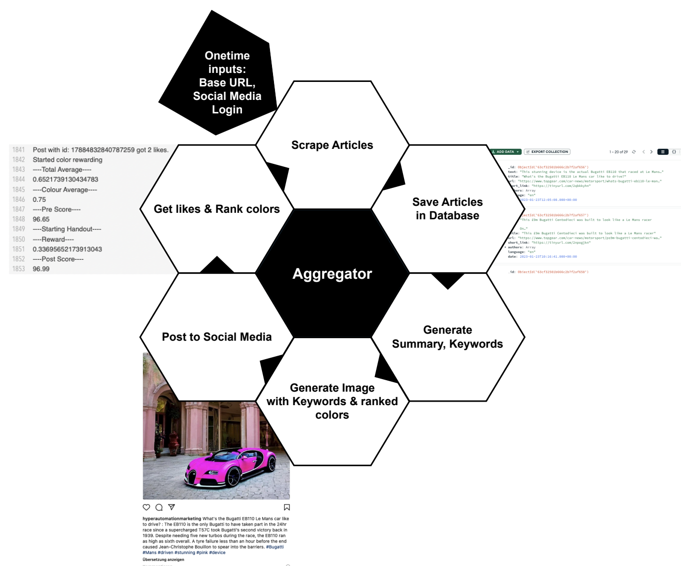

Fig. 5. Aggregator Flowchart

The aggregator is the core loop of the project, and it brings together all the microservices into one cohesive system. As a prerequisite, the aggregator requires specific inputs such as a URL to scrape posts from, the number of posts to make per day, and the credentials of the Instagram page where the posts will be published.

To begin the process, the web-scraping service downloads a predefined number of articles and their content from the specified webpage and stores them in our database. The background scheduler then schedules future web page scrapings based on the required number of posts. Once everything is set up, the aggregation process begins.

The color for the future image is determined based on the current color ranking, as explained in V-F.

Next, the text and title of the currently processed article are fetched from the database, and the Keyword Extractor microservice is used to generate keywords. Using these keywords and the previously determined color, an image is created using our Image Generation microservice, which is then uploaded to the web using the Imgur API to make it accessible for our Posting microservice. The text of the article is then processed again to create a summary using the Summarization microservice.

Hashtags are an important part of any social media post, and our aggregator generates them using the keywords. The Social Media Posting microservice is then called to create an Instagram post containing the URL of the generated image, the extracted title, the summary text, and the hashtags. Once the post has been created, the posted article is moved to the posted collection in our database. Afterwards, the program waits a predetermined amount of time for the likes on the posted article to accumulate. Finally, the color dictionary is updated again to prepare for the next posting iteration.

This process is executed continuously. The result is an automated system that generates and posts content to Instagram, reducing the time and effort required for social media management.

VI. Results

A. Prototype and Exemplary Use-case

The prototype can be demonstrated using the fictional car manufacturer BMV as an example. BMV provides the base URL to their company homepage, ”example-bmv.com” and their Instagram Account credentials. The BMV website is then scraped for new articles (V-A). These are saved in a database (V-B).

For each article, the main text is summarized (V-E) and keywords are extracted (V-C) to build the post description with hashtags. The post image is generated (V-D) from the keywords and dominant color of the ranking (V-F). After posting, the predefined amount of time needs to expire. Afterwards the likes of the post are counted (V-G) and the color rating is updated (V-F). This process is repeated for each new article, so BMV is equipped with a hyper-automated pipeline for its social media presence.

To mimic such a car manufacturer the base URLs ”TopGear” [22] and ”Carwow” [23] were used. The resulting Instagram page after 5 days of running is presented in Figure 6.

Out of 98 generated posts, we found 20 to be inappropriate, containing content that did not fit well with the original article. One example is found in Figure 6. Thus, the pipeline has room for improvement. Possible factors for inappropriate results are that the prototype struggled with generating images of people, text, and sometimes even cars. This may be attributed to the limited training data set that only covers data through 2021. Also, some posts have strange hashtags such as ”Javascript”, ”Skip”, and ”Published” which are the result of scraping attribute text of images and dynamic content requiring Javascript in some articles. Since these hashtags are used as prompts for the image generator, the image quality also suffers.

However, we found the majority of 78 postings [26] appropriate. An example of this is shown in Figure 6. We assume it performs best for prompts that have the most training data available, such as famous car models and brands. The color prompts were accurately executed and worked well with car-related content. As a result, the prototype’s Instagram account grew to five followers and received between 0 and 5 likes per post within the five days of running.

In conclusion, to further improve the prototype, fine-tuned models related to the desired content could be used. If available, old articles may be included in the training set as well. This is an opportunity for further research.

The image generator should only be used if no article image is provided. Additionally, feeding data directly into the automated pipeline without the need for a scraper could help eliminate the problem of attribute texts in keywords and prompts.

If the Instagram page of the company already exists and has posts from the past, that data could be used for the initialization of the color ranking algorithm. The preexisting images could be scraped from the Instagram page, the dominant color extracted, and consequently fed, together with the number of likes, into the color ranking algorithm.

However, the self-improvement mechanism is only feasible for content where color plays an important role, and the like count may not be the only performance indicator. According to research, such as the study by Gräve Jan-Frederik (2021) [27], the significance of comments and their sentiments also play an important role in determining the post’s performance. Therefore, it is necessary to consider how other metrics such as views, comments, and shares should be included in the self-improvement mechanism as well. This is an opportunity to research the most fitting indicator for self-improvement post generation.

B. Survey

As the time frame of this work is too short to conduct an analysis based on Instagram feedback, a survey was conducted to evaluate the results of the posts. The survey was composed of two parts. First, participants rated the quality of the colors of car images that were either generated or real. After that, the quality of the description and hashtags are rated, with 1 being the lowest quality and 4 being the highest quality. Respondents were randomly shown real posts taken from car manufacturers social media presences and our generated posts.
The survey results from 31 respondents show that real images and posts scored slightly higher in attractiveness. However, the generated images and posts perform almost as well and require less time and cost, since no additional photo shoots need to be done and only a content outlet on the website needs to be fueled.

This diagram in Figure 7 represents the results of the first part of the survey, in which the quality of five generated and five real car images are evaluated. Results show that more than 50 percent of the generated and real car images were rated as very high or high quality. Besides that, results for generated and real cars were rated almost equally as very high and very low. But real cars got more votes when rated as high quality.

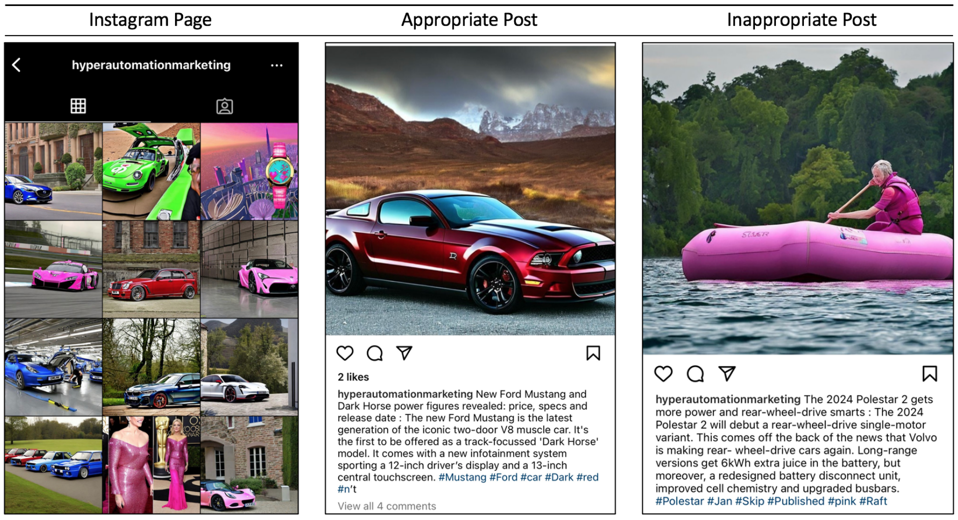

Fig. 6. Instagram page and examples of appropriate and inappropriate generated posts [24]–[26]

Furthermore, generated cars were rated low-quality three times more often than real cars.

The diagrams in Figure 8 and 9 represent the result of the second part of a conducted survey, in which five generated and five real car Instagram posts are evaluated with regard to the quality of the hashtags and texts. The diagram regarding the quality of hashtags shows that more than 50 percent of the real car posts were rated as good or very good, while generated car posts were not rated that well. In terms of text quality, the results show that more than 50 percent of the generated and real car posts were both rated good or very good. As can be seen in the diagram, the votes in all four categories are distributed almost equally for both post types with slight differences. What stands out is that generated cars received more votes as good and fewer votes as very poor than real cars. In general, 24,9% of real car posts and 19,8% of generated car posts were rated as very high quality. Also, 40,0% of real car posts were rated as high quality, while the rate for generated car posts is 32,47% . As low quality, 23,01% of real car posts and 32,68% of generated car posts, and as very low quality, 12,9% of real car posts and 15,05% of generated car posts were rated.

Although real cars scored better, the results show that for every level of quality the number of real car posts compared to generated ones is always less than 10%. This shows that there is only a small gap between the quality of generated and real posts. In conclusion, our generated content performs almost as well as real posts, especially when considering the effort required to create the content.

VII. Conclusion

Although AI has made tremendous strides in recent years, there is still a lot of room for AI-driven marketing solutions like ours. Our hyperautomation marketing solution offers a unique and powerful approach to modern marketing. By leveraging the power of social media, our solution streamlines the marketing process, making it easier and more efficient to reach a large, engaged audience. With features such as automatic content generation, posting, and a well-tested color ranking algorithm, our solution saves time and resources, allowing marketers to focus on more high-impact tasks. In today's fast-paced digital landscape, companies need to stay ahead of the curve, and our hyperautomated solution aims to help business looking to stay competitive and succeed in the long term.

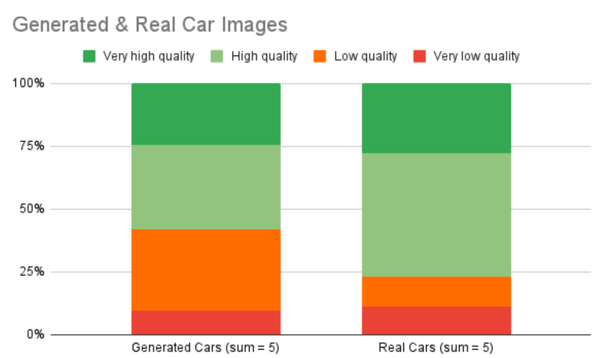

Fig. 7. Survey result on quality of generated and real car images

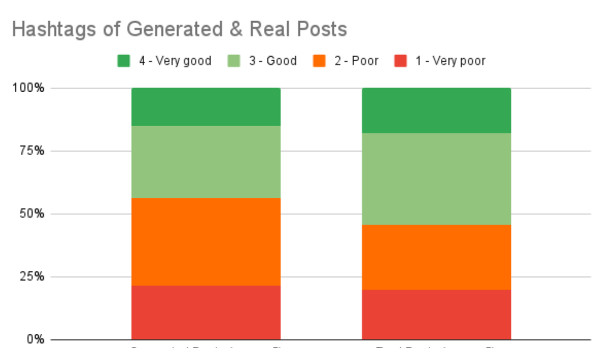

Fig. 8. Survey result on quality of generated and real car hashtags

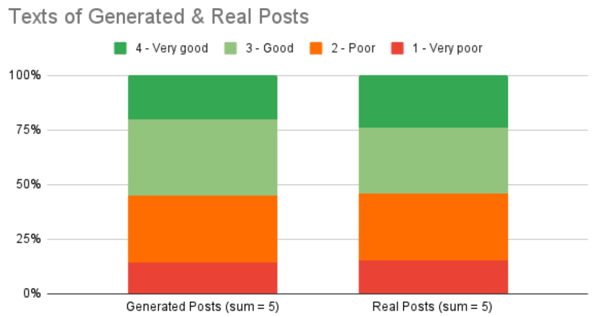

Fig. 9. Survey result on quality of generated and real car texts

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