Pharmadology

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Abstract

Egypt like many other countries is suffering from many problems which affect the economy, environment, social life and sustainability. Health care in Egypt is one of the catastrophic problems that waits to be the ruling grand challenge in our country, so directing our forces towards it will help improving Egypt's current status in medical field. Egypt's health challenges disproportionately affect the rural poor and have the potential to impact the country's economic prosperity more broadly over the long term. One of the most serious health issues is the shortage of medicine combined with the patients' inability to get their medicine especially in urgent situations. Nowadays, this problem is really concerning as, day by day, people fall ill and it might be a serious issue if the medicine is not available or if there is so much effort needed to find it which consequently leads to health deterioration and even death. Effective and efficient communication is crucial in healthcare. Our website "Pharmadology" provides the perfect connection between the patients and the pharmacies helping them in getting medicine, information about the nearby pharmacies, ordering their medicine online or even reserve it. Pharmadology website also helps them to check availability of any required medicine, developing a great communication between the patient and any professional doctor for consultation to improve their healthcare. Pharmagology was built using C# programming language which encompasses a strong typing, functional, and component-oriented programming in addition to the MVC framework which is used to design and create interfaces and structure allowing each to change without affecting the other.
Some special design requirements were determined to test the website and they are classified into two main categories: functionality and design. A survey was then made in order to target different aspects of the website and tests these design requirements to ensure its effectiveness in solving the problem providing a new way using modern technology to help the patients reduce the time, effort, and money needed for getting their medicine. From our users' feedback, it was concluded that the website is working in an effective way as all users were satisfied by using the website. Therefore, all of the determined design requirements were achieved making the website a suitable and reliable solution ready for commercial using worldwide.

Introduction

Egypt like many other countries is suffering from many problems which affect the economy, environment, social life and sustainability such as pollution, urban congestion, climate change, and so many others. All of these problems critically need to be solved as they represent an obstacle towards its development. The project for this semester is to work on solving one of these critical challenges using advanced technological methods. After doing lots of research, the necessity of working to solve and cut off the problems regarding the Health field has dominated over all of the others due to huge number of critical issues concerning health sector. That is why eradicating the public health issues in Egypt was found to be one of the vital challenges needed to be solved.

In particular, the problem being solved by our project is related to the inability of the patients or any ordinary customer to find and get their medicine easily, especially if they are strangers or there is a shortage of some types of medicines. This problem has markedly increased in Egypt during the past few years. Some prior solutions have been tried to solve this problem, however, it was not totally efficient. One example was an application called" Yedawy" has been developed that enables the users to search their medicine in different pharmacies using any location, but this application was not effective enough primarily because it is an android application that needs huge storage space on mobile phones which makes it unsuitable for all segments of users in addition to its inability to be accessible from all the browsers. Therefore, the chosen solution for this critical problem will be simply a website called "Pharmadology" designed to easily connect between patients and pharmacies with the ability of ordering medicine and reserving it online. Also, it provides extra features such as photo recognition that enables users to upload their medical prescriptions and send it directly to the chosen pharmacy.

In order to make sure that "pharmadology" website is effective, some measurable design requirements have been determined to test the website which are classified into two main categories: functionality and design. For functionality, it was determined to test all the functions of the website including checking medicine availability, ordering medicine online, reserving medicine or even uploading medical prescriptions.
For website design, other requirements were determined including the easy user interface, familiar formats, well formatted content, and browser compatibility. A survey was then made in order to target different aspects of the website and tests these design requirements to ensure its effectiveness in solving the problem providing a new way using modern technology. The test was conducted on samples of 10 users using a survey analysis. From our users' feedback, it was concluded that the website is performing with an efficient technique as they were all satisfied by using the website. This way all the design requirements were met making the website a suitable and a reliable solution ready for worldwide commercial using.

Materials

Methods

The methodology that was followed in order to build up "pharmadology" website is divided into some specific consecutive steps shown as following:

First: The type of the application (mobile app, web site, desktop app)
The prototype was chosen to be a website rather than a mobile or a desktop application so as not to take huge storage space. In addition, a website can be instantly accessible from any browser of any phone with any OS.

Second: The website functionality, design, and database
The work on the website was divided into three main parts which are:

- **Website functionality,** in which the programming language and the technology used to build the website were determine as follows:
  - ✓ C# programming language as it is suitable for writing applications for both hosted and embedded systems.
  - ✓ Model View Controller (MVC) software design framework
  - ✓ Entity framework, works as ORM (Object Relation Mapper) between Models (classes) and Database (tables).
- **Website design,** in which the HTML was used for creating the structures, the CSS for styling the selected tags of HTML, and the JavaScript language for building up the functionality of the website.
- **Website database,** in which the SQL server was used with its primary function of storing and retrieving data as requested by other software applications which can run on any computer across a network.

Third: Analyzing the project
In this step of analyzing the project, the back-end and the front-end users were determined.

- For the back-end, there are two users: the super domain (our team), and the domain (the pharmacies).
- For the front-end, the main user is any customer using the website.

Fourth: Designing the website
In this step, some sketching, models and diagrams were used in order to facilitate the process of building up the functionality code of the website.
For example:

- Website sketching
- Activity Diagram
- Use Case Diagram
- Class Diagram
- ERD (Entity Relation Diagram)

Fifth: Developing the functionality code
using Visual Studio application and C# programming language, the functionality code of the website was written applying the functions and the relations in the constructed diagrams.

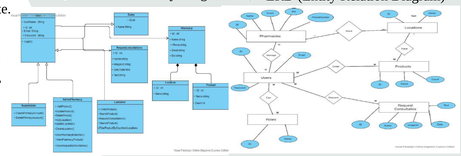


Fig.1, Showing Class diagram

Fig.2, Showing ERD diagram

Test plan

In order to test the website and be sure that it will be an effective solution in solving the problem, some specific design requirements were set and classified into two main categories: functionality requirements through which all of the functions of the website will be tested and website design requirements through which the simplicity of the user interface will be tested.

Functionality requirements

- **Determine medicine availability,** it will be tested if the website has the ability to show the medicine available in the pharmacies, its quantities and prices to inform the user if it is available to be ordered or not.
- **Order medicine online,** this function will be tested ensuring that the medicine will be delivered by the pharmacy to the user's location determined in the online-ordering form.
- **Reserve medicine online,** the ability of the website to reserve an order and update in database of available medicine will be tested ensuring that the user will be able to get the medicine during the validity days.
- **Uploading medical prescriptions effectively,** which will test whether or not the user is able to upload a photo of a medical prescription and if the photo was sent to the chosen pharmacy and approved by it or not.

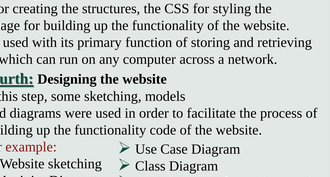
Website design requirements

- **Easy user interface**, as it will be tested whether or not the user is able to easily deal with the website without help to ensure that it is suitable and easy-used by a wide range of users from different social levels.
- **Showcase the website's features effectively,** as it will be tested if the content of the website is clear and obvious or not and whether or not there is a difficulty in viewing its features.

All of the determined design requirements were tested using different ways according to the demands of the users who tested the website. The sample of these users were exactly 20 people of different ages, jobs, criteria, and even different social levels. These ways were in the form of: ➢ An offline survey ➢ An online form
This is all to ensure that the website will be suitable and useable by a wide range of users.

Results

Based on the survey results, it was observed that all the functions of "pharmadology" website are working proficiently which is obvious as shown in graph(1) as all of the users were able to check the medicine availability in different pharmacies. In addition, 90% of the users were able to order their medicine online and completed this process successfully. Also, 80% of the users were able to complete the process of reservation, but only 4 of the total number of users had problems as some of them did not find the suitable amount of medicine while others had their medicine out of stock of the pharmacies.

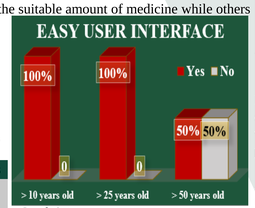


Graph.1, Showing the functionality test results of the website

According to design testing results and the graph(2) shown, it was founded that all users who aged from above 10 years old to 50 years had faced no problems dealing with the website and only half of the users aged above 50 needed a little help with navigation. also, all of them stated that the content is clear, obvious, and well formatted. Thus, the design requirements were successfully met according to these results, making the website ready as a suitable solution for the problem.

Table1, Showing the number of users opinions on the website format.

	>10 years	>25 years	>50 years
Unproficient	0	0	2
Proficient	0	0	2
Well proficient	6	6	4



Graph.2, Showing the design testing results of the website

Analysis

Communication in a healthcare setting is one of the most important tools that have to be existed for providing a great care for patients and enhancing the health field. The main obstacles that may occur in communication between pharmacies and patients are: language, cost of medication or the most challenging obstacle which is the inability of the patients to get their medicine easily especially if there is a shortage of some kind of medicine or the pharmacies are far apart from the users that they will not be able to reach them searching for their medicine. All of these obstacles combine to form a kind of a catastrophe that eventually lead to death of patients as they will not be able to get their medication on time which will cause health deterioration and more hard complications and finally death. That is why enhancing the communication between the patients and the pharmacies is an effective tool that saves the patients' life.
According to the project scientific base, identifying its design requirement is a main principle to reach its success. The website and its testing results was an evidence that shows how the solution met the determined design requirements which were classified into two main categories: the functionality and the website design that will enable us to test all the functions of the website in addition to the simplicity of the design and the user interface.

Functionality requirements	Website design requirements
➢ Determine medicine availability ➢ Order medicine online ➢ Reserve medicine online ➢ Uploading medical prescriptions effectively	➢ Easy user interface ➢ Showcase the website's features effectively

All in all, combination of all the previous requirements including functionality and website design requirements lead us to achieve an ideal solution to solve the huge problem we are addressing "communication of the patient and pharmacies". This way we met all the design requirements we have previously determined as the survey results proved that the functions of the website are working appropriately and its design is easy and simple regarding user interface. That showed through the satisfaction of almost all the users have tested the website.
Also, their feedbacks greatly helped us in determining how to best improve website design in order to be more and more easy for the user to make use of it.
There are many functions and features provided by "pharmadology" website and the main ones of them will be discussed in details with their codes shown as follows:

Search medicine online

As shown in the figure (3), the user can order medicine online through selecting a city, area and the required medicine. After that, a list of pharmacies in this area at which the medicine is available will appear to the user to choose the suitable one.
This will be done by getting two inputs from the user: the medicine name stored in the variable of string datatype named "productname" and the location that is stored in another variable of the same datatype named "LocationName".
After that, some built-in functions were used as the "Select()" function which was used in a loop to filter out the other pharmacies and select only the ones that match with the "Productname". Another function named "tolist()" was also used in a loop to list all of the matched pharmacies. Finally, the "view()" function was then used to help view and show the list done.

```
[HttpGet]
[AllowAnonymous]
public ActionResult GetAllMedicine(string productName, string LocationName)
{
    _context.Configuration.ProxyCreationEnabled = false;

    var product = _context.products.Where(p => p.Name == ProductName);
    var localCode = _context.Locations.Where(l => l.Name == LocationName).Select(l=>l.Id).ToList();

    var Pharmacies = _context.Locations.Include(p => p.Pharmacy)
        .Where(p => p.Name == LocationName).Select(p => new PharmacyDto
        {
            Id = p.Pharmacy.Id,
            Name = p.Pharmacy.Name,
            Text = p.Pharmacy.Text,
            Email = p.Pharmacy.Email,
            PhoneNumber = p.Pharmacy.PhoneNumber,
            Products = product.Select(r=> new ProductDto
            {
                Id=r.Id,
                Name=r.Name,
                Count=r.Count,
                Price=r.Price
            }).ToList(),
        }).ToList();

    return View(Pharmacies);
}
```
Fig.3, Showing the code part related to the function of searching medicine online

Order medicine online

As shown in the figure (4), the user can order medicine online if the pharmacy has this services. A receipt of all the details will then be appeared for the user immediately. This will be done by getting two inputs from the user: the user name stored in the variable "username" and the medicine name stored in the variable "ProductName". A function called is included in the code to add order of the user then the function "return()" will redirect the user to home page.

```
[HttpPost]
[AllowAnonymous]
[Internal Helpers | 0 changes | 0 authors, 0 changes | 0 requests | 0 exceptions]
public ActionResult Order(String userName, String productName, string Count, DateTime DateTime
{

    order order = new order();
    order.productName = productName;
    order.userName = userName;
    order.DateTime = DateTime.Now;

    _context.Orders.Add(order);

    _context.SaveChanges();
    return RedirectToAction("Index", "Home");
}
```
Fig.4, Showing the code part related to the ordering medicine online function

Uploaded medical prescriptions

As shown in the figure (5), the user can upload a medical prescription and choose the pharmacy he wants to order from then he will have to add his home address and phone number to complete the process. This will be done by getting four inputs from the user: the user name stored in the variable "name", the description stored in the variable "prescription body ", the phone number stored in the variable "phone number", and the uploaded photo stored in the variable "imagepath" of data type "HttpPostedfileBase". Then an" if" condition was put to ensure that the user will not submit the ordering form without an uploaded photo and that the type of the uploaded photo is only in a jpg format to be stored in the database, through this line:

prescription. Imagepath=image link:

```
[HttpPost]
[AllowAnonymous]
[Internal Helpers | 0 changes | 0 authors, 0 changes | 0 requests | 0 exceptions]
public ActionResult CreatePrescription(string Name,string prescriptionBody, string PhoneNumber
                                       ,HttpPostedFileBase ImagePath)
{
    string pic = "";
    string imageLink = "";
    if (ImagePath != null)
    {
        pic = System.IO.Path.GetFileName(ImagePath.FileName)+ DateTime.Now.ToString("yymssfff");
        string path = System.IO.Path.Combine(Server.MapPath("~/Images"), pic);
        ImagePath.SaveAs(path);
        imageLink = "/Images/" + pic;
    }

    Prescription prescription = new Prescription();
    prescription.Name = Name;
    prescription.PrescriptionBody = prescriptionBody;
    prescription.PharmacyId = Convert.ToInt32(PharmacyName);
    prescription.PhoneNumber = PhoneNumber;
    prescription.PhoneNumber = PhoneNumber;
    prescription.ImagePath = imageLink;


    _context.Prescriptions.Add(prescription);

    _context.SaveChanges();
    ViewBag.message = "your prescriptions is Added Successfully.";
    return RedirectToAction("Index", "Home");
    //var data = true
    //return Json(data, JsonRequestBehavior.AllowGet);
}
```
Fig.5, Showing code part related to the uploading medicine prescription function

Reserve medicine online

Here, the user can reserve medicine online if the pharmacy does not have the delivery services. This way the user orders the medicine required and then got a receipt by all the details as time, price, ID for the order, and the validity day of the reservation as the user will have only 24 hours available to go and get the medicine from the pharmacy otherwise the reserved order will be canceled automatically.

All of these functions are related to the front-end users of the website. However, there are also other important functions regarding the back-end users (pharmacies) that will be able through "Pharmadology" website to add their branches and fill in their medicine databases providing their offers to be showed to front-end users.

➢ **Learning Transfer:**
At a level, a combination of science and technical subjects which is the learning transfer that is integrated with our capstone project helped us as for example:

In Statistics: We have learned about how to get and determine a sample of a population in order to conduct a survey which helped in determining the users of the website in which our population is the Egyptian citizens and our samples are specified by whom who are aged above 10 years old. We have also learned about how to do a survey analysis survey using the mean, median, mode, the standard deviation and the 10 % condition which help us with analyzing the results of the survey.

In Physics: While using our website, radio waves will be used for communication as they have wavelengths longer than infrared light. They also have frequencies as high as 300 gigahertz (GHz) to as low as 30 hertz (Hz). At 300 GHz, the corresponding wavelength is 1 mm, and at 30 Hz is 10,000 km. that is why it is really appropriate for our project. In addition, the variety in the frequencies means dealing with different antennas with different mobile phones which widen the range of the users.

Conclusion

To conclude, the "Pharmadology" website has succeeded in developing a strong communication between the patients and the pharmacies making it a suitable and a reliable solution ready for a worldwide commercial use. All of the determined design requirements were achieved successfully, and that was ensured by the results of the test plan which was conducted in a form of a survey tested on users of various ages.
The users' feedback proved that the project has successfully satisfied our customers and pharmacies as 80% of the users who tested the website stated that it was a simple interface with no complications and about 90% declared that the website was efficient and conventional as it saved their time, money, and effort making our project stands out when compared to other prior solutions especially in the following aspects:.

1. By simply entering your location, it suggests the nearest pharmacies (you can search for a specific pharmacy) and whether the medicine needed can be found there.
2. The medicine can be reserved or ordered online easily from the pharmacy.
3. Consulting the pharmacist about the condition by uploading a picture to clarify his/her situation.
4. As from the perspective of pharmacies, they are able to deal with a lot of more customers easily without their privacy being hacked.

Recommendations

There are so many modifications that could be applicable in the future for our project. Thus, for anyone who wants to follow our footprints and make further developments regarding "Pharmadology" website. It is recommended to:

- Use the database provided by GPS maps in order to activate the feature of locating and detecting the nearby pharmacies using the GPS in the website.
- Add an option that combine the idea of other prior applications which will allow the website to provide some extra features as: making health profiles for the patients
- Develop a mobile application version of the website making it suitable for and useable by the disables.
- Provide an extra feature in the website which will let the users fill in their medical history when signing up their accounts in order for the pharmacies to regard their sensitive medication when ordering their medicine online.
- Add a feature to the website that could enable the pharmacies to view their special daily offers.
- Add a database of the red-listed drugs to ensure that no one can order any of them using the website.

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