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Smallest Linking Routes and ICT: Enabling Seamless Navigation and Digital Health Access

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Abstract

The paper revolves around the basic concept of navigation. In this, we are trying to add some linking places in between the source and the destination to map a new and different navigated route and provide it to the user for additional beneficial use. Healthcare has undergone significant digital transformations driven by the widespread adoption of information and communication technologies (ICT). Many individuals remain unable to access healthcare services due to factors such as a lack of awareness about available services, physical or mental disabilities, geographical distance, lockdowns, sieges, or other barriers. The accessibility of healthcare has been further influenced by innovations like electronic health records, artificial intelligence, sensors, wearable devices, the Internet of Medical Things (IoMT), blockchain, big data, and other advanced applications. The basic GPS, GPRS, and some hardware technologies are also being studied for a better understanding of the whole work.

Keywords: SLR, GPS, GPRS, linking places to healthcare, Mental disabilities

INTRODUCTION

In today's fast-paced world, efficient navigation and accessible healthcare have become paramount concerns. The integration of Smallest Linking Routes (SLRs) and Information and Communication Technology (ICT) has emerged as a promising solution to address these challenges [1]. This literature review explores the role of SLRs and ICT in enabling seamless navigation and digital health access, highlighting their significance in enhancing efficiency, improving healthcare delivery, and promoting wellness for all [2].

SLRs refer to the shortest or most efficient routes that connect various locations, allowing for optimized navigation. Several studies have focused on identifying and utilizing SLRs to enhance transportation systems, logistics, and urban planning. The integration of SLRs in navigation systems, such as GPS or mapping applications, offers users the ability to select routes that minimize travel time and distance. By leveraging SLRs, individuals can reach their desired destinations more efficiently, saving time and resources.

Navigation is completely based on a global network of satellites that transmit radio signals in Earth orbits. For this, a total of 24 working Global Positioning System (GPS) satellites are used. With approximately 7.8 meter accuracy, and 95% of the time, the GPS plays an important role in positioning and location searching anywhere on or near the surface of the earth. In order to make all this happen, the 24 satellites emit signals to receivers that determine their location by computing the difference between the time that a signal is sent and the time it is received.

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The whole and sole idea behind this study is to provide users with the benefit of adding an additional place (one or more than one) to visit between the source and the destination. By doing this, the user will be able to visit some places that he/she want to visit for health and will be able to get a proper navigated route from the source to the final destination along with the desired linking places.

BACKGROUND (TECHNOLOGY)

GPS Technology

A GPS tracking unit is a device that uses the global positioning system to determine the precise location of a vehicle, person, or other asset to which it is attached and to record the position of the asset at regular intervals [3]. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location database, or internet-connected computer, using a cellular (GPRS), radio, or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real-time or when analyzing the track later, using customized software (Figure 1).

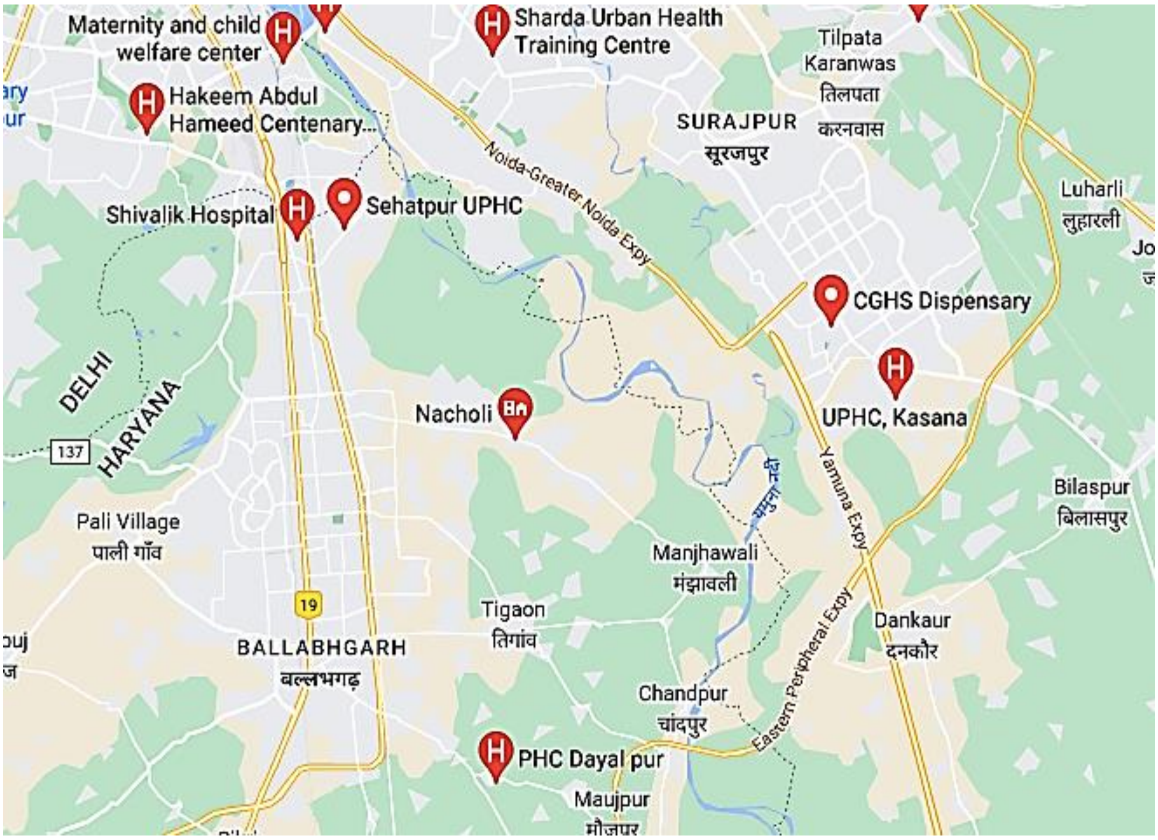

Figure 1. It is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

GPRS Technology

GPRS technology allows a mobile phone to be used for sending and receiving data over an internet protocol-based network, and the mobile system can keep communication with the monitoring center when the vehicle is traveling at speeds over 100 km/h [2]. So we can do a real-time radiation survey in a large area. The system is useful to the works such as routine patrols, nuclear terrorism, radioactive pollution accidents, and nuclear accidents. General Packet Radio Service is a packet-switching technology that enables data transfers through cellular networks. It is used for mobile internet, MMS, and other data communications. In theory, the speed limit of GPRS is 115 kbps, but in most networks it is around 35 kbps. Informally, GPRS is also called 2.5G (Figure 2).

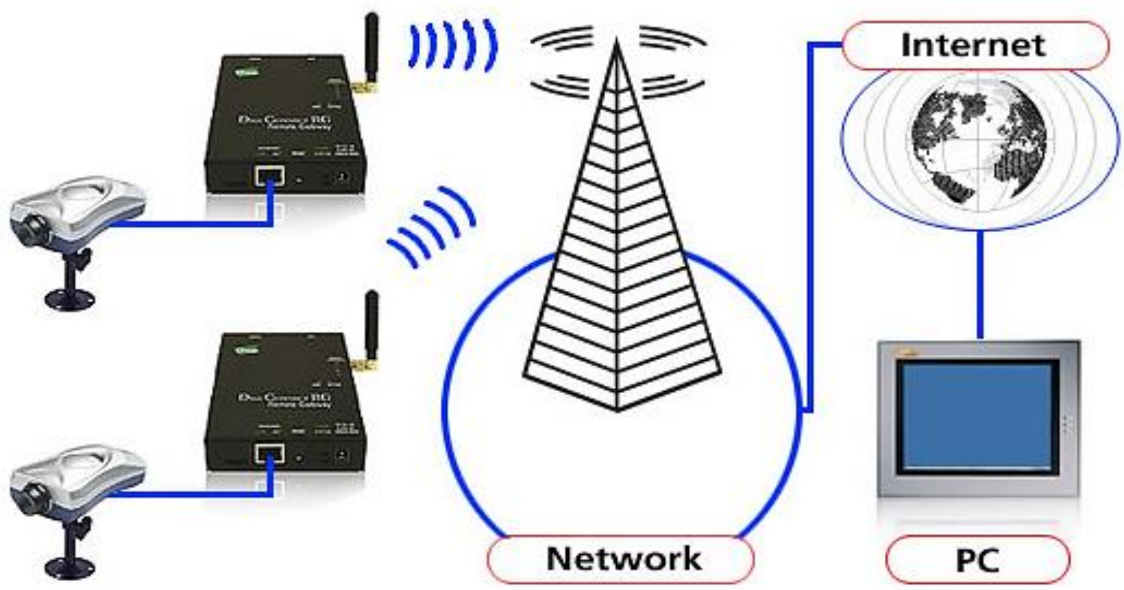

Figure 2. GUI of GPRS technology.

Google Map

Google Maps is a web mapping service developed by Google. It offers satellite imagery, street maps, 360° panoramic views of streets (street view), real-time traffic conditions (Google Traffic), and route planning for travelling by foot, car, bicycle (in beta), or public transportation [4, 5].

Android

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software, and designed primarily for touch screen mobile devices such as smartphones and tablets. In order to access the features Android application is developed and used (Figure 3).

Figure 3. Architecture of connectivity of Android.

Interface

The coding is done in Java and XML languages, where Java is the back-end coding, where logics and functionalities are done, and XML provides the front-end, i.e., the designing structure of the application. For accessing the map in the application, Google provides the Google Maps API, which can be used to access the Google map in the application [6, 7]. Further coding is done for extra features like color and location access and searching, and many more (Figure 4).

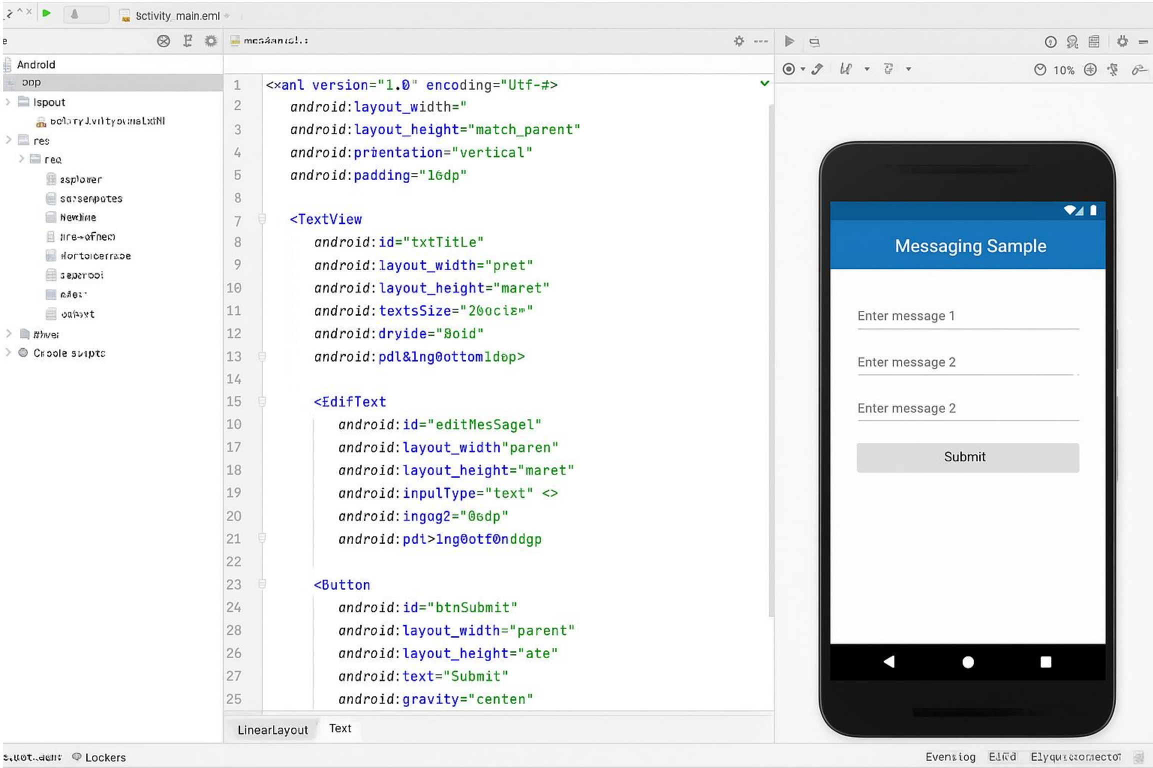

Figure 4. Application interface.

STUDY

The combined influence of SLRs and ICT extends beyond navigation to encompass the broader concept of digital health access. By utilizing SLRs to improve transportation and integrating ICT into healthcare systems, individuals gain easier access to essential health services. This integration becomes particularly significant in underserved or remote areas, where healthcare facilities may be limited. ICT enables the provision of remote diagnostics, telehealth solutions, and health education through digital platforms, ensuring that individuals can access vital healthcare resources and information irrespective of their physical proximity to healthcare facilities. By removing geographical barriers, SLRs and ICT contribute to the realization of "Digital Health for All," enabling equitable access to healthcare services and promoting overall wellness.

The GPS provides an unparalleled range of services to commercial, military, and consumer applications. This provides the users to know their exact velocity, location, and time whenever and wherever on earth. There is a total of 24 satellites that are strategically located 10,600 miles from Earth, and all of them are in circular orbit with respect to each other. The orbital period is around 12 hours, and all the satellites are equally distributed in six orbital places having equally spaced angles [8, 9]. 21 out of the 24 satellites are active, while the remaining three are in space. The GPS satellites are placed in such a manner that 4 GPS satellites will always be beyond the horizon.

$$d_1 = c\left(t_{t,1} - t_{r,1} + t_c\right) = \sqrt{(x_1 - x)^2 + \left(y_1 - y\right)^2 + \sqrt{(z_1 - z)^2}}$$

$$d_2 = c\left(t_{t,2} - t_{r,2} + t_c\right) = \sqrt{(x_2 - x)^2 + \left(y_2 - y\right)^2 + \sqrt{(z_1 - z)^2}}$$

$$d_3 = c\left(t_{t,3} - t_{r,3} + t_c\right) = \sqrt{(x_3 - x)^2 + \left(y_3 - y\right)^2 + \sqrt{(z_3 - z)^2}}$$

$$d_4 = c\left(t_{t,4} - t_{r,4} + t_c\right) = \sqrt{(x_4 - x)^2 + \left(y_4 - y\right)^2 + \sqrt{(z_4 - z)^2}}$$

The GPS calculation in the receiver uses four equations in the four unknowns x, y, z, *and* t_c, where x, y, z are the receiver's coordinates, and t_c is the time correction for the GPS receiver's clock. The four equations are:

where

- c = speed of light (3×10^8 *m/s*)
- $t_{t,1}$, $t_{t,2}$, $t_{t,3}$, $t_{t,4}$ = times that GPS satellites 1, 2, 3, and 4, respectively, transmitted their signals (these times are provided to the receiver as part of the information that is transmitted) [10–14].
- $t_{r,1}$, $t_{r,2}$, $t_{r,3}$, $t_{r,4}$ = times that the signals from GPS satellites 1, 2, 3, and 4, respectively, are received (according to the inaccurate GPS receiver's clock)
- x_1, y_1, z_1 = coordinates of GPS satellite 1 (these coordinates are provided to the receiver as part of the information that is transmitted); similar meaning for x_2, y_2, z_2, etc.

The receiver solves these equations simultaneously to determine x, y, z, and t_c.

All these calculations are further added to the algorithms on which the application works for navigation. The Google API is used in the application, and then, for further features, coding is being done in Android Studio for this. The Android coding is being divided into two sections: XML coding, which is the front end of the application, second Java coding, which is the back end of the application, where all the basic algorithm coding is done. To find the current location of the user in the application, the internet control permission and control permission are taken in the manifest files. Buttons are added in the XML code for accessing the location and other things. Action listeners are added in the Java sections whose work is to perform a suitable action whenever a button is pressed.

PROPOSED WORK

In the previous section, we came to know how the GPS works and gives the appropriate location to the user.

Here we will discuss the updates that can be done in the application to make it furthermore useful. Some new additions can be made to the navigation system that will be more user-friendly and will help the user in many ways. If the concept of linking places is added, then it will be a good update in the navigation system [14]. The concept of linking places works on the principle that not only should the route guide the user to the destination, but it should also guide the user to the places that have to be visited by the user in between the source and destination, provided initially whether those linking places are on the shortest route or not. That is, sometimes the user might be having some work somewhere between the source and the destination, and actually that place is not in the shortest guided route, so in this case the user, in general, must first provide the source, i.e., the current location of the user and destination here will be the linked place in between, and further, the user has to provide the source, i.e., current location which at that time will be the linked place itself, and here the destination will be the final destination where the user ultimately wanted to reach.

This creates a problem of multiple changes in the source and the destination. What if the linking places are more than 1, say 2 or 3, then the source and destination must be changed a couple of times [12, 15–18]. But what if this problem no longer exists? What if the user no longer needs to change the source and destination multiple times? What if an option of linking devices were there so that the user can add those linking places over there so that the system provides the user a way that starts from the source, leading to all the linking devices, and ending at the destination. If this happens, then the user will get a better outcome, and the navigation system will get a user-friendly update [19].

This can be done by treating the source and destination as a linked list and applying the algorithm used to calculate the shortest distance between the source and destination. The algorithm will have separate parts like in the first section the current location will be the source and the first linked place will be the destination for this first the shortest part will be calculated and saved then the first linked place will be treated as source and the second linking place as destination then the shortest path will be find between them and the route will be saved this procedure will continue till the last linked place is treated as the source and the actual final destination will be the destination [9]. This is how the final route will be calculated and will be displayed on the screen [20].

The option of multiple vehicles will also be applicable here, and in addition, there will be an option of multiple vehicles in a single route that will somehow save time as well as money. This means that the user no longer needs to travel the whole route via the same vehicle; the user will be able to change the means of transport as per the availability and as per the need to save time.

A whole Android app can be made on this, which will include some front-end XML coding for the structure designing and providing animation and designing to the application, and on the other hand, JAVA coding part for the actual logics and algorithms that would be designed for the functioning of the above work discussed. The Android application will provide the user access to the newly added feature. Here, permissions are taken in the manifest, action listeners and buttons are created, all the algorithm is used to enhance the functioning [12]. Here, the repeated change in the source and destination is settled by using the concept of linked link, in which every part is linked to the other part.

RESULT ANALYSIS

The new guided navigation route is ready for the user, and now the user can visit all the places between the source and destination and can complete all the different works via the new route. Now the time of the user is saved, and the user is getting a better experience of the navigation provided.

The functioning of the application changes a bit, codes become a bit lengthy, and the calculation and assessment become more complex, but the overall benefit has the upper hand in the situation as better functioning of the application is provided to the user, which is the main purpose of every service provided (Figures 5 and 6).

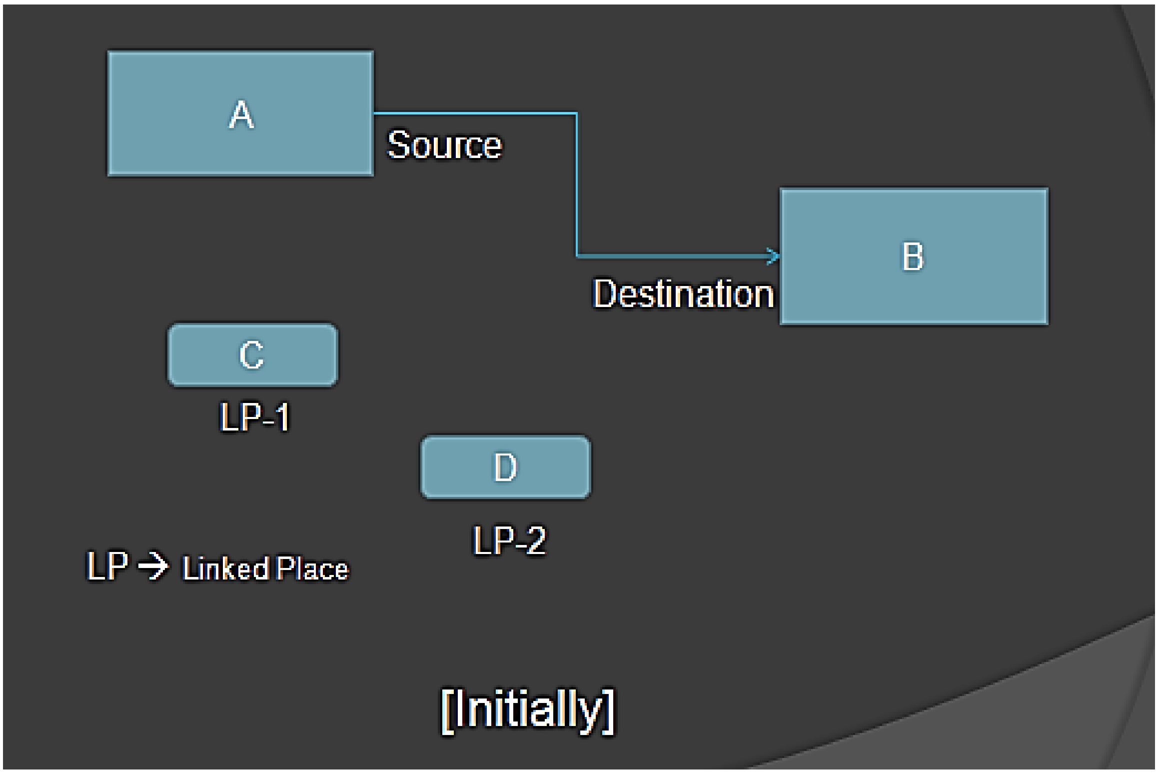

Figure 5. Initial stage of architecture.

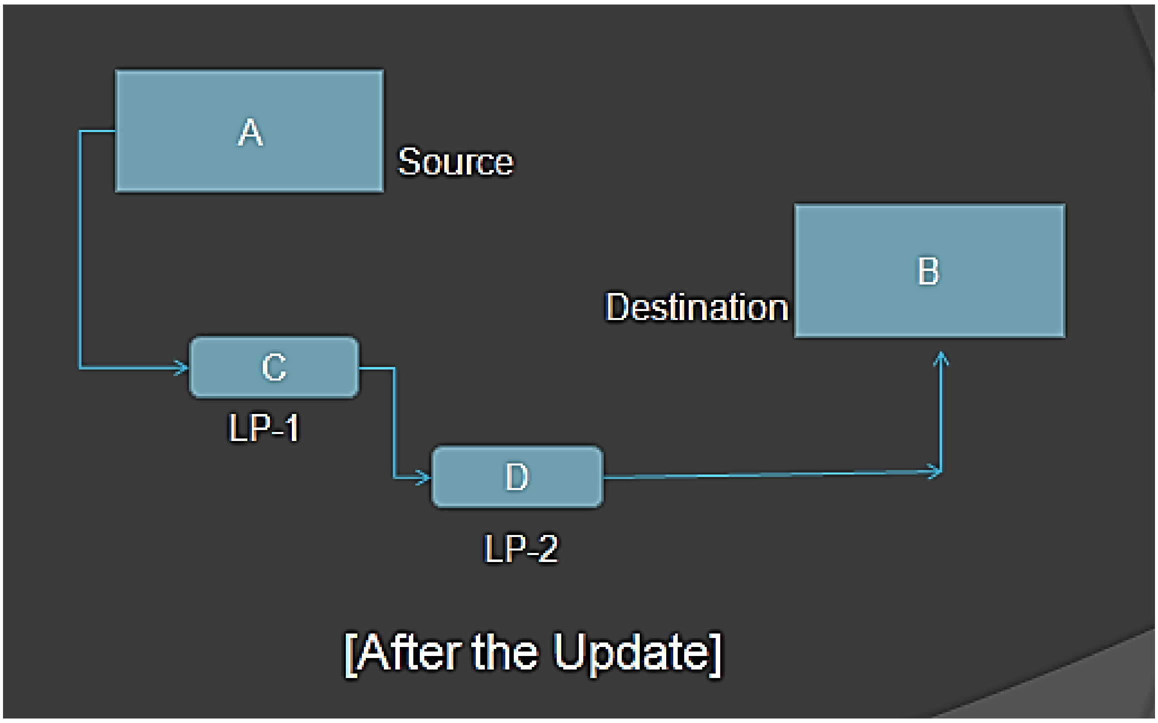

Figure 6. Result analysis architecture.

CONCLUSIONS

The literature review highlights the crucial role of Smallest Linking Routes (SLRs) and Information and Communication Technology (ICT) in enabling seamless navigation and digital health access. The integration of SLRs in navigation systems optimizes travel routes, saving time and resources. Simultaneously, ICT empowers healthcare providers to deliver efficient and accessible healthcare services through real-time data, telemedicine platforms, and remote monitoring. The combined influence of SLRs and ICT promotes wellness for all by ensuring equitable access to healthcare resources, particularly in underserved areas. This integration represents a promising avenue for enhancing efficiency, improving healthcare delivery, and creating a more inclusive healthcare ecosystem.

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