Emergency Expert

Project Proposal

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1. Abstract

Several people are distressed because of patients crowding a single medical institute. Because of this, patients have to wait for a while before they can get treatment. Such scenarios also result in overburdening the medical staff of the institute. Even if a patient is fortunate enough to find a bed, there are the issues such as the needed treatment not being available at that moment, the doctor not being available or being busy with other patients, and the desired medicine not being available at the hospital pharmacy or even the nearby pharmacies. There is also the matter of reaching the hospital that meets all the patient's needs. The patient sometimes goes to a farther hospital rather than the nearer hospital, simply because of either not knowing the location of the closest hospital or not being sure if all the required services are available at the closest hospital. These issues can put the patient's life in jeopardy by delaying their treatment.

We plan to develop a mobile-based AI expert system application capable of diagnosing the patient's illness, and then send them to the closest hospitals with all the treatment, equipment, medicine, a bed and doctor readily available so that the patient can receive the treatment instantly. The application will also help in the even distribution of patients and workload in all available medical institutes in a city. This will lead to the prevention of unnecessary loss of life.

2. Introduction

In moments of mass crisis (such as COVID-19, earthquakes etc.), patients usually go to a single well-known large government hospital, which causes an overload of patients at a single hospital. The hospital staff give their best efforts to cater all the patients, but even to the best of their abilities, a considerable number of patients cannot receive beds or doctors or treatment timely.

When a patient faces an emergency, in all the panic, they travel to a hospital that takes more time to reach than a nearby hospital because either the fear of incomplete services or not knowing about the existence/location of that hospital. This also minimizes the amount of time a doctor might have to save the patient's life, as it is wasted in traveling to the farther hospital.

Even if the patient is aware of the location of the nearby private hospitals/semi-private hospitals/clinics (all available to cater for the patient's needs), because of the doubts such as:

1) Unavailability of desired medical treatments
2) Unavailability of qualified doctors
3) Fear of huge check-up fees
4) Unavailability of good medical equipment

Patients avoid taking the chance.

Because of patients clustering at a single hospital, medical supplies often become scarce too, as, in such scenarios of catering to this many people, some medicine is bound to run out of stock.

All of these uncertainties, inconveniences and delays can decrease the chances of recovery/survival, and in some cases, even lead to loss of life.

The root causes are:

1) unequal scaling of the medical workload in the medical institutes of the city
2) patients visiting medical institutes that do not have the required treatment/doctors/medicine
3) large travel time required to reach the hospital

After careful analysis of the root causes, we propose to build a mobile-based AI expert system application that first asks users to enter their symptoms (or with an illiterate user, ask them simple yes/no questions), and diagnose their illness with a certain threshold of certainty and guide them to a medical institute with all the requirements.

The application will ensure that no hospital will have to cater to a strength of patients any larger than the threshold of the hospital and will equal distribute the workload in all the medical institutes of the city that are registered on the application. In case a patient (who is not using the application) mistakenly reaches a hospital where there is no availability of beds or doctors, the application will also assist the hospital staff in promptly guiding the patient, to nearby hospitals with beds and necessary services needs for the patient, so that the patient can get instant treatment. This will ensure the avoidance of any discomfort faced by the patients or loss of life caused by the above-identified problems.

3. Goals and Objectives

Objectives of this FYP are listed below:

- Creating an Expert System for effectively diagnose the disease (via simple Questions)
- Find the nearest hospitals that provides the treatment for the diagnosed disease
- Check the availability of beds in the hospitals
- Check the availability of Doctors in the hospitals
- Check the availability of tests and equipment related to the diagnosed disease in hospital Labs or Labs in a nearby fixed vicinity of the hospitals
- Check the availability of medicines related to the diagnosed disease in the hospital Pharmacy or Pharmacies in a nearby fixed vicinity of the hospital
- Check the rush in the wards and estimate waiting time for availability of bed/treatment to assist the patient in deciding if he should wait or move to a different institute
- Rank the hospitals according to their services and patient feedback
- Assist the patient in getting a token/reservation/appointment in a hospital (only in cases of the hospitals which work on token system)
- Provide the optimal route to the hospital selected by the patient
- Assist the Hospital Staff in management of the beds
- Assist the Hospital Staff in redirecting the patients to any nearby hospital with the desired services (if necessary)

4. Scope of the Project

This project is an industrial level project which requires a large amount of computational power and resources along with real-time data of the medical institutes, to reach its full potential. With the vast variations of unlimited number of diseases/illnesses (all related to a distinctive field of medical science i.e. Optometry, Dentistry, Radiology, Neurology, Cardiology etc.), there is also the challenge of developing an expert system capable of identifying these vast variety of diseases, which, with the limited time of 1 year, is highly difficult to achieve.

With the limited time, we aim to make a prototype of our model in our tenure of FYP and be sure to achieve as many functionalities as possible.

Therefore, the scope of the project will cover the following functionalities:

- Diagnosis of common illness and diseases (via simple Questions)
- Find the nearest hospitals that provides the treatment for the diagnosed illness
- Check the availability of beds in the hospitals
- Check the availability of Doctors in the hospitals (via simple Availability Status)
- Check the availability of medicine needed for the diagnosed illness
- Estimate minimum waiting time for availability of beds in the hospital
- Assist the Hospital Staff in management of the beds
- Provide the optimal route to the hospital selected by the patient
- Ranking of hospitals on patient feedback
- Assist the Hospital Staff in redirecting the patients to any nearby hospital with the desired services (if necessary)

More Advance Functionalities such as: Advancement of the Diagnosis system for identification of more diseases, Verification of the documentation and registrations of hospitals, Check the availability of tests and equipment related to the diagnosed disease in hospital Labs or Labs in a nearby fixed vicinity of the hospitals, Verification of the documentation and registrations of pharmacies etc. will be employed in the further future extension of the project after the tenure of the FYP.

5. Initial Study and Work Done so Far

By far, we are reviewing research papers and articles that fall under the same field of work as our Project. We have also gathered information (from multiple highly credible sources) that have deepened our understanding of different components of our Project and guide us in their implementation.

1. Comparison with Existing Services

In order to understand what is already available in the market and to distinguish how our product is different from those services that are already existing in the market, we have made a simple comparison table to illustrate the difference in the products.

The Table is as shown below:

Services / Features		Diagnose Illness	Bed Availability	Doctor Availability	Medicine Availability	Medical Equipment Availability	Required Test Availability at Hospital Lab	Optimal Route to Hospital	
Mayo Clinic [1]		✓	×	✓	×	×	×	×	
WebMD [1]		✓	×	✓	✓	×	×	×	
Your.MD [1]		✓	×	✓	✓	×	×	×	
IMS Maxims [2]		×	✓	✓	×	✓	×	×	
Symptomate [1]		✓	×	×	×	×	×	×	
Ada- The personal Doctor [1]		✓	×	✓	✓	×	×	×	
Acgil [2]		×	✓	✓	×	✓	×	×	
Emergency Expert		✓	✓	✓	✓	✓	✓	✓	

The Information for this table is drawn from Ref. [1] and Ref. [2].

Through the above table, it can be clearly seen that currently there are no product that provides all the functionalities given by Emergency Expert.

2. Existing APIs for Integration in Project

As this project demands a considerable amount of time and resources, so after careful evaluation, we have determinate that the following are some APIs we consider to be useful for integration in our application:
https://developer.infermedica.com/
https://apimedic.com/
(Source: Ref. [3])

Both of the above APIs can be integrated to help us in the development of an expert system cause of diagnosing common illnesses.

3. Hospital Bed Management Methodologies

For the Bed Management System Development, using the TOC to create an interface for the targeted hospitals help form the basis for improving bed management processes and increasing the understanding among the hostipal staff with regard to operational functions and the existing constraints that cause problems in the bed management of the Hospitals.
(Source: Ref. [4])

4. Pharmacy Inventory Management Methodologies

As for the Effective Management of the pharmacy Inventory, there are three methods used in pharmacy to manage inventory: the visual method, the periodic method, and the perpetual method. We will be creating an interface that can best cater all the three methods for optimal performance. (Source: Ref. [5])

5. Optimal Route Algorithms

After careful evaluation, we either plan to use the Graph hopper API or Google Maps API as both of them search the best route using the Genetic Algorithms in real time. The main advantage of Genetic Algorithm is that it produces a number of different optimal solutions since the result can differ every time the Genetic Algorithm is executed to be best suited to the real time environment. (Source: Ref. [6])

(Note: We can switch to any other API, methodology or technique in case of finding it more suitable to our objectives, for acquiring optimal results)

So, by far, we have shown comparison of our product with our market products and researched on the diagnose of illness, bed management, pharmacy inventory management and optimal route. However, further work is required to not only integrate all these technologies and methodologies into our application but also find methods to further improve their overall performance.

6. References:

[1] The Medical Futurist. (2019, Apr. 11). The Big Symptom Checker [Online]. Available: https://medicalfuturist.com/the-big-symptom-checker-review/

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[3] Altexsoft. (2020, Dec. 15). Symptom Checker APIs: How They Improve Medical Triage and Diagnosis [Online]. Available: https://www.altexsoft.com/blog/symptom-checker-apis/

[4] Hospital bed management: An analysis from the perspective of the theory of constraints - Article in Espacios · January 2016 [Online]. Available: (PDF) Hospital bed management: An analysis from the perspective of the theory of constraints (researchgate.net)

[5] Hospital bed management: An analysis from the perspective of the theory of constraints - Article in Espacios · January 2016 [Online]. Available: https://www.researchgate.net/publication/268037045_Inventory_Management_in_Pharmacy_Practice_A_Review_of_Literature

[6] A Review and Evaluations of Shortest Path Algorithms - Article in International Journal of Scientific & Technology Research · January 2013 [Online]. Available: (PDF) A Review and Evaluations of Shortest Path Algorithms (researchgate.net)