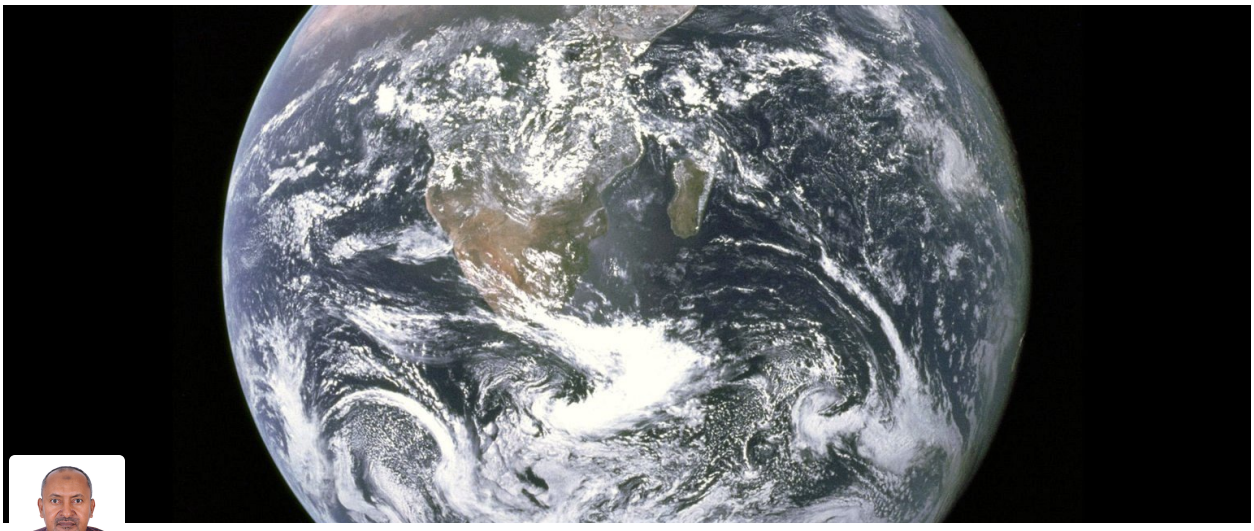

Contemporary GIS needed skills to accommodate the changing geospatial technologies

Introduction

Although , there are many definitions to the Geographic Information Systems(GIS) , but could be thought of as a database in which any single piece of data is spatially indexed(Melnick, 2002) .As many commentators agree, spatial data is so special,this is because, when projecting geographic data into plain papers and monitors, it is difficult to preserve altogether all the geographic properties-distance, direction, shape and area- without distortion- and it is possible to conclude that spatial data is very unique in shape and structure(Leung, 2010).In other words, the preserved properties of the map projection are not sufficient to guarantee the precision of the projected maps(DeMers, 2008).In general,the complexity of spatial data underlines the need for special manipulation techniques(Serhan and Nermin, 2010).

Advances in computers, hardware and software applications have made it possible to change the conventional mapping and cartographic approaches into a new era of digital mapping .Since the first emergence in Canada; in the 1960s, GIS has evolved significantly, making use of the ongoing developments in technologies and computers. Furthermore ,the nternet has changed the way we do the usual GIS business and introduced a new era of Web GIS. Web GIS has

fundamentally changed the global state of the market, modified, what businesses do and how they work(Singh, 2016).Consequently, a new age of GIS platforms has arisen and evolved continuously with advancements in cloud computing.

Improvements in GPS data collection and satellite industry offered voluminous data, that,needed to be explored, analyzed and visualized with new innovative methods. We may infer that GIS has changed significantly, as has the meaning of the word itself(Figure 1). Contemporary GIS is not tied to the old GIS description, nor are the GIS components the same as we used to teach our students.

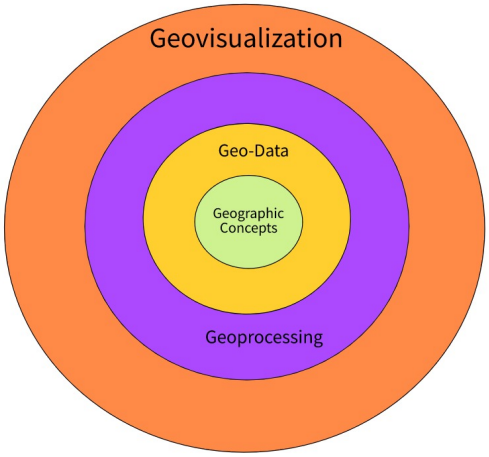

Figure 1 GIS Evolving components, modified after (David Andes, 2006)

Many authors shed the light on the new eging technologies and how these technologies can shape and impact the GIS business in the future(Assimakopoulos, 2007,Tan et al., 2008,Richardson, 2017). Furthermore, the National Geospatial Advisory Committee (NGAC) addressed five aspects that will shape and impact the GIS business in the future(Richardson, 2017). It is very clear that the GIS industry is changing rapidly, making use of advances in computers, software and changing the way we capture, store and manage spatial data. Below are some perspectives that discuss the emerging trends in GIS market, and how GIS researchers and consumers can compete to solve and address new GIS challenges.

1.**Real Time Geospatial Data**

Real time data is the data that is delivered immediately after it has been processed. Real time data means more information ,more people and extra attention for the distribution of real time data(Ponniah, 2011). The real time geospatial data is different than the real time data model in that it requires inputs of spatial data at the user domain level (client)and some sort of spatial analysis at the system(server) domain as in Figure 2. A very clear example of the real time data is the location based services which need real time interaction like those captured by the private taxi services (Uber, Tirhal, Lemon, Kareem, etc...). In the private taxi service, like Tirhal in Sudan, the user at the client level using his or her smart phone, given that he or she already installed the application, identified his or her location using any online mapping facility, with the pick up and drop off locations identified and shared . At the server side, the driver will see this request and have the freedom to accept or skip it, but if he or she accepted the request, the information will be communicated to the requester with spatial information about the location of the driver and the time that will take to reach the requester. All these interactions need Web-GIS services that can communicate and analyze the data between the client and the server domains.

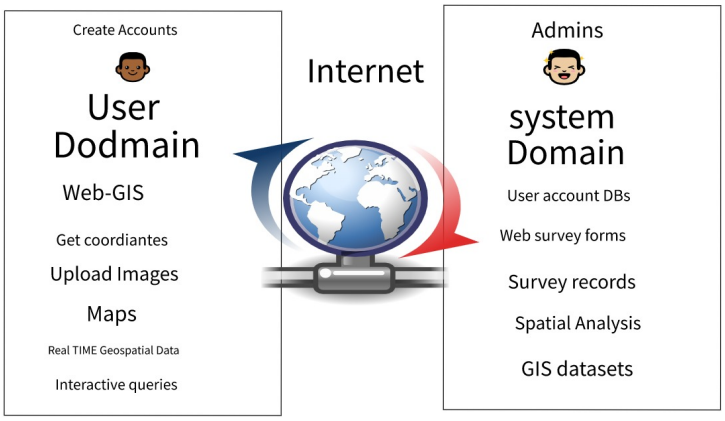

Figure 2 Real time location based data model,

Real time geospatial data examples are many and diverse, like tracking people in humanitarian situation , monitoring moving objects which may include aircrafts, drones, vehciles and so many. Consequently ,streams of geospatial data is being produced on a minute temporal scale and with an increased precision and resolution. Geospatial information is backed up by satellite imagery, crowdsourced data and mathematical models. These data allowed researchers and developers to

better understand different geographic phenomena about our globe, making predictions and projections of high statistical significance in a timely manner. This has helped a lot in adapting to and dealing with natural hazards, understanding weather conditions and with better and faster relief response.

2. Internet of Thing(IoT)

IoT is another emerging technology that changed the way we collect , process spatial data and share it with different devices and platforms. IoT is a system of interrelated devices to the internet to transfer and receive data from one to the other. The ability to manufacture smaller devices has played a crucial role in helping the GIS society to make new innovations, as smaller devices are portable, simple to transport and of low cost. This helped has contributed to an immense increase inn IoT. Until recently ,access to the internet was limited via devices like smartphones and computers, But now with IoT all appliances can be connected to the internet and monitored remotely.

IoT has optimized multiple sectors with spatial elements, such as urban agriculture, robotics and food safety(Holler et al., 2014).Tracking space with IoT has been useful in providing real time maps. Integration of Artificial Intelligence(AI) and spatial IoT was found promising in decision making in different areas,yet, revolution in Spatial IoT still to come.

A good example of IoT with AI can be found in developing autopilots for smart cars (e.g. Tesla's autopilot). Autopilots systems contain a highly precise GPS along with cameras and radars to navigate and steer cars autonomously. The endgame for autonomous vehicles is to connect them all together to optimize traffic. due to the efficiency of autonomous vehicles a study predicted that they will increase highway capacity by 273% (Ackerman, 2012).

Autonomous cars are currently in use. These cars are connected over an IoT network called CV2X (Apostolos, 2017).

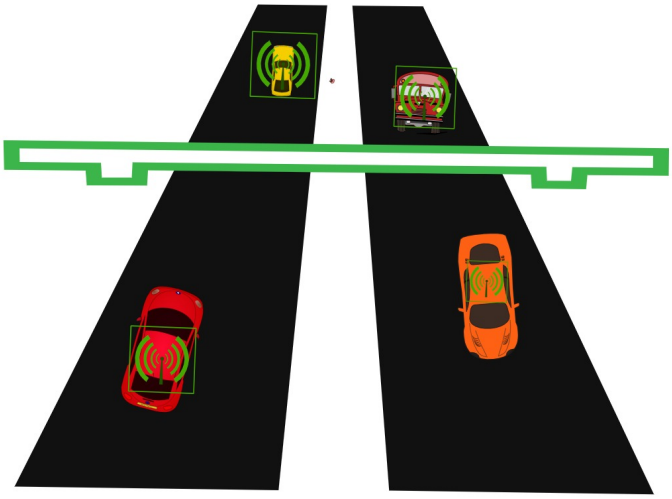

Figure 3, Autonomous cars

3.Unmanned aerial vehicles(UAVs)/drones

Drones (Figure 4) were first introduced and implemented by the security authorities, but their usage was extended in different civilian activities like emergency response, environmental monitoring, public safety,agriculture etc.

Figure 4 Collecting data with drones(source: free to use image from unsplash.com)

4. Geoportals

Geoportals as(Figure 5) are web portals using the internet and web browsers to access and manipulate geospatial data and services. Besides that, geoportals represent cornerstones for spatial data infrastructure.

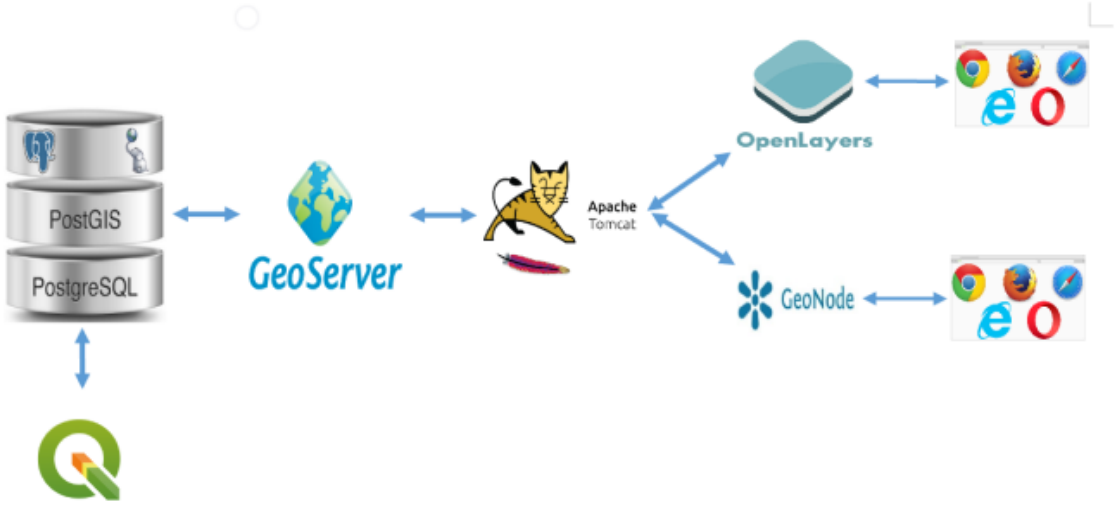

Figure 5 Showing how geoportal is constructed(courtesy of the author)

5.GIS cloud computing

GIS cloud computing is a hybrid of GIS and cloud computing that digitally delivers storage, applications and contents, accessible through web browsers, desktops, laptops or cell phones(Wong and Zhu, 2014). Users can connect, process and view data on demand in a very flexible manner. In simple , they are GIS platforms, hosted by vendors and accessed via web browsers. Cloud GIS computing is attractive to businesses as it allows to different users new means of participation, engagement,collaboration, efficiency and cost effectiveness. Google Earth Engine is one of the good examples that researchers and GIS users exploit with little knowledge of programming and access to the internet, connecting users to vast satellite databases like Landsat, Sentinel, SRTM and many other datasets.

Desperate need for developing competing skills

As you can see from the above, that, GIS is a diverse discipline that requires different skills in addition to good teaming up with others and below are some listed skills that GIS researchers

and users can build and enhance to compete in the evolving field of geoinformatics and prepare for better opportunities in GIS business.

1. Good knowledge in office applications with specific reference to spreadsheets and databases with specific reference to spatial databases.
2. Basic knowledge in HTML,CSS and with enhanced skills in JS.
3. Basic knowledge in computer programming with much focus on Python.
4. Extended capacities in teaming up with others as most GIS projects need different capacities.
5. Good knowledge in project managements.
6. Good knowledge in working with GIS software at the client, server and the cloud levels.
7. There are many to list, but I think these are the most needed skills that a researcher and GIS users need to compete in an evolving Geoinformatic field.

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