Future Applications of GIS in UAE Healthcare Industry: Emphasis on Geo-tagging Hospitals for Emergency Vehicle Routing and Drug Management

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Abstract

Advancements in GIS technologies offer huge benefits to the healthcare industry in United Arab Emirates by offering a platform which facilitates several tempo-geospatial analyses. Healthcare industry can use innovative techniques to harness the power of spatial visualization, data fusion and analytical integration to answer critical questions pertaining to current location, route planning for ambulance and emergency vehicles, drug supply inventories, capacity information etc. A specialized map containing information about locations of hospitals and associated measures of accessibility can greatly enhance patients' experiences. Ambulance and emergency vehicles can benefit from GIS layers with the geo-tagged hospital information along with data fields in ArcObjects© of ArcGIS© which can specify smaller set of accessible roads that provide shortest distance and avoid congestion. In addition, the information embedded in ArcObjects© can also be fed into drug shortage databases, where geographically nearby hospitals can share their inventories status of critical and life saving drugs which are in short supply, thereby risk pooling and enhanced resource management. We discuss paradigms of such benefits that can help healthcare policy researchers, economists, hospitals, Insurance industry on the need, benefits of adoption and use of GIS based technologies.

Keywords: GIS applications, Healthcare, Vehicle Routing, Information Management, Location Analysis.

1 INTRODUCTION

The rapidly developing healthcare sector in the United Arab Emirates (UAE) brings significant opportunities for improvement and the need to innovate towards achieving healthcare related goals as presented in UAE vision 2012[1], Abu Dhabi 2030 vision[2]. Globally healthcare services management in terms of accessibility and affordability is becoming challenging and expensive, leading to an unsustainable model. UAE has the key advantage and the infrastructure to become a dominant player in the healthcare services business and add to its reputation as center of excellence for hi-technology medical innovation and service delivery hub. Currently UAE spends approximately 3.2% of its GDP towards healthcare services, combined with other economic issues in the delivery of care; the need for high quality healthcare services is likely to grow rapidly in the future. This presents a strong need to develop and use innovative technologies to match the healthcare demand. Historically spatial mapping methods and visualization has been used by epidemiologists to predict the disease outbreaks, geographical spread of infections including sources of outbreaks [3]. The earliest reference on the use of geographic mapping in epidemiological research is often attributed to pioneering work of Dr. John Snow's use of maps to predict the source of cholera outbreak during mid-1850 in Soho, United Kingdom [4, 5]. Dr. Snow's hand drawn maps on the location of the patient deaths, superimposing the map on public water source supplies helped to identify the exact source of infection, thereby reaffirming the long held belief of medical community that cholera is a water-borne disease. Currently Geographic Information mapping and systems are applied in healthcare to address several important issues such as measuring physical access[6] - using AccessMod© – ESRI Arc view 3.x, monitoring healthcare safety net services [7], mapping healthcare networks to map patients and provider locations- that maps the location dimension of patient relative to the access of care [8] etc. The importance of geographic location, data mapping and visual display now makes it easier to apply GIS tools to device novel services and decision making tools. As Medical services are getting increasingly

complex; to cater to the needs of the competitive market effective delivery platforms, intelligent query tools such as ArcView GIS Query tool are also required by healthcare public health and policy makers, insurance industry and other stakeholders. Geospatial data have been successfully used to measure accessibility in several areas such as retail industry, distribution, transportation services, humanitarian and relief efforts. The application of GIS data is well suited to tailor accessibility needs in healthcare as well. Healthcare maps can infuse critical attributes, rastering, and visual display of cost and effective outcome analysis. GIS models applied to accessibility in healthcare can be found in [11,12,13].
The remainder of the paper is organized as follows, In section 2 we briefly overview the existing infrastructure of spatial mapping in UAE and its current uses in health care. We present two possible Geo-Tagging applications applied to healthcare services which has the potential to transform the service delivery of healthcare in UAE in section 3. In section 4 we present the summary conclusion.

2 GEO-SPATIAL INFRASTRUCTURE IN ABU DHABI, UAE

The Abu Dhabi Spatial Data Infrastructure (AD-SDI) is a programme of the Government of Abu Dhabi, administered by the Abu Dhabi Systems and Information Centre (ADSIC) e-government programme to facilitate the sharing of geospatial data among government agencies and other stakeholders [18]. Launched in 2004, the programme has been highly successful in mapping applications for urban planning, water resource management, Oil exploration among various applied areas. There are 36 entities from government, academia and the private sector which use geographic information system (GIS) technology and Geo-Spatial maps to help deliver location-aware, customer-centric e-services in Abu Dhabi and UAE. Also, AD-SDI is actively working on globally recognized issue of geo-spatial data standards to improve the quality and timeliness of widespread use of geo-spatial data.

On the potential uses of geo-spatial maps by health authority [9], the Health Authority of Abu Dhabi (HAAD) currently uses GIS information to plan and manage medical resources for large scale emergencies. The HAAD operations center which continuously gathers information on critical healthcare resources and patient movement patters to better coordinate logistics and deploy assets where needed. When any major incident occurs, the accurately maps the exact location of the incident is matched with internal system information existing hospital resources for evacuation and to mobilize first responders. Other uses of the system include, exact areas to be evacuated in the event of a calamity, monitoring the disease outbreaks, status of hospital resources, location of patient mobility. The existing infrastructure permits the system to perform intelligent queries and optimize resources

*Source [9]

Figure-1: Map showing the multispecialty hospitals in Abu Dhabi emirate

* Abu Dhabi Map Book, 2009 [10]

Figure-2: Health care facility locations and details of northeast of Yas Island

Figure-2 shows health care facility locations and details of northeast of Yas Island in Abu Dhabi including hospital contacts and resource details, with helicopter landing site at Al Rahba Hospital. Similarly, an GIS application for healthcare planning which includes monitoring catchment area and facilities management in Saudi Arabia [14].

The existing GIS infrastructure could be adequately leveraged to suit a variety of interesting healthcare applications, in the next section we present to possible application of geo-tagging applied to emergency vehicle routing and drug inventory management across hospitals in Abu Dhabi.

3 MAPPING APPLIED TO HEALTHCARE

In this section we discuss two key applications of GIS mapping and the need for geo-tagging of hospitals, applied to emergency vehicles routing and drug inventory management. Geo-tagging consists of adding geographical Meta data to various media such as webpages, RSS feed, pictures etc. Geo-tagging can find a variety of potential applications in areas where location is critical attribute. Non-coordinate based information such as street name, route, building code can also be added to geotagged media via geo coding.

The Routing of emergency vehicles presents an extremely challenging and difficult in situations where geotagged information of the ambulance/ emergency response vehicle can be used to provide tactical decisions on which is the nearest healthcare facility that can cater to the needs of the patient onboard the vehicle. Often the struggle faced by first responders include triangulating their exact position to update this information in GIS based information system to ideally locate the facility that is not only closest but also available capacity. This presents a stronger case for geotagging hospitals and emergency vehicles.

The second application focuses on the need to provide geotagged hospitals information for monitoring the drug inventory levels at hospitals. One of the growing issues in healthcare industry is due to the shortages of critical and lifesaving medications. The global emphasis of this problem has led to compromised patient safety, delay in care and treatments, various unexpected outcomes in episodes of care. Several healthcare providers currently order supplies in unrealistic quantities that they anticipate drug shortages to occur. This leads to a system wide issue, where one provider has stockpile of medicines while providers are in shortfall. Often the provider with excess inventory of the drug ends up wasting it due to limited shelf life of such drugs. Health Authority of Abu Dhabi proactively monitors drug availability to improve response in the event of critical shortages [19]. To address this issue not only the information on where the critically short supply is available is necessary but also the real time stock status, and closeness proximity is very important. Instead we propose an idea of Geotagged hospital information that can be resourcefully used to share information on inventories of critical shortfall drugs between hospitals to provide a platform for resource pooling and

risk sharing. We refer the readers to [15, 16, 17 and 20] for more details on the emphasis and deployment of such tools.

4 CONCLUSIONS

In this paper we present two possible applications of geo-tagging applied to healthcare in UAE. GIS based systems has been used by the healthcare industry for a very long time, yet in order to achieve significant improvements innovative techniques need to be developed to harness the power of spatial visualization, data fusion and analytical integration. The current location along with several attributes can be meaningfully combined for optimal route planning of emergency vehicles; information on drug inventory capacity for resource optimization can be shared between providers. The existing infrastructure on spatial data can very well be leveraged to address several operational issues in healthcare industry.

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