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Research Article

Biophilic Design of Vital Urban Area and Planning of Resilient Territorial Mobility for Healthy and Smart City

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Abstract:

The challenges of urban mobility include two main problems stemming from increased urban population density and inefficient urban infrastructure.

As a result of increased population density, traffic problems such as traffic congestion and environmental pollution worsen, and the lack of harmony between public transport infrastructure and the urban fabric highlights the inability of cities to provide essential services and increases urban isolation.

While high population density is a difficult urban challenge so too is urban isolation resulting from inefficient and ineffective infrastructure in accessing urban service centers. Which affects the quality of urban life?

Through this research, we explore two approaches for planning resilient and vital urban mobility in a healthy and efficient urban environment in the region of Ouzera.

The efficient mobility planned with an ecological urban context of Ouzera Town using a biophilic vital design approach with optimized zones for high urban efficiency that serves health and integrated modern infrastructure of healthy and smart city.

Planning is also being done using an urban resilience approach to ensure efficient and resilient urban mobility to and from Ouzera Town with its urban fabric suitable for optimal urban planning toward the densely populated city of Médéa Center.

Within the regional framework of Médéa and the urban context of Ouzera with its strategically location and nascent urbanization distinguished by natural Landscaping and ecological area of scientific buildings; highly efficient specialized healthcare services are being developed the urban fabric is being designed with optimized zones for healthy efficient and sustainable smart city.

Plans were also made to ensure the effective and resilient integration of services with Médéa through an exchange hub in Ouzera Citywhich includes transports services, Railway services and continuous cable car services via a line linking scientific healthy site in Ouzera with important sites of Médéa.

Keywords: Smart City, Healthy city, Biophilic design, Optimized zones, Cable car, exchange hub, Vital mobility, Resilient mobility.

1. Introduction

In parallel with Transaharian Motorway the Algiers Tamanrasset high speed railway project is progressing.

The work is underway on the section linking ChiffaBoughezoul to implement the section in the highlands regionwhile the section crossing the mountainous the regions remains under study and review.

Some want to follow the study completed in 2014 and approved in the wilaya of Médéa which has published in an article in the website ALGERIA 360°. In the study of 2014 the route passes through Ouzera town and due to the length of the line passing through the western territory of Médéa. Continuing it parallel to the trans Saharian Motorway was considered an effective solution away from the effects of the antibiotical complex as it passes directly through the Tel Atlas Mountains toward Blida with a less distance estimatedto 44 Km and less time and effort for travelers heading south.

In both cases , the project passes through Ouzera and its region.

So how is an effective exchange hub planned with the main axix is the railway line of Algiers Tamanrasset and the Trans Saharian Motorway as this hub provides vital and resilient mobility services to the largest possible number of residents in the wilaya of Médéa and visitors from the National territories.?

And how can adequate facilities be provided in Ouzera Town in order to Smart City that serves health and meets the specification of smart City?.

2. The ranking Of Ouzera Region.

We present plan Wilaya plane of Médéa for development its regions ; which was completed by thCETIC in an analytical reading of the ranking of Ouzera Town shown in the plan , than we present a development approach according to the actual ranking of Ouzera from 2025 to the horizons of 2035.

2.1. Analytical Reading

It is noted from the Wilaya Spatial Planning Plan (PATW) completed by the center of information and communication technologies (CETIC). That it lacks an effective forward looking vision for the horizons of 2030. Mainly due to the omission of essential elements in the plan that are necessary for classifying cities rank and its consistency with effective development prospects.

We find that the town of Ouzera the subject of this study is an administrative center of Daira for comprising four municipalities; it is classified as a residential area encompassing the surrounding rural population. However in reality , it is a town with a well organized urban fabric speed in two kilometer square and land transport is active in the vital street in the face of University compus.

It is noted that there is an urban pole under construction and based on the type of the predominant building types in the town, it can be estimated that more than fifty percent of the total population of the town main urban center is employed in the services sector. This population was approximatively eight thousand inhabitants according 2008 statistics.

This lead us to classify it as a first class town This is clearly evident from the size of the green Motorway panals, which indicate a important town and , considering its urban center and the suburb with secondary population density where agriculture is practiced at a rate not exceeding twenty percent based on the area of agricultural land and the nature of predominant agricultural investments that rely on mechanization and because most of the suburbs young residents rely on trading , services , and land transportation and in addition to the noticeable artisanal activity in the town with the presence of a territorial center of vocational training in various trades and professions.

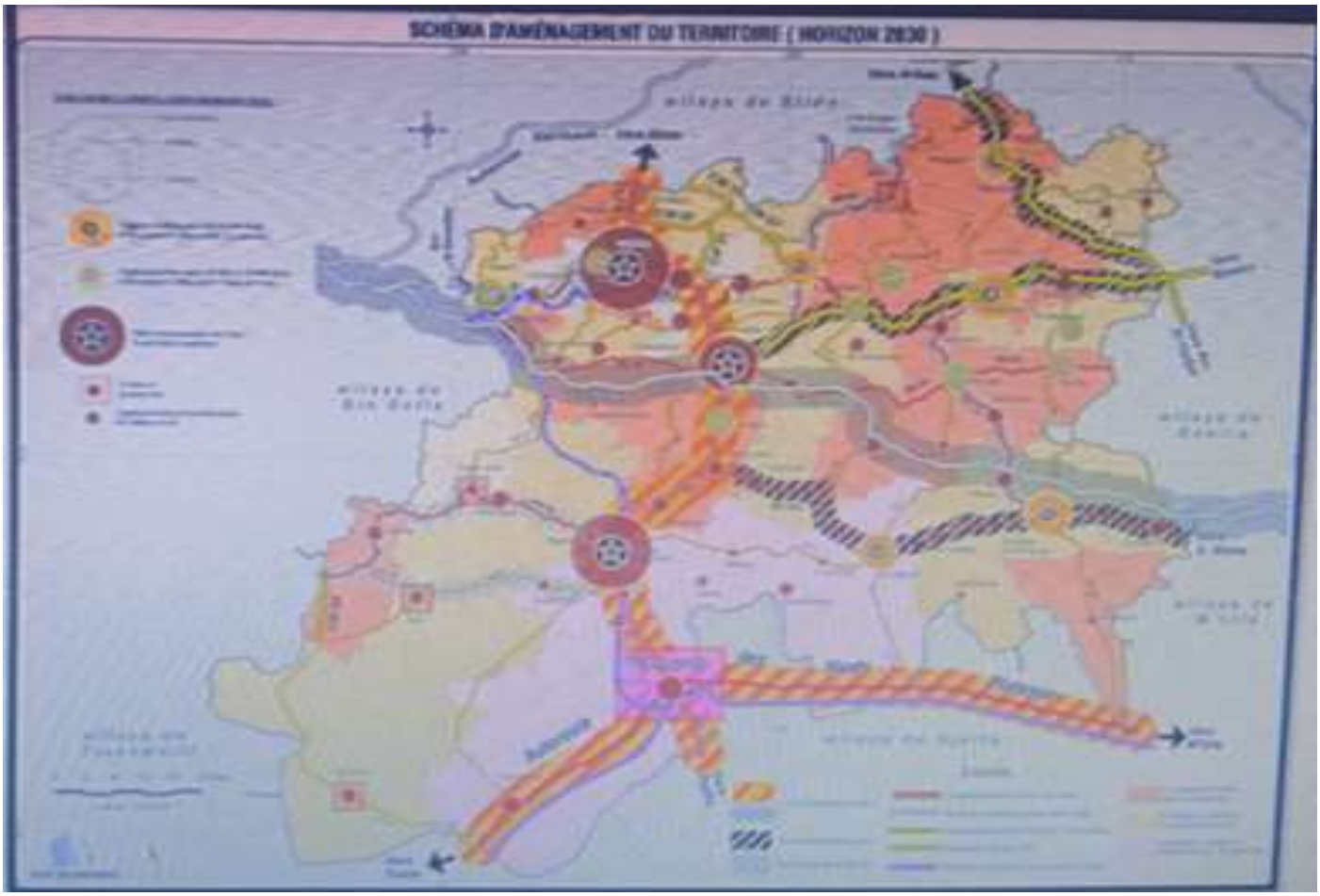

Fig1 : Urban Classification Of CETIC in the territory of Médé

2.2.A development approach to 2035 horizons

The development plan of Ouzera town for the horizons of 2035 includes the approach to transitioning from an ecological town to a smart green city .focusing on developing services in the sectors of health , higher education and scientific research sector and relying on the transport and trade sectors integrating with services of the industrial sector in the urban fabric of city.

The sustainable urban operation of Ouzera as smart city relies on the agriculture , industry and trade sectors as diverse sources of funding .This includes the development of organic farming , wholesale of fruits and vegetables and grocery , flowers cultivation and production and trade of natural perfumes .It also encompasses the clothing industry and the wholesale trade of textiles and apparels.

The development projects for the 2035 horizons in addition to those under construction and planned for the urban center, include smart interface projects comprising an exchange hub , university of fourth generation and smart university hospital.

These projects are complemented by additional initiatives such as a training center for smart architecture technicians , a training center for clothing designers and technicians , a business tower, a bank branch, and court.

Most of these projects are located on available land in the Main urban center of Ouzera to ensure integration between the existing

urban fabric and the emerging urbanization in order to successfully transition toward smart spaces within urban fabric and direction of smart city.

The surgical recovery facility is planned for sanitary pole in the northern suburbs of Ouzera City near the North South Motorway in an ecological area.

The eastern suburb has also developed as a second urban center with the addition of a new university campus and a research center on animal medicine and productivity that implement the approach of one health and planning a new urban pole encompassing all facilities within an enhanced architectural framework for eastern suburb of Ouzera town.

This urban fabric harmonizes the design of university campus specializing in Agriculture, Earth sciences and veterinary sciences in the environment of One Health providing permanent accommodation and high quality of services for professors and researchers at this scientific campus to horizons 2035.

Through this smart city model for Ouzera town there are now two smart models along the penetrating center railway .

These are :

- The smart city construction Model of Boughezoul.
- The model for the transition of ecological town in Ouzera into a smart city.

The following schema illustrates the urban context of Ouzera city for horizons 2023 in the old territory of Médéa.

Fig2 : Ranking Of Ouzera Town in the old territory of Médéa to 2035 Horizons (Author 2025)

3.Urban context of Ouzera Town.

The urban framwork of Ouzera is considered the basic for managing the town cleaning services and the urban agglomeration administratively affiliated community center with need continious services to nensure a healthy urban environment.

Like any city the urban context of Ouzera town includes urban fabric , streets and quarters planning ,and infrastructure includes water, electricity , gas , communications networks and sewerage networks. It also encompasses the distribution of areas from residential to scientific and industrial /commercial zones as well as population distribution and the interaction between urban center.

Mobility , Road networks and transportation are also considered essential elements based on those fundamental elements and their integration , we can identify four key areas for sustainable planning of the main urban center of Ouzera municipality

The cleaning services provided by the Municipality to its urban area are considered a foundation upon which the urban framework is built ensuring urban environmental health .

From this , the expanded urban framework of Ouzera Town is defined , which includes in addition to the main urban center a secondary urban center on the eastern side of town which appears to be consistent with the main urban center . in addition to the emerging urban center in the north of Ouzera Town.

The main urban center , which is considered as a vital center in Ouzera region , is characterized by its structured fabric which represents the town with its nascent urbanization and massiveness buildings in old quarters.

Fig3 : Site of urban CENTER and urban developing areas in Ouzera region (Author 2025.)**

The town of Ouzera has witnessed remarkable urban development , and we can distinguish four urban zones that can be considerd as a transition from ecological town to a smart ngreen city nwith an efficient and healthy urbanspace serving secondary urban centers of Ouzera.

These zones are relied upon for urban integration and service provision , and they are as followres:

- Exchange hub.
- Pole of sciences and health services.
- Zones of activities and commercial activities.

Centre of commerce and services.

Fig4 : Model of urban spaces for Ouzera City (Author 2025.)**

4. Planning and design of vital urban area

The vital urban space is planned with a vital mobility plan centered on the exchange hub and the effective planning of the urban space serving health is done with sports facilities , resident of patients companies , and an optimized public place through biophilic design that are in harmony with the urban architecture in the site of commercial zone and zone of activities that designated with biomimetic approach.

4.1. planning of a vital mobility in Ouzera Town

The transport network plan for the city of Ouzera ensures seamless connectivity between the exchange hub and various urban areas with urban centre ,commercial center zones of activities forming a surrounding space around which urban life is organized , integrated with smart interface of City.

The service of taxi cater to the needs of urban services and accompagning healthcare services ensuring flexible mobility during the winter months and contributing to a vital urban environment throughout the four seasons

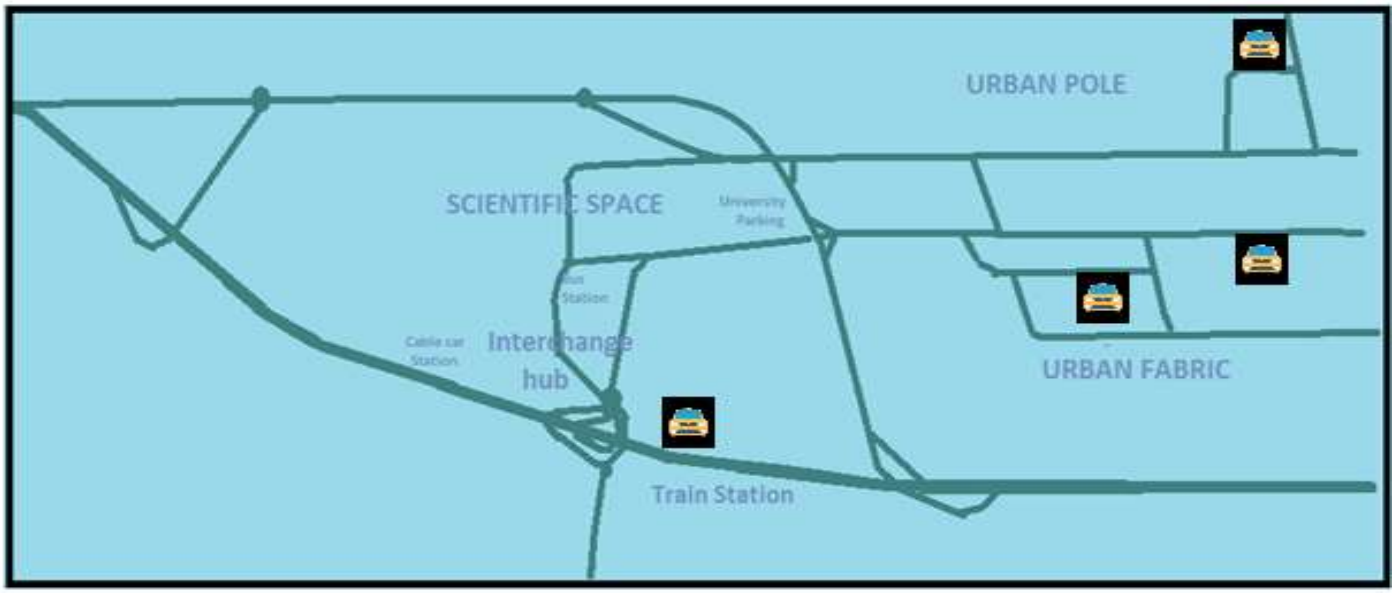

Fig5 : Network of transport system in Ouzera City at night (Author 2025)

4.2. Exchange hub in smart interface of Ouzera city

The exchange hub features a smart interface with its surrounding area designed to serve the specialized University hospital and the Campus of sciences and technologies .

The integration of this hub of transportation with the urban fabric aims to improve the efficiency of services , scientific spaces ,zone of activities and commercial activities and the overall vitality of urban areas by ensuring continuous transportation access.

The design of this exchange hub in Ouzera City also aims to build urban interface integrated with transport lines consistent with its function of connecting different modes of transportation in strategic and healthy area of smart city.

Fig6 :Tansport modes and services in exchange hub of Ouzera City (Author 2025:)**

4.3. Biophilic design for healthy optimized urban fabric

The biophilic design of the optimized urban fabric in Ouzera City is based on the health facility as a vital urban element.
The poluclinic is attached to garden whose design is based on the following elements:

- Nature in Space through Landscape architecture.
- Natural Analogue with smart vision.

The urban improvement is also designed for the alley that connects the square centre of city to the urban space near the policlinic ensuring easy access for pedestrians during rainy and snowy weather .
The alley is designed with a covered steps and the façade decorated with arches and aromatic plants.
The biophilic design is evident through the natural analogue highlighted in the night by lighting provided by the solar panels designed in one of the alley doors. Whose entrance takes the form of an arch in harmony with the garden entrances, which also appear with distinctive façades featuring solar panels.
The solar panels provide economical lighting at night in the garden and create a healthy urban atmosphere in the urban space of policlinic.
Through the landscape design , the presence of green elements within the urban space is ensured , the trees ans plants that form the garden improve air quality and enhance visual connection with nature.
The waterfall feature further enhances the façade , harmonizing with light of sun and at light of night for a distinctive view of garden.
The spatial configuration of the urban environment ensures quiet and distinctive alley that guarantee flexible mobility in vital urbanity and a harmonious fabric that serves public health.

Fig7 : Experimental garden in the urban fabric of Ouzera City (Author 2025;)**

The use of natural analogue in the design of garden includes the use of contemporary and organic materials such a wood in covered alley , and the architectural patterns in the façades form a distinctive architecture for the urban space , in which colors and materials are used that are in harmony the healthy urban space , and the ceramic panels of natural landscape add a cultural heritage that is clearly visible in the main alley of city square

4.3. Design of optimized zone for healthy urban fabric

The design principles of the optimized zone within urban fabric include the integration of biomimetic and biophilic designs.
The optimized zones designed optimally by integrating the area of sports and dedicated residence for patients companion in the pole of health .
This approach improves the quality of life by providing healthy and comfortable environments for the population and activating resilient means of transport within a sustainable infrastructure.
The biomimetic design of commercial zone and zone of activities are enhanced by an integrated urban fabric with an important facilities in city namely , a pool and a hall of multi Sport and an ecological area for individual sports.
The optimized urban fabric is designed for the pole of health using biophilic design approach to ensure a comfortable environment for the improved area near the area of activities.

This is clearly appeared by a space with waterfalls and ornamental trees in harmony with the architectural elements dedicated to collecting water in the area of activities .
These urban elements also maintain tranquility in the vicinity of the residence for companions of patient.

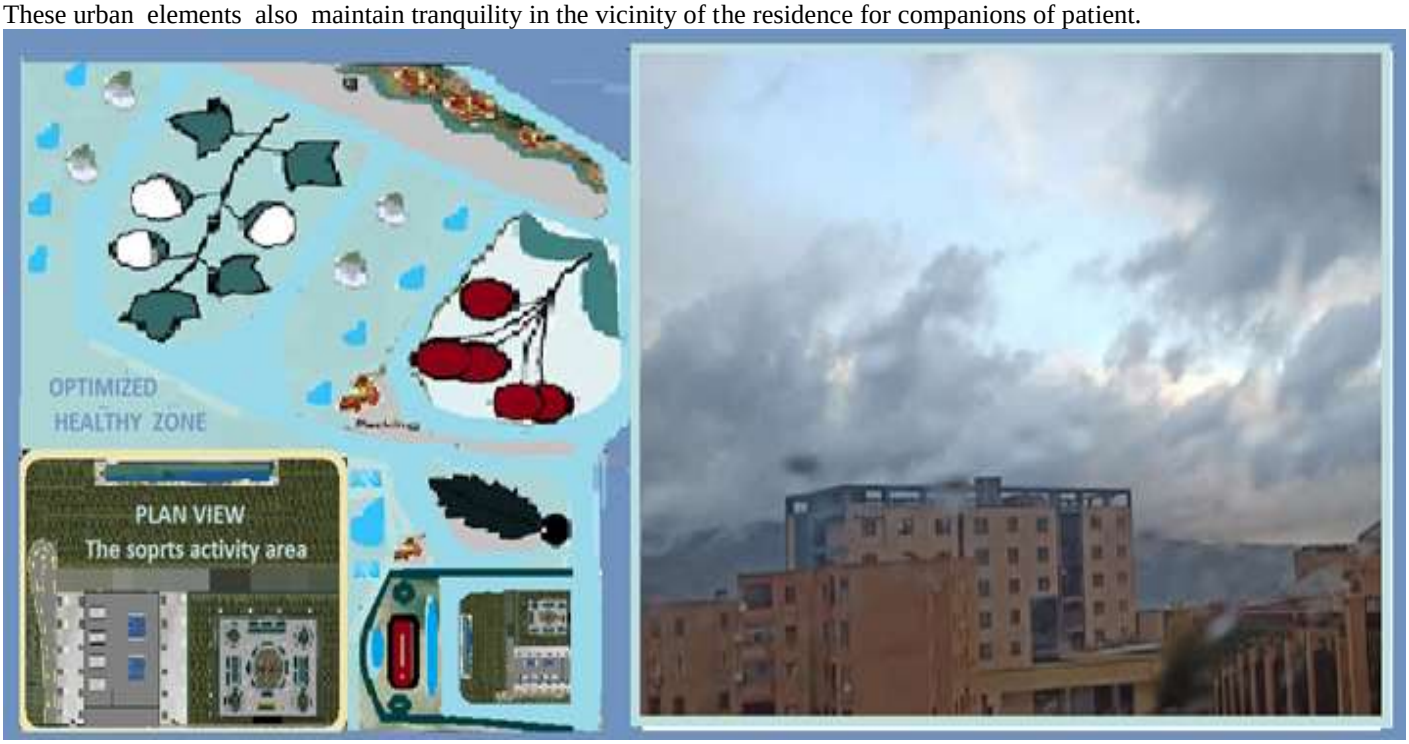

Fig8 :Biophilic and biomimetic design Of optimized area (Author 2025;*)

A distinctive sight towards the Atlas Mountains is designed from the public square , which is at the façade of the improved area characterized by green and blus networks.
The buildings of residence for companions of patients appears with an architecture distinguished by its tiled roof to serve as an architectural landmark by which the public square are known.
The wall that surrounds the residence adds an urban character with its prominent architecture of arches.
The biophilic design is clearly evident in the space of resience through the aromatic climbing plants .the integration of water and plant elements into the garden of residence and the use of natural analogues in the overall design of the residence for companions of patients

5. Combining effective mobility planning and biophilic design in Ouzera City

The approach of optimized zone in healthy and smart city of Ouzera is based on efficient and resilient mobility planning and biophilic design of healthy urban fabric and since the biophilic design appears integrated into the biomimetic design of high speed train station through the elements of design in the space surrounding the station and

Fig9 : Urban landscape Scientific space in Ouzera Town (Author ;*)

The efficient mobility planning in multimodal exchange hub makes the optimized areas vital zones in the service healthy landscaped site.

5.1. The suitability of site for vital mobility

Analyzing geography of site on the urban periphery in the south of Ouzera Town from accessibility and preferential connection perspective allows for an assessement of its feasability for urban development.
The selection criteria reflect this analysis of the issues at stake they notably includes :

- Land availability and the possibility of transforming the existing area on the urban periphery.
- The accessibility for various modes of transport particularly the possibility of building a bus station consistent with the emerging urban development of Ouzera and the North South Motorway.
- The capacity to accommodate all mobility services including smart parking , commercial spaces in the site of train station , and the possibility of establishing a cable car station within a scientific and healthcare area form a smart urban interface of smart healthy city.

The potential for connection with existing public transport lines and future urban territorial mobility lines.

Fig10 :Noth South Railway line ;Site Of Train Sation (Author ;*)
(Anersif/ National Agency For Studies And Monotoring Of Railway Investment)

The biomimetic and biophilic designs of the space of train station and rest area helps integrate the location of the exchange hub into the landscaped ecological space , which the distinctive design of the health science space and the land station contributes to shaping the smart interface of healthy City.

5.2. Integration of transports modes and provision of urban services

In landscaped smart interface

The services of transports in the vital street of city are integrated with restaurants and accommodation and the exchange hub with its smart environment forms the center of transportation in the smart city offering a variety of services including cafeteria , rest area and specialized facility of health .
The proximity of the train station and the cable car station ensure vital urban mobility and resilient mobility across the territories.
The southern gate of city is designed as an architectural icon that distinguishes the smart façade , and the western gate leading to the motorway is designed in the same architectural shape.
The architectural icons define the smart interface and highlight the vital road that integrates its urban services with the exchange hub centered in the Motorway and integrated transports networks.
Each architectural icon in the smart interface resembles the eucalyptus leaf in an areal view and the columns with their prominent capitals shaped like palm trees with biophilic design for the icon landmarks for smart interface of City.

Fig11:Iconic Gate of Ouzera City in the Smart Interface (Author 2025)

6. Planning urban territorial mobility

Based on the 2035 vision for Ouzera as healthy and smart city the regional urban mobility is being planned within the joint plan between the municipalities in the wilaya of Médéa and within the development p)lan of the wilaya of Médéa.

This plan aims to reduce congestion in the city of Médéa by using cable car line that connects the exchange hub in the smart city of Ouzera with the poles of Médéa city and the wilaya seat.

The cable car line serves as a smart gatway ro the city of Ouzera home to the scientific and healthy pole and a sustainable green bridge to the City of Médéa with houses the seat of the wilaya of Médéa.

This line will facilitates the relocation of future population density in the eastern suburbs of Ouzera with cold include new urban pole with capacity of 9000 housing unit.

This line also contributes to ,linking administrative services across the Médéa seat via the exchange hub of Ouzera ,which is directly connected the western region of Médéa via the southern bypass of Médéa city starting from the southern motrway interchange at the Kilometer Point 78 and reaching the western borders of the Médéa Daira at National Road N°18. Passing through the largest residential area in the southern area and the road continues as a road of fourth generation towards the interchange of the fourth ring Motorway

7. Conceptual reflection on cable car lines and territorial mobility

The cable car line in Médéa is one of the seven new lines programmed for the 2026 finance law in order to strengthen cable car transport lines in Algeria which is considered a strategic solution to overcome the topographical obstacles of the difficult terrain in Médéa and considerd an ecological means of transport with sustainablity compared to thermal vehicules.

The conceptual reflection of the cable car line includes achieving vital mobility across Ouzera region and ensuring urban resilience across the structural city of Médéa .

The line connecting the exchange hub of Ouzera and the city of Médéa to passes through the east southern gate of Médéa City and heads towards the northern gate of Médéa where the bus satation is located and ensures urban resilience through two mains routes that experience traffic congetion and whose roads are mondatory for passing towards Médéa center.

This line complements the souithern bypass reducing traffic congestion by up 50 % by ensuring smooth access for residents of southern an western neighborhoods to the North South Motorway directly via the new southerns gates to the City of Médéa.

The cable car line remains a vital transports link providing seamless access to the city enter from the north and east.

The new line of National Raod N°18 starting from Ouzera interchange toward the southern bypass raod of Médéa ensures a quick connection with the train station in the exchange hub in Ouzera City and ensures easy mobility and new line of transport passing through southern to western of Médéa without passing through the Médéa interchange in order to avoid traffic congestion in the

future due to the Médéa interchenge located near to the density populated residential areas.

To ensure efficient services to the Médéa Regions from the high speed train station the exchange hub is complemented by cable car line connecting Ouzera station to the station of Médéa seat passing through several important stations including.

- Médéa Southern Gate .
- Urban pole and University pole.
- Médéa bus station.

Médéa administrative Court.

Fig12:Releaf cable car lines (Author 2025,)**

The section can be designed as follows with the principle being a straight line between the seven stations including four terminal stations. This routes are primarily oriented North South, while the route connecting the bus station and the station of Médéa seat is oriented West East.

the flexibility of transport for the exchange hub of Ouzera city will be ensured through cable car line and the design thinking for a prototype cable car line aims to be tested technically in the final design phase

7.1. Landscaped section of the cable car line.

This section rich in natural landscaping connects two urban areas, it stretches for three kilomiters crossing hills and offering signts of the North South Motorway as well as the tell Atlas Mountains renowned for their snowy winter landscapes.

This section links the exchange hub of Ouzera City and the South Eeastern Gatway of Médéa city . it presents technical challenges as it cross high voltage electical lines requiring pylons to be designed to the necessary height to cross these lines in accordance with applicable standards.

This line extend to the terminal station in the urban pole in a vital area where the line heading towards seat of Médéa Begins.

Fig13:Landscaped section of cable car line (Author 2025,*)

7.2. Territorial urban section of the cable car line.

The urban sections pass through steep slopes and also cross urban roads and dense urban areas most of wich have fully finished building of a reasonable height for the passage of this type of cable car line.
This urban station face challeges in the constructioin of the pylons particulary regarding the terrain which necessitates a thorough geotechnical studies for the design of structues especially those located in sloping areas with fragile soils.
The section begins at the urban station and extends towards the bus station of Médéa.It relies on pylons that require careful design.
The final location of pylons will be determined after comprehensive site survey.
The stations on the urban sections require the use of suitable urban spaces
From functional stand point the urban pole site is ideal for the departure route for payment to Médéa center and to exchange hub of Ouzera with two adjacent stations for each route

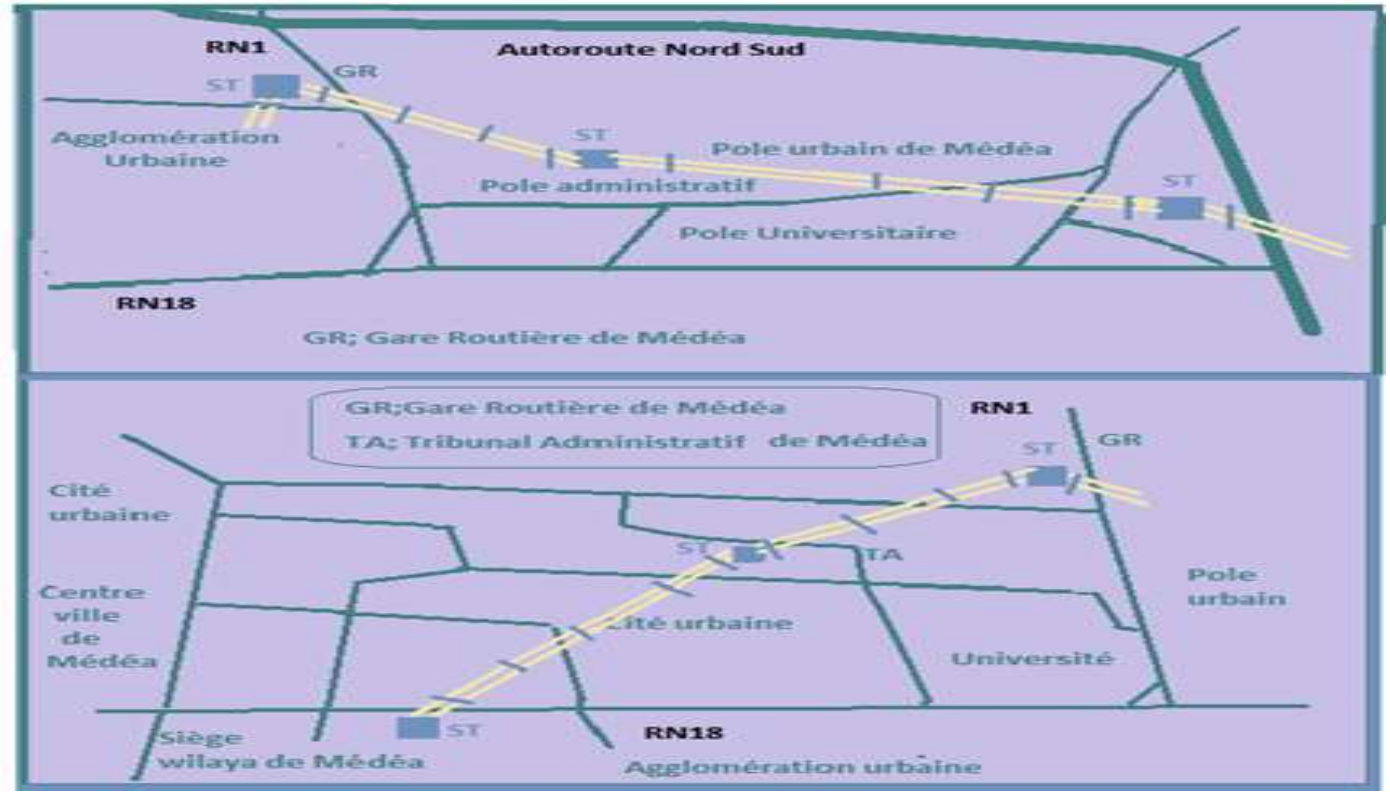

Fig14:Urban Section of Cable Car line (Author 2025)

8.Conclusion

Sufficient services are provided in Ouzera City with the specifications of smart city that serves health by improving access to facilities and residential quarters through biophilic design for optimized and integrated urban planning that includes sports facilities , public spaces and green spaces that promote urban health .
The health facilities are supported by accommodation for companions of patients suffering from chronic illnesses in order to provide integrated and effective services.
The urban fabric and its optimized urban space are linked to a multimodal exchange hub by providing a transport network that ensures vital mobility and rapid access to cervices of health especially in winter through the use of smart mobility applications.
The efficient and resilient mobility plan is being developed across Médéa region via the exchange hub strategically located in the City of Ouzera , and within an ecological space that serves health with specialized university hospital and a therapeutic pool.
The exchange hub is characterized by the diversity of transport modes and focuses on high speed train station and the land station near of North South Motorway .
The cable car station ensures the vitality of the ecological site and the continuity of services in healthy site as a line that connects the city center of Médéa provides a resilient and continuous transport services across the territories for the largest number of residents of the wilaya of Médéa and Visitors of Regions.

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