

# A Novel Approach for Developing Web GIS-Based Navigation System



Adamu Dessalegn Tadesse, Tariku Kebede Tofu

**Abstract:** *The campus area is gradually expanding with the increasing number of university students. Consequently, it is difficult for freshmen or visiting staff to find a specific building at the campus. The study aimed to Develop a Campus Web GIS Navigation System for the study area using Geospatial technology. The general procedures to create a web map navigation application are Geo-referencing Images, digitization, Road Network Analysis, Overlay Analysis, and finally, a Web GIS Based Campus Navigation System has been developed. The main activity of the system application is the map activity. It displays the campus map of the Wachemo University. The user can zoom and scroll this map to get to his/her desired places. The building map is the basic layer of this screen. The end user can access it by using this link: <https://wcu-webmap.github.io/Web-Map-of-WCU/>*

**Keywords:** *Campus Navigation, GIS Web, and Wachemo University*

### List of Abbreviations:

GIS: Geographic Information System  
RS: Remote Sensing  
ERDAS: Earth Resource Data Analysis System  
DEM: Digital Elevation model  
LULC: Land Use Land Cover  
UTM : Universal Traverse Mercator  
WCU: Wachemo University  
WGS: World Geodetic System

## I. INTRODUCTION

In recent years, with the reform of the world's higher education management system, many universities have been developed one after another, so that the same college has multiple campuses, which brings a lot of inconvenience to students' teaching and management. At the same time, the college and university campus area is larger, with more buildings, the ground and underground pipe network, power supply, communication lines cross-distribution, and information with the management of routine difficult to achieve effective management [1]. A university campus is a complex infrastructure. Especially new students and people who are on it for the first time have a hard time orientating themselves and finding places [2].

There will be different workshops, seminars, and conferences at colleges, the college cultural fest, Events in which teachers and students from other colleges may wish to face problems like finding the location, which route should be taken, and updates in an event [3].

The Wachemo University campus occupies more than 200 hectares [6].

The University commenced and functioned in 2012, admitting 538 students in 12 departments under 4 colleges [7].

Currently, the University has admitted over 18,400 students in regular and continuing education programs in 48 departments under 6 Colleges (<https://wcu.edu.et/>) [7].

The population of campus has been increasing year by year, and the construction of buildings has been continuously expanding [0]. This has caused many inconveniences for the new arrivals and visitors who are not familiar with the campus to realize and visit the campus. To provide school freshmen and campus visitors with more convenient services, the campus navigation system will be studied and designed based on GIS technology [10].

Maps and route services are vital for navigation. The mobility of mobile devices makes it likely to use maps for navigational purposes. On the other hand, in desktop applications maps are used mostly for route planning. The rapid development of new technologies enables high-speed internet in mobile devices which further makes it possible to use advanced online services for navigation [4]. The main activity of the system application is the map activity. It displays the campus map of the Wachemo University. The user can zoom and scroll this map to get to his/her desired places.

## II. MATERIALS AND METHODS USED

### A. Description of the Study Area

Wachemo University (WCU) is one of the public higher educational institutions, which was founded in 2009 G.C. It is located 230 km southwest of Addis Ababa, at Hosanna town in an area of over 200 hectares. The geographic location of the study area is from 7° 30' 00" to 7° 35' 00" North latitude and from 37° 49' 00" to 37° 53' 00" East longitudes.

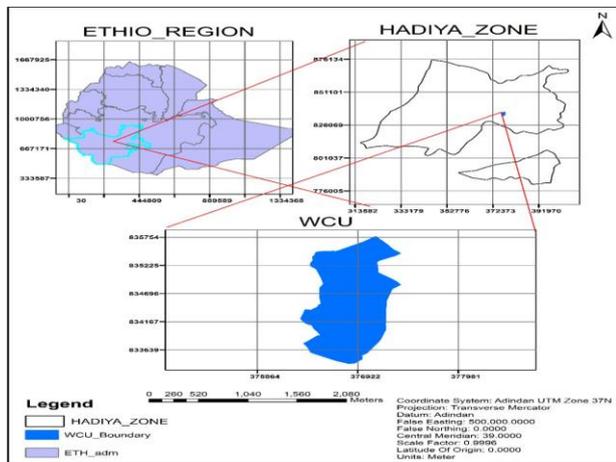
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[Fig.1: Map of the Study Area]

**B. Data Types and Sources**

The main sources of the data in this study were both primary and secondary. Collecting accurate and reliable data was the most determinant factor for any research as it determines the quality of the research. Accordingly, the necessary data was collected from the respective sources.

**Table 1: Data used and its Source**

No	Data Required	Source	Data Format
1	Road network	Google Earth	KML
2	Aerial image	Geospatial information institute	Raster(.tiff)
3	GCP	GPS	Point (CSV)

**C. Softwares Used**

Software is programs that are used for the collection, organization, analysis, interpretation, and presentation of data. Different software will be utilized in this study. To achieve the objective of the study QGIS, ArcGIS, and ERDAS IMAGINE software were used.

**Table 2: Software Used**

No	Software	Version	Purpose
1	ArcGIS	10.8	Storing, managing, and analyzing spatial information and producing a map
2	ERDAS IMAGINE	2015	Processing and analyzing Aerial images
3	QGIS DESKTOP	3.30	Development and Functional Design of Campus Navigation System

**D. Method**

The method is a set of procedures followed in the study to achieve the goal of the study.

**Image Processing:** - This is a method to perform some operations on an image, to get an enhanced image, or to extract some useful information from the image. It is a type of signal processing in which the input will be an image and the output may be an image or characteristics/features associated with that image.

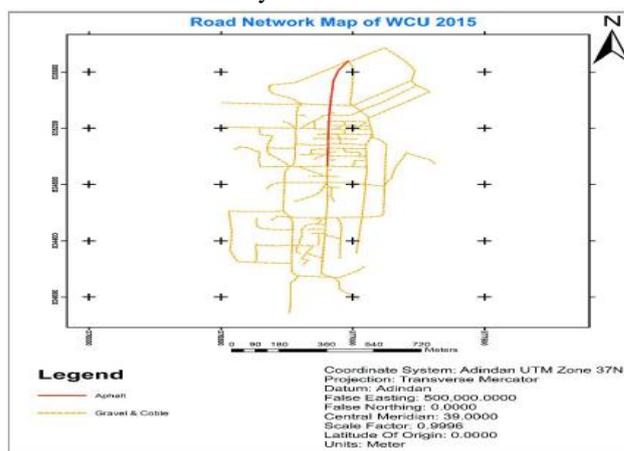
**Georeferencing** is the process of aligning imagery with spatial data such as points, lines, or polygons. The process of georeferencing essentially defines the location of a raster file and assigns real-world coordinates to the image so that it may be analyzed with geographic data. In a GIS environment,

raster data is georeferenced using a control layer such as a highly accurate road network, but any layer that contains known coordinates can be used as a point of reference [5].

**Digitization:** -Digitization is simply defined as the process of converting analog data into digital data. Road network and Buildings will be digitized.

**Road Network Analysis:** - Network analysis is used to determine the best route between two destinations based on a specific travel expense. Developing a Network Dataset for

ArcGIS Network Analyst tool is a powerful extension of ArcGIS. It provides network-based spatial analysis including routing, travel directions, closest facility, and service area analysis. ArcGIS Network Analyst tool enables users to dynamically model realistic network conditions, including turn restrictions, speed limits, height restrictions, and traffic conditions at different times of the day. Thus, the existing road network of the study area is shown below.

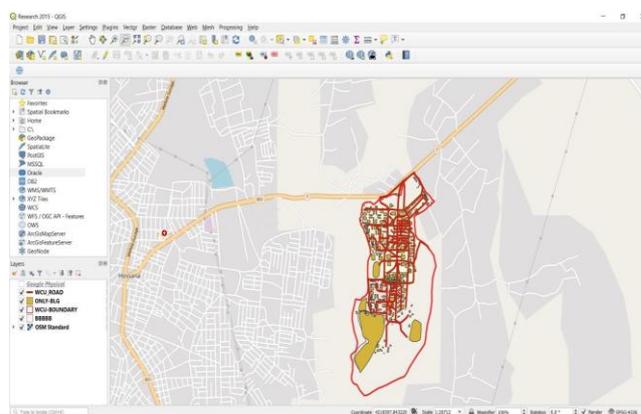


[Fig.2: Road Network of the Study Area]

**E. System Application Interface**

*i. Main Menu*

The main menu shown in Figure 3. is the entry point of this application. It offers four self-explanatory options to the user, while it is open, we can see the map displayed underneath the menu depending on the map mode the user has selected.

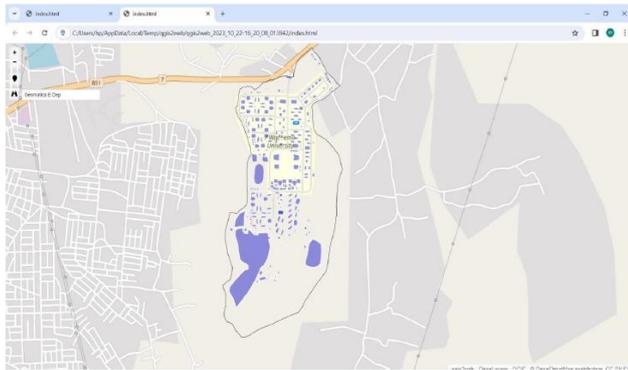


[Fig.3: Search Form]

This search form can be accessed by clicking on the search icon on the display layout as shown in Figure 4. With the standard keyboard the user can specify his/her search criteria and the automatic search



begins on each tap of the keyboard to save the user the stress of having to traditionally tap on a search button or click a “Go” command button to initiate the search.



[Fig.4: Search Form]

**Map View:** The main activity of the system application is the map activity. It displays the campus map of Wachemo University as shown in below URL: <https://wcu-webmap.github.io/Web-Map-of-WCU/>

The user can zoom and scroll this map to get to his/her desired places. The building map is the basic layer of this screen. The end user can access it by using the above link.

### III. CONCLUSION AND RECOMMENDATION

#### A. Conclusion

Campus Navigation System is a system with severely unique functions and properties that delivered in a well user-friendly way to typical users of the system. It gives the user productivity with the combination of technical and user requirements in advance. This system is being introduced to enhance user satisfaction and ease the self-touring experience within Wachemo University.

The goal of this project was to create a system that incorporates a mobile application that helps people on the campus of Wachemo University to orient themselves and find their destination.

The implementation of the Campus Navigation System has quite an impact on the university environment, given that the system allows students, lecturers, and visitors (guests) to navigate, and search for a place of interest with complete ease. The end user can access it by using this link: <https://wcu-webmap.github.io/Web-Map-of-WCU/>

#### B. Recommendation

Based on the findings in this study, the researcher makes the following recommendations.

☞ Strengthen of further research should be done on the web-based campus navigation.

Future studies should consider the name of each building to create high-quality and more accurate results.

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Publishing research in journals has many purposes, such as Scholars can share their findings, insights, and innovations with the academic community and establish credibility. However, both authors have qualified scientific findings but financial limitations have challenged us to disseminate our research paper. Thus, to encourage us the board directors of the International Journal of Soft Computing and Engineering (IJSCE) to consider our paper for full waiver on the Article Processing Charge (APC).

### DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The first and second authors contributed by conducting research and writing the manuscript. We both contributed by, arranging, organizing, and directing the manuscript's full write-up. Thus all authors reviewed the results and agreed on the final version of the manuscript.

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