2019 5th IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE)

A Proposed Integrated System Towards Digitizing the Maternal Health and Children Support Process in Developing Countries

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***Abstract*— Pregnancy can be a crucial time in a women's life. Every pregnancy has some risks. Complications might be faced because of pre-existing conditions during or after pregnancy. Any of these can affect the mother's or baby's health or both severely. Furthermore, the prevailing socio-economic conditions in developing countries magnify such health risks dramatically. Constant health monitoring, emergency care, medical and financial aid are the most important during this stage and only the combined effort of important parties- namely doctors, health workers, volunteers, and various organizations can tackle this challenge. Though we have managed to digitize our lives in almost every sector, we don't have any proper automated system that can integrate all these parties to ensure maternal health and children's support. In this paper, we introduce the concept of digitizing the medical and financial aid process of pregnant women and deprived children. The paper focuses on the idea itself, the complex structure of the Database, the features and the initial implementation of the system. The proposed system is developed in a web platform, capable of managing data in a well-structured manner reducing the scope of data loss. It works as a bridge between pregnant women and doctors, donors and children support organizations by providing time-efficient, reliable, user-friendly and a secured platform.**

***Index Terms*—Cloud Database, Database Systems, Digitization, e-Health, Health records, Integrated Management Systems, Pregnancy, Web Applications.**

I. Introduction

Nothing comes without a cost, so is pregnancy. Pregnancy can be a time of excitement and expectation but it is also very common to face few to many major complications. The growing fetus depends entirely on its mothers healthy body for all of its needs, increasing the importance of ensuring the healthy state of the mother for the sake of both lives [1]. Some diseases naturally are more likely to occur during pregnancy which complicates the situation further.

Especially in developing countries, the prevailing socio-economic conditions like lack of monitoring, awareness, and access to health care, financial burden and most of all, absence of a proper way of distribution of medical and financial services drastically increase the health risks during pregnancy. As the report by World bank [2] suggests, underdeveloped and developing countries constantly ranking high in infant mortality rates whereas the overall trend is decreasing globally, bear testimony to this situation. A digitized system that integrates the involved health care parties can help to tackle this challenge. We believe that the features mentioned in III can be an easy and unique way to improve the situation. The ever increasing internet literacy and smartphone users in these countries also make it a viable option in our opinion.

For instance, in a developing country like Bangladesh, a major and leading cause of death among women is complications during pregnancy and childbirth. Approximately 5,200 women in Bangladesh die each year due to preventable causes related to pregnancy and childbirth, which makes it 8% of the total deaths among women of reproductive age [3]. This maternity mortality rate is higher between women living in areas where medical help is not much available and also among poorer communities. We believe an integrated, online approach where all involved parties can remotely monitor and provide support to the patients during pregnancy and deprived children can help in this regard.

Analyzing the bottlenecks and hindrances of these above-mentioned problems of Bangladesh, we set the objective of this research to develop a cloud-based application to ease the life of would-be mothers and deprived children. Pregnant women from any place can join our website for any kind of medical help. On the other hand, doctors who are willing to help people remotely, will also be a part of our system. Our system will act as a bridge among the patients, doctors, volunteers, and health workers, providing the mothers appropriate medical help whenever required, even in the time of emergency, absolutely free of cost and hassle.

Furthermore, there are donors and organizations present in these countries who are willing to help. However, lack of digitized management, communication and distribution is a hindrance. Our system also aims to help in this regard.

The rest of the paper is organized as follows: Section II presents the related works in the relevant field and demonstrates the present scenario. While III describes the features, conceptual design and implementation along with the work flow of our proposed approach. The over all discussion has been added in Section IV. Finally, Section V concludes the

978-1-7281-4499-3/19/$31.00 ©2019 IEEE

article.

II. Literature Review And Present System

A signicant number of project work has been carried out on the design, development, and evaluation of the cloud-based system for providing medical and financial aid to people. This section will briey introduce some work focusing on pregnant women and deprived children all around the world and compare our proposed system to them.

A limited number of approaches were conducted focusing on the health of pregnant women. In [4] authors proposed a co-operative IoT approach for monitoring and controlling health parameters of rural and poor people. *Health and Pregnancy Guide* [5] is a website that has some static information to help one learn what to expect from the day of conceiving to the first trimester to labor. Another website [6], *Parents*, provide the future parents exclusive parenting ideas daily. One can speak to a maternal child health nurse for advice and guidance and discover all about pregnancy and being a parent by raising a child through the Australian initiative *pregnancy, birth & baby* [7].

Again there are also approaches available for helping deprived children, but few. *Children of the Dumb* [8] provides education and family support to deprived children living in the Philippines. A child right focused movement-based website is *Defence for Children* [9], which ensures effective implementation of the United Nations Convention on the Rights of the Child (UNCRC) internationally. *Save the Children* [10]is an Indian website to help and change the lives of deprived children with the help of donors. To help the refugee children, *World Vision* [11] encourages the donors to donate.

In summary, the previous studies suggest separate websites to assist pregnant women as well as deprived children, from different perspectives. However, there is a lack of a collaborative system that integrates pregnant women with doctors, health and emergency workers, volunteers and donors. In our study, we didn't find any exact integrated system that couples the mothers and deprived children together as well. In addition, helping pregnant women with advice and medical care is common in all the maternal websites, but financial and volunteer support is missing, which is one of the core features of our system.

III. Proposed System

In this section, we have discussed how our proposed system is designed and developed. We have represented this with four sequential steps that include- (A) Requirement Analysis, (B) Conceptual Design, (C) System Architecture and (D) Development of the system.

A. Requirement Analysis

We went to a hospital in Dhaka, Bangladesh and consulted with a gynecologist and interviewed her about the maternal and newborn child health care. We also created a Google form [12] to understand the user requirements for our system. Analyzing those requirements we developed the initial database and web app.

B. Conceptual Design

The conceptual design and work-flow of the system has been defined based on user requirements. Core concepts of the system are represented below:

1) **System integration:** Our system creates a platform connecting the doctors and the to-be-mothers. It also ensures a secure system for the donors, which lets them donate to the deprived children.
2) **Consulting with appropriate doctor:** According to the mothers explained problems and complications, the system can set appointment with the respected doctors by suggesting them some appropriate doctors name with proper specializations and let them choose one.
3) **Setting up appointment:** While setting up an appointment with a doctor, it first gives patients the option to set the time manually, otherwise it can set a time according to the doctor's available time.
4) **Emergency response:** The system also has it's own emergency helpline number to help the patients 24/7 with the help of some dedicated doctors.
5) **Availability of reports:** Through our system doctors can send the reports directly to the patients profile and then our system will store them systematically. So, next time there will be no hassle in finding the reports.
6) **Automatically generated nutrition chart:** Mothers go through various physical and mental changes in different stages in their prenatal period.It affects their health most. So, a static nutrition chart can not ensure their proper health. Through our system the nutritionists can update their patient's nutrition charts as per their reports and health.
7) **Notification alert:** Pregnancy does cause memory loss, as a result, it is quite obvious to forget to take medicines from time to time [13]. In the notification section, the patients will be notified to take their medicines as per their prescriptions. Patients will also be notified of their upcoming visits to the doctors as per their appointment.
8) **Data confidentiality:** The information that our system is dealing with is very sensitive. That's why it doesn't make all the information visible to all. Our system admins decide which user can access which information.
9) **Finding appropriate donor:** The system lets the donors explore through the information of deprived children and let them donate to help those children with any amount of money. If needed, mothers are also provided financial help from those funds.
10) **Preventing fraud:** Before appointing a doctor or letting any organization use our website, their proper identifications and registration is verified by the system admin.
11) **Ease of access:** The system is designed with a very user-friendly UI. It has a responsive web interface that can be accessed through any computers or mobile devices. Users can easily navigate through their dashboard which is very organized and can access their reports, prescriptions, nutrition charts easily.

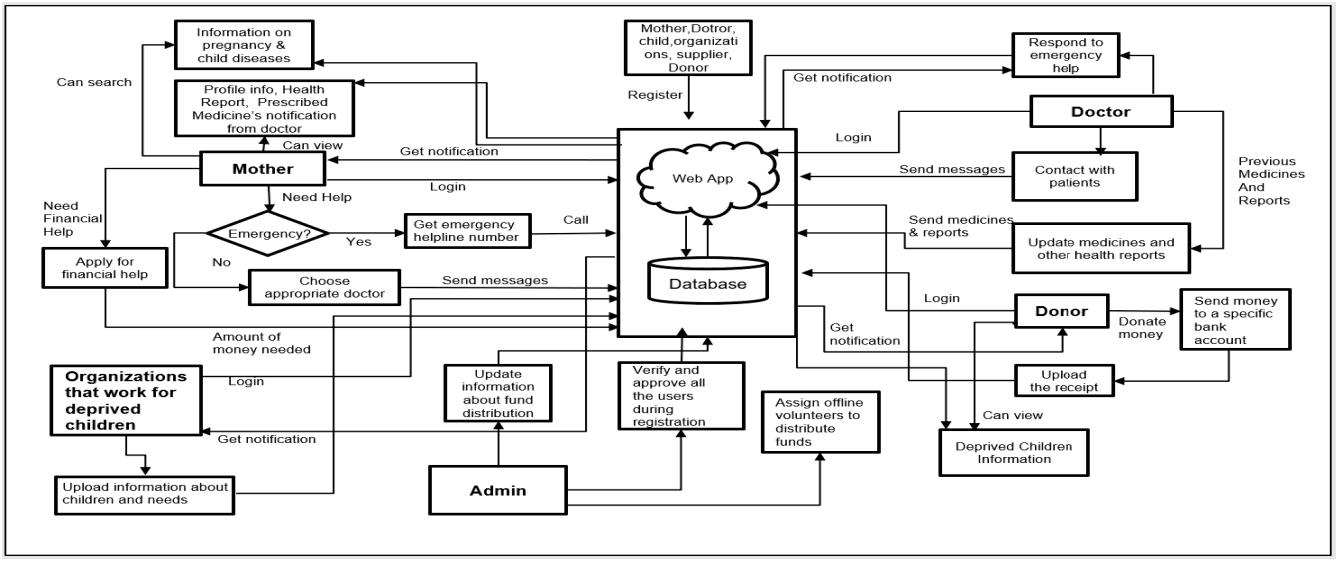

Fig. 1: Work-flow diagram of the initial system

C. System Architecture

The database that we designed can be accessed through our web application hosted in the cloud. Patients can interact with respected doctors through the website's interface. Doctors will also be able to observe each patient's regular checkup details. Children organizations are also expected to find proper donors through our website.

Fig. 2: System Architecture

D. Development of the System

Here we have described our design of the overall system which we implemented. The main stakeholders of this system

TABLE I: Users And Actors In Our System

System Users	Actors Of The System
Mother Children Organization	Admin Doctors Donors

are mothers and children organizations. They can register their account in the system by providing valid information which will be verified by the system admin. There are three main actors in our database. They are- Admin, Doctors, Donors. To get into the system, doctors need to request registration to the admin and need to provide their valid documents-certificates, license which will ensure their identity and their professional area. After verifying them according to their role admin will either deny or grant their new account request. After gaining access, they can log into the system. We ensure user verification for all stakeholders this way as we believe it's integral in such systems. Admin also holds the power to grant the users and workers to view certain data or to modify and update it, insert information and view queries.

Whenever one logs in as a mother in our system, the first thing she'll see is her profile. The next thing to notice is the health report. Here she can see all her previous health reports. It will be shown as line charts, bar charts, pie charts. And they can also download the PDF version of the prescription. The system will keep updating the report after each patient-doctor appointment. Another section is look for cure. There is a search bar that is implemented to search for diseases. If the health issue is minor, she can search that in the search bar to know the required medicines.

Now let us come to the major part, which is "Contact to Doctors" section. The system lets the patient write her problem first and then by analyzing their need or problems, the system suggests them some doctors name with their specializations and let the patient choose one. But if the health issue needs an emergency solution, they may press a button called "emergency", which will provide them a helpline number where they can call to get emergency solutions. We also let the mothers apply for any kind of financial help through financial help section, with proper validation of their application.

If any child orphanage, refugee camp, volunteer registers for deprived children in the system will redirect them to a profile where they need to update all the necessary information about the children, which will help the donors to donate for them.

Fig. 3: Implemented Web application of our proposed system

Whereas when a donor logs in, he/she will see the information of the deprived children. When the donor is convinced enough and wants to donate, the system will provide the donor a bank account information where he/she will have to deposit money, manually. After depositing, the donor has to upload the receipt in the system as proof of donation. The system admin assigns some offline volunteers to distribute the fund to selected organizations in the form of both money and supplies like food, education materials, cloths, medicines, etc. After the delivery, the concerned organizations and donor will get notifications. Figure 1 shows the work-flow of our system.

Our plan is to make the donation and delivery process automated through our system. We designed an Entity Relationship Diagram and schema diagram to structure our data both of which can be found in [14]. The tools that we used to develop our system are shown in Table II

TABLE II: Tools Used to Develop Our proposed System

Number	Tools We used	Description
1	HTML,CSS	Used for designing and creating skeleton of the web page
2	Bootstrap	We used this for designing responsive web application and also for complex designing purposes
3	Node js	This played the role of fetching data from the database and redirecting these to the front end.
4	Express, EJS, body parser,chart js	These were used to make the web application more user interactive.
5	Oracle DB 11g	We used this as our database to organize and store our data as conveniently as possible.

IV. Demonstration and Evaluation

The Maternal Health and Children Support System was tested in an academic environment. A Focus Group Discussion (FGD)[15] was carried out to evaluate the performance, usability, and benefits of the proposed system. We randomly selected 15 final year students, 5 faculty members, to replicate the FGD process. Among them, 8 were women. At first, we demonstrated our system to them and then we let them explore our website for 20-25 minutes. In the end, participants were asked to provide their opinion about the systems feasibility, performance, usability, and functionality. All the participants found that the developed system performs each function accurately. They also found the user interface of our web application very user-friendly and easy to navigate. Some of them suggested to include more features like the automated donation process, which we already had in mind to implement in the future. After initial implementation, a more in-depth performance and UI/UX testing was done with a sample size of 23 consisting of different stakeholders of our system - 6 to-be mothers, 4 mothers, 3 doctors and 10 volunteers, where various performance, UI/UX and feasibility parameters were evaluated and we achieved favorable reviews [14].

V. Conclusion

Our system will stretch helping hands to the mothers themselves and also to the deprived children around the country. A Mother's health during pregnancy has a heavy impact on the health of the unborn child. Keeping this in mind, our system provides necessary info and bridges mothers with doctors, health workers and volunteers to provide important services. In addition, it's possible to get financial aid for the welfare of mothers and deprived children through the system, to assure them a standard life by fulfilling the basic rights. We believe that full implementation of this system will assure a better future for mothers, newborn and children who are in need of help, particularly in developing countries.

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