Web portals for monitoring covid-19 patients, heuristic analysis.

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Abstract
Due to the global importance of managing the information of people affected by COVID-19; The countries decided to automate this information by developing web systems accessible to all people in order to obtain this data directly from those affected and to be able to make quick and efficient decisions. This research performs a usability analysis of these platforms, for which eight (8) countries were focused. The heuristic analysis method of Torres-Bruniel and the web portal of Chanchi et al were applied, two proposals that are based on the heuristics of Jakob Nielsen and the ISO/IEC 25000 quality standards. As a result, it was obtained that the web developments analyzed reached a general average of 3.7 in the heuristics evaluated, that is, a compliance percentage of 75%. This research leaves the necessary recommendations that must be taken into account to improve the usability of these platforms.

Keywords
Heuristic analysis, web portals for covid-19, usability criteria, heuristics.

1. Introduction

In these years, a process of digital transformation is taking place throughout the world, even more so, with the health problems generated by COVID-19 and other pandemics, the pace of change and the speed of transformation have accelerated and this has forced countries to accelerate their technological advances and to invest more in technology and rapid development of web systems, based on agility [29]. The pandemic accelerated the use of digital technologies in 10 years [18] and in this period of time, business organizations of all kinds had to respond to social demands, without losing sight of recovery and preparation for the future.

In terms of health, SARS-CoV-2 or Covid-19 forced countries to develop very fast software applications to track, in real time, those infected people and their family circle because contact tracing was key to slowing the spread of the virus. [19]

Analyzing these developments from the perspective of usability is mandatory, due to the condition of their users and the fatality of not being able to easily access these platforms to obtain what they are looking for. It is well known that usable software generates trust and security [20]; no user would trust a portal that is difficult to understand.

From this perspective, this research makes a heuristic analysis of web developments for covid monitoring, for which it focused on 8 randomly chosen countries and from the different continents of. the world, to achieve this, 11 Torres Burriel criteria [21] were followed, due to that they comply with the principles, intentions and purposes of the research.

Although in addition to the Torres Buriel Instrument, there are different web usability inspection methods such as the SIRIUS heuristic test [27]. These methods use very similar actions because, starting from a definition of a set of heuristics and usability criteria, they take As a reference, Nielsen's general purpose heuristics [22] are sufficient for the identification of usability problems in websites. However, this research decides to work with the Torres Burriel test because it takes into account a set of accessibility criteria, an important and fundamental element for the websites analyzed, which can guarantee that people can access a website without taking into account its context of use [28].

This project proposes an analysis of the web portals dedicated to the follow-up of COVID patients, the results of which can ensure two important aspects: first, the quality of the site in terms of usability and, therefore, ensure that the results obtained from the sites are the ones that really the user has needed to make their decisions.

2. Methodology

To find both quantitative and qualitative results, the project followed the structure of mixed typologies and was based on a case study [23]. For the development of the method, four phases are proposed: exploration of the Torres Burriel usability test, selection of the websites, Analysis of the sites, Results, and finally a case study. (see figure 1. Phases).

Figure 1: Phases

Phase 1 - Exploration of the Torres-Burriel usability test: In this phase, an analysis of the TorresBurriel template is carried out, in order to identify the heuristics and criteria proposed for web analysis, looking for coincidences and application methods to the objectives of the investigation.

Phase 2 – Selection of sites: Based on the reports of the World Health Organization, and national reports (Colombia), it was decided to categorize the countries with the most signs of contagion, of which a selection was made taking into account the technological similarities that they have been developing to contain the spread of the pandemic, in addition to those who had developed visible and easy-tofollow-up web systems for these infections. The list of countries and their monitoring proposals are described in the countries and monitoring methods for COVID people section. Organized by continents.

Phase 3 – Analysis of the sites: Once the sites have been selected, in this phase the analysis of eight (8) countries is carried out using an automatic tool for the inspection of website usability [24].

Phase 4 – Results: Which are collected from the achievements of each phase and which served to obtain the final results and the necessary recommendations to improve the analyzed sites.

3. Theoretical Framework

For the development of the project, some important concepts that supported the research were considered:

3.1. Usability

Based on the ISO 9241-11 standard, it is understood as the degree to which a software product can be used by certain users to achieve their objectives effectively, efficiently and satisfactorily in a specific context of use [26].

3.2. Torres-Burriel usability test

They are a group of 11 features based on Nielsen's heuristics, in order to evaluate the usability of different websites. Each characteristic has a set of criteria that are evaluated on a scale of 1 to 5. (see Table 1).

4. Countries and methods of tracking COVID people

According to the WHO, COVID-19 is a disease caused by SARS-CoV-2. The WHO first became aware of the existence of this new virus on December 31, 2019, when it was informed of a group of cases of "viral pneumonia" that had been declared in Wuhan (People's Republic of China). [1]. From this moment, due to the seriousness of the virus, he decided to monitor the number of infections in the world in addition to making a series of recommendations to avoid it. Among them, he invited them to automate an alert system that would report in real time the data generated with said monitoring.

Table 1 Heuristics and Torres-Burriel criteria

Heuristic	Description	N°. Criteria
H1: General Aspects	Aspects related to the objectives of the website, the correct and easy recall of both external and internal URLs, the adequate organization and structure of the contents, as well as the use of clear, concise and familiar language for the user.	9
H2: Identity and information	It evaluates what is related to the identity of the site, the mechanisms to contact the company, the protection of personal data and authorship of the contents.	7
H3: language and writing	It refers to whether the website speaks the same language as the user.	4
H4: Labeled	It expresses elements related to the meaning, proper use and familiarity of the content labels.	5
H5: Structure and navigation	Elements referring to the adequate organization, layout and structuring of the information in addition to the navigation of the site.	11
H6: Page Layout	Aspects related to the distribution and appearance of the navigation.	7
H7: Search	Evaluates aspects related to the search system implemented on the website, related to ease of	6

	access, as well as elements related to the effectiveness of searches	
H8: Media Elements	Aspects related to the level of adequacy of the multimedia content of the web porta	4
H9: Help	Aspects related to the help available to the user while browsing the site.	4
H10: Accessibility	Aspects related to the ease of use of web pages by any user, in which elements are evaluated with respect to size, type and color of font, weight of the page, compatibility with different browsers and elements that allow browsing comfortable.	8
H11: Control and feedback	Aspects related to the user's freedom to undo or redo navigation actions, as well as the timely and clear information provided to the user in the interaction.	6

Since the WHO declared Covid-19 a pandemic in 2020, there have been many prototypes in technological advances to control this virus [2]. Here is a list of countries that, in addition to presenting a high report of infections based on the WHO report, have also developed similar technological strategies to counteract it:

4.1. Covid-19. In Latin America

In the city of Cartagena (Colombia), they carried out a pilot test of a software for the telemonitoring of vital signs in Covid-19 patients of the ICU of the Crecer Medical Center, a mobile application of the ICU of the Crecer Medical Center [3]. Project, which was replicated in Bogotá (Colombia) with some adjustments and which was called a Business Plan for the creation of an occupational health management and monitoring system. Case study: Covid-19, an application that can be used by any health organization to manage its users as long as they comply with the guidelines stipulated by the Ministries of Labor and Health. The management system, in addition to monitoring covid-19 patients, guarantees the health and safety of employees, and thus reduces the rate of contagion by Covid-19. The contribution of this business plan is contact tracing, biosecurity protocols and transport of pathogens.

In Cuba [4], within the project Government management and Cuban science in the confrontation with COVID-19, whose main objective was to reflect on the experiences accumulated with Covid-19, different tools were developed that sought to systematize the actions emanated by the government against contagions of the population. To do this, Big data techniques were implemented to evaluate the mobility of the population during the pandemic, statistical information systems and a website were developed for the standardization and visualization of information and geographic information systems and automation of the epidemiological fence.

In Ecuador, [5] a development of a web application was carried out that supports the monitoring of the health status of people exposed to Covid-19 contagion through medical teleconsultation at the University of the Armed Forces ESPE Latacunga Headquarters, the objective was supporting the monitoring of the health status of people exposed to contagion through telemedical advice at the University of the Armed Forces ESPE Latacunga headquarters. Also in this country, they developed a system for mobile phones called a mobile application for the control of those infected with Covid-19 (ASI), [7] used to prevent and reduce Covid-19 infections, in cooperation with the private company and the government of Ecuador. . The digital tool is free and allows you to find out if someone was close to a person who has tested positive for the new strain of coronavirus.

Argentina, [6], carried out the project called Telemedicine in the context of the Coronavirus pandemic - Home Telemonitoring project. A health professional, through an automatic system, evaluates the patient's residential environment, if it is appropriate for home care through telemedicine and avoids taking these people to health centers. This project bases its conclusions on measurements made to the patient such as: temperature, heart rate, respiratory rate and oxygen saturation in the blood, blood pressure.

In Peru [8], a project based on the development and evaluation of the feasibility of a mobile application for active surveillance and monitoring of suspected cases of COVID-19 carried out by Community Health Agents (ACS) in the Nauta-Loreto region. The software was called CommCare. The operational feasibility of the average daily use of the application registered some 50.14 visits, detected approximately 5.14 suspected cases and 35.79 people with risk factors. Also in this country, a Chatbot-based technology was used to monitor COVID-19 patients with mild symptoms [9]; Developed at the Universidad Nacional Mayor de San Marcos and helped strengthen communication between patients, in addition to allowing daily evolution to be identified in a timely manner, avoiding the exposure of other people to sources of contagion. The government in this country, accompanied by the private company, supported the project called the Telemonitoring and Teleorientation Plan in times of the COVID 19 pandemic [10]. The project provides assistance using telehealth tools as a fundamental means to achieve continuity of care for people with chronic diseases and people infected with covid19. This is a service to provide users with counseling and advice for promotion purposes. health, prevention, recovery or rehabilitation.

4.2. Covid-19. In Europe

In Spain, a web system was developed to report on the factors associated with mortality and sequelae in users of residences for the elderly hospitalized for covid-19 [11], a longitudinal study with 6 months of follow-up. Where the main factors associated with the prognosis (mortality, sequelae at 6 months and readmissions) of patients with Covid were evaluated at the San Cecilio Clinical Hospital. Although they obtained key percentages among them, the mean age of the cohort was 66.4 years, with 55.1% male; in-hospital mortality of 18.1%; Patients living in nursing homes had a higher mean age and higher frequencies of comorbidities, mortality and hospital readmissions. The data changed after 6 months due to the fact that sequelae were not taken into account (59%), in addition to a higher frequency of confusion, with hematological, nephrological problems and superinfections. Also in Spain, the Conceptual Architecture of a technological platform for epidemiological surveillance for CoVId-19 [12] was developed, whose objective was the systematic and constant collection, analysis and interpretation of data on specific health problems in populations, their processing and analysis. to use them in the planning, execution and evaluation of interventions for the prevention and control of risks or damage to health. The project is based on Telemedicine and tele-monitoring or remote monitoring of patients, data analytics for the probability of contagion in the population based on data such as symptoms, signs, pre-existence, location and contact-tracing.

In France [13], they worked with the system called Covid-19 alert and monitoring indicators, in order to carry out an evolving surveillance system based on definitions of possible, probable and confirmed cases. However, the daily count was limited to cases confirmed by reverse transcriptase polymerase chain reaction or SARS-CoV-2 serology (currently through the SI-DEP platform), The system was in charge of collecting detailed information demographic, clinical, bacteriological, virological and prognostic of patients hospitalized in intensive care. To face this challenge and guide its responses, the Assistance Publique–Hôpitaux de Paris (AP–HP) established an epidemiological monitoring based on indicators collected at the national and local levels and, based on these indicators, developed projections aimed at informing the decision making.

In France, another application of COVID-19 to SAS, emergency medicine on the front line, is also important [14]. Because, according to reports, the epidemic significantly affected this country, with more fatalities compared to those of World War II. This software identifies and routes patients to

designated infectious disease centers based on their location, as well as locates suspected or contact cases that could become potential cases. The medical regulation found many benefits through video-consultations or video-assessments and directly directing patient files in monitoring software (COVIDOM).

In Italy [15], the system was developed, Feasibility and efficiency of an advanced home care followup model of patients with or suspected CoViD-19. The included patients were monitored daily at home, through the measurement of pulse oximetry at rest and after the rapid test. Feasibility results were planned (at least 80% of patients recommended for referral to the ER were actually transferred within 24 hours of reporting). Due to the increase in infections, in Italy, they also supported another project based on Telemedicine and virtual reality in times of the Covid-19 pandemic [16] ", a system that was responsible for the administration of monitoring services through the use of telecommunications technologies, with the main objective of facilitating access to treatments avoiding hospitalization or Covid-19 symptoms, where patients can be evaluated and monitored remotely. Monitoring has also been important in this country, and for this reason they developed the Telecovid system: development and experimentation of applications for remote monitoring of patients. [17] for monitoring and preventing the spread of the Covid epidemic. This health crisis highlighted the need to improve health services and telemedicine, which is a valuable resource to provide the necessary care to patients, developing two chatbots, using Telegram. PoliTo Hospital, COVID-19 Bot, used by medical and paramedical staff in hospitals to monitor hospitalized patients, but can also be used by anyone who wants to monitor their health parameters.

5. Results and Analysis

For the usability analysis, due to the fact that the referenced platforms had similar characteristics and sought similar objectives: monitoring covid-19 people, a web platform from each country mentioned above was taken as a reference (eight (8) in total). To facilitate the evaluation, the web application developed by Chanchi, et al, which uses the Torres-Burriel heuristics, was used. The characteristics are presented in the form of questions and are evaluated in ranges from 0 to 5, where 0 is the total absence of the characteristic in the portal and 5 when it completely complies. The platform (see figure 2 Web interface) was developed using the Python Flask framework (in the backend) and the Javascript language (in the frontend) is designed by tabs and in each one the different characteristics to be evaluated are found.

Figure 2: Web interface

The monitoring of the analysis of the characteristics or usability criteria in the selected websites was based on the following flowchart (see Figure 3 DF-Monitoring).
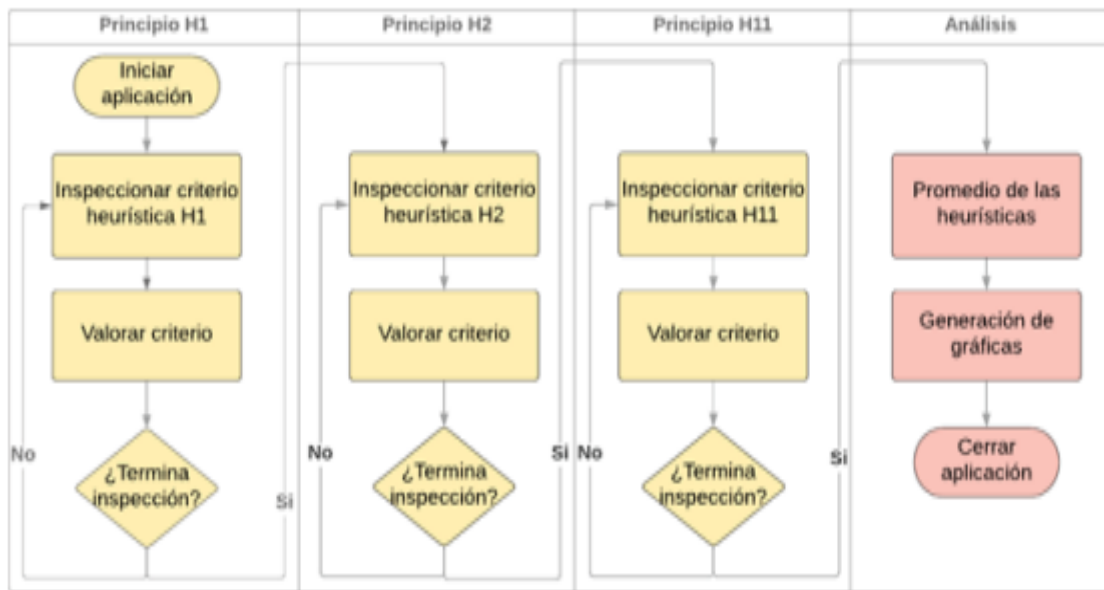

Figure 3: DF-Tracking

Once the analysis was finished, of the different characteristics of the focused platforms, the averages of each one of the heuristics were calculated, in addition, the general average obtained from the result of the usability inspections was also calculated (see figure 4 Results of the inspection) . These averages allowed the evaluators to identify critical aspects of the websites analyzed, in addition to making their general observations and recommendations in this regard. (see figure 4 Results)

| H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 H11 Radióñúdos Diagrama Barras Diagrama Porcentaje Diagrama Torta |

Resultados Generales

Promedio de las heurísticas de Torres-Burriel

Criterio	Valor
Principio H1	2.444
Principio H2	2.857
Principio H3	2.5
Principio H4	3.2
Principio H5	3.273
Principio H6	3.571
Principio H7	2.167
Principio H8	4
Principio H9	2.75
Principio H10	1.625
Principio H11	3.333
Promedio General	2.884

Figure 4: Results

6. Case study

The inspection applied to the web portals was carried out taking into account their contents, their services, data management and updating, as well as each of the events prescribed in these pages. Figure 5 shows one of the examples of the analyzed pages. (see figure 5 – Cuba web portal).

Figure 5: Cuba website

To develop each of the proposed activities, based on the heuristics, the expert collaborators of the investigation, make a tour of the proposed web portals and were in charge of giving a rating to each characteristic according to the level of compliance. The evaluation carried out by the group of experts who, in addition to knowing usability criteria [25], are also working on pandemic issues, from technological perspectives in order to mitigate the effects of the virus.

When calculating the average of the reviews carried out, it is found that the platforms used by the countries for COVID monitoring have usability shortcomings, since in one of the characteristics they reach an average of 4.2, on the scale of 1 to 5, which which corresponds to 83.2% of compliance with the characteristic. (Figure 6 shows these results)

Figure 6: Graphical average of the characteristics

On the other hand, eight of the characteristics reached scores between 3.4 and 3.8, that is, a compliance percentage between 64% and 76%. It was also verified that two of the characteristics reached a score of 2.7, that is, 53% compliance.

Based on these results, it was possible to verify that the heuristic or characteristic that best meets the criteria is the one defined as "Labeled" (H4), reaching a rating of 84%, and the characteristics that received less rating are those of "Identity and Information". (H2) and "Help" (H9). Regarding the "Accessibility" characteristic (H10); As the assessment shows, it had more acceptance, although the level of compliance is acceptable at 70.6%. (see figure 7 compliance percentages)

Figure 7: Compliance percentages

Based on the general average, the level of usability of the analyzed pages is 3.7561, that is, a level of compliance of 75.122% (see table 2). It is advisable to take into account the different usability criteria so that the portal has a value greater than 80%, which can be considered adequate in terms of usability.

Table 2 Average by heuristic

Principle	Average	Percentage
H1: General aspects	3.56	71.20%
H2: Identity and information	2.65	53%
H3: Language and writing	3.6	72%
H4: Labeled	4.2	84%
H5: Structures and navigation	3.44	68.80%
H6: Page Layout	3.23	64.60%
H7: Search	3.251	65.02%
H8: Media Elements	3.8	76%
H9: Help	2.65	53%
H10: Accessibility	3.53	70.60%
H11: Control and feedback	3.65	73%
GENERAL AVERAGE	3.7561	75.122%

6.1. Recommendations from the results

With the results obtained, the experts make a series of recommendations that must be taken into account, to improve the usability of these applications, especially when they are of continuous use and that require precise results for the decisions that must be made. As a result of the inspection carried out on the portal of the Municipal Mayor's Office of Popayán, this section presents a set of recommendations (see table 3) for the eleven heuristics evaluated and taking into account the principles and criteria that, based on the evaluation of the evaluators, obtained the lowest value. These recommendations are intended to help in order to generate possible improvements, taking into account the number and diversity of users who access this type of government portal.

Table 3 Recommendations

Principle	Recommendation
H1	Although the portals look consistent, the presentation of their contents must be unified, and different links (connection buttons) This will make it possible to access faster and deliver and receive information more efficiently
H2	It is necessary to include relevant information or representative taglines of the management that is done in each platform site, because there are different events that take place in them and the linearity of the application is lost
	Mechanisms for communication and contact with users (messaging, chat, banners, etc.) must be improved. The purpose of these platforms is to reach the largest number of users regardless of nationality; therefore, these elements must be consistent and clear
H3	For greater security, the series of recommendations and content regarding the subject in question of the platforms must have legal and/or scientific support.
H4	Because users are from different parts of the world, it is recommended to improve communication issues by using different languages or the possibility of a translator to the most used ones.
H5	Because users are from different parts of the world, it is recommended to improve communication issues by using different languages or the possibility of a translator to the most used ones.
	The platforms chose to require enough information from users to be more precise in their recommendations, but it makes the structure of the web extend and users can easily get lost in their navigation. Issues that must be corrected from the designs
H6	The information on the platforms is important, but it must be adapted to what is specifically necessary. This will avoid generating information overload.
H7	It is necessary to improve the advanced search systems, the platforms contain a lot of important information, which must be explored and known by people.
	Search results should not only present a title of that search, some lead nowhere. It is better to present the full search result.
H8	It is necessary to place representative images of the contents, it will make the platforms more pleasant and better remembered.
H9	Frequently asked questions should be given greater relevance and answered in due time.
	Provide the user with context-sensitive help because it usually performs various tasks
H10	These are portals that should be used by anyone; therefore, the minimum accessibility standards must be taken into account.
	The size of texts and images must be optimized; It is easier to navigate within the platform
	The applications must be allowed to be handled from any device; therefore, the layout and adaptation must be better.

H11	The user must be able to control the error, therefore the language and navigation must be clearer and more precise, easy to learn, easy to use.

7. Conclusions and future work

This research provides a usability analysis of the web platforms developed to monitor people infected with COVID-19, based on the Torres-Burriel usability test and a web portal developed by Chanchí et al, which are based on the proposed heuristics. by Jacob Nielsen.

The research aims to support designers and developers who have dedicated themselves to the construction of websites dedicated to health, due to the delicacy of the information that is handled and the data that feed these pages. The purpose is to be more accessible and inclusive, developed for anyone.

Evaluating each of the criteria allowed us to know how information is being provided and how data is being requested from users. What makes it possible to know how true the results thrown by these platforms are.

The analysis revealed that the countries, due to the rush to automate this information in times of pandemic (and it is reasonable for this research), forgot certain usability standards, which led to generating4 some errors in their results.

It is recommended that this type of web platform, including all health-oriented ones, should take into account the "Accessibility" heuristic, this will allow the inclusion of any type of person regardless of the context of use.

Platforms must be compatible with different devices; this will make it easier for users to use these contents.

As future work derived from this research, it is intended to design and develop a series of recommendations based on heuristics and quality attributes for developments oriented to the health sector.

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