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SmartX Virtuality: A Smarter way to Interact Virtually with Physical Objects

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Abstract- The paper presents a new approach to interact with real world objects from a distance. This approach is guided with a purpose to modify the attributes of the real world objects and establish communication between multiple such objects using gesture control. The user is required to point the camera of a smartphone at the physical object, the object gets recognized automatically and a graphical user interface (GUI) is mapped onto the smartphone screen. This GUI furbishes the user with multifarious choices to alter the properties of that object. The paper attempts to elucidate the implementation of the system, the functionalities it has to offer and the aspects that make it better than the previous systems.

Index Terms- Augmented Reality, GUI, Smart object, Smart phone

I. INTRODUCTION

In today's smart-phone governed world, people do not take their eyes off the phone screen. This paper explores an approach where controlling real life objects require minimal visual attention. People can control the attributes of a physical object and the relationship between multiple physical objects using gestures [1]. The method developed is an embodiment of augmented reality technology [2] and smart objects. It has a server at its heart and this server establishes wireless communication between the physical objects and smart phone. The system devised has been named SmartX Virtuality (SXV). SXV is compatible even on low-end phones. It is an affordable system. It works well even on android SDK 2.2. The method devised is an attempt at closer integration of the physical and virtual worlds.

II. IMPLEMENTATION

SXV incorporates augmented reality into everyday objects [3] seamlessly. It gives the user a platform to contemplate and control real world objects using an augmented reality based depiction of the object on the phone screen. The concept involves a smart phone connected to a server and this server is connected to the physical objects. The server has the primary task of tying together the system (see Figure1). The instance an action is executed at either of the two ends, data is sent to the server informing it of the action being performed. It is then the server's responsibility to comprehend the data and forward it to the respective interface. The smart phone captures the image of a real world object. Using digital image processing, the object is detected by the phone and a wireless connection is established to the server and further to the real world object. The moment the connection is made, a virtual representation of the objects pops-up on the smart phone screen. This representation is laced with multiple functionalities using a graphical user interface based on augmented reality. Once the GUI appears, modification of attributes can be done using gestures.

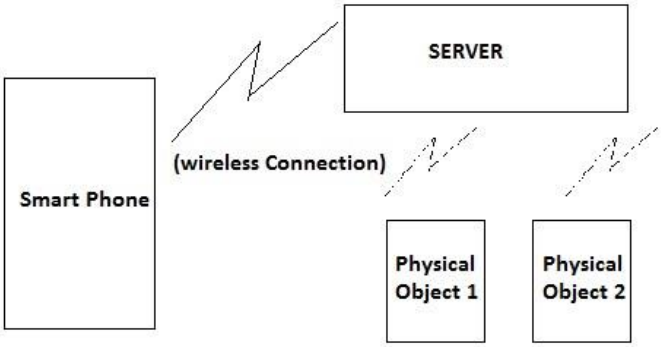

Figure 1: Block Diagram of the SMARTX VIRTUALITY system with the server interconnecting the smart phone and the smart objects

The heart of the Server is microcontroller MSP430G2553 from Texas Instruments [4] which is used to process the input instructions coming from Smartphone. After getting input bytes from smartphone, the Server finds out which object needs to be connected to Server and what property of it needs to be changed. The communication established between server and physical objects can be either by Bluetooth or by RF and communication between Server and Smartphone is only using Bluetooth.

Some hardware implementations of this concept include an RGB lamp system. The user needs to have a view of RGB lamp through the camera of smartphone and the GUI for the lamp appears (see figure 3) on the screen. This GUI enables the user to change the colours of the lamp, turn the lamp on/off, control the physical scroll of the lamp and even connect scroll to multiple lamps. A line drawn to a specific colour in the colour palette from the bordered circle (see figure 2) will change the colour of the RGB lamp to that colour. A line to the green circle turns on the lamp. Similarly, a line to the Red circle turns it off. Each lamp also has a scroll attached to it so that the control remains manual as well. To increase the flexibility of the system there is a choice of both automatic and manual control. In case of presence of two lamps, a line is drawn on screen can interconnect them (see figure 3). The scrolls can be exchanged such that scroll 1 directs the behaviour of lamp 2 and scroll 2 of lamp 1.

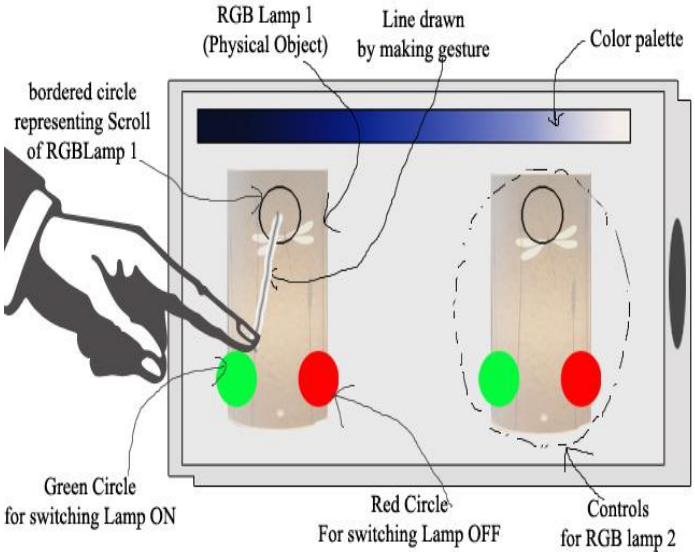

Figure 2: Sketch to illustrate RGB lamp system seen through the smartphone screen

Another implementation of this system involves controlling the ceiling fans, tube lights and several electrical devices in a room. One needs to see the switchboard through the camera of smartphone. The switchboard is recognized by the Smartphone and the corresponding virtual buttons pop on the screen. By using gestures, drawing lines on the screen, the user can regulate the appliances in a room. The switches can be turned on/off from a distance with a simple swipe on the screen. Even the operational functionality of the switch board can be turned off such that if the user manually tries to operate the switches no appliance is affected. User can even swap the functionalities of the buttons such that the button which was earlier used to operate ceiling fan is now controlling tube light and vise versa.

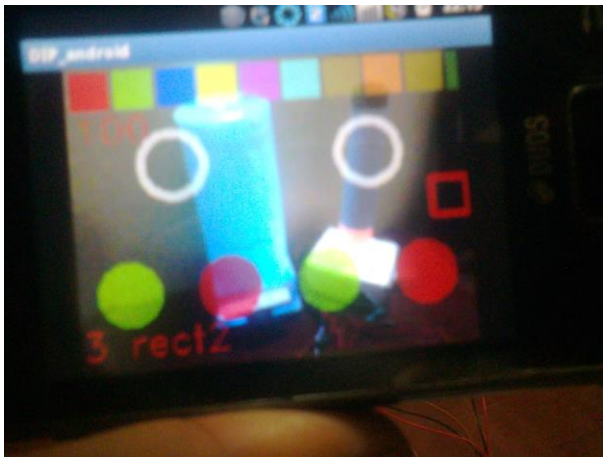

Figure 3: Interaction of two RGB Lamps

III. Enhanced Features

The system developed uses Texas Instruments MSP430G2553 ultra low power microcontroller as its server. This ensures that the server caters to more than one type of object at the same time. SXV has a wide ranging operability. From Android SDK version 2.2 to above, it works on all versions. There is no requirement of high-end, costly smart phones for the system to function. This makes the system affordable and accessible to all. The concept uses digital image processing to detect as well as connect to the real world object. There is no obfuscation regarding selecting of objects. Selection is purely automatic and based on digital image processing. And once the object is detected all possible alterable attributes are displayed on the screen. The properties are modified not by clicking but by gestures so the user can afford to be minimally visually attentive.

IV. Related Work

Augmented Reality technology provides for a digitally enhanced view of the real world [5]. Augmented Reality products furnished by the likes of Layar [5], Wikitude [6] and Junaio [7] enable the user to work on smart phones, tablets and wearable electronics. Enhancement in the domain of Digital Image processing and processing capacity of mobile phones [8] has made possible the current progress in this sphere. The project on I/O bulbs [13] investigates the existing connection between physical objects to directly map digital information onto them. Internet-0[13] is another technology developed to address the issue of connecting inexpensive and small device. The Reality Editor [12] is a system developed by the Fluid Interfaces Group that allows reprogramming of the real-world object's behavior by associating the object with a virtual object using a visually interactive GUI. The Smart-Its technology [11] is another such concept which delivers an embedded computing and communication platform to augment everyday objects. It is proved that a much better interface is provided when a real-time image interacts intuitively through the screen using augmented reality [9]. Augmented interfaces are employed to regulate smart objects in a home-use scenario [10]. These ideas have been incorporated and further developed in the SXV system. The SXV approach requires minimum space in the phone memory and minimal consumption of energy. Also, most commercial applications utilize internet to network smart objects while SXV explores the use of Bluetooth or RF so that the application functions on low-end smart phones as well.

V. Conclusion

SmartX Virtuality gives a simple means to interact with physical objects. More objects, whose attributes are modifiable, can be accommodated on the server and controlled. It fuses the real and virtual worlds together.

References

[1] M. Bhuiyan and R. Picking, "A Gesture Controlled User Interface for Inclusive Design and Evaluative Study of Its Usability," Journal of Software Engineering and Applications, Vol. 4 No. 9, 2011, pp. 513-521.

[2] Wendy E. Mackay, Augmented reality: linking real and virtual worlds: a new paradigm for interacting with computers, AVI '98 Proceedings of the working conference on Advanced visual interfaces, Pages 13 – 21, ACM New York, NY, USA ©1998

[3] Heun, Valentin, Shunichi Kasahara, and Pattie Maes. "Smarter objects: using AR technology to program physical objects and their interactions."

CHI'13 Extended Abstracts on Human Factors in Computing Systems. ACM, 2013.

[4] http://www.ti.com/product/MSP430G2553?247SEM

[5] Layar. http://www.layar.com/.

[6] Wikitude. http://www.wikitude.com/.

[7] Junaio. http://www.junaio.com/.

[8] Wanger, D. 2009. History of Mobile Augmented Reality, Communications. Retrieved fromhttps://www.icg.tugraz.at/~daniel/HistoryOfMobileAR

[9] Liu, C. Huo, S. Diehl, J. Mackay, W. Beaudouin-Lafon, M., Evaluating the Benefits of Real-time Feedback in Mobile Augmented Reality with Hand-held Devices, CHI'12.

[10] Lee, J. Kim, J. Kim, J. Kim and Kwak, J. A Unified Remote Console Based on Augmented Reality in a Home Network Environment, ICCE'07.

[11] Beigl, Michael, and Hans Gellersen. "Smart-its: An embedded platform for smart objects." Smart Objects Conference (sOc). Vol. 2003. 2003.

[12] Heun, Valentin, James Hobin, and Pattie Maes. "Reality editor: programming smarter objects." Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication. ACM, 2013.

[13] Underkoffler, J., The I/O Bulb and the Luminous Room, PHD Thesis MIT Media Lab 1999.

[14] Krikorian, R., Internet 0, MS MIT Media Lab 2004.

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