ConstruNET - A Collaborative Tool to Provide Offers of Construction Supplies

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Abstract—**This article deals with the theoretical and practical aspects of developing an app called ConstruNET. It was created by a research group in the Graduate Program in Telematics of the Federal Institute of Education, Science and Technology of Tocantins, Brazil (IFTO). This solution was developed with available Web applications and has the goal of providing users with information about offers from a list of construction supplies sold by stores in the city of Palmas - Tocantins - Brazil. The purpose is to show the importance of an app such as ConstruNET to aid the search for building material products, as well as to avoid the waste of time and money in construction activities. This article demonstrates the planning, conception and utilization of ConstruNET as a mobile technology app directed towards civil engineering construction supplies.**

Keywords-Collaborative tools; App; Construction; Mobile Devices; Internet.

I. INTRODUCTION

The advent of globalization has brought access to various technologies that greatly facilitate communication and interaction between people. Today, people have several services at their fingertips in ways that were impossible ten years ago. This is because of the opportunity for acquiring mobile devices and Internet access services.

The use of smartphones and tablets has increased the production of applications, making it possible to solve day-to-day problems. Today, it is possible to verify the prices of several products online, as well as to compare them, evaluating them and pointing out what needs to be improved.

This paper is structured into six parts. After the Introduction, in Section 2, the publications related to this research are presented. In Section 3, we present the problem and its justification, besides the general and specific objectives established for the project. In that section, we describe how we used the physical relationship diagram and virtual tools in meetings of the research group. In Section 4, we present the online survey and statistical graphics. In Section 5, we present our overview of ConstruNET.

II. RELATED WORKS

Mobile devices play a fundamental role in the information dissemination process.

Research works are aimed at finding a solution that would allow people to search prices of civil engineering construction supplies in a given region. Appsheet® [1] was the main tool for development of mobile applications because it is easy to use and low-cost.

The authors in [2] show how the Appsheet® tool was used for calculating water consumption of the reference plants, presenting an easy way for data storage and for developing an application. The tool is an alternative for data storage and management.

The researchers in [3] use the Appsheet® tool for developing a solution for providing a low-cost electronic data collection tool for a health facility survey study. They created an online application using the Appsheet® tool functionalities.

In [4], the authors use the Appsheet® tool to develop a Web solution to support decision-making. The Appsheet® tool was used as the main tool for development and the authors realized the advantages of the Appsheet® tool, considering its operation and ease of programming, as well as its database robustness.

The researchers in [5] present a database model totally based on the Appsheet® tool, showing its performance and ease of operation. They address the use of the Appsheet® tool in building a database for facilitating location and development of a warehouse management system.

The use of a mobile application that aims to save time and money for users when they need to search prices for products and / or building materials in their city is the focus of this paper.

III. PROPOSAL

According to Meireles [6] citing the 29ª Annual Survey of Information Technology (IT) Usage conducted by GVCia (Center for Applied Information Technology of the Getúlio Vargas Foundation), in the year 2018, Brazil already has about two hundred and twenty million active smartphones, proportionally well over one smartphone per inhabitant. Even with this information and the increasing use of mobile applications, there is a lack of tools that facilitate daily tasks. For example, when there is a need to make a small renovation, there is almost always inconvenience in obtaining offers of construction materials, tools and accessories from the stores, along with the best prices.

ConstruNET was born with the proposal of presenting to the user a solution that uses a mobile application to facilitate access to a list of offers of construction material products from several stores in Palmas, the state capital of Tocantins.

The general purpose of this article is to provide an app for the population that allows a comparison of prices of construction materials in the main stores of a given locality, allowing the consumer to quickly find a better price, thus reducing the time spent on construction or remodeling.

Additionally, there are three specific objectives of our work:

- Allow the consumer to register the building material products whose information will be shared.
- Provide a list of products containing their respective prices and the stores that are offering them.
- Provide maintenance tips that will assist the consumers in resolving minor repairs or renovations to their homes.

A. Materials

ConstruNET was planned and documented using tools from the Google family (Docs [7], Sheets [8], Slide [9], Classroom [10] and Forms [11]). We considered User-Experience and Usability for developing the APP using a spreadsheet with Nielsen Heuristics [12] and a document in Card-sorting format.

The ConstruNET app prototype was created using the AppSheet® tool. The physical resources used during development included mobile devices for tests such as a Samsung® GT-7102 smartphone, a Motorola® MOTO G5 Plus smartphone, a Samsung® A9 Pro smartphone and a Samsung® Galaxy S7 smartphone, all of them connected in WI-FI 802.11n internal networks and 3G and 4G mobile networks.

All physical equipment was from the Telematics and Application Laboratory at IFTO (Federal Institute of Education, Science and Technology of Tocantins).

B. Methods

The idea of ConstruNET was conceived during face-to-face meetings and through distance learning (Google Classroom tool) in the graduate program in Telematics, carried out at the Telematics and Applications in Education Laboratory at the Federal Institute of Education and Technology, Palmas, Brazil from March to August of 2018 and was based on the Problem Based Learning (PBL) methodology.

The data collection instrument consisted of an online questionnaire from the Google® Forms tool, shared and answered by one hundred and seventeen users in Palmas and who evaluated the feasibility of creating an application that could offer prices from construction materials. During the Telematics Graduate classes, the Google Docs tools were used to prepare documents that supported the application test, Google Sheets spreadsheets for the AppSheet® tool Database and the results were shown using Google Slide. The Google Classroom tool served as the basis for communication between the teacher and the students.

In the second stage of planning, the skeleton, design and usability plans, and the Nielsen Heuristics worksheet based on the needs of the online survey constructed using the Google Sheets and Google Forms tools, were also thought out and idealized through card-sorting for ten users with the objective of testing their views regarding issues of application navigability. The presentation of the results was done by the Google Slide tool.

In the creation phase, the ConstruNET prototype was designed, using the AppSheet® tool. The application was initially created with four screens, where the offer list sessions, stores, products and categories were made available. Given its hybrid nature, the AppSheet® tool made it possible to make use of the application on the Android® and IOS® platforms through its access database.

As a result of the planning and design processes, ConstruNET was designed and operates according to the diagram in Figure 1 below:
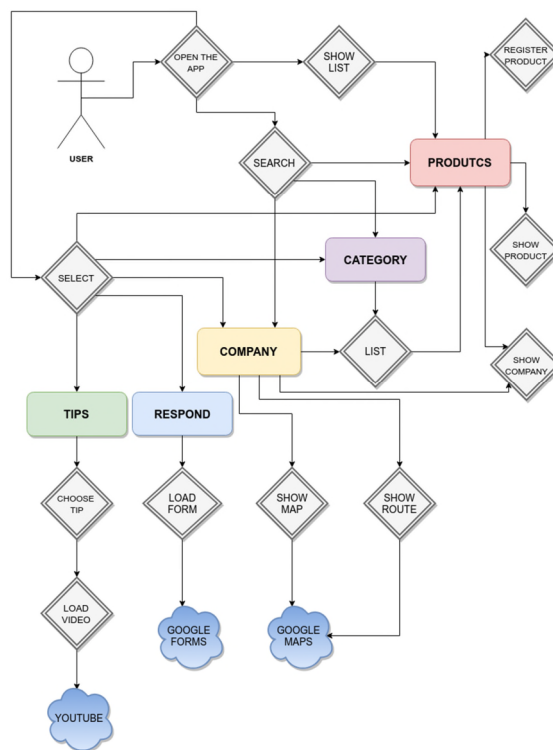

Figure 1. Relationship Diagram.

When the users run the ConstruNET application, they view the list of available products sorted in alphabetical order and from the lowest to the highest price. In the initial screen, the user can search for a product (product module), category (category module) or company (company module). On the initial screen, the user can also select the module tips, answer survey, company, category and products for visualization.

If the user has selected the item related to the company search, the search result will be the company entered by the user. As a result, detailed company data such as name, address, telephone number, storefront photo, map with company location and available company products will be shown. Also in relation to the company, the application uses a map to invoke the Google Maps® [13] tool and a route is drawn from the user's GPS location to the company location.

When the user chooses a category search, the application shows the categories of products available, e.g., hydraulic or electric and when a category is selected, a list is shown with all products registered in the selected category.

If the user chooses the tips module, the APP will present a list with simple maintenance procedures that can be performed by the user without the need of a professional. When the user selects a tip, the system loads the YouTube® [14] video for viewing within the ConstruNET application.

The module responds, when accessed by the application user, by loading a form created in the Google Forms® tool, which contains a survey on the use of the ConstruNET application, which may or may not be filled out by the user.

The products module is the most important of the application, because it is what contains the information for which the system is intended to be created. The user, when accessing this module, can register a product, view product details and view the company that sells the product. In the product details is presented an image of the product, the selling price, the company that offers the product, technical specification and description and the category of the product. Also in the product description, the user can access data for the company that sells the product and the category of the product, presenting all products registered in the category.

In the main list with the products registered, the user has the option of registering a new product. In the product register, it is necessary to fill in the product, price, company and category fields. Optional fields are image (product photo), description and specification.

For tests using the ConstruNET functionality, a copy of the application in developer mode and six copies of it in a limited mode for six invited users in the city of Palmas-Tocantins were installed in four smartphones of the graduate students.

IV. RESULTS

ConstruNET was conceived during face-to-face meetings through distance learning (Google Classroom tool) of the Graduate Program in Telematics, held at the Telematics and Applications in Education Laboratory of the Federal Institute of Education, Science and Technology, Palmas, Brazil, during the period from March to August of 2018 and was based on Problem Based Learning-PBL methodology.

The data collect instrument consisted of an online survey from the Google® Forms tool, shared and answered by one hundred and seventeen users in Palmas, which evaluated the development viability of creating an application that could provide prices / offers of construction materials.

TABLE I. SURVEY QUESTIONS

Number	Questions
1	Gender
2	Age
3	Have you bought any kind of construction and / or maintenance material?
4	At home, who usually performs minor repairs / maintenance?
5	How do you usually buy your materials, tools and / or accessories to use in your building or home?
6	How much do you use building and / or maintenance materials?
7	Would a search application that provides information on building and/or maintenance materials be useful when shopping?
8	Would you like an app that shows the lowest price of a building material, tool or accessory for maintenance in the stores in your area?
9	Would you like to receive a quote for all the materials you need, at the lowest prices, from the application?
10	Would you like the application to show tips about minor repairs that you can do yourself?
11	Would you like the app to showcase supplies, tools, and / or accessories for stores in your area?
12	How much do you think the app will help in saving time and money at the time of purchase?

The initial study pointed to a need for the application and in light of the results, the prototype of the ConstruNET has the following functionalities:
- Product registration.
- List of products and information of companies that sell them.
- List of companies that sell building materials.
- List of categories.
- Viewing details of a product.
- Viewing details of a company.
- View of the route of a customer to a selected company.
- Maintenance tips.

Some screenshots of functionalities in the ConstruNET prototype are shown in Figures 2 and 3.
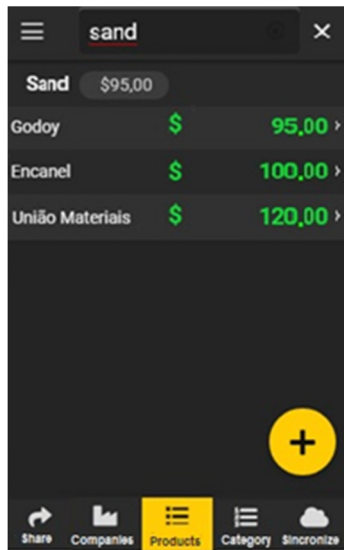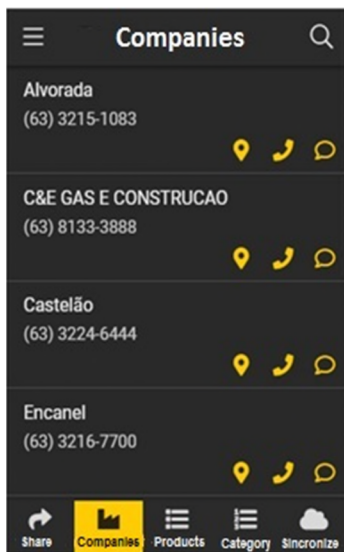
Figure 2. List of products

Figure 3. List of companies

A. Data Analysis

In Figure 4, we can see that 67% of the public, who answered the survey are male with an average age of about 18-40, as shown in Figure 5.
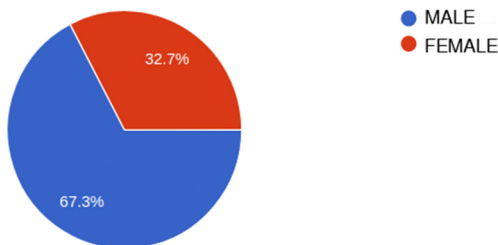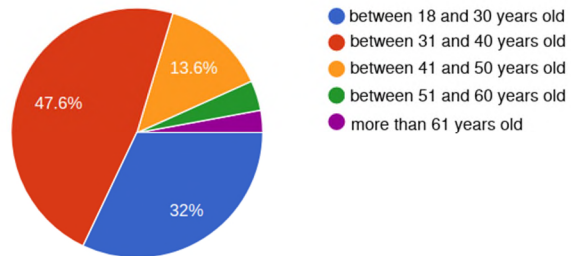

Figure 4. User gender

Figure 5. User ages

According to Figure 6, 91% have already bought some type of construction material, about 46% have already made minor repairs to their home and only 26% call a specialized professional.
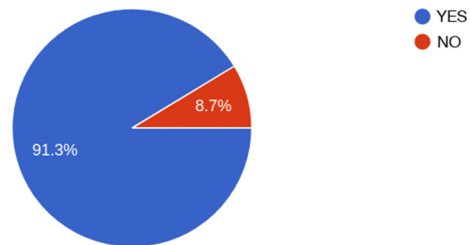

Figure 6. Users who purchased materials

An interesting figure is that 78% buy building materials from physical stores and about 95% would find it much more interesting to have an app that could resolve budgets, make comparisons, and show offers for construction materials from a variety of stores for a possible future purchase.
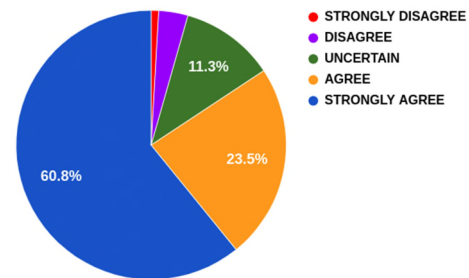

Figure 7. Users would like an application that helps them save time and money

It is also worth mentioning in Figure 7 that 60.8% of those interviewed would like an application that helps them save time and money when shopping.

In addition to the results presented, ConstruNET will provide the features of:

- Informing the location of the closest companies that contain the product searched by the user.
- Generating a budget
- Comparing prices.
- Ranking the users in relation to the veracity of the information inserted.

- Authentication of the user through Social Networks.

Additionally, application features will be verified through field testing to assess usability and user acceptance.

V. CONCLUSIONS AND FUTURE WORK

Usability issues in ConstruNET were handled with due attention by the application development team. In evaluating it, several techniques were used that inform indicators to be improved, both in navigability, as well as design and interaction with the end user.

Jakob Nielsen's Heuristics were used in the application, with the evaluation of some specialists and light of the result, it was verified that ConstruNET has a good set of colors that assist its users, besides providing a better visualization of the app at any time of the day, in addition to saving the battery of the mobile device on which it is installed. Another positive point is that the application has a unique font, making it easier to identify, changing only the font size, and the words are well associated with their respective functions. The structure of the screens is consistent, which facilitates learning how to use ConstruNET.

Points for improvement are the inclusion of titles and sections informing where the user is and translation of help and error messages. Images should be standard size and aligned on all screens. One point also to be improved is understanding of the product screen in relation to the information that should be highlighted.

As assessed in the evaluation, the application should also go through future implementations, such as social networking login and migration from the Appsheet® tool (where it currently is) to the Ionic platform.

Although the prototype was developed with limited Web applications, ConstruNET presents itself as a good solution to the proposal for which it was conceived. In future updates, the suggestions captured by the users will be covered through research and testing using the application during the prototyping phase.

ConstruNET is at the service of users of mobile technology, and through its announced offers it facilitates the planning of small reforms, as well as expediting decision-making in the acquisition of materials for construction.

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