

## THE USE OF GIS IN REAL ESTATE

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### Abstract

*The paper aimed to present a different way of identification of a zone of interest for clients of the real estate companies based on the evolution of prices and other essential aspects related to buying a property. For a long time now, they have noticed the need to discover and appreciate the information regarding the real estate domain in a different way. Normally, an agency or private buyer finds information on multiple platforms or other types of advertising, without the possibility of combining all their search criteria in one place but this can change. For this purpose, three types of web maps have been developed based on a data base created in ArcCatalog and ArcMap to help the real estate agencies or individual clients in order to consult as many points of interest as they could. Regarding this aspect, these web maps can ensure a "geographical view" of the details that influence the real estate market by implementing methods of filtering, searching or classifying the points of interest within a certain perimeter. For this paper we used ESRI software's, for the database and also for processing that information, which led to the expected results.*

**Key words:** geographical view, information, real state.

### INTRODUCTION

For a long time now, the real estate companies, or real estate agents have encountered difficulties in trying to convince potential buyers that the area of their choice is the best according to their criteria. Based on the narratives from real estate conferences in Cluj-Napoca, we deduced that an idea which can help solving this problem, it could be a program that uses GIS data (Salagean et al., 2016).

GIS (Geographic Information System) can be presented as a system that allows the collection, management, processing and analysis of geographical or spatial data. Starting from the base, from the classic geography, a GIS can integrate several types of data. In a geographic information system, it will be possible to process or analyze spatial locations and/or organize them in multiple layers using 2D or 3D maps and scenes.

Using this advantage, a geographic information system will always help users understand data more easily for better decision making (ArcGIS Overview).

Regarding to general information, the study was based on the data about Cluj-Napoca, the city being situated in the North-West side of Romania, and having an official population of 325 000 people (2011 - last census).

### MATERIALS AND METHODS

For this project we used ESRI software's, for different stages of the paper.

In order to create a Data Base, we worked for start in ArcCatalog (Figure 1), where we created the layers necessary for the next step. The ArcCatalog application provides a catalogue window that is used to organize and manage various types of geographic information for ArcGIS.

The kinds of information that can be organized and managed in ArcCatalog includes: Geodatabases Raster files, Map documents, globe documents, 3D scene documents, and layer files, Geoprocessing toolboxes, models, and Python scripts, GIS services published using ArcGIS for Server, Standards-based metadata for these GIS information items (Matei et al., 2014).

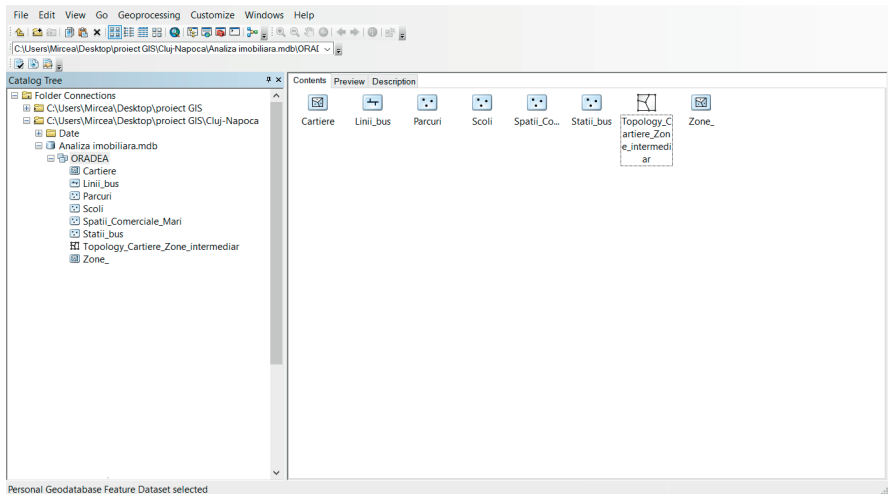
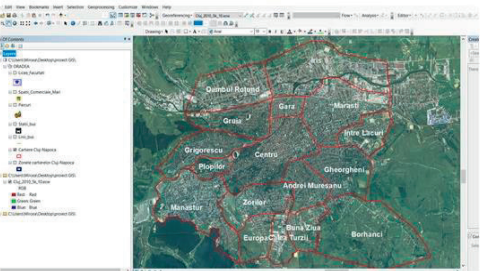


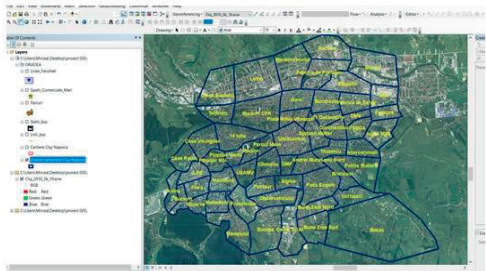
Figure 1. ArcCatalog Data Base

Moving to the next step, we used ArcMap 10.4, which represents geographic information as a collection of layers and other elements in a map. Using an orthophotomap of the Cluj County, we were able to digitize the neighbourhoods, the zones of the neighbourhoods, lines of public transport, bus

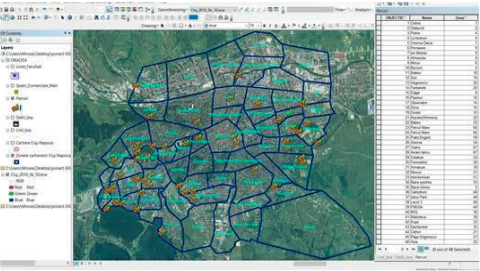
stations, supermarkets, major parks and the high schools and universities (Figure 2 and Figure 3). In each layer we introduced attributes who were received from the local online platforms, like prices/square meter for the last 3 years for each area (Chiorean et al., 2018).



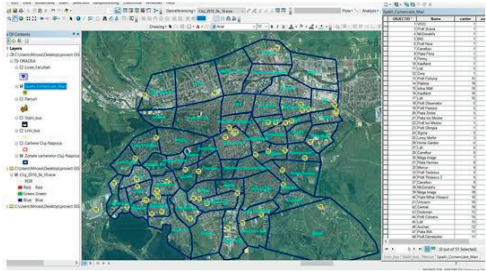
(a) Neighborhoods



(b) Areas



(c) Parks



(d) Shopping Places

Figure 2. Digitizing Map in ArcMap

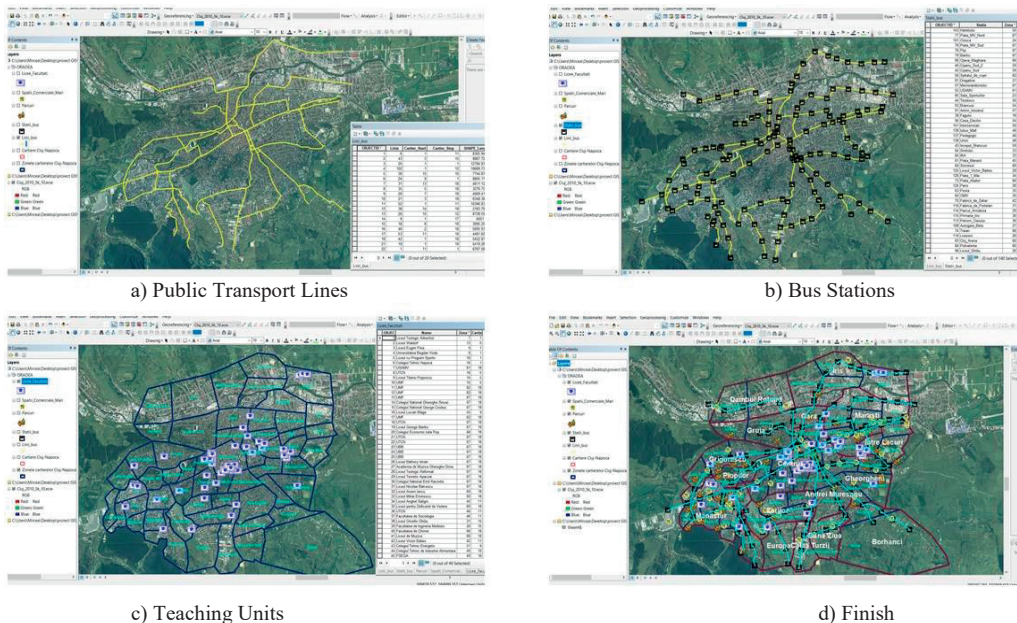


Figure 3. Completion of Digitization in ArcMap

In the following step we passed to ArcGIS for Developers. This application allows to create interactive data visualizations with ArcGIS APIs and SDKs in 2D or 3D, labels and pop-ups, data-driven styling.

When sign in, the dashboard and tools can be accessed to manage applications, maps, monitor credit usage and manage data. The dashboard also gives access to other ArcGIS applications tools across the platform. In order to be usable, data must be imported in shape format (.shp) from ArcMap, to create a WebMap in ArcGIS Online (ArcGIS Online for Developers).

A Web Map is a 2D map that you can create, style, and share between different applications. Web maps are JSON objects defined by the Web Map Specification and contain configuration settings for the map extent, base map, layers, layer styles, pop-ups and more. The Esri Web Map Specification is a JSON specification which provides a lightweight standard for sharing, creating, editing, visualizing, and consuming web maps across the entire ArcGIS platform. As JSON files, web maps can be hosted on an ArcGIS Server and consumed with the REST API. Technically, web maps are Content Items stored in ArcGIS Online or ArcGIS Enterprise.

Every web map has a unique ID, and may be made public or restricted to certain groups and users. Web maps can be created in ArcGIS Online and ArcGIS Pro, and displayed in many other applications such as Navigator, Collector, Storymaps, Esri's configurable apps and apps built with the ArcGIS APIs and SDKs. When an application loads a web map, it automatically loads previously saved configuration settings, making it easy to develop applications and share 2D maps across the ArcGIS platform (ArcGIS Online Help).

Using the Analysis function which is available only in ArcGIS for Developers, different commands have been executed on the database in order to create a Web Map that can be manipulated in an easy way by the user. In order for the user to obtain a precise result regarding the choice of the area of interest for the investment, the most common and requested search criteria were developed under the form of some queries/analyses (Hickman, 2010):

1) Firstly, the areas were classified according to the average prices per square meter of the last 4 years (Figure 4), also configuring the pop-ups and the details of the map (Kuntz et al., 2014).



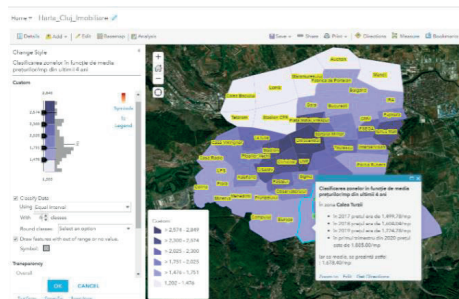


Figure 4. Areas-Prices

2) As a second task, the areas had to be classified according to the number of educational units, exclusively highschools and universities, this being the second principle after which most clients are guided when they intend to purchase a property, especially an apartment, being about an urban agglomeration such as Cluj-Napoca (Figure 5).

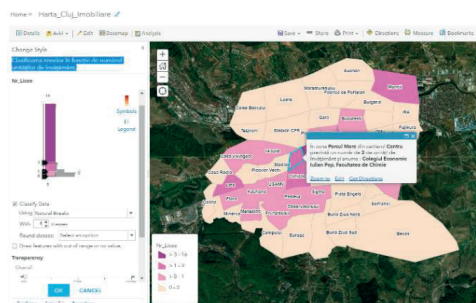


Figure 5. Classification of Areas According to the Number of Educational Units

3) On the third place in criteria rankings came the number of bus stations available for each area (Figure 6).

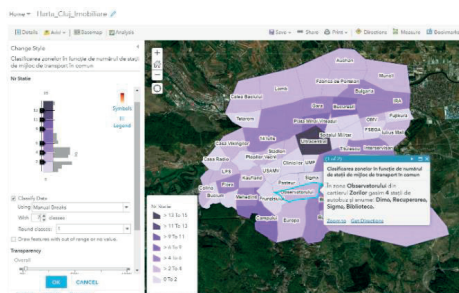


Figure 6. Classification of Areas According to the Number of Bus Stations

4) Because most of the investments in apartments in Cluj-Napoca are related with the rental market, so based on the demand of most tenants, which is taken into consideration by most investors, the further on the list is situated the problem of shopping places (Figure 7).

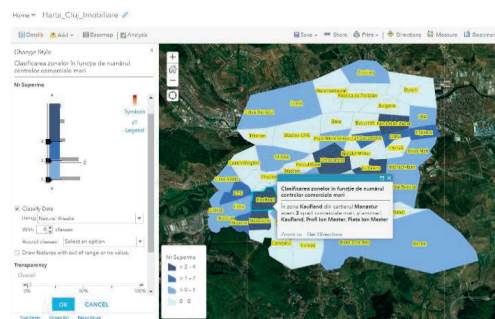


Figure 7. Classification of Areas According to the Number of Shopping Places

5) The possibility of recreation, of sport activities, or just the idea of vegetation, makes buyers to put parks in their preferences when it comes to acquisition so we classified the areas according to number of parks (Figure 8).

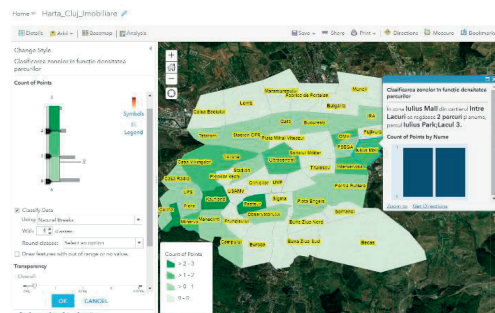


Figure 8. Classification of Areas According to the Number of Parks

6) The last criteria are about the distance between a highschool or a university and a bus station (Figure 9). This way the client/user will be able to see and evaluate the situation according to his needs (Eraker et al., 2015).

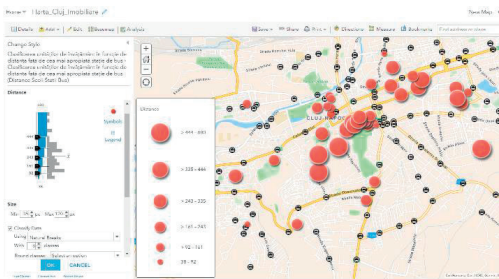


Figure 9. Classification of Areas According to the Nearest Bus Station

Also, in this stage of data processing, we proceeded to make available to the user 3 types of web maps.

The first type of map, makes it possible for the user to view all the classifications on each layer, in particular of the main areas, but also of other types of layers.

The next objective was to create a web map that would allow the users to view all the points of interest within a certain perimeter set by them.

Related to the main idea of the paper, that is to create a webmap with an easy-to-use interface for clients interested in finding the best investment area according to their own criteria, it was proceeded to apply filters from the ArcGIS Online application.

A filter presents a focused view of a feature layer in a map. By limiting the visibility of features in a layer, it can reveal what's important. For example, we created a filter on

an area layer so only the areas with prices between two values appear on the map.

As a map authors, we could also set up interactive filters to help our clients explore data themselves. By providing prompts and hints about the available values in the layer, we wanted to guide our clients toward other filters they might want to apply on the features. For example, we set up an interactive filter on the route of the public transport lines layer so that customers can see the areas through which a certain bus line passes along with characteristics related to bus stations.

## RESULTS AND DISCUSSIONS

The application allows the distribution of layers, maps or other items created in ArcGIS by a developer to public, or to a group of people or an agency. The public items offered by the developer are accessible without authentication. If they instead try to access the parts set as "private" by the developer, the application will immediately request authentication (ArcGIS Online for Developers). In order to view the database and the previously executed classifications to be accessible to users/ clients, it was necessary to create a Public Web Map.

The first map that was published makes it possible to view previously created layers and classifications along with every corresponding legend (Figure 10).

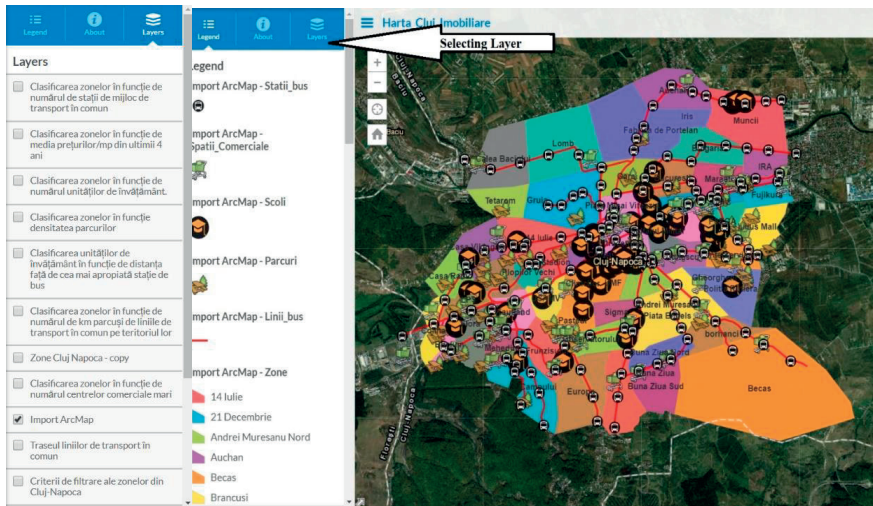


Figure 10. Public Web Map

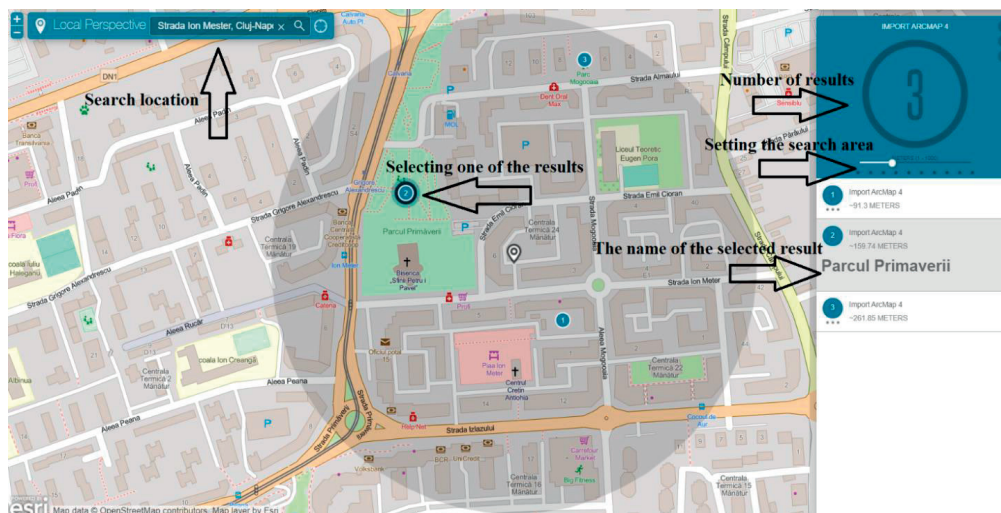


Figure 11. Local Perspective Web Map

The following type of web map, namely Local Perspective made accessible by publication refers to the possibility of the user or client, to search for a location and set a certain perimeter to see the points of interest available in that perimeter, more precisely, high schools or universities, shopping centres, bus stations or parks (Figure 11).

For example, if a search was performed on Ion Mester street in Cluj-Napoca, setting a search perimeter of about 300 meters, it was displayed after this command, that in the respective area, there are a number of 3 parks, being possible to also select each of them to see more details about them. Also, without needing another search or setting of another perimeter, only by selecting the type of points of interest to show, the rest of the information can be viewed as follows (Figures 12, 13, 14).

As a last aspect, a Filter Web Map was made available to users with access to the filters created in ArcGIS for Developers.

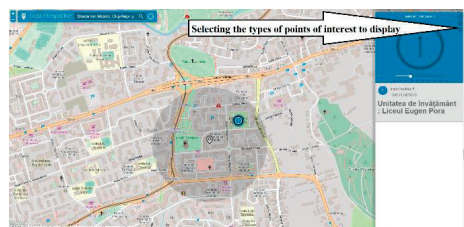


Figure 12. Displaying Teaching Units in the Perimeter

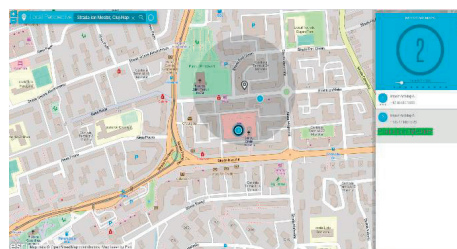


Figure 13. Displaying Shopping Centers in the Perimeter

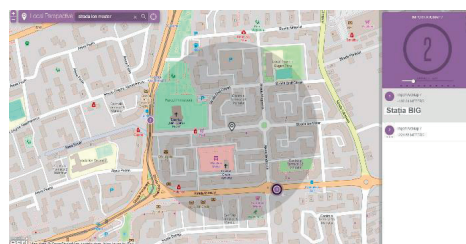


Figure 14. Displaying Bus Stations in the Perimeter

In the left side of the window you can see all the selection options available for each type of filtering chosen, as well as the option for choosing the type of filters you want, in our case being about the criteria for filtering the areas in Cluj-Napoca, and an interesting option for viewing each route of the public transport line (Figure 15).



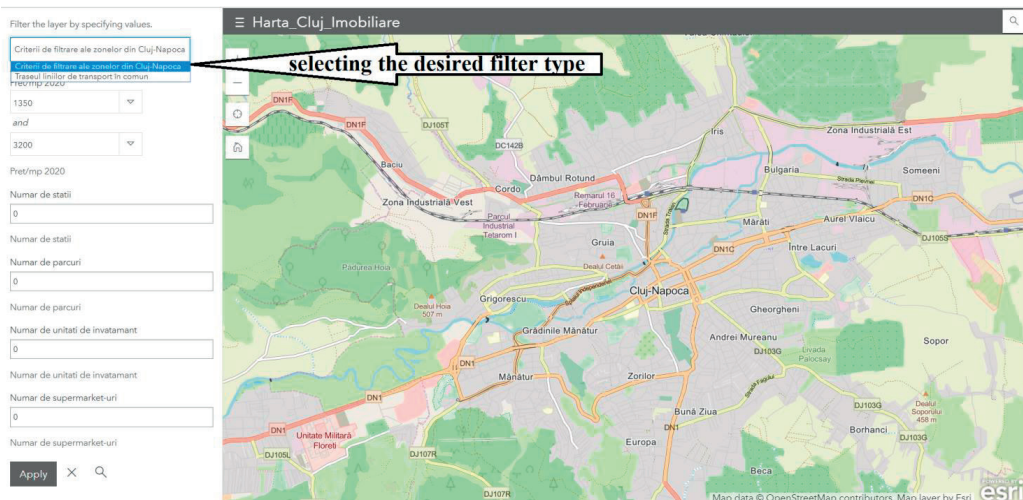


Figure 15. Filter Web Map

For the first type of filtration, namely the Filtering of the Areas in Cluj-Napoca, we have different filling options. If you want, for example, a search for an area that falls in the price range 1900-2100 Euro/square meter, has a

minimum of 3 bus stations nearby, at least 2 parks, a school and 2 shopping places, the application will show the following result (Figure 16).

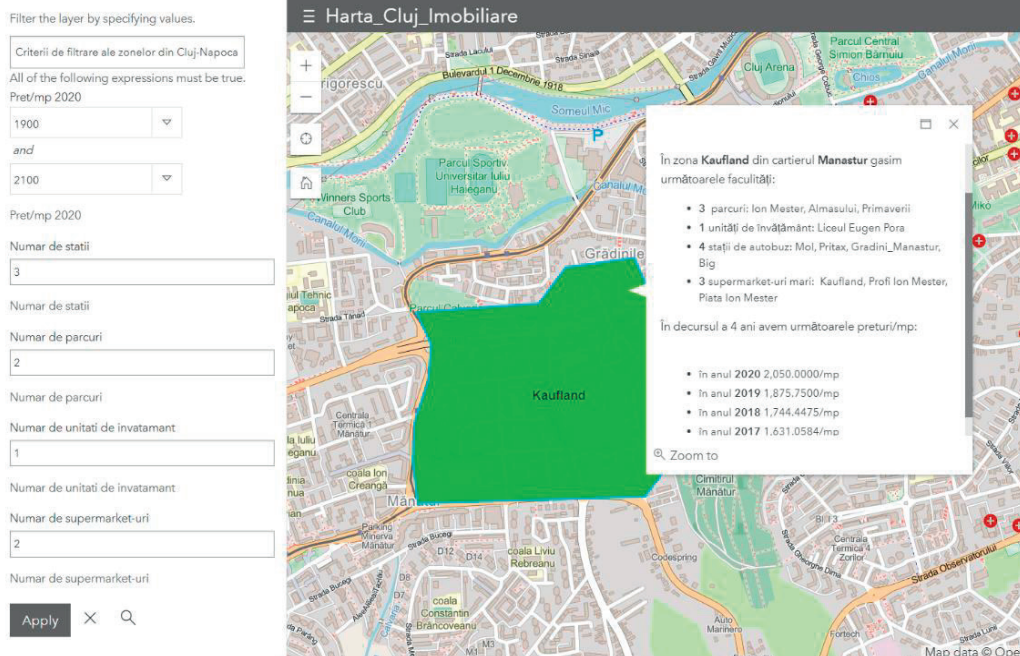


Figure 16. Result of the Filtration

The second type of filtration is called Bus Lines Routes through the areas, so if however,

it is desired to visualize the route of a certain bus line through each area, for example the

route of line 52, all we have to do is select the appropriate filter type and enter the line number.

In this way, all areas through line 52 will be displayed, along with the main details of each one, such as the stations of line 52 in that area and of the educational units. This can be paired by a potential investor with the classification

from the previous map that was previously made available by developers that refers to the distance between each educational unit and the nearest station (Figure 9). Thus, it can be observed that line 52 passes through 14 zones, and if you want to see the above mentioned details, you can see that the LPS area has 3 bus stations, and 2 educational units (Figure 17).

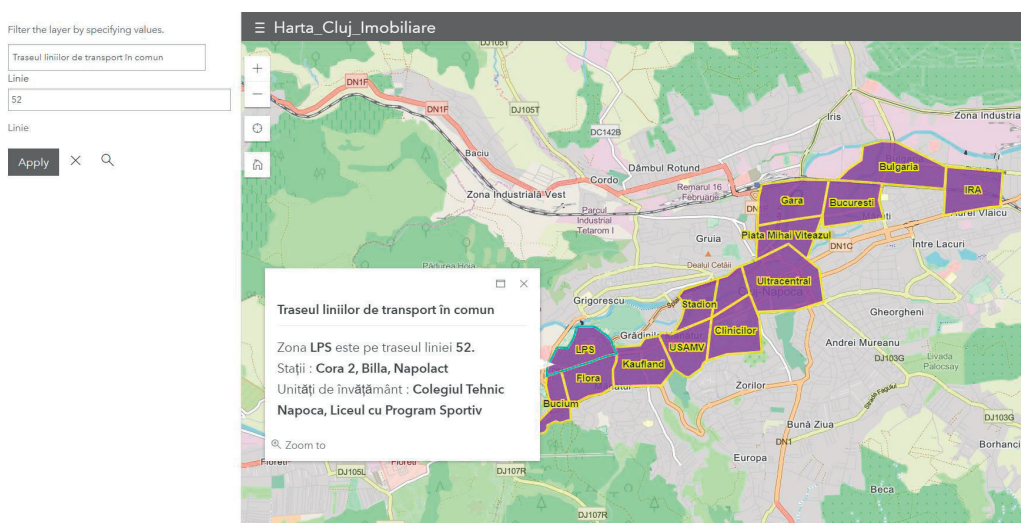


Figure 17. The Route of Line 52

## CONCLUSIONS

Considering, the operations performed, starting with the creation of the database in ArcCatalog together with ArcMap and importing them into ArcGIS Online for Developers, brought us one step closer to achieving the objective of this paper. The purpose of the creation of these Web Maps was the geographical visualization of the points of interest and the classifications of the areas of Cluj-Napoca according to them, by the potential clients or users. The geographical visualization allows an overall analysis on the whole city of what means areas of interest and positioning the objectives pursued such as bus stations, parks, shopping places or educational establishments within a certain perimeter set by the user.

Using all the options available for developing web maps from ArcGIS Online such as editing pop-ups that provide a better and more interactive presentation of the details of certain

objectives on that map, or introducing filters to help narrow down the search, 3 types of web maps were created to help users who want a more detailed analysis of their preferences.

In conclusion, if a user manages to take into consideration all the details of the maps made available by the developers, along with the filtering performed by him, he will be able to reach their right decision.

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