1. INTRODUCTION

Interaction design is an integrated discipline of designing interactive environments, digital products, and services for our everyday lives. Most interaction design research and practice is aimed at supporting computer-augmented artifacts and graphical user interfaces, and user experience [4, 8]. Increasingly, interaction design is increasingly adopting a broader approach that takes into account space, architecture, and cities [2]. Research work in interaction design is addressing user experiences in the city- the physical, the social, and the sensible [5, 7]. This paper presents a novel approach to reimaging humane cities by introducing interaction design to an interactive design studio. The student-created interaction design projects are exhibited in a remodeled old house in a historical city. The process, method, and outcome of interaction design practices are explored for culture and urban revitalization.

Keywords: Interaction Design, Humane Cities, City Sense, Smart Living

2. A SHIFT TOWARDS AN URBAN AGE

The primary challenge in interaction design practice is how to use state-of-the-art human-computer interaction technology to augment human experience. While this is an important and on-going grand effort, some researchers argued the key change of human-computer interaction is the shift towards an Urban Age. When speaking of an Urban Age, people predict that quality of urban life will largely depend on the abilities of cities to reach their full potential. If we want to apply information technology to improve the quality of life, we need to highlight some of the issues of future cities. It has been argued that the realization of a humane city could contribute to reducing some of the problems that are faced by today’s cities. Interaction design practice needs to shift to investigate human experience from two perspectives: how to manage a person’s life in future cities, and how to manage the urban environment of future cities [6].

Based on the recognition of Urban Age we have entered, we initiated an interaction design studio towards urban regeneration. The primary focus of the interaction design studio is to create design examples of human-computer interaction that are responsive to the urban environment. The student-created interaction design projects (i.e. the outcome of the interaction design studio) were exhibited in a remodeled old house in Tainan City, a historical city in Southern Taiwan. The interactive exhibition in the old house was expected to play a unique role of information hub revitalizing the environment of old communities. The theme of interactive exhibition is called “Re-imaging Humane Cities”. The process and the consequences of this interaction design studio and exhibition will be elaborated in more detail in the next section.
3. A FRAMEWORK

This paper presents an approach to augmenting our smart living with these interactive technologies. The physical devices (e.g. personal devices, sensors) are networked with city information, all connecting together to support a smart living pattern. A smart living environment should be both green and humane. Green means a more sustainable, more energy efficiency and more healthy environment. Humane means that smart technology should augment human’s capabilities, such as mobility, memory, and health.

A framework for support a smart living environment is presented in Figure 1.

As wireless broadband sensor network, smart home and industrial applications, information security and other cross-field technological progress, which shape the smart network environment infrastructure. The development of ubiquitous smart living environment can support the different levels of smart interactive devices.

1. Personal Devices: such as PDAs, smart phones, tablet… personal device can manage personal information in daily life. Users directly manipulate the interface with the devices; users can directly receive information and output the instruction.

2. Architecture / Environment: Intelligent environment around the sensors and actuators, where can record the environmental information and amplify personal devices’ computing capacity, which can provide a ubiquitous computing space.

3. Smart Living: Integrated personal device with the sensor network in smart space that connect people to people, people to space, which not only provide data transmission, but also become a smart social network. The smart living should become an integrated new living pattern with personal devices in smart environment with sensor network.

4. Humane Cities: Extended to the city-level information, integrated all the city information into system, which includes education, healthcare, public safety, energy utilities, social services, traffic, communications, economic development… all the integrated information can provide us a smart and sustainable future living in a humane city.

4. INTERACTION DESIGN STUDIO

The interaction design studio course was structured through four, themed projects. Each successive project incorporated a theme and methods from the design pedagogy. Each project addressed a different aspect of technological, spatial, and cultural issues.

- Physical Computing
- Interactive Architecture
- Pervasive City Sense
- Augmenting Smart Living
- Re-imaging Humane Cities

The course was organized by combining inter-disciplinary approaches, including human-computer interaction, architecture, and industrial design. A similar approach to teaching interaction design practice was reported in [3]. Our approach is different in that we placed a strong emphasis on design, making, and exhibition in the real-world context. Students came from different background, including architecture, industrial design, media, education, journalism, etc. Their works were essentially tested and evaluated by the visitors of interactive exhibition.

4.1 Physical computing

Physical computing introduced human-computer interaction technology by making physical interface, software interface, and electrical interface. The interface is the medium of the communication between the user and the system. Students were asked to connect sensors to the inputs to convert physical interaction like touch, motion, and sound into electrical energy. Motors, speakers, and other actuators may attach to outputs to convert electrical energy into physical actions. In essential, students learned programming interactivity by designing how the input changes affect the outputs.
The first stage focused on physical computing that used physical inputs to produce digital or physical feedback. Students began to write code, work hardware, and create simple interactive installations using Arduino with Max/MSP and Processing. The making and programming activities are shown in Figure 2.

Interaction design is more than the use of an interface. The designers must ensuring that users always know what the system is doing at any time, and understand how their modifications to one aspect of the system might affect another. The difficulty of creating this kind of interaction is to find the “right” physical interface that can provide affordance for users. A good interaction design gives good cues that help users understand what’s going on.

4.2 Interactive Architecture

A challenge that emerged is that interaction design is focused on problem exploration in addition to problem solving. In order to explore real-world problems, physical computing is followed by brainstorming. An intensive one-week design workshop was conducted to brainstorm in order to generate ideas on a specified topic.

The notion of “interactive architecture” was chosen as a workshop topic for prototyping interfaces in the context of our built environment. Interactive architecture is defined as an interactive building system that can dynamically change its shape and properties in response to environmental change or users’ needs. The main purpose is to utilize interactive technology to augment building performance for smart and sustainable living [2]. In order to give substance and demonstrate the concept of interactive architecture, students were asked to design three examples: space that senses, space that thinks, and space that respond to change [3]. An initial attempt was to embed sensors, actuators, micro-controllers into building elements such walls, floor, and furniture. For example, a room can change its spatial configuration dynamically. The roof can change its shape to cut heating costs and open skylights to improve natural ventilation. Later, cellular kinetic robots were explored to change a building façade design, as shown in Figure 3.

4.3 Pervasive City Sense

To move toward urbanism, the second project focuses on pervasive sensing with a particular focus on urban environment. Real-time monitoring of urban conditions is increasingly explored and has recently received a lot of attention due to the fast rise of pervasive sensor technologies.

Figure 4 illustrates the real-time monitoring of urban conditions in Tainan City. The left image is a screen snapshot of Max/MSP. The right is a snapshot of Google Map of Tainan City. Technically, we used a Python parser to retrieve, parse, and transform a city’s performance data from Internet. The variables were automatically recorded and stored in the cloud database. The Max/MSP then retrieved the data from the cloud and represented it with art installation. This involves sensors, sensor networks, computing infrastructure, data manipulation and analysis, and graphical visualizations. This area of technical development of sensor networks and cloud server database systems was described in [1].

4.4 Reimaging Humane Cities

The city is a container of human clustering life, which contains a variety of information. The design studio discusses the future demand of humane cities from different faces; from individual to community, from local to global, from virtual to reality, start from the personal interactive devices and extend to a smart living environment. The studio tried to put forward a smarter, healthier, more sustainable and more convenient humane city.
The city needs a public platform, an information pub, and a city lounge for public participation and culture revitalization. We attempted to install students’ interaction design works to the city. The interactive exhibition is expected to play a unique role of activating the community to re-examine the city they live.

5. INTERACTIVE EXHIBITION

To exhibit students’ work for culture and urban revitalization, we remodeled an old house located in downtown Tainan City for interactive exhibition. The old house was abandoned and neglected by neighbors for decades. One of the projects remodeled the old house and transformed it into a public exhibition space, which we called it as REC-house. The REC-house has different meanings, such as REConstruction, RERecording, and REgeneration.

In the course discussion and exhibition, humane cities are defined as actual societies that pursue the flow of information, that are healthy, and that become more social in the future. With the advancement of the times and technological developments, modern human desires have gradually sought control over the surrounding information, pursued a more healthy life, and searched for more intimate social activities with other people. This section uses two actual exhibition cases to explain the application and practice of interactive art installations in the exhibition of humane cities.

5.1 The Sound of City

In cities in real life, numerous complex activities happen at the same time. Most people can only sense the environmental activities around them, such as weather changes, festivals and events, and traffic. They are unable to sense the complex information in the overall city. The interactive device in this exhibition attempts to reproduce the city’s overall activity. The device uses the traffic and transportation information of the city in an attempt to shrink the information about the entire city, which is presented as an artistic performance in the exhibition.

The device uses MAX/MSP as the sound source and an 8-channel speaker as the output device. The system captures real-time traffic volume information from Google Maps, and then converts the traffic volume data into frequency and sound parameters for MAX/MSP. Speakers hanging in the exhibit output the traffic information in different places. The system framework is as shown in the diagram. This interactive art installation produces different sounds on different dates, at different times, and at different traffic volumes; therefore, audiences who view the exhibition at different times will experience different urban information. The entire device is connected to the city’s traffic conditions in real time, and the audience can sense the traffic activity in the overall city in real time as well.

5.2 Energy Cloud

Individuals pursue healthier humane cities that can provide greater socialization. This device is an interactive art design that allows for collective public participation. A mobile phone app is used as the input end, and all participants can download the app to record their own exercise records. Users can save their exercises and number

![Figure 5: The exhibition of “Re-imaging Humane Cities.”](image)

![Figure 6: The system rig of “Sound of the City.”](image)

![Figure 7: The system rig of “Energy Cloud.”](image)
of calories expended after exercise on the app, and then upload the information to a cloud database. The overall system is shown in the image. The interactive device is made up of Arduino chips and 128 acrylic boards, in which LEDs are embedded. The system device is connected to the cloud and continuously downloads the caloric data of the participants. If more people continue to upload caloric data, the LEDs will blink more actively. Conversely, if the participants do not exercise and do not upload caloric data, the entire device’s LEDs will blink less frequently and become dimmer. The interactive device hopes to use hints to remind participants that they should be more active. It also increases socialization opportunities for the public, who can provide and participate in more activities to burn calories; thus giving them healthier lives. The device photographs are shown as follows.

6. CONCLUSIONS

Our transition of an interaction design studio from in-class workshop to in-the-world practice was quite successful. Students explored a whole range of interfaces and user experiences, ranging from physical computing, smart artifacts, interactive architecture, to making pervasive city sense. All these domains were explored in the context of Tainan City. The experimental design studio highlights the concerns that interaction designers need to put themselves in the real world to observe user needs, validate their designs, and be sensitive and empathetic to explore cities of the future.

Through the exhibition of “Re-imaging Humane Cities”, the REC-house becomes a venue for exhibitions, a location for experimental activities, and a resting area for city tourists. In addition, the REC-house serves as an information hub for pervasive urban monitoring. Our experience shows that it is possible to use interaction design to enhance and revitalize the environment of old communities. By combining new interactive technology, the historic spirits in the past can be represented and transformed into the citizen’s new experience. Our experimental interaction design studio demonstrates a possibility of creating a new urban regeneration platform and an opportunity for young designers to stimulate creative industries.

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