J. Appl. Environ. Biol. Sci., 4(9S)52-59, 2014

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Optimal Hospital Location Using Case Based Reasoning

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Received: September 12, 2014
Accepted: November 23, 2014

ABSTRACT

Global Positioning System (GPS) is used because of its tremendous functionality and now is one of the key enablers for Location Tracking. Global Positioning System also provides variety of services to commercial, military and consumer applications. In this paper, we have proposed to incorporate functionality of GPS in medical area; we've used Case Based Reasoning to determine the nearest location of relevant hospital for any patient. Our system handles two types of patients, the algorithm returns nearest hospital if the patient belongs to class A and best hospital of the city if the patient belongs to Class B. Class A and B are made on the basis of diseases.

KEYWORDS: Global Positioning System; relevant hospital.

1 INTRODUCTION

In the first global era, time is the most important factor in human life. People tend to search things on the basis of two priorities, either in less time or in a best way. Similarly when a person gets ill, the first problem is how to choose a hospital to visit. Today Global Positioning System (GPS) is playing an important role to find the location of the nearest hospital and best hospital without requiring any interference of doctor. The purpose of this paper is to develop a software application for patients to immediately show the nearest hospital. GPS will keep track of all hospitals that are for maternity as well as for children. The system will also give patients the details of nearest hospitals with address of the hospital and contact number. Most importantly, two classes of diseases have been defined, Class A is for non-critical diseases and class B is for critical diseases, in case patient belongs to class A then GPS will calculate the distance and accordingly return the nearest hospital otherwise the best hospital for the given disease in the area would be returned.

2 RELATED WORK

It was claimed in a research paper about novel hybrid large scale medical diagnosis system LMDS that combines the advantages of human and agents in medical diagnostic elaboration (Lazlo et al., 2007). Emery, Watson, and Rose (1999) proposed in their paper about Genetic nurse Specialist outreach, Primary health care and General practitioner's supporting role in the field and the demands of future and variety of health care systems. This shows how the General practitioners assess the genetic risks and explore doctor's awareness for specific genetic diseases for their patients in countries such as UK. A Real Time System for Detecting and Tracking People (Haritaoglu, Harwood and Davis, 1998) shows the tracking, detecting and monitoring system for people outdoor. It's about recognizing the actions of people, movements, and locations between two objects with the help of surveillance devices and matching algorithms for security purpose. A research (Parala et al., 2013) evaluated the existing tracking devices for elderly people and identified the difficulties and possible solutions in the performance analysis. There were two GPS (global positioning system) tracking devices examined and the first issue found was how to handle patients with memory loss. The second was maintenance and recharge ability to handle devices. Vehicle Accident Alert and Locator (VAAL) by Mathews et al. (2011) did research work completed in accidents (car) state of alarm. The authors presented programmed module GPS/GSM trackers which combined accident report automatically by GSM communication platform which uses sms for sending message to the nearest

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agencies such as hospitals, police stations and fire institutes. Positioning System gives exact position of the point where accident has occurred. This will allow initial response and will rescue accident victims, save lives and property.

3 GPS Investigator System

Choosing a proper and nearest hospital for any patient is the biggest problem these days. This even results in much **time wastage** in finding the right hospital and sometimes this happens because of **wrong guidance**. Sometimes the patient is having particular symptoms and might go to a hospital that does not have doctors who can treat that disease and help them to relieve. And sometimes patient might **get confused** which hospital to go to and which might be the best and right choice for him. Sometimes people aren't aware of nearest hospital in their locality and even in case of having non critical diseases they tend to travel far from home. Hence the proposed solution of this problem is outdoor positioning of hospitals through **GPS INVESTIGATOR SYSTEM.** It will provide the patient with the best hospital when he/she enters worst disease like aids, cancer etc. and nearest hospital when normal disease i.e. fever, malaria are entered. GPS will keep track of all hospitals that are for maternity as well as for children

3.1 Case Base Reasoning (CBR)

The term CBR is the process of solving new problems based on the solutions of similar past problems. Each case typically contains a description of the problem, a solution and/or the outcome. To solve a current problem: the problem is matched against the cases already stored and similar cases are retrieved. The retrieved cases are used to suggest a solution which is reused and tested for success. If necessary, the solution is then revised. Finally the current problem and the final solution are retained as part of a new case. As in CBR, there are cases stored and each case consists of a problem, its solution, and typically, annotations about how the solution was derived, so in our project, we have defined cases in the form of diseases and hospitals associated with it. Our system will refer the nearest or best hospital to user/patient according to his disease. It is also keeping the track of all hospitals that are for maternity as well as for children. The patient will enter his location and the disease name from which he/she is suffering. The system will match the disease with the cases stored and identify all hospitals associated with that disease from cases stored. Once it has been matched and hospitals are identified, it will find the nearest or best hospital depending on patient's disease or location and will display that hospital on the map. It is also possible that the user might enter an area that is not known to our system or it might not in the data sets. To handle such cases, the system is trained to implement String matching technique which will search the records that are the nearest match for the area or the information that the user enters. The results will be null if string doesn't match. Thus, the accuracy of our system is approximately 80 percent.

3.2 GPS Investigator Flow Chart

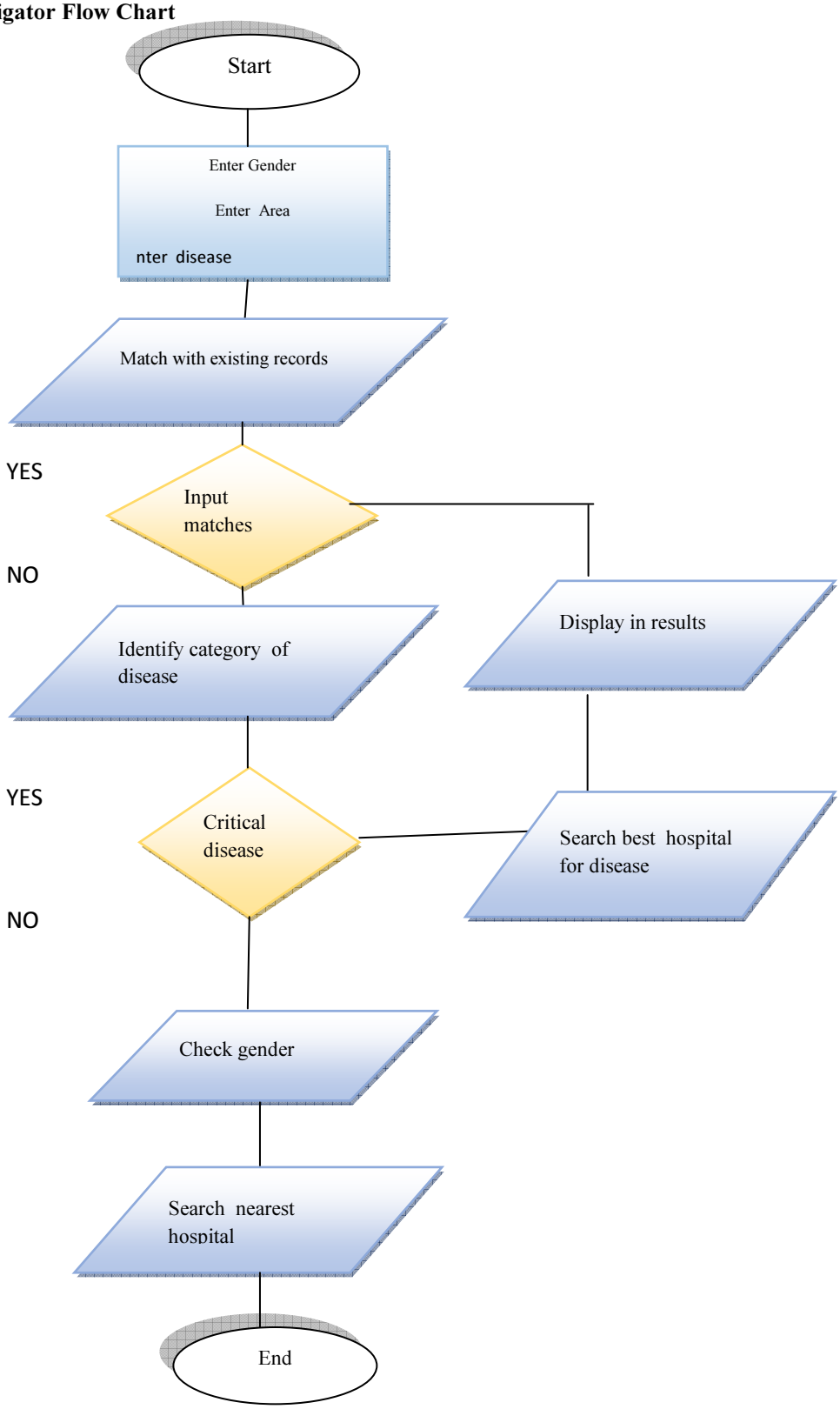

Figure. 1. Flow chart of system

3.3 Accuracy of Algorithm

- Input disease, location area and category {disease: string type, area: string, category: string}
- Apply string matching by checking disease gender and area from record

```
If (matched)
    Return stored location of matched case
```

- if category==“Others” or Gender ==“Female” and disease!="maternity"

```
    num = category1(disease)
    ifnum== 1
            area2= worst (disease)
            return location for critical disease
    else
            num = catogary2 (disease)
            ifnum ==2
            area2=nearest (area)
            return nearest hospital
else if  Gender=="Female" and disease=="maternity"
            return nearest maternity home
else
    if category== "Child"
    return children hospital
```

- **category1(String disease)**

```
If disease is critical
        return 1
```

- **category2(String disease)**

```
if disease is normal
    return 2
```

- **nearest (String area)**

```
if area is in nearest record
        return nearest location
```

- **worst (String disease)**

```
if area is in worst record

        return critical disease location
```

4 Experiments and Results

The given flow chart (Figure 1) depicts the flow of our system. After performing many experiments, it has given 90.99 % accurate results. The data sets are categorized in four different classes (male, female, children and others [i.e. others can include any person]. Diseases fall into two classes A and B: critical and non-critical.

Experiments For Existing data sets						
Inputs			outputs	Expected results		1=accurate result 0=inaccurate result
Class	*Disease*	*Area*	*location*			*True cases*
Others	Cancer	Street7 Walton road Lahore	Shuakatkhanum Hospital Lahore	Shuakatkhanum Hospital Lahore		1
Others	Flu	Johar town Lahore	Hope Rehabilitation Center Lahore	Hope Rehabilitation Center Lahore		1
Children	Diabetes	Faisal town Lahore	First medical hospital	First medical hospital		1
Female	Maternity	Gulberg 2 Lahore	Concept fertility center Main Gulberg Lahore	Concept fertility center Main Gulberg Lahore		1
NEW Cases Results and Experiments						
Class	*Disease*	*area*	*Matched area*	*location*	*Expected results*	*True case*
Others	Measles	Gulberg 4	Gulberg lahore	Surgimed hospital lahore	Surgimed hospital lahore	1
Children	chickenpox	Walton cantt Lahore	NULL	NULL	Children hospitals ferozpur road	0

Figure. 2. Few results generated by system

The Figure 2 shows the true and false cases i.e. (0 in case of inaccurate output and 1 in case of accurate output). If the disease is critical, it will show the best hospital for the disease in the city. For instance, if the disease entered is "cancer" then the output will be "Shaukatkhanum Hospital Lahore" rather than any nearest hospital to the patient's location. If the user selects female maternity hospital, then system will show the nearest maternity hospital. For instance, if the user selects maternity hospital and enters location Krishanagar, then the system will show the "Family Welfare and Maternity Hospital Krishanagar". It is also possible that the user might enter an area that is not known to our system or it might not in the data sets, to handle such cases, our system is trained to implement String matching technique which will search the records that are the nearest match for the area or the information that the user enters. The results will be null if string doesn't match. Thus, the accuracy of our system is approximately 90.99 percent.

4.1 Results

Results are shown in the form of google maps and texts. It depends on the system. If the user enters input to search for the first time, then output or results will be shown by displaying the location on Google Maps. But if the same input is entered by user second time, then the system is trained to display it simply in the form of Tex. It will not browse Google Map after first time.

Accumulative Percentage for all cases = (X1+X2+…..Xn/n)*100 = ((47.95+42.4+46.14)/150)*100
=90.99 %

Figure. 3. Data showing calculation of accuracy of experiments

Figure 3 represents accuracy of experiments, seven different cases for every type (maternity, children, nearest and best) from the case base are used for the accuracy calculation. n Number of runs are performed to check the result of same case for a specific type. Means values are calculated that are showing very promising results of the proposed algorithm.

4.2 Graphs

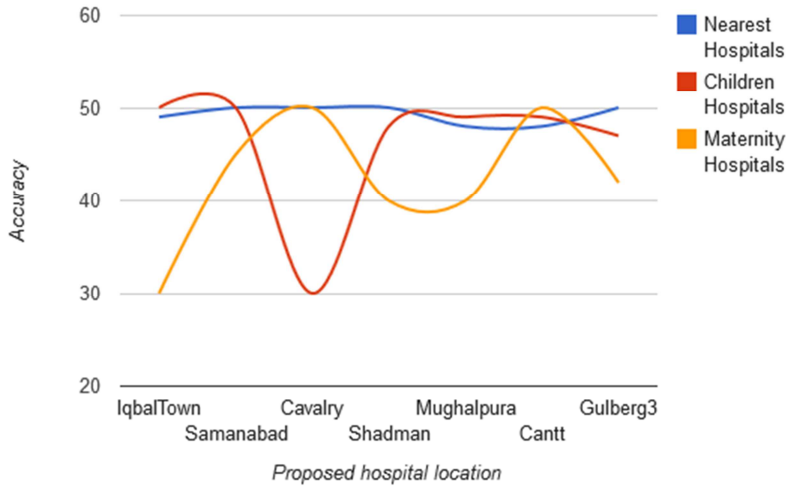

Figure. 4. Accuracy of Algorithm on 55 runs for specific case

x-axis: Proposed nearest hospital location and y-axis: Total numbers of correctly specified hospital location.
Accuracy of algorithm is shown by a graph in figure 4. Highest accuracy is for finding the nearest hospital, for a case randomly chosen from the case base. After selecting the case, 55 runs of algorithm was performed which gave n number of times accurate result.

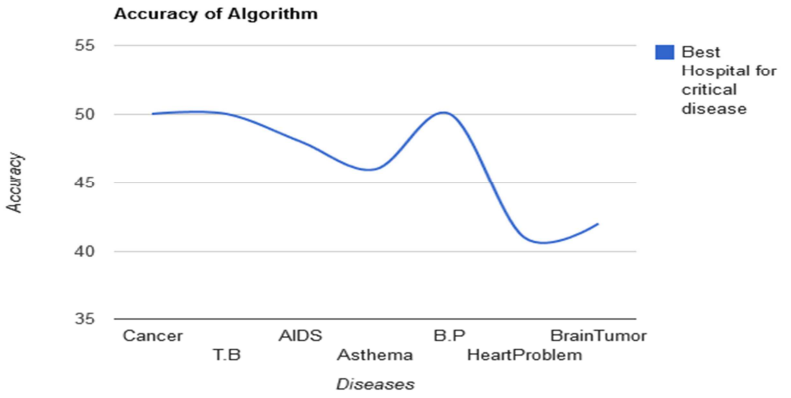

Figure. 5. Calculation of accuracy for suggesting best hospital (55 runs for every testing case)
In figure 5, graph shows the accuracy calculated through the proposed algorithm, it is highest for cancer.

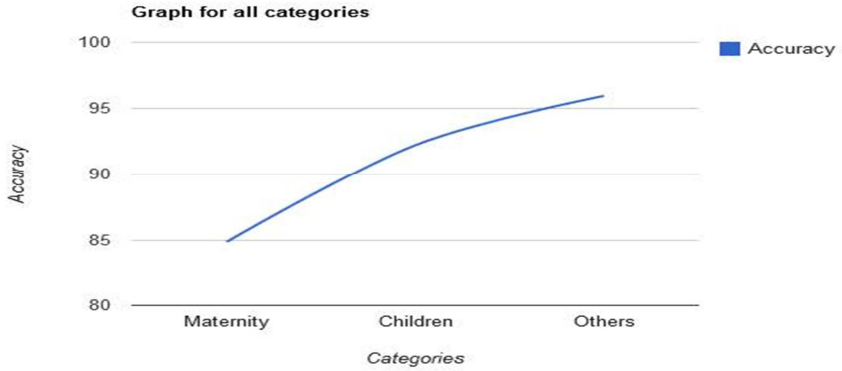

Figure. 6. Accuracy rate for every category

Figure 6. shows overall results of the three categories (Female, children and others). The accuracy rate of Maternity/Female hospitals is lowest as there are less number of maternity hospitals in Lahore.
Percentage of accurate results of Maternity/Female Hospitals: **84.85%**
Percentage of accurate results of Children Hospitals: **92.2%**
Percentage of accurate results of "Others" category:-
Others category includes:
Mean value for nearest hospitals= 49.2
Mean value for best hospitals= 46.7
Mean value for others category= (49.2+46.7) / 2=47.95
Percentage for others category= (47.95 / 50)* 100=**95.9%**

5 Limitations and Future Recommendations

- One major limitation is that our GPS Investigator is limited to a specific area of Pakistan (Lahore). More data can be trained.
- Another major limitation is that the User requires Internet availability so that the system can search right hospital for him and facilitate him.
- Disease analysis can also be provided. The system can be made intelligent enough to provide the patient with details of disease if he enters any symptoms and may provide him with location where that disease is being treated.
- More APIs of global positioning system can be used to make system more effective.

6 Conclusion

The technology of the Global Positioning System is in use for huge changes in society. The applications using GPS are constantly growing. The system we have made will provide the patients with hospitals by just entering their disease. It will provides the patient with the best hospital in terms of entering worst disease like aids, cancer etc. and nearest hospital in case of entering normal disease like fever malaria etc. The cost of the patient is dropping while at the same time the accuracy of the system is improving, therefore the GPS investigator system for hospital location is beneficial for the patients.

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