



**Institute of Internet and Intelligent Technologies**  
Vilnius Gediminas Technical University  
Saulėtekio al. 11, 10223 Vilnius, Lithuania  
<http://www.isarc2008.vgtu.lt/>

**The 25<sup>th</sup> International Symposium  
on Automation and Robotics in Construction**

**June 26–29, 2008**

**ISARC-2008**

## **AN INTRODUCTION FOR MEGA HOUSE**

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### **ABSTRACT**

Life cycle information integration is a significant to construction projects. Radio frequency identification (RFID) technology is highly potential for integrating the information over the construction life cycle. Saving information with RFID tags, essential information can be saved and updated along different phases of the construction life cycle. Moreover, Open-Building (OB) is an ideal platform to implement the life cycle information integration. Therefore, this project constructs an Open-Building “MEGA house” with four major issues, namely (1) Material, (2) Electronic, (3) Green, and (4) Automation, during MEGA house life cycle. The Material issue focuses on material sustainability. This project uses Nano-coating materials on the building’s outer walls. Accordingly, the walls can get clean by themselves. Besides, due to the request of change older, extension, rebuilding and relocation, the natures of open buildings were facilitated to the MEGA house for decreasing materials consuming. Secondly, Electronic denotes electronic facility networks. This project employs the RFID technology for systems of door control, sensor network, wireless air conditioner and an information doorplate to increase living safety, decrease energy consuming and keep essential information available. Moreover, Green means green concepts in the building design. The facilities including 3-in-1 solar panel, insulation glass, solar chimney and earth tube were implemented in the MEGA house, where the 3-in-1 solar panel provides clean energy for the building; the insulation glass keeps the extremely sunlight out of the building; the solar chimney makes a fresh air circulation with low power consuming, and the earth tube transfers the underground temperature with a thermal conduction exchange mechanism to keep the indoor temperature stable. Finally, Automation presents automatic building construct with information technology (IT). This project developed RFID Life Cycle Information Management System (RFID-LCIMS) to integrate the life cycle information related to the construction management. In the design phase, the information essential for construction was stored in the RFID tags embedded in building components. So that engineers not only track and monitor components’ construction states in the construction phase, but also the information for the demands of building extension, rebuilding or relocation can be retrieved in the maintenance phase. Summarily, this project focuses on the MEGA issues for the sampling house. This paper introduces this “MEGA House” project in Taiwan through this forum.

### **KEYWORDS**

Construction life cycle, radio frequency identification, open-building, MEGA house.

## 1. INTRODCCTIONS

### 1.1 Background and propose

Construction life cycle information integration is a significant to construction projects. The related information must be accessed and exchanged between life cycle phases. Therefore, each life cycle phase must be feedback its information for other related phases. The Radio frequency identification (RFID) tag is an ideal medium storage which can be embed in buildings to enhance the self-data-providing abilities of building. Therefore, RFID technology provides high potentials for integrating the information across different phases in the construction life cycle. RFID technology was widely applied in the construction industry such as Song [1] uses RFID technology to automating tracking the pipe delivery. Ghanem [2] uses RFID for real-time estimation the productivity and efficient. Cheng and Ergen [3,4] use RFID to management the life cycle data in to a streaming information flow. Wang [5] uses RFID to automated collection the construction quality inspection information. Wang [6] uses RFID to develop a mobile devices PDA and web portals system to providing dynamic supply chain operation control and management, and applied in construction industry either [7-9]. The Open-building (OB) is an ideal platform to implement the construction life cycle information integration. The open-building architecture philosophy was applied in more and more building projects, due to the waste and resource consuming resulted from building reconstructions [10]. This paper focus on apply RFID technology in the open-building namely "MEGA House" life cycle. By saving information within RFID tags, the necessary design parameters can be passed to the different phases of the MEGA house life cycle.

### 1.2 Objective

1.2.1 RFID life cycle information management system development:

The RFID technology is a major part in this paper. This paper aims to develop an RFID Life Cycle Information Management System (RFID-LIMS) to integrate necessary information through the whole life cycle of MEGA house.

1.2.2 Manage and monitor the MEGA house whole the life cycle by RFID-LIMS:

Apply RFID-LIMS to manage and monitor the planning/design, construction, maintaining and Re-location phase necessary information of the MEGA House.

1.2.3 Systematic open-building construction framework Development:

Base on the MEGA house life cycle and applied RFID technology, this paper develops an open-building construction systematic framework. To provide the users have a standard and systematic method to build the open-building house and using RFID technology during the construction life cycle.

1.2.4 Various technologies for the open-building MEGA house:

This study not only applied the RFID technology but also has various technologies for the open-building MEGA house, such as Nano-coating, Sensor network system, RFID Door control system, Insulation glass, Earth tube, Solar Chimney and 3-in-1 Solar Panel etc. The various technologies will introduce afterward chapters and sections

## 2. PROJECT OF MEGA HOUSE

The project of open-building MEGA house is a third floors building. The section drawing shows at Figure 1. MEGA house is a four years project includes planning/design stage, construction stage, maintaining stage and re-locate stage. Each stage works shows at Table 1.

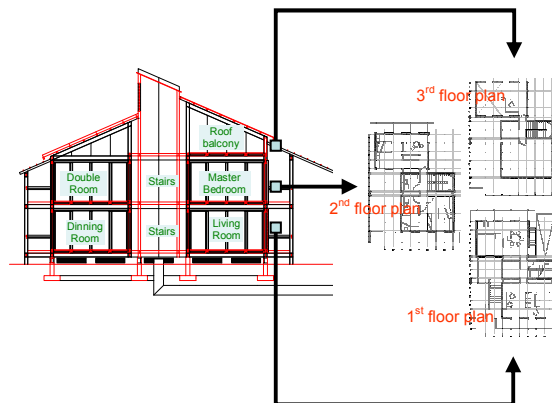


Figure 1. MEGA House section drawing

Table 1. MEGA house each stage works

Stage	Works
Planning/ Design	MEGA house planning and design RFID base Life-Cycle Information Management System (RFID-LIMS) development
Construction	MEGA house components manufacture and construction RFID base Rebar Inspection System (RFID-RIS) RFID-LIMS implement and validation RFID base Material Management System (RFID-MMS) development RFID base Construction Management and Labourer Safety System (RFID-CMLSS) development Nano-coating Energy conservation components installation (solar chimney, 3-in-1 solar panel, insulation glass, earth tube)
Maintaining	MEGA house extension mechanism RFID base Sensor Network System (RFID-SNS) development RFID base Door Control System (RFID-DCS) development RFID base Doorplate Information System (RFID-DIS) development RFID base Facility Management System (RFID-FMS) development RFID base Approach Pipeline Positioning System (RFID-APPS) development
Re-locate	MEGA house re-locate mechanism RFID-LIMS final validation

### 3. ISSUES OF MEGA HOUSE

The term of MEGA is mean combining (1) Material, (2) Electronic, (3) Green and (4) Automation for mechanisms integration. This project constructs an open-building MEGA house with four major issues during the Construction Life Cycle. The MEGA house 1:10 scale model already constructed (see Figure 2). This 1:10 model include (1) Nano-coating, (2) Sensor network system, (3) Door control system, (4) Insulation glass, (5) Earth tube, (6) Solar chimney, (7) 3-in-1 solar panel and (8) RFID-LIMS integration. The detail concept will introduce with the term of M, E, G and A as the follow.

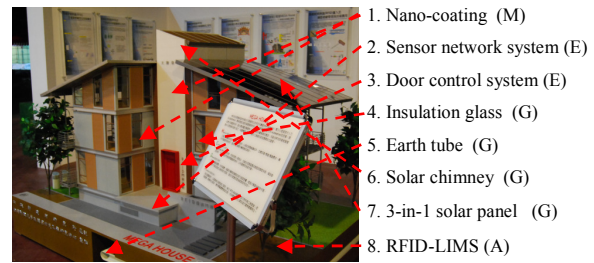


Figure 2. 1:10 scale model of MEGA house

#### 3.1 Material-M

This project uses Nano-coating materials on the building's outer walls and earth tubes. Accordingly, the walls and tubes can get clean by themselves to reduce clean frequency and reduce maintain cost (see Figure 3 and Figure 4). Besides, due to the request of change older, extension, rebuilding and relocation, the natures of open buildings were facilitated to the MEGA house for decreasing materials consuming.



Figure 3. Out-wall before/after use Nano Coating.

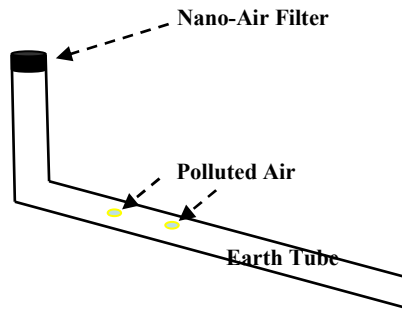


Figure 4. Earth tubes use Nano-Coating.

### 3.2 Electronic-E

Electronic denotes electronic facility networks. This project employs the RFID technology for systems of door control (see Figure 5), information doorplate (see Figure 6) and sensor network wireless air conditioner (see Figure 7) to increase living safety, decrease energy consuming and keep essential information available.

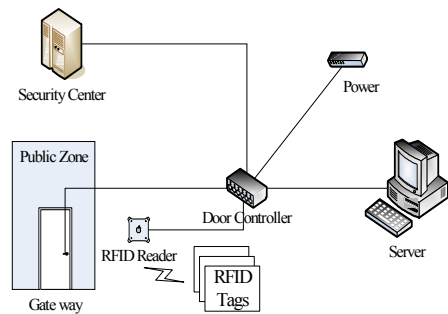


Figure 5. RFID door control system

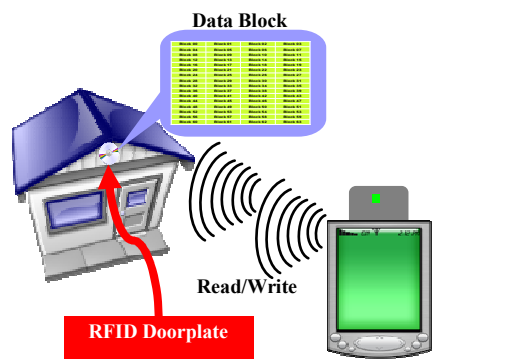


Figure 6. RFID information doorplate system

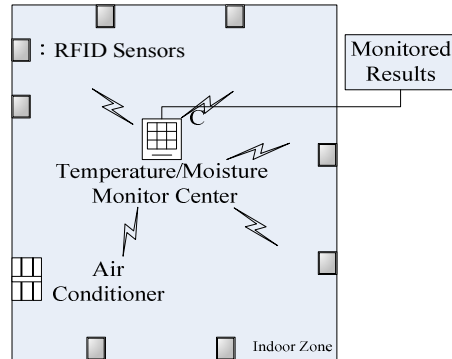


Figure 7. RFID sensor network system

### 3.3 Green-G

Green means green concepts in the building design. The facilities including 3-in-1 solar panel (solar, insulation and self-clean), insulation glass, solar chimney and earth tube were implemented in the MEGA house (see Figure 8), where the 3-in-1 solar panel provides clean energy for the building; the insulation glass keeps the extremely sunlight out of the building; the solar chimney makes a fresh air circulation with low power consuming, and the earth tube transfers the underground temperature to keep the indoor temperature stable with a thermal conduction exchange mechanism. Besides, this project behave in conformity with energy conservation design, the steps are: (1) collection the simulation parameters, (2) simulation and development network system, (3) validation and implementation network system base on the monitoring and response feedbacks, (4) adjustment the MEGA house facility on/off to effeteness the energy use (see Figure 9).

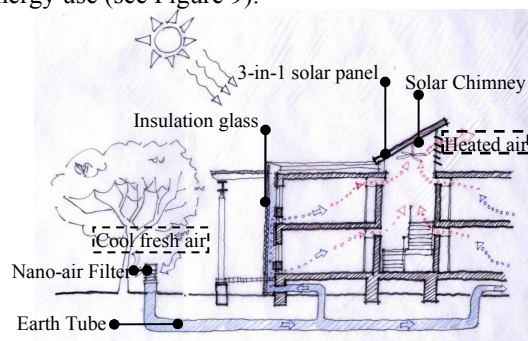


Figure 8. Air circulation mechanism

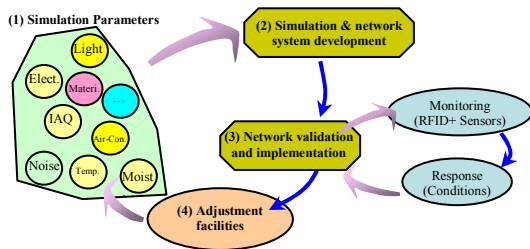


Figure 9. Energy conservation concept

### 3.4 Automation-A

Automation presents automatic building construct with information technology (IT). This project developed RFID Life Cycle Information Management System (RFID-LCIMS) (see Figure 10) to integrate the life cycle information related to the construction management. In the design and manufacture phase, the construction life cycle essential information was stored in the RFID tags embedded in building components. So that engineers not only can track and monitor components' construction states by the RFID + 4D real time monitor (see Figure 11) in the construction phase, but also the information for the demands of building extension, rebuilding or relocation can be retrieved in the maintenance phase.

### 4. CONCLUSION

The MEGA house focuses on sustainable “Materials” use and components recycling for decreasing materials consuming.

The MEGA house realizes “Electronic” house and smart building philosophies by combining the RFID technology.

The MEGA house combined with energy conservation facilities to enhance the energy conservation efficiency of “Green” buildings.

The MEGA house combined with RFID and 4D technology to provide “Automation” construct and manage the buildings.

The systematic open-building construction framework can be developed by combining RFID with open-building philosophies and provide the engineers frame of reference.

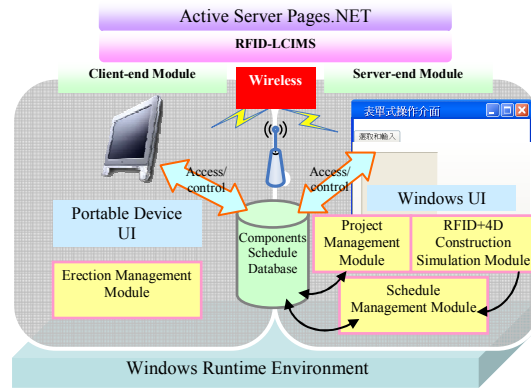


Figure 10. RFID-LCIMS structure

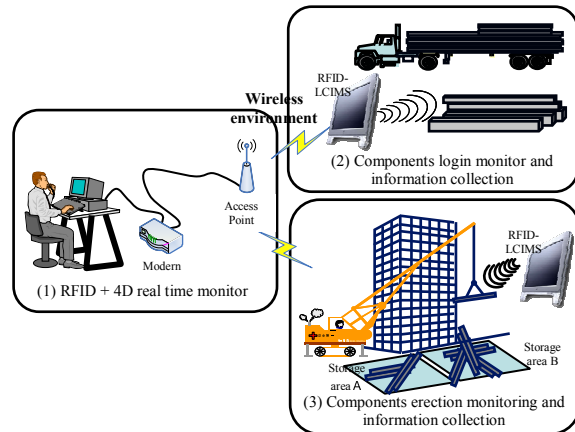


Figure 11. RFID-LCIMS 4D real time monitor

Summarily, this project focuses on the MEGA issues for the sampling house and the development experience in Taiwan was introduced in this paper.

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