

A Proposal on U-Eco Space System for Sustainable Smart City

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ABSTRACT : Urban development and industrialization cause many problems on urban environment such as climate changes, natural disasters and a decreasing number of species. Problems on urban environment are the main factor of that lower the quality of life and obstruct continual development. As a result, eco space becomes the important part of an urban planning. We suggest accretion with Ubiquitous (Ubiquitous will be Written “U-”) technology to three physical divisions, which are lithosphere (land), hydrosphere (water), and aerosphere (air), that interact with the whole biosphere by forming a u-eco space system.

As examining U-Eco Space system from ecological aspect, green ecosystem and water ecosystem cannot be a perfect habitat only by themselves. U-Eco space system will be effectively function on the ecosystem When It have plan and design U-Eco space system with three elements U-Green belt, U-Blue belt, U-White belt. Ubiquitous technology will embody sustainable smart city with clean environment, health ecosystem and people convenience

Keywords: U-Eco City, U-Eco Space system, Ubiquitous, Eco

1. INTRODUCTION

Soil, water, air, animals, plants, and microorganisms; these are part of the Earth's environment and human beings continue to live their daily lives while being surrounded by them. However, the urban developments and industrialization have not given enough consideration about the city's environment or its ecosystem. Due to this, the damages done to the cities natural

environment have provoked problems such as changes in the city's weather, disasters, and decrease in the existence of living organisms. The problems concerning urban environment are one of the main reasons which cause deterioration in the quality of one's life, the growth of the economy, and the continuance of development in one's country. That is why the space of natural environment is being emphasized while planning an urban development, because it will enlarge both the citizens' expectation

on the basic standard of life and the overall living standard. By inducing the state of the art technologies produced by the advancement of the city's infrastructure, the convenience and safety of daily life will be guaranteed and that is why the request of nature and the city's environment co-existence is on the increase.

In order to solve the problems concerning urban development, this research will look into the country's entire district areas that are pursuing the U-City business that is aiming at the convenience of one's daily life. Three solutions will be proposed to foster a bridge between the environment and the city's space. All of them are physical divisions and they are green (earth), hydrosphere (water), and the earth's atmosphere. The three features will be merged with the technology of ubiquitous which will create U-Green belt for the green, U-Blue belt for the water, and U-White belt for the atmosphere. These will compose and increase the city's environmental health status and together, it will prevent calamities and give an effective rise to safety by creating U-Eco space.

2. Theoretical examination on U-Eco City

2.1 The Technology of Ubiquitous

Ubiquitous computing is a concept that has derived from Latin, meaning, "It hangs over everywhere," and "It always exists whenever, wherever," and it indicates environment that can be easily, conveniently, and safely used whenever, wherever, and by anyone through computer and network. Mark Weiser who has been named, "Father of Ubiquitous," initially put the concept "Ubiquitous Computing" forward in 1988.

After Weiser initially introduced the concept, the word "Ubiquitous Computing" has been used somewhere or other, and the meaning is keep changing inch by inch. Explosive diffusion of cell phones especially largely dilated the meaning of Ubiquitous Computing. So to speak, a contention that when it becomes to be able

to set a computer chip in mobile unit, which cell phone is the center, and use it 'anywhere,' it might be included in a sphere of "Ubiquitous," is being rising. Moreover, more and more people think that mobile units are playing the leading part of "Ubiquitous." Namely, the definition, "It is possible to use computer anywhere (there are computers in everywhere, and people can use them freely), has enlarged to "People can bring (small size) computers anywhere." Additionally, as computer chips are being built in electric home appliances, which are called information appliance, these also became to be possible to network, and named 'Ubiquitous'

To get a general image of the technology of ubiquitous, it is composed with RFID/USN, Sensor, IPv6, Cable and Wireless network, Middleware, Embedded S/W and other basic technologies. It also has a variety of technologies for practical services like GIS, LBS, and GPS. These technologies are not only used independently, but they are known to have greater effect if merged together as one.

2.2 General Idea of U-Eco City

Inducing cutting edge technologies to the cities by the cause of enlargement in the citizens' expectation on living standard will increase the convenience in life and safety. Also, the request of nature and the city's environment co-existence is on the increase. Relating to this issue, U-Eco city is the rising candidate as a future city, because it is composed of state of the art IT technology that is merged with the construction skills of ecopolis. Yet, the general idea of U-Eco City has not even been established, and already, some people are misleading the true meaning of U-Eco City by patching it up with fragments such as only 70 people per 1ha involving the population density, conducting more than 30% of park areas, and creating passageways that will prevent road kill of animals.

As seen in Figure 1, U-Eco City is a place where nature and human beings can

co-exist as a tower of strength that is intended for happiness. It is a natural city that shows how the intellectual ecopolis can live in the society of the while reconciling with human beings.

That is why U-Eco City can be justified as the following: “State of the art science technology has been applied and as part of the construction of the city, it is now seen as a complex organism. It is a city where new activities and attributes of the city are visible. A dream city for the future where the variety of pureness of the natural environment, circulation, and safety is intellectually harmonized with human being’s convenience. Where all mode of life can co-exist in peace in the space of the city.”



Figure 1. U-Eco City Philosophy

The important point here is U-Eco from U-Eco City is simply not a vocabulary that is combined with Ubiquitous and Ecology. The term is derived from the concept of the previous Eco-City which is ‘A city that is equipped with the agreement of humans and nature or environment.’ In addition, the ubiquitous 3 factors anytime, anywhere, any device and spaces, things, and interactive communication between people in the city have merged to see if these two can work out as an environment. Sections, spaces, and the pureness of natural environment of ecopolis and the ecosystem that becomes one through cable and wireless network gives the entire meaning of nature and environment as an integration. U-Eco’s notion is where humans, ecosystem, and the basic facilities for society are made for

pureness for the city’s life, environment, and space. For this, the 3 spaces that compose the city’s environment which are forest and green, water and river, air and atmosphere and the 6 ecological spaces which are greens, cropland, life, ocean, and underground can be explained as U-Eco.

Due to the U-Eco City’s elements that form the environmental space which are fresh forest and greenery, clean water and river, pure air and atmosphere, this research is classified into 3 sections. That is why U-Green belt, U-Blue belt, and U-White belt have been proposed.

3. A Plan for the Construction of U-Eco Space System

Soil, water, air, animals, plants, and micro organisms; these are part of the Earth’s environment and human beings continue to live their daily lives while being surrounded by them. However, since the 19th century, this environment started to collapse very rapidly due to sudden industrialization. The main reason was that cities were created without considering the environment.

With the purpose to solve the problems mentioned above, this research has proposed U-Eco Space System as well as system composed of the three physical features that can interact with all living organisms. They are green (earth), hydrosphere (water), and the earth’s atmosphere. The three features will be merged with the technology of ubiquitous which will create U-Green belt for the green, U-Blue belt for the water, and U-White belt for the atmosphere.

3.1 U-Green Belt System

3.1.1 The Elements of the Formation of U-Green Belt

The elements of the formation of U-Green belt include parks and forests that are also making up for the greenery of city. The lineups of the forest areas such as the side, lines, and raindrop details can be seen in table 2. Just like Figure 2, from the area of

the city to the greenery of the forest, the roadside trees, and groups of living organisms in rivers; all of these are connected with each other by covering the entire greenery of the city in order to fill in all the gaps. This is what makes the Green Network.

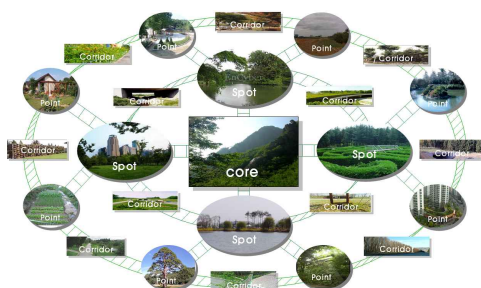


Figure 2. U-Green belt constitution

The selection of areas for the elements of U-Green belt formation is just like the following.

■ U-Green belt core zone: Core area in the U-Green belt will be the fountainhead of source of supply of genes for the diversity of living organisms. It will deduce a large scale of space for nature from preservation areas that has to do with nature and its eco system, nature and its environment, forestry, and protection of tide.

■ U-Green belt spot zone: Spot area connects the core and the dots. It selects large scales of natural parks, lakes, ecological parks, living organism parks, and urban areas to provide inhabitation vicinity for living organisms that are in the middle class of the ecosystem due to changes in the space.

■ U-Green belt point zone: Point areas are selected by focusing on tree planting areas. Gardens in houses or afforestation of rooftops, afforestation of walls and ponds, giant trees, gardens within cities, sequestered lands, roadside trees, plants, all of these can be among the candidates as long as they are based on spot biotopes.

■ U-Green belt corridor zone: Corridor areas may be a small scale, but it connects two areas of inhabitation which makes transportation possible for living organisms.

This plays an important role in the U-Green belt and it connects the core, core and spot, and spot to spot by lines creating a natural space for rivers and waterways. This allows the selection and creation of a biotope.

Using the technology of ubiquitous on the chosen regions mentioned above, information have been collected to protect the native plants and wild animals in the area from damage by blight and noxious insects as well as natural and human traces of disaster. By following the assembled data, U-Green belt system will be constructed to recognize and face these situations intellectually.

3.1.2 U-Green Belt System Flow

Large Category	Medium Category	Small Category
Facet Factor	Core	Ecological Conservation Area, Forest that is over 1 level 7 in Green belt, Environmental Conservation Area, Forest Conservation Area
	Spot	Large-scale Nature Park, Reservoir, Lake, Eco-park, Forest in a City
Point Factor	Point	Garden in a house, Roof Garden, Tree-planted wall, Pond, School Garden, Old Monumental trees, Kitchen Garden, Roadside trees, Flowerpots
Linear Factor	Corridor	Riverside Vegetation Zone, Trailside Vegetation Zone, Linear break wind/Traffic Noise Vegetation Belt, Quickset in a house

U-Green belt system uses core, spot, point, web cam (CCTV) that are in the corridor zone, RFID/USN temperature sensor, and humidity sensor to systematically monitor the native plants and wild life activities, territory, and their life. It also senses fire or drought of greens and the perceived situation connects the Actuator and the controlling center from the Gateway. The Actuator then, activates the Sprinkler to immediately take strong measures of the

conditions by either bringing the fire under control or providing water for the plants while the controlling center will automatically notify the related systems to recover and preserve the pure green environment. A construction of the U-Green System can be seen in Figure 4 to show these possibilities. By simply taking a look at the U-Green service, attaching an RFID tag to the tree will gear up the RFID Reader and the web database. This will measure the humidity of the greens through the controlling captain that is in charge of U-living organisms and humidity sensor which is responsible for the primary harmful insects of the trees and its life. If a sign of ambient temperature is given, the Actuator will activate the Sprinkler to maintain an appropriate humidity to prevent fire among the greens and with the temperature sensor, the U-fire controller will perceive fire outbreaks. Moreover, RFID tags will be attached to the native plants and wild animals and by using the CCTV, their transportation and territory will be checked by the U-native plants and wild animals' controller that is in charge of their lives.



Figure 3. U-Green belt application

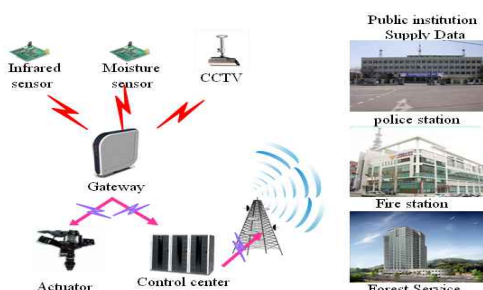


Figure 4. U-Green belt system flow

3.2 U-Blue Belt System

3.2.1 The Elements of the Formation of U-Blue Belt

The elements that compose the formation of U-Blue belt has paved roads for the vertical water circulation of the city and horizontal water circulation for the roadside, stormwater management, and best undercurrents. The elements shown in Figure 5 explains the theory of the water circulation and like this, water garden, streamlet, ecological ponds and grounds, lakes, and rivers will be repaired according to the space of the city.

The elements of the formation are as follows shown below.

- Paved roads that are able to breathe
 - Permeating and ventilating stormwater
 - Recovering the underground ecosystem
 - Contributing to expansion of natural grounds
 - Contributing to the maintenance of the city's water balance
- Storm-water sewer
 - Important position of horizontal water circulation
 - Function of Circulation pipe
- Streamlet
 - Formation of natural waterway that flows between complexes
 - Inhabitation of various swampy land vegetation
- Swampy land Eco-pond
 - Eco-pond with dragonfly, lightning bug, and so on's habitat function as the central feature
 - Performs functions as habitats of organisms and water-purification
- Stormwater reservoir
 - Purification of roadside pollutants
 - Stormwater, surface water, reserved water, and so on from adjacent forest
 - Formation of habitats of organisms
- Eco-lake Park
 - Educational and resting place for habitants
 - Generating habitat of various wild animals

■ Eco-river

- River that various swampy land ecology habitats
- Induction of nature river factors such as native rocks, swamps, shallows, and so on

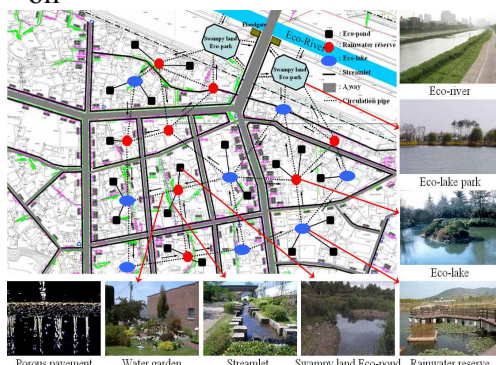


Figure 5. U-Blue belt constitution

3.2.2 U-Blue Belt System Flow

The U-Blue belt system is a designed water system that helps the circulation of the water resources in the city and it is able to sense the quality of water, the volume of the water, and the convention of the water. Also, the CCTV makes it become aware of water pollution, flood, drought, and any other signs of omens. When they actually do occur, the Actuator will automatically active the floodgate and it will pass through the circulation of the stormwater management. These will underflow the water that is overflowing and it will hold it as a water supply in case of water famine. Besides this, through the USN net that is made for the U-Blue belt, the water within the U-Blue belt will be able to move anywhere, due to the stormwater management circulation system that will be made intellectually for the purpose of care and control. What's more, the Storm-water sewer will be repaired according to the space of the city just like the Chonggyechon stream and thus, by providing an area of rest and culture where life is flowing inside the city, citizens will be able to recover their emotions. Figure 6 below shows the circulation system and Figure 7 shows the flow of the system.

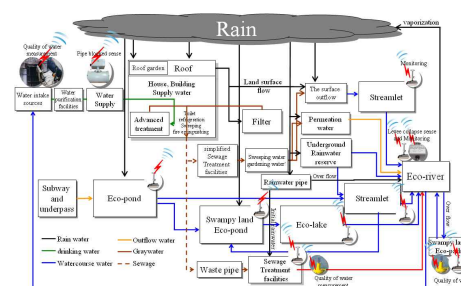


Figure 6. U-Blue belt circulation

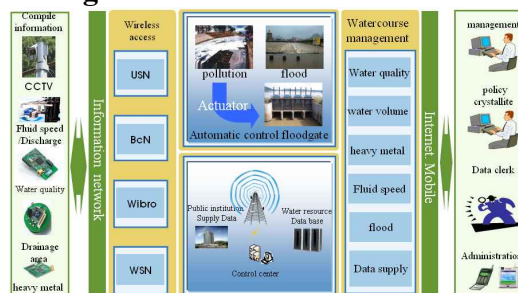


Figure 7. U-Blue belt system flow

For the purpose of controlling the water resources for the pureness of the city, the U-Blue belt system has prevented the bad quality of water and floodgates of effluent streams from flowing into the mainstream. This is made possible, because when there is a floodgate, a floodgate control called U-floodgate control will be activated and through USN, the discharge of sewerage and wastewater will be watched at all times. There will also be a U-disposal of sewerage and wastewater controlling system for this. Moreover, when floods and heavy rainfall occurs, the rainfall that will flow into the river will be detoured by making it pass through the circulation corridor. This will send it to several undercurrent places inside the city. This will block natural disasters caused by floods and heavy rainfalls and it will be called the U-flood and heavy rainfall prevention system. Besides these, there is the U-quality and volume of river control, U-Eco River, U-water resource controlling system, and much more.

3.3 U-White Belt System

3.3.1 The Principal Conducement of U-White Belt

Like Figure 8, when planning the unit of the earth, the pathway for the wind will also

be designed by considering the transportation of both the region and the mountain winds that are flowing following the water circulation and the greenery system. As you can see in Figure 9, creating enough open space between the surrounding of the grounds and the green parts of the mountains will also help gain an area where winds can flow so that the inner side of the city will be filled with cool and fresh air.



Figure 8. U-White belt wind road

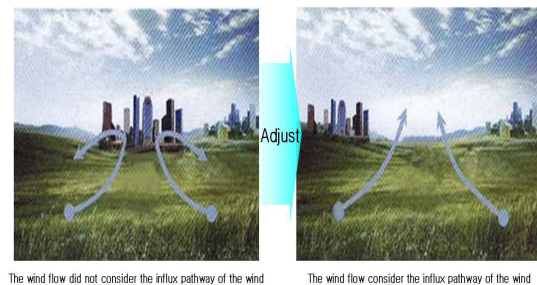


Figure 9. The influx pathway of the wind

3.3.2 GIS's Detailed Base for the Wind's Pathway

Fresh air can flow at the heart of the metropolis as long as greenery and water are designed to be connected during the construction of the city and planning out the wind's pathway so that polluting substance can escape is also essential. Using the GIS on to input the design of the earth's Land Use Data onto the Computational Fluid Dynamic (CFD) model must make the earth's surface deduce the wind spot, because that is the only way to make pure air flow within the U-Eco City.

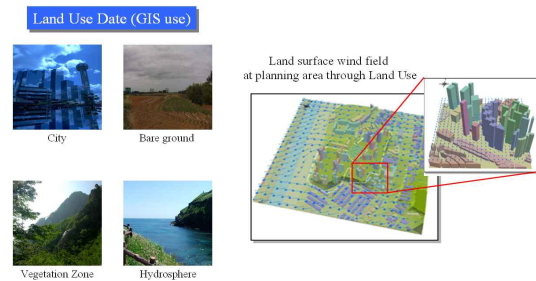


Figure 10. GIS based land surface wind field

3.3.3 U-White Belt Air Pollution Management System

Following the law of the atmosphere environment preservation, installing air sensors on all discharging facilities and in several other places within the city will prevent outbreaks of air pollution substances, because if this is linked with RFID/USN, the unification controlling center will be made to observe the discharge of air pollution substances. In case the quantity of the discharged air pollution substances goes over the baseline, immediate measures will take place. When accidents do occur, warning signals will be given to the damaged districts by using the neon signs and mobile phones. This will help minimize the damage for the citizens that are in the danger zone.

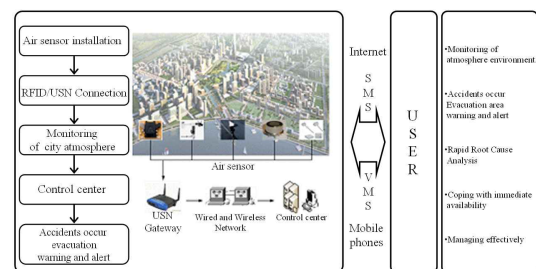


Figure 11. U-White belt air pollution management system

Furthermore, using sensors that are able to perceive tiny dusts and yellow sand that are here and there in the city will be notified to the citizens by using the U-yellow sand management service which will send messages and signals through mobile phones and neon signs. Lastly, when the temperature sensor is installed in the city, the U-heat island management service will

be in charge of the condition of the heat island.

4. Conclusion

While building the U-City, in order to solve the rising environmental problems within a city such as destruction of the resident's environment and the city's ecosystem, establishing the U-Eco City theory that is defined as merging the pure natural environment with state of the art science technology as one is the first priority. When thinking of U-Eco City "Adapting the state of the art science technology will allow us to see the elements of urban construction as one organic complex. The new activities of the city, its components and intellectually harmonizing the ecosystem's diversity, circulation, and safety of the pure natural environment of the city's space can be justified as to providing convenience for humans and ultimately being the dream city of the future for allowing all ecosystems to co-exist peacefully." That is why the U-Eco Space system has been proposed to create a high-technological city space environment.

U-Eco Space system has combined the technology of ubiquitous with the three physical divisions which are green (earth), hydrosphere (water), and the earth's atmosphere, that interacts with all living organisms. Accordingly, U-Green belt for green, U-Blue belt for water, and U-White belt for the atmosphere are the constituents. The purpose of the U-Eco Space system is to create a space where all living organisms can live a safe life in a clean environment. Hereupon, when constructing U-Eco Space system, merging the technology of ubiquitous such as RFID/USN, sensor, IPv6, cable-wireless network, middleware, Embedded S/W, GIS, LBS, and GPS can help put up the U-Green belt, U-Blue belt, and U-White belt. This in all predicts that, it will actively challenge against fire, drought, flood, water pollution, and other changes in the environment to provide a safer clean environment.

Also, when looking at U-Eco Space system from an ecological side, both the green and water ecosystem can not be considered as one perfect stronghold, because they are able to function properly as a stronghold and transportation corridor for wild animals when unified together. Considering these circumstance, it is better to plan out something that will combine U-Green belt and U-Blue belt, because these systems will be secured as a corridor for wind. Afterwards, fresh air will be able to flow in the complex while polluted air will be pulled out, creating an organic relationship.

Hence, when building a new city and from the perspective of the environment, merging U-Green belt, U-Blue belt, and U-White belt is much more preferable. As a final point, humans and nature as well as environment and the city's infrastructure should be intellectually harmonized so as to plan out a high-technological clean natural city by the U-Eco System.

REFERENCES

- [1] Kim, Gwi-gon. 2006. A Study On the Method of Planning An Uiwang-Poil 2 Eco-City. Korea National Housing Corporation. Korea
- [2] Kim, Gwi-gon. 2005. A Study On the Method of Construction an Pangyo New City Water Circulating System. Korea National Housing Corporation. Korea.
- [3] Oh, Kyushik. 2005. The Effects of Urban Spatial Elements on Local Air Pollution. Journal of Korea Planners Association. Vol 40. No 3. pp. 159~170. Korea
- [4] Lee, Dong-geun. 2000. A Study On the Establishment of Green Network to Design Eco-city, Sangmyung University Vol.9, No.0, pp. 44~59. Korea.
- [5] Gu, Ji-hui. 2004. A Study On the Applications of a GIS/LBS of Ubiquitous technique. Ministry Construction & Transportation. Korea.