웹 및 모바일 폰에서의 인터랙티브 3D-View 이미지 서비스 기술

Interactive 3D-View Image Service on Web and Mobile Phone

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Abstract This paper presents web service and service on mobile phone about research on virtual URS(Ubiquitous Robotic Space). We modeled the URS. Then, we find the location of robot in the virtual URS on web and mobile phone. We control the robot view with mobile phone. This paper addresses the concept of virtual URS and introduces interaction between robot in the virtual URS and human using web and mobile phone service. Then, this paper introduces a case of service on mobile phone.

Keyword: virtual URS, interaction, web service, mobile phone service

1. Introduction

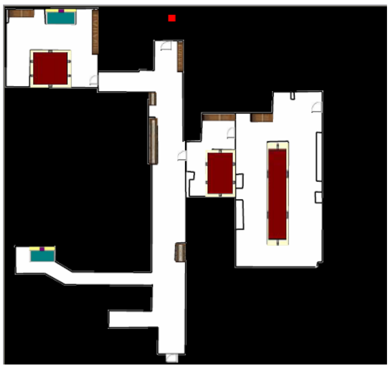
This paper introduces the concept of virtual URS (Ubiquitous Robotic Space) and its service on mobile phone. Here, URS means ubiquitous robotic space on which robot can communicate with sensors of USN (Ubiquitous Sensor Network). The virtual URS can provide virtual model of physical space and status of robot and salient objects for intuitive and interactive service.

For virtual URS service, there are several research issues, such as, how to model indoor physical space, how to represent robot status while coordinating between virtual model and robot on physical space, and how to interact or command to robot. Moreover, it is one of advantage of virtual URS to provide virtual robot path navigation on the virtual space.

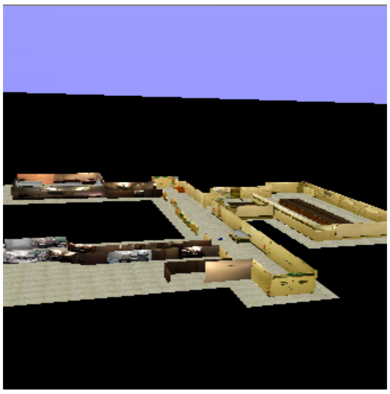
We present our simple and easy to use method to build both of 2D map and 3D textured model. Here, we build 2D map using 2D laser scanner while acquiring texture images at the corresponding position. For simplicity, we assume that the wall is orthogonal to 2D map and then the texture acquired was mapped into the corresponding wall. So, our approach builds a hybrid model of the environment by extracting geometry and using texture mapping. Our researches on the virtual indoor environment modeling can be used for the application of remote surveillance, game contents, museum indoor modeling and so on. Our 2D/3D indoor map has the following features.

First, the developed indoor 2D/3D map is based on standard format, SVG format for 2D map and VRML format for 3D map. It has an advantage in view of 2D/3D map compatibility to users. Second, the 2D/3D map can be accessed through internet explorer everywhere. It should be noted that the traditional approach requires the installation of special client program. Third, we also address mobile application for remote access. Our SVG 2D map can be accessed with WIPI based cellular phone. For accessing 3D map with WIPI based cellular phone we go through the specific process.

Figure 1, Figure 2 show 2D SVG map / 3D VRML map.



<Figure 1. 2D SVG map>



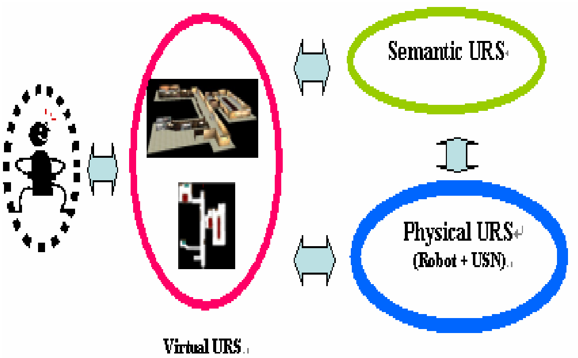
<Figure 2. 3D VRML map>

In this paper, We present the process for 2D / 3D map service on web and mobile phone. We also address mobile application for remote access and interaction between robot and human.[1-4]

2. Virtual URS

2.1 Concept of Virtual URS

The virtual URS is a virtual space for intuitive human-URS (or robot) interface.

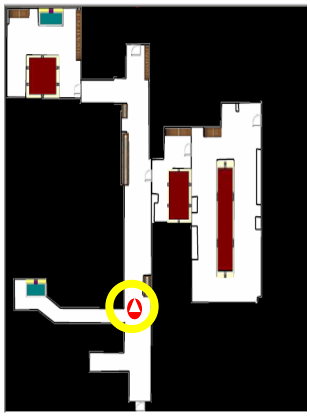


<Figure 3. the concept of Virtual URS>

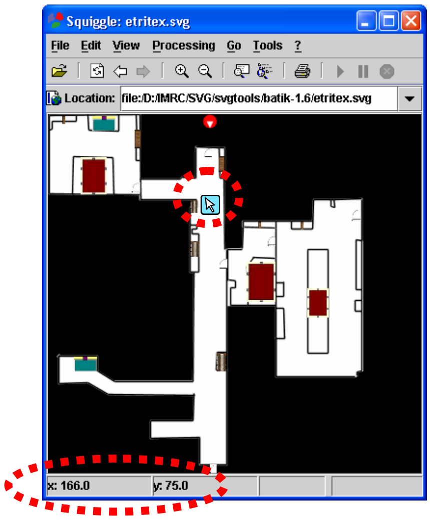
Basically, the virtual URS provides 2D / 3D Model of URS, which supports indoor space model, object model and status update according to event occurred in physical URS. In other words URS is the virtual space where robot moves.

2.2 Robot positioning and path planning

The virtual URS also provides the functions such as, display of robot location of physical URS and planning & commanding of robot path.



<Figure 4. Robot position display>

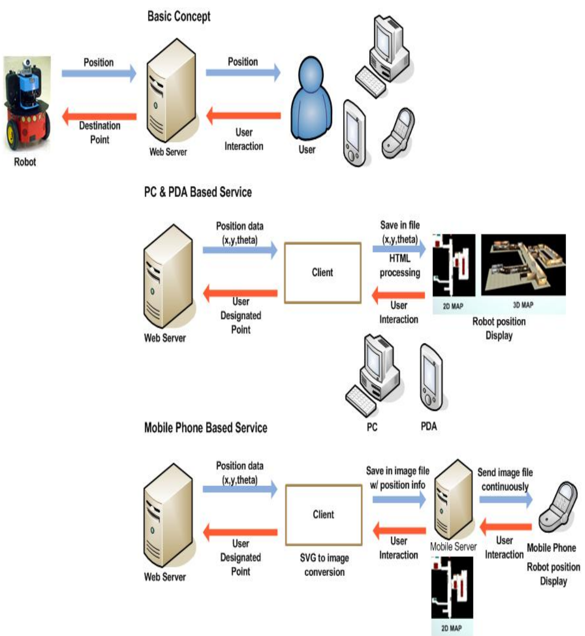


< Figure 5. Robot positioning >

<Figure 6. Robot path planning>

2.3 System Architecture for Virtual URS Service

We would like to control the remote robot and recognize the circumstance of that environment from robot using our result which is 2D and 3D map. The 2D and 3D map which we see are the VR space and through the VR space, we can interact with real object which is robot. In order to that, the user has to have the 2D and 3D map first to control the robot and there has to be somewhat connection between user device terminal and robot. Figure 7 shows overview of interactive robot service platform. The robot position and viewing angle are continuously updated to web server and user get that information from server and see that in map that user has. On the other hands, when user wants to move the robot to check the status of some point in environment, user designate the desire point using map and that information is passed on to robot trough web server. User can see that robot reaction in the map and get the required status of environment by interactive action with map.



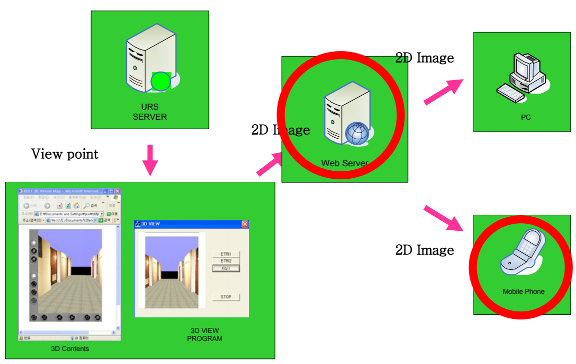
<Figure 7. Overview of interactive robot service platform>

As shown in the Figure 7, we can use the PC, PDA and Mobile phone as the terminal of our interactive robot service into account. In case of PC, the resource is much more abundant than PDA or mobile phone so that it is comparatively easy to implement. However, in case of PDA or mobile phone, we firstly have to consider the platform in view of computing resource and implementation convenience. Here, we use the SVG and VRML viewer to display SVG and VRML format and the Javascript to process the interaction information of robot and user in PC terminal. In PDA terminal, we use same method to PC terminal, but if the texture size increase, it is hard to display 3D map in PDA due to computing resources. So, we only take the 2D map into account to display and interact in PDA and mobile phone. We develop in Window CE platform for PDA.

In case of mobile phone, there is limitation to display SVG format in mobile phone due to lack of SVG player in it. We alternately choose the method of transferring image of SVG file with interactive information. VRML file also can't implement in mobile phone. So we convert 3D VRML model to 2D image file. When the web server sends robot position to client computer, client computer receive that information, generate robot position information involved SVG file / VRML file and make it image file. And then, the client computer becomes a mobile server which sends the image file to the mobile terminal. After all, existence of the client computer that process interactive information is caused by lacking the SVG / VRML player in mobile phone originally. WIPI platform for mobile phone especially support the C and Java language in implementation. This is one of the important reasons why we choose the WIPI platform in case of mobile device.

3. Web and Mobile phone service

The 2D / 3D models of URS are implemented with SVG / VRML. We can see our 2D / 3D map in any internet explorer browser just with SVG/VRML plug-in and interact with robot in remote environment through 2D / 3D map. Additionally we also implement SVG / VRML browser for web and cellular phone application.[5].



<Figure 8. Web and Mobile Service>

Figure 8 shows the process for web and mobile service of 3D map.

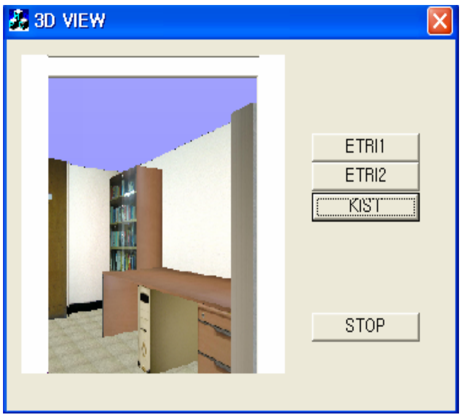
URS server receives robot position from robot. Then, server sends robot position(view point) to server where 2D / 3D model exists.

SVG can't implement SVG (2D model) and also can't implement VRML (3D texture model) for cellular phone application.

So we convert SVG file to image file in the case of SVG. In the case of VRML we similarly convert 3D VRML to 2D image and transmit 2D image to mobile cellular phone in real time. We make a 3D view program. The role of 3D view program is to capture the VRML 3D view and save it by 2D image file. There are 3 URS zones where robot moves. So we capture 3D robot view in 3 URS zones at same time. The time interval capturing 3D robot view is 0.5 second.

After capturing 3D robot view, 2D image file is generated. In other words 2D image file is generated per 0.5 second. And the generated image is saved in database. Because robot moves, all processes are executed in real time. So the image file is updated continually.

Figure 9. is result when executing 3D view program.



<Figure 9. 3D View program>

3.1 Web service

For web service, we link web server with database where image file is saved. So we can see the map on web. Because image file is updated in real time, we can see the updated image on web. Figure 10 shows web page.

When clicking button of region to see, we can see the map.

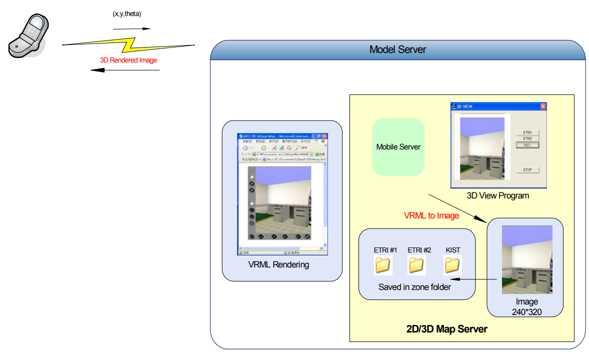
<Figure 10. 3D map on web page>

3.2 Mobile phone service

For cellular phone 2D map service, SVG file can be rendered with internet explorer browser. We also implement SVG browser for cellular phone application with WIPI[5] (Wireless Internet Platform for Interoperability) based mobile phone which is Korean Standard Wireless Internet Platform for mobile device. Fig. 9 shows the rendering of 2D map model with WIPI based cellular phone.

For cellular phone 3D map service, we download the image in the database. Cellular phone is client and database is in our server at this time. So cellular phone connects to the server and takes the image in the database in real time. We use TCP/IP socket for connecting server with client. The phone we use is WIPI phone.

Figure 11. shows total process for mobile service.

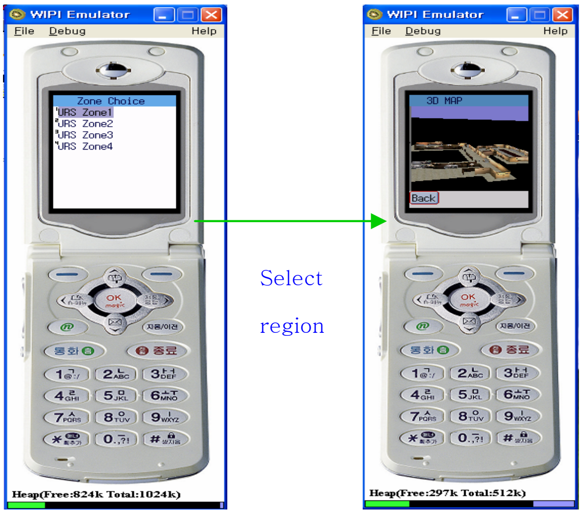


<Figure 11. Process overview for mobile service >

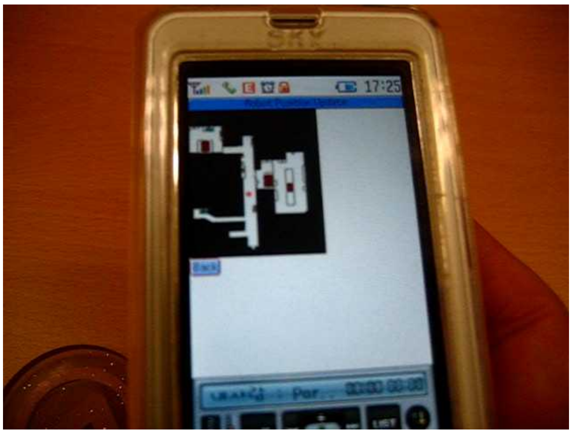
Robot interactive service is possible in cellular phone. If we want to look at the specific view, we can see the view through controlling cellular phone button.

Figure 12 shows 3D map on emulator. There is the limitation of file size on emulator.

We can control the robot and find location of robot in mobile phone.



<Figure 12. 3D map on emulator>



< Figure 13. 2D map on mobile phone>

<Figure 14. 3D map on mobile phone>

4. Conclusion

We did modeling for building 2D and 3D model for virtual indoor environment. As a real application of the presented algorithm, data set of 83 images and 2D metric map data was recorded at ETRI 7th building 1st floor, covering parts of a region of about 25 × 25 meters. The 2D map was shown in Figure1 and a screen shot of the final textured 3D model is shown in Figure 2. The 2D map data that we generate are 112 wall planes. This model is generated as VRML format and it can be viewed in a web browser with a VRML plug-in. We see our technique as a successfully easy and simple method to generate 3D model. The big advantage of our method is in vivid described model that is texture of model is very realistic. In order to communicate with robot and human through virtual model like the 3D model in our paper, it needs to be very accurate and realistic. We are confident to build a 3D model simply and easily in human's wants that is realistic enough to interact with robot. And we will control the robot using mobile terminal (PDA, cellular phone etc). Our system will be applied for robot positioning and robot path simulation as shown in Figure 5 and 6.

Finally, we built 2D and 3D model for virtual indoor environment. Regarding our future work, we will develop our algorithm in terms of more automatic processing of 2D map generation and texture matching. And by modeling the object in environment, we will be able to get more intuitive and understandable 2D and 3D model to interact with robot in remote distance. Moreover, interacting information that we use now are just robot position and rotation. The user might have more immersed feeling through additional environment information like sensor status in that environment.

5. Reference

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