Digital platform based on geomarketing as an improvement in micro and small enterprises

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Article Info

Article history:

Received Feb 2, 2022
Revised Apr 21, 2022
Accepted May 28, 2022

Keywords:

Digital platform
E-commerce
Geomarketing
Micro and small enterprises
Scrum methodology

ABSTRACT

After the situation generated by the pandemic caused by COVID-19, micro and small enterprises (MSEs) faced a complex reality, having to cope with business uncertainty. This research proposes a digital platform based on geomarketing as a growth and support strategy for MSEs, with the objective of improving their labor and capital productivity, through the incorporation of the technological factor, which will have a great impact on them, helping them to continue operating and not having to close their businesses. The platform was developed under the agile Scrum methodology because it is adaptable to the constant changes in the mobile application development process, having as indicators labor productivity and capital productivity. Finally, the results revealed that labor productivity increased by 30.86 percent, meaning that, for every hour worked per person, more sales were made. As for capital productivity, it decreased by 1.47 percent, meaning that investment decreased for each value added of each product sold.

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1. INTRODUCTION

Currently in Latin America and the Caribbean there is a boom in micro and small enterprises (MSEs), which are the largest source of job creation [1]; however, they have low levels of productivity and high informality [2], with 11 million economic units that have at least one employee, of which the majority are micro and small enterprises, with around 10 million.

MSEs play a central role in the development of the Peruvian economy; according to official data, they constitute more than 99% of business units in Peru [3], create around 95% of all jobs and generate approximately 40% of the gross domestic product. According to Instituto Nacional de Estadística e Informática (INEI), after the impact of COVID-19, 75.5% of companies in Metropolitan Lima are operational, while 24.5% are inoperative, of which 67.4% of those that are operational recorded a decrease in sales [4].

During the second quarter of 2020, one of the main problems faced by the companies that remained operational as a result of the pandemic was the decrease in demand [5], with 77.0% of these companies reporting a decrease in demand and 59.0% reporting high costs to implement sanitary safety protocols [4]. One of the most important consequences of the impact of COVID-19 focused on labor [6], [7], since 54.8% of the companies decided to reduce working hours, an action that has a direct impact on sales, which are already part of the effect caused by COVID-19. Likewise, 16.9% of the companies had limitations in accessing financial sources and 33.0% had difficulties in accessing supplier credit [4], [7].

Many of the productive sectors where MSEs were located have been affected by the COVID-19 situation, which has led to the need to reorient these businesses in search of technological alternatives that allow easy adoption, strengthen this sector and, above all, allow them to reach more people [8]. In view of this problem, the use of geomarketing is proposed, which is a group of techniques that aim to analyze the socio-economic reality seen geographically, through cartographic instruments [9], [10]. Through the implementation of geomarketing in the research, the aim is to improve or expand the range of supply and demand in a given geographic area for micro and small businesses in Peru, including a digital platform as an independent variable.

Nowadays digital platforms have become one of the usual ways for citizens to access goods and services [11], especially for young people [12], [13]. Being one of the elements that are helping to redefine the way we travel, move around the city, get information, shop, make purchases, entertain ourselves, participate in public debates or meet people [14].

Therefore, the objective of the present research work is to realize a digital platform based on geomarketing, which aims to improve the productivity of labor and capital of MSEs [15], this is given through customer acquisition through geolocation, management of participating businesses located around the customer and basic management of products in stock available in the businesses. This will generate new solutions, having a great impact on MSEs, providing a technological tool for them to continue operating and not having to close their businesses and finally contribute to their development and growth [1].

This research is organized as follows: i) introduction, ii) related literature of previous research and the impact it has had on end users, iii) method to be used and describes its different stages, iv) results and Discussions of the pre and post implementation tests of the application with respect to the indicators studied, v) conclusions of the research where the proposed objective of the digital platform based on geomarketing as an improvement in Peruvian MSEs is enhanced.

2. RELATED LITERATURE

Encouraging MSEs to search for channels that direct their businesses towards progressive growth by adapting to current demands remains a challenge, even more so after the current global economic situation [8]. Currently, the challenge to achieve the digitization of an organization lies in the knowledge and management of the strategy taken by its members [16], highlighting that nowadays e-commerce has a great preference by users due to its easy interaction and effectiveness [17].

Different research papers have been found on the subject, focused on generating solutions using technology to improve MSEs' trade. This section is a compilation of the work done and the results obtained.

A descriptive study on the use of information and communication technology (ICTs) in MSEs [18] in developing countries found that, despite the fact that MSEs are the main source of income, only a small proportion of these enterprises implement ICTs to make sales. In that sense the implementation of mobile applications has helped to improve the sustainability of trade in the midst of the crisis, so in the research [19], a study was conducted based on mobile applications used in 343 small and medium enterprises (SMEs) in India. The results obtained showed the influence of these based on the data obtained after their implementation, achieving a better orientation for decision making, as well as helping to propose a better business strategy.

Research has been developed based on the e-commerce system in contribution to the sales of micro and small enterprises [20], with the purpose of generating more sales opportunities, evidencing that the adoption of technologies provides options to excel in the business environment by generously increasing their income [21]. Likewise, recommendation systems with geolocated clusters [22] have been used to study customer behavior in contribution to retailing, which helps to provide recommendations on marketing strategy, as well as to predict cyber threats.

The research [9], shows a system based on geomarketing implemented with bluetooth low energy (BLE) technology, which detects the user's location and then sends a notification through the wireless fidelity (WIFI) server, informing the mall promotions that are in force. The system finally generated a pleasant experience for both customers and marketing staff. Likewise, a system for online product suggestion to buyers [23] was developed, using visual feature learning techniques. A 96% accuracy rate was obtained, being evidence that the use of these approaches and technologies are better.

The studies shown allow us to learn about the strategies developed and implemented in order to evaluate the effectiveness of the proposed solution. Although the proposals are quite good and interesting, most of them do not show real results derived from the experimentation with the clients at the end. However, the benefits that the implementation of technologies in MSEs has brought in spite of the current situation are highlighted.

3. METHOD

To successfully complete this project, the agile Scrum methodology was used, since it is adaptable to the constant changes in the process of software development and mobile applications [24], consisting of an iterative process that generates value through deliverables or versions. With the purpose of applying a set of best practices that help to work collaboratively within a team, allowing adapting to the needs of the company [25]. Thus, there are two main stages that mark the beginning and the development of the digital platform.

3.1. Inception of the project

Due to the current situation faced by Peru as a result of the COVID-19 pandemic, the most affected businesses were those that invested the least in technology, so the MSEs business was decreasing. From this situation Store & Service is born, a digital platform that allows to increase, promote and provide the technological support needed by businesses in the MSEs segment, based on geomarketing, which according to reference [10], will allow to enhance supply and demand. For the reasons mentioned above, it was necessary to have tools that help the performance of their workers and the management of MSEs through digital channels as these technologies have grown much more in recent years [26].

3.2. Execution of the project.

3.2.1. Database design

For the database design, the tables were organized into three categories: security tables, business tables and configuration tables. This allows for better organization of the data stored in the platform. Primary and secondary key referencing was also included to aid in the speed of querying the database, Figure 1 shows the tables in the security section.

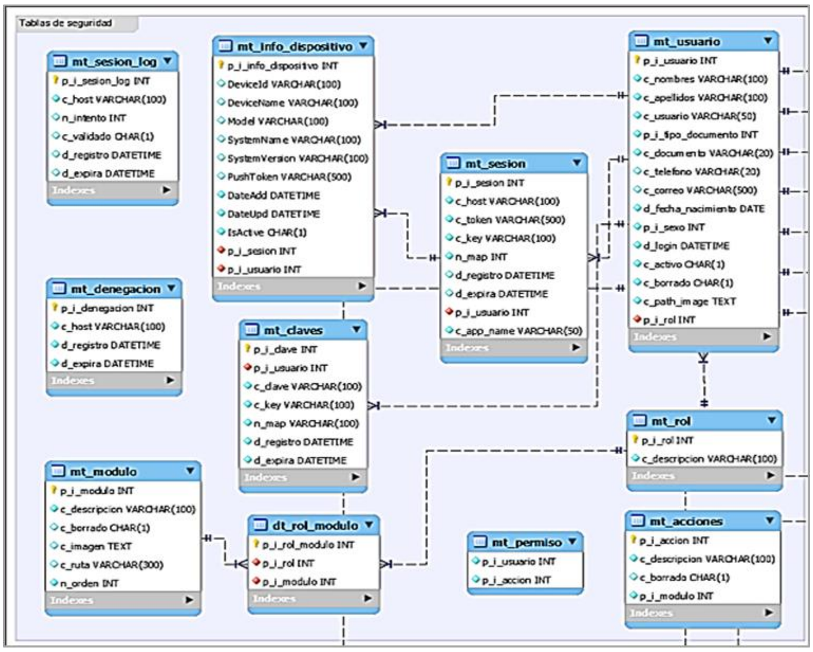


Figure 1. Database design for the platform

3.2.2. Solution architecture

For the architecture of the solution (illustrated in Figure 2), it was proposed to work with the Google Cloud [27] provider that provides us with different applications for the integration of our platform. As well as some other platforms that provide different services such as: emails, and robotic agent validations.

The proposed architecture is based on a dedicated instance that was used to deploy the application programming interface (API) representional state transfer (REST) and host the database in MySQL [28]. This instance was redirected so that through the Google domain name system (DNS) service, the umadev.pe domain points to the dedicated IP of the instance. When deploying this production instance, the firewall had to be configured to enable the ports to connect to the database from a local environment. Likewise, within the API REST, the accesses for the communication of the Microsoft Graph were placed, which provides us with the sending of emails to the accounts that register through the digital platform.

For security reasons, version 3 of recaptcha was used, which allows robotic agents to attack and make the registration platform unavailable. To enforce this measure, JSON web token (JWT) [29] was used to give access to the services deployed in the API REST. The applications also use the function of sending notification messages. To send the different communications and transactions that require it. Thus using the Firebase Cloud M service [30]. They use the Firebase Storage service as a repository where images and other files that are required through the platform will be hosted.

To display the maps within the application we have made use of the Google Map API REST [31]. Through a secret key provided by Google for the use of maps in mobile applications. In this way, the central region of the United States in its zone A was concentrated within the Google zones. This reduces usage costs and provides us with good application response latency.

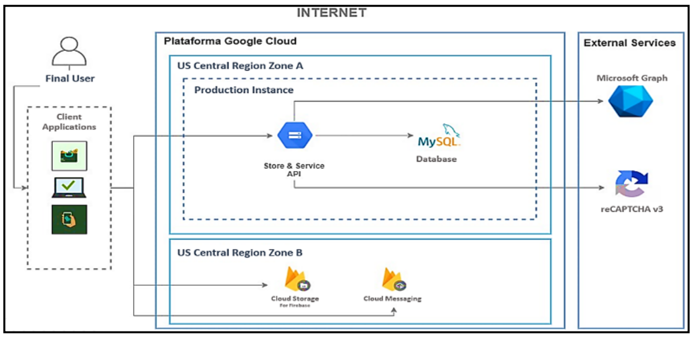


Figure 2. Solution architecture

3.2.3. Development sprint 1-project architecture

The purpose of Sprint 1 is to establish clear policies for the development of the project, focusing on the deployment and configuration of the instances that will host the platform applications. Figure 3 shows the development of the DNS configuration for the umadev.pe domain. Figure 4 shows the production instance in Google cloud platform, which were developed in sprint 1.

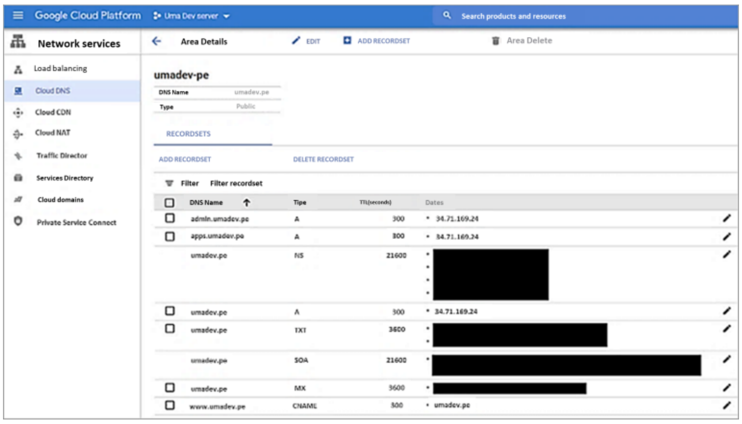


Figure 3. DNS configuration for the domain

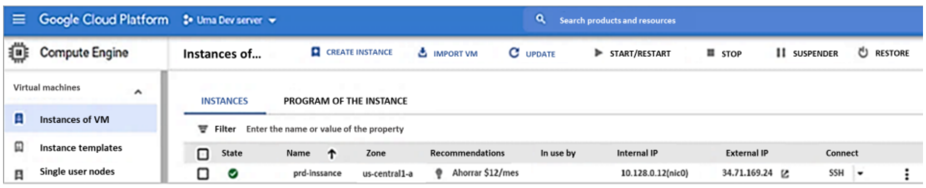
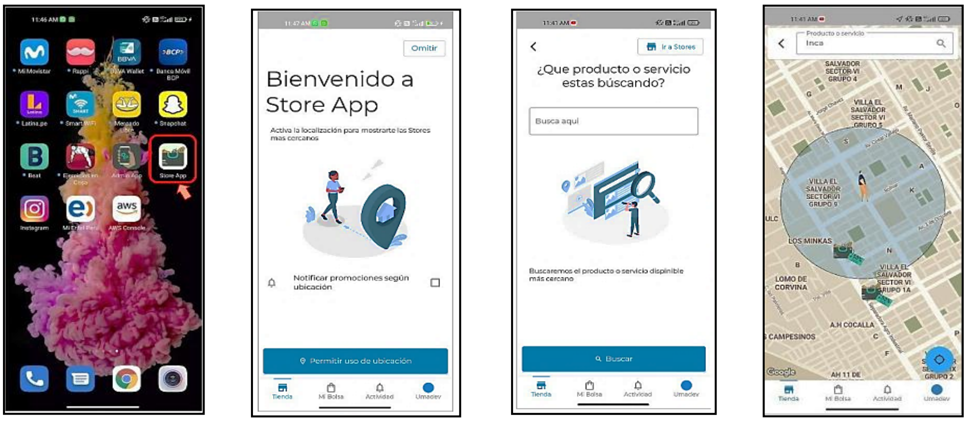


Figure 4. Production instance in Google cloud

3.2.4. Sprint 2 development-base functionalities

The purpose of sprint 2 is to start with the base functionalities of the application that are important for the first flow within the planned. Review issues such as user account security, data updates, among others identified during the sprint. Figure 5 shows the interfaces of the StoreApp application developed in sprint 2. In Figure 5(a), the logo of the application installed on the Smartphone is shown, in Figure 5(b), the application start interface is shown where the location confirmation is performed. In Figure 5(c), the product search interface is shown and finally in sprint 2 the interface of stores found (illustrated in Figure 5(d)) was performed, according to the location detected by the app.

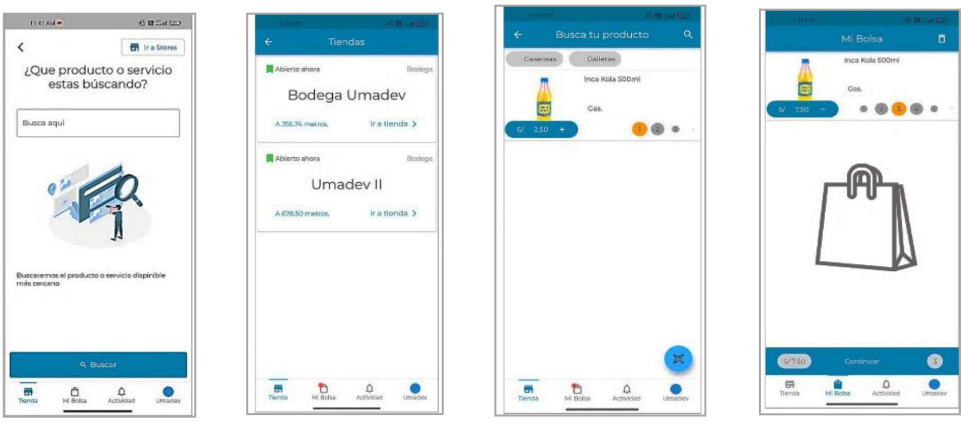


(a) (b) (c) (d)

Figure 5. Interface designs delivered in sprint 2 in (a) application logo, (b) startup interface, (c) product search, and (d) location interface

3.2.5. Development sprint 3-base functionalities 2

Sprint 3 aims to reinforce the second sprint with auxiliary functionalities that complement the processes required to run the application within this released version. Figure 6 shows the interfaces of the Store App application developed in sprint 3. Figure 6(a) shows the finalized product search interface, Figure 6(b) shows the interface of the list of the nearest stores found. Figure 6(c) shows the view of the products offered in the selected store from the previous interface. Finally, in sprint 3, the shopping bag interface (illustrated in Figure 6(d)) was realized, according to the product selected in the previous interface.

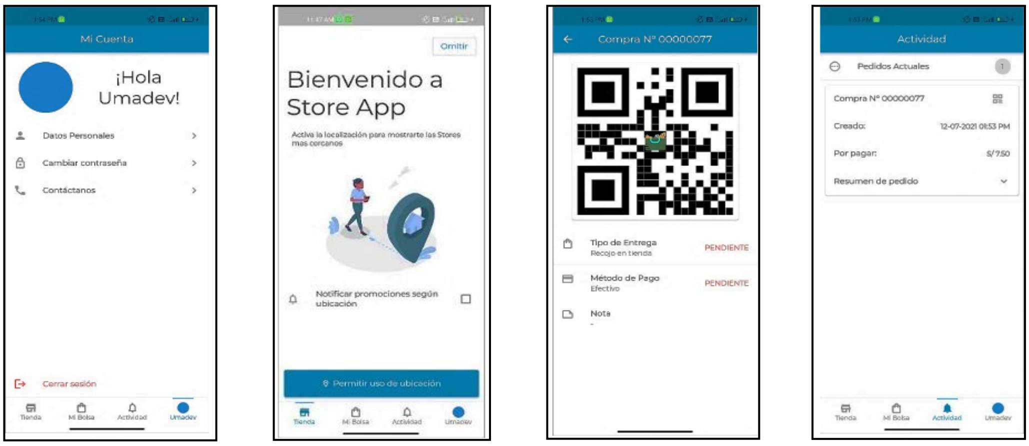


(a) (b) (c) (d)

Figure 6. Interface designs delivered in sprint 3 on (a) the finalized product search interface, (b) the list of stores, (c) products available in the store, and (d) the shopping bag interface

3.2.6. Development sprint 4-base functionalities 3

The next and final sprint is intended to complete the requirements necessary to complete the user experience within the application. Figure 7 shows the interfaces of the store app application developed in sprint 4. Figure 7(a) shows the login interface of the store app application. In Figure 7(b), we observe the finalized welcome interface with its respective fixes. In Figure 7(c) is the quick response (QR) code of the app purchase order, which leads to the interface in Figure 7(d), where the current store app orders are shown in detail.



(a) (b) (c) (d)

Figure 7. Interface designs delivered in sprint 4 on (a) login interface, (b) finalized login interface, (c) purchase order QR, and (d) order detail

4. RESULTS AND DISCUSSION

Table 1 shows the results of the descriptive statistics of the pre-test and post-test, with more emphasis on the KPIs measured. This will detail the analysis and interpret the results and Figure 8 shows the average labor productivity before and after the implementation of the store app digital platform. The mean value of work productivity in the pre-test of the sample was 52.71%, while for the post-test a value of 83.57% was obtained; this indicates a difference before and after the implementation of the digital platform. It was also identified that the minimum values of work productivity were 13.33% in the pre-test and 21.68% in the post-test.

Table 1. Comparison of averages before and after the implementation of the digital platform

Indicator	Pre-test (mean)	Post-test (mean)	Coefficient of variation	
			Pre	Post
Labor productivity (KPI_1)	52,7083	83,5676	62,77	65,42
Capital productivity (KPI_2)	5,0692	3,5936	89,75	99,32

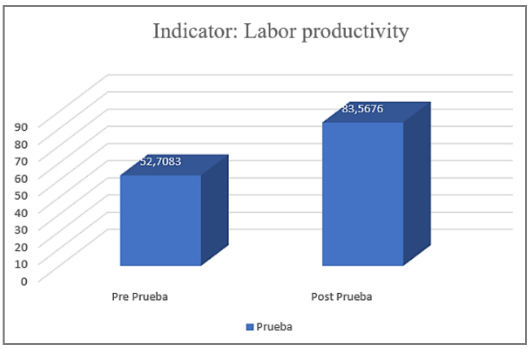


Figure 8. Comparison of the entry and exit tests of work productivity

With respect to the dispersion of labor productivity (see Table 1), it can be verified that for the pre-test it was 62.77% and for the post-test it was 65.42%, showing that the variability with respect to the data does not differ much, consequently, the comparison of the means is considered adequate, since the data are not much higher and lower with respect to the mean, that is, the data are not very dispersed. Figure 9 shows the average capital productivity before and after the implementation of the digital platform.

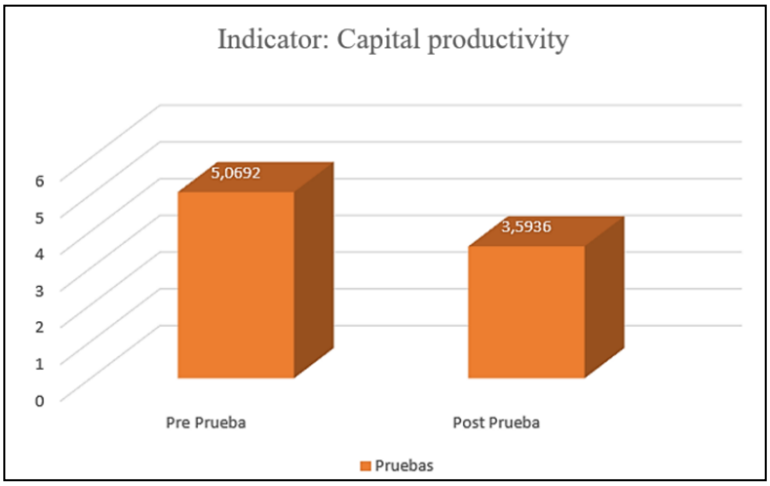


Figure 9. Comparison of capital productivity input and output tests

The average capital productivity in the pre-test of the sample was 5.07%, while for the post-test a value of 3.60% was obtained; this indicates a difference before and after the implementation of the digital platform. Likewise, it was identified that the minimum values of labor productivity were 1.88% in the pre-test and 1.49% in the post-test. Regarding the dispersion of capital productivity, it can be verified that for the pre-test it was 89.75% and for the post-test it was 99.32%, showing that the variability with respect to the data does not differ much, consequently, the comparison of the means is considered adequate, since the data are not much higher and lower with respect to the mean, i.e., the data are not very dispersed.

5. CONCLUSION

The main focus of this research was the development and implementation of a digital platform, noting that the platform meets the proposed objectives, managing to encrypt customer data and manage the participating businesses, in addition to providing the necessary tools to have the basic administration of the products. Search for products and/or services close to the current location. Regarding KPI_1: labor productivity increased by 30.86%, which means that for every hour worked per person, more sales were made. After the analysis of the results, it is concluded that the implementation of a Digital Platform based on geomarketing significantly influences the work productivity of SMEs. This is confirmed by the sample results. Regarding the indicator KPI_2: capital productivity decreased by 1.47%, which means that the investment decreased per added value of each product sold. Concluding that the digital platform based on geomarketing significantly influences capital productivity in the trade of MSEs. It was concluded that the digital platform based on geomarketing has a significant influence on capital productivity in the medium and large company, the micro and small company (MYPEs) business. This is confirmed by the results of the sample, in addition to proving that the platform positively influences the MYPEs trade, in addition to having a significant decrease in the hours dedicated to the sale of products. The scientific contribution provided by this research work is very important in the scientific environment as it is the basis for future projects that want to implement technologies such as geomarketing, which will have a great impact on e-commerce. For future work it is proposed to implement technologies such as big data, which helps to collect and analyze data obtained from customers for better decision making for the benefit of trade.

REFERENCES

[1] A. N. A. Rozmi, P. N. E. Nohuddin, A. R. A. Hadi, and M. I. A. Bakar, "Identifying small and medium enterprise smart entrepreneurship training framework components using thematic analysis and expert review," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 6, pp. 298–309, 2021, doi: 10.14569/IJACSA.2021.0120633.

[2] C. Ferraro and S. Rojo, "MSMEs in Latin America and the Caribbean: an integrated agenda to promote productivity and formalization (in Spain: Las MIPYMES en América Latina y el Caribe: Una agenda integrada para promover la productividad y la formalización)," *Organización Internacional del Trabajo*. pp. 1–54, 2018, [Online]. Available: https://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/---sro-santiago/documents/publication/wcms_654249.pdf.

[3] C. Mares Ruiz, "Micro and small businesses in Peru (in Spain)," 2020. [Online]. Available: https://www.comexperu.org.pe/upload/articles/reportes/reporte-mypes-2020.pdf.

[4] E. Peruano, "In Metropolitan Lima, 75.5% of the companies are operational (in Spain)," 2020. Accessed: Jan. 08, 2022. [Online]. Available: https://www.gob.pe/institucion/inei/noticias/535011-en-lima-metropolitana-el-75-5-de-las-empresas-se-encuentran-operativas

[5] J. D. Cassou, M. C. Deza, and K. Moreno, "Peru: development challenges in the post-COVID-19 (in Spain: Perú: Desafíos del desarrollo en el post COVID-19)," *Washington, D.C., D.C.*, Sep. 2020. doi: 10.18235/0002658.

[6] H. Dempster *et al.*, "The Effect of COVID-19 on the Economic Inclusion of Venezuelans in Peru," *Policy Pap.*,2020. Accessed: Feb. 12, 2022. [Online]. Available: https://www.cgdev.org/

[7] I. N. de E. e Informática, "Metropolitan Lima opinion survey on the impact of COVID-19 on companies (in Spain)," *Inst. Nac. Estadística e Informática*. 2020. Accessed: Feb. 14, 2022. [Online]. Available: http://m.inei.gob.pe/media/MenuRecursivo/boletines/resultados-encuesta-covid-lima_metropolitana-2020.pdf.

[8] ComexPerú, "Peruvian MYPE and the adoption of new technologies (in Spain)," 2020. Accessed Jan. 10, 2022 [Online]. Available: https://www.comexperu.org.pe/articulo/las-mype-peruanas-y-la-adopcion-de-nuevas-tecnologias

[9] D. Zaim and M. Bellafkih, "Bluetooth low energy (BLE) based geomarketing system," in *2016 11th International Conference on Intelligent Systems: Theories and Applications (SITA)*, Oct. 2016, pp. 1–6, doi: 10.1109/SITA.2016.7772263.

[10] V. Akre, A. Rajan, J. Ahamed, A. Al Amri, and S. Al Daisi, "Smart digital marketing of financial services to millennial generation using emerging technological tools and buyer persona," *2019 Sixth HCT Information Technology Trends (ITT)*, pp. 120–125, Nov. 2019, doi: 10.1109/ITT48889.2019.9075106.

[11] W. A. Ali, M. Mukhtar, and I. Mohamed, "Validating the factors influencing social commerce adoption in small and medium enterprise in Malaysia," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 17, no. 1, p. 440, Jan. 2020, doi: 10.11591/ijeecs.v17.i1.pp440-447.

[12] H. N. Bhor, T. Koul, R. Malviya, and K. Mundra, "Digital media marketing using trend analysis on social media," in *2018 2nd International Conference on Inventive Systems and Control (ICISC)*, Jan. 2018, no. Icisc, pp. 1398–1400, doi: 10.1109/ICISC.2018.8399038.

[13] T. Wijaya, A. Darmawati, and A. M, "E-lifestyle confirmatory of consumer generation Z," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 10, pp. 27–33, 2020, doi: 10.14569/IJACSA.2020.0111004.

[14] L. Alfaro, C. Rivera, J. Luna-Urquizo, J. Carlos, A. Portocarrero, and A. Barbosa, "Immersive technologies in marketing: state of the art and a software architecture proposal," *International Journal of Advanced Computer Science and Applications*, vol. 10, no. 10, pp. 482–490, 2019, doi: 10.14569/IJACSA.2019.0101064.

[15] P. S. JosephNg and H. C. Eaw, "Making financial sense from EaaS for MSE during economic uncertainty," in *Future of Information and Communication Conference*, 2021, pp. 976–989, doi: 10.1007/978-3-030-73100-7_67.

[16] A. K. Mohamad, M. Jayakrishnan, and M. M. Yusof, "Thriving information system through business intelligence knowledge management excellence framework," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 12, no. 1, p. 506, Feb. 2022, doi: 10.11591/ijece.v12i1.pp506-514.

[17] I. K. Arsad, D. B. Setyohadi, and P. Mudjihartono, "E-commerce online review for detecting influencing factors users perception," *Bulletin of Electrical Engineering and Informatics*, vol. 10, no. 6, pp. 3156–3166, Dec. 2021, doi: 10.11591/eei.v10i6.3182.

[18] T. T. H. Tambunan, "Evidence on the use of internet for businesses by MSEs in a developing country. The Indonesian case," *Anais da Academia Brasileira de Ciências*, vol. 92, no. 1, 2020, doi: 10.1590/0001-3765202020180555.

[19] S. Rakshit, N. Islam, S. Mondal, and T. Paul, "Mobile apps for SME business sustainability during COVID-19 and onwards," *Journal of Business Research*, vol. 135, pp. 28–39, Oct. 2021, doi: 10.1016/j.jbusres.2021.06.005.

[20] A. Tupia-Astoray and L. Andrade-Arenas, "Implementation of an e-commerce system for the automation and improvement of commercial management at a business level," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 1, pp. 672–678, 2021, doi: 10.14569/IJACSA.2021.0120177.

[21] A. Khaskheli, Y. Jun, and M. A. Bhuiyan, "M-commerce and mobile apps: opportunities for SMEs in developing countries," *Journal of International Business Research and Marketing*, vol. 2, no. 2, pp. 20–23, 2017, doi: 10.18775/jibrm.1849-8558.2015.22.3003.

[22] N. A. Zamani, A. Fadillah, and S. Norul, "Recommender system based on empirical study of geolocated clustering and prediction services for Botnets cyber-intelligence in Malaysia," *International Journal of Advanced Computer Science and Applications*, vol. 9, no. 12, pp. 473–478, 2018, doi: 10.14569/IJACSA.2018.091266.

[23] S. K. Addagarla and A. Amalanathan, "e-SimNet: a visual similar product recommender system for E-commerce," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 22, no. 1, p. 563, Apr. 2021, doi: 10.11591/ijeecs.v22.i1.pp563-570.

[24] J. P. Zumba, "Evolution of the methodologies and models used in software development (in Spain)," *INNOVA Research Journal*, vol. 3, no. 10, pp. 20–33, Oct. 2018, doi: 10.33890/innova.v3.n10.2018.651.

[25] F. García, "Software engineering (in Spain)." pp. 277–388, 2018, [Online]. Available: https://repositorio.grial.eu/bitstream/grial/1228/4/07-rep.pdf.

[26] M. Odeh and M. Yousef, "Effect of COVID-19 on the electronic payment system: usage level trust and competence perspectives," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 22, no. 2, p. 1144, May 2021, doi: 10.11591/ijeecs.v22.i2.pp1144-1155.

[27] R. K. P. Mok, H. Zou, R. Yang, T. Koch, E. Katz-Bassett, and K. C. Claffy, "Measuring the network performance of Google cloud platform," in *Proceedings of the 21st ACM Internet Measurement Conference*, Nov. 2021, pp. 54–61, doi: 10.1145/3487552.3487862.

[28] S. Zygiaris, *Database management systems*. Emerald Publishing Limited, 2018.

[29] A. Rahmatulloh, R. Gunawan, and F. M. S. Nursuwars, "Performance comparison of signed algorithms on JSON web token," *IOP Conference Series: Materials Science and Engineering*, vol. 550, no. 1, p. 012023, Jul. 2019, doi: 10.1088/1757-899X/550/1/012023.

[30] M. A. Mokar, S. O. Fageeri, and S. E. Fattoh, "Using Firebase cloud messaging to control mobile applications," in *2019 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE)*, Sep. 2019, pp. 1–5, doi: 10.1109/ICCCEEE46830.2019.9071008.
[31] H. M. Habeeb and N. Al-A'araji, "Extracting implicit geolocation based on google maps geocoding API of social media networks," *Research Journal of Applied Sciences*, vol. 11, no. 10, pp. 1083–1088, 2016, doi: 10.3923/RJASCI.2016.1083.1088.

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