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Mobile AR Contents Based on IoT(Internet of Things) Using Shading Language over Smartphone and Arduino Bluetooth Sensors

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Abstract

We propose IoT based AR mobile contents by using environmental index information detected by various sensors. The method detects environmental change of real world and augmented reality by using seismic sensor, micro phone sensor, illuminance sensor and LED device, and converts it into environmental index information to apply to AR Mobile game contents background etc. to maximize augmented reality effect in real situation. We use a shading language for fast real-time application of this proposed method, and construct a formula for delivering real-time realization information to implement effective special effects. At this time, sensor information was processed by applying IoT based bluetooth communication method. In order to verify the proposed technique, we produced the AR mobile game and applied to confirm the performance, and found suitability. The proposed method can be used as basic data for advanced content creation based on emotion.

요 약

다양한 센서를 사용하여 검출한 환경지수 정보를 활용하여 IoT 기반의 AR 모바일 콘텐츠를 제안한다. 지진 센서, Micro Phone 센서, 조도센서, LED 디바이스 등을 활용하여 실세계 및 증강현실의 환경 변화를 검출하고 환경지수 정보로 변환하여 AR Mobile 게임 콘텐츠 배경 등에 적용해 현실상황에 증강현실 효과를 극대화하는 방법이다. 이 제안 방법의 빠른 실시간 적용을 위해 셰이딩 언어를 사용하였으며, 실시간 실감 정보 전달을 위한 수식을 구성하여 효과적인 특수효과를 구현하였다. 이때 센서 정보는 IoT 기반의 블루투스 통신 방법을 적용하여 처리하였다. 제안한 기법의 검증을 위하여 AR 모바일 게임을 제작하고 적용한 결과 성능과 적합성을 확인 할 수 있었다. 제안한 방법은 향후 감성기반의 고급 콘텐츠 제작을 위한 기본 자료로 활용될 수 있다.

Keywords
IoT, AR mobile contents, sensors, shading language, background

Ⅰ. Introduction

The performance improvement of the IT equipment and the development of the Internet, leading to the fourth industrial revolution, have created a new field of Internet of Things. Everything in everyday life is connected to the Internet to create new services, and the Internet of Things is combined with the Big Data to pioneer new forms of business that have not been seen before. The prospect of the Internet of things is

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unlimited in its utilization[1]. As time goes on, the Internet will become deeply involved in our lives and its importance will increase day by day. In this situation, the growth of exponential Internet devices is not difficult to predict. The number of devices supporting the internet is different for each market research organization and global company. And it is expected to reach approximately 30 billion to 50 billion by 2020[2][3]. Things Internet is a technology that has been widely publicized in recent years. IoT(Internet of Things) refers to the technology of connecting sensors and communication functions to various objects and connecting them to the Internet. It is a technology that enables Internet connected objects to exchange Internet data of objects, analyze it by itself, provide the learned information to the user, or remotely control the user. Here, things become various embedded systems such as household appliances, mobile equipment, and wearable computers. Things to be connected to the Internet must be connected to the Internet with a unique IP that can identify themselves, and a sensor can be embedded to obtain data from the external environment[4]. The core technologies of the Internet are the sensing technology, the interface technology, and the networking technology. Sensing technology is a technology that measures physical quantities such as temperature, humidity, heat, gas, position, speed, and illumination using various methods. In the object internet, basic signal processing and There is a need for a built-in smart sensor technology including a module capable of performing algorithms. Interface technology is a technology that works with application services that perform specific functions through human, object, and service, which are the main components of the Internet of things. Networking technology is a wired and wireless networking technology that performs physical connection of various devices in a distributed environment. It is composed of Wireless Personal Area Networks (WPAN), Wireless Fidelity, 3G · 4G, Long Term Evolution (LTE) Ethernet, BcN(Broadband convergence Networks), satellite communication, etc. [5]-[8], which have been used to demonstrate the usefulness of mobile devices such as smart phones and HMDs[8], Augmented Reality is a realistic media technology that naturally fuses virtual information or content to the real world and extends human sense and perception. In contrast to virtual reality, augmented reality reduces the burden of 3D modeling / rendering for realistic virtual world construction because it utilizes real space as media. In contrast, virtual reality or contents. The new technical difficulties must be addressed because they have to be provided adaptively[9]. Unlike the console game, the smartphone game uses the voice recognition function to allow the user to make a command to the game character, to use the interface using the touch screen, or to interact with the objects and objects using the network communication. And users can easily play the game[10][11]. The IoT technology, in which the interaction between these objects is achieved, will be facilitated by the rapid diffusion of smart phones and the realization of wearable computing, which will facilitate access to various new information using various sensors. Through these technologies, people and objects, Will interact with each other[12][13]. The Internet of things with these characteristics is actively studied by the standardization organizations for smooth connection of equipment. However, in order to control or acquire information on the Internet devices, there is a need to separately develop interworking issues (IP address, Wi-Fi, Bluetooth, NFC, etc.) and related application software or apps. In the smart digital era, the key is the communication of emotion and technology, and the future information service will become a sensibility-based service in which the value of products and services is determined by touching, feeling, and communicating with devices in viewing and listening. In particular, it is highly likely to be developed as a next-generation platform that provides intelligent services that provide contents according to the situation using augmented reality technology and

object Internet technology, or provides data to users in real time in a changing environment. Considering the same technology trends, we produce mobile augmented reality IoT contents using mobile camera output as background. The collected contents are collected and analyzed using bluetooth based IoT sensor data, and the environmental index information is detected and transmitted to the mobile phone. In the mobile phone, the external environmental change according to the environmental index information is applied to the background of the augmented reality contents and output. We can provide emotional information for a more natural and deep immersion to users of mobile AR contents created by applying such environmental index information. The results are confirmed through experiments.

II. 4.0 Bluetooth Interface

In this paper, we use bluetooth communication with low power consumption for interaction with smartphone. Bluetooth refers to short-range wireless standard technology that enables the exchange of information between devices and devices. After bluetooth version 1.0 was released in December of 1999, bluetooth announced EDR, which increased data transmission speed by up to three times in 2004. Bluetooth EDR has a disadvantage of high power consumption but high transmission speed. The bluetooth low energy(BLE) technology has been developed to secure these shortcomings. BLE technology is a technology that significantly reduces standby power consumption compared to existing EDR. In addition, it is possible to simplify the connection procedure of the device and to reduce the communication packet size. The advantage of BLE is that it is suitable for direct object communication between potable healthcare, wearable terminal and neighboring terminals[14][15]. In addition, currently available smart phones are equipped with BLE technology in the device, so they can easily communicate with other objects when they need to interact with objects using smart phones.

III. System Configuration

Augmented reality is the latest technology that tried to converge physical space and digital space. Augmented reality provides multidimensional information to users exposed to physical environment by fusing information sensing technology of physical space and information data of digital space[16]-[21]. In the IoT environment using the bluetooth communication method with the tablet PC on which the AR environment is established, the user can freely move the virtual objects on the AR game implemented in the tablet PC using the joystick to play the AR game. We use Arduino and sensors to detect environmental information. A vibration sensor for detecting vibration and shaking information such as an earthquake, an MP (micro phone) sensor for detecting external noise, a CDS sensor for detecting the degree of darkness, and an LED device for confirming whether or not these sensors are stuck. For example, if there is an external earthquake, the vibration sensor on the Arduino senses it, and when it sends the earthquake information to the smartphone using bluetooth communication, the phone will use the information of the earth to detect the background.

To a state of earthquake. To do this, we apply shading language to background graphic in real time and output it. In addition, according to the size of the dark input information, the CDS sensor detects it and sends it to the smartphone to output the background of the game content in dark real time. When the external noise is large, it detects it and displays various effects such as crack on the background of the game. Can be implemented. Through this, it is possible to produce high-quality realistic contents that direct environment information to the user in real time and direct them on the currently used contents. This is shown in Fig. 1.

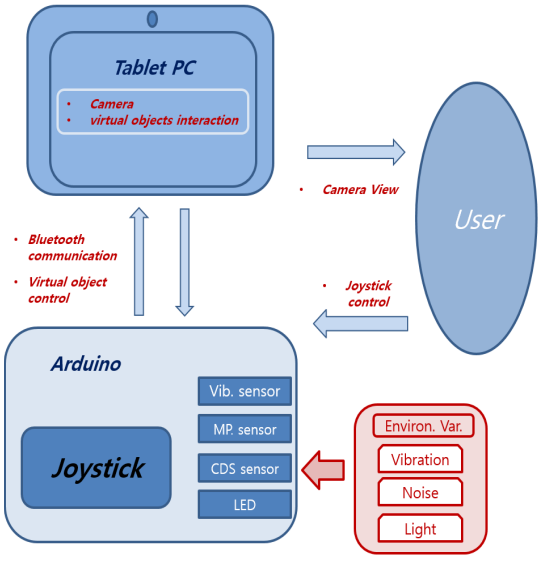


Fig. 1. System configuration diagram proposed in this paper

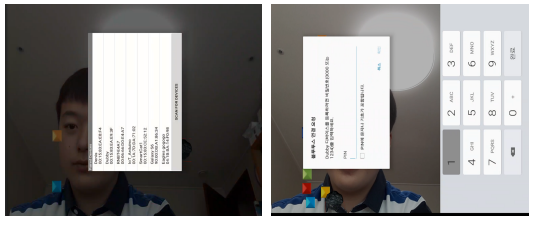
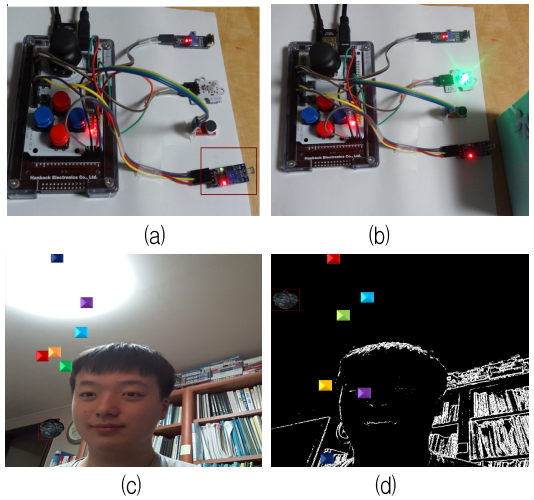


Fig. 2. Pairing for bluetooth connection with arduino and smartphone



(a) (b)

(c) (d)

Fig. 3. Using the CDS sensor to detect the environmental change index according to the light intensity and experimental results applied to the background in real time

Ⅳ. Experiments

4.1 Experiment 1

Experiment 1 shows a pairing operation for connection between Arduino and smartphone using bluetooth communication. Through this connection, external environment information is collected by vibration sensor connected to Arduino, CDS sensor and MP sensor, and sent to the smartphone. Using the LED device, the status of current sensors can be output using on / off have.

4.2 Experiment 2

In Experiment 2, when the external environment is dark, the background of the currently used content is expressed differently in real time according to the dark information.

Experiment 2 adds a CDS sensor (see Fig. 3(a)) to detect light intensity information and apply it to the background of the augmented reality. Fig. 3(a) shows that when the light is bright, the resistance of the CDS sensor is low, and the red of the power supply and the green of the resistance are turned on. However, when the amount of light decreases and becomes darker, the resistance value becomes larger and the green light is turned off, which shows that the amount of light in the surrounding environment is reduced to dark state (see Fig. The phone detects the change of the light information according to the change of the environment and adjusts the background image according to the value to make it dark in real time. Fig. 3(c) shows the steady-state augmented reality image. Fig. 3(d) shows the darkened image according to the CDS sensor value. It is an edge-detected image to show surrounding object information.

4.3 Experiment 3

Experiment 3 tests how to convert the camera color image of a smart phone into a monochrome image effectively. For this purpose, when the color image is converted into a gray image and the gray image is converted into a monochrome image, if the edge information of the image is represented, the object shape information of the color image can be outputted without much loss.

Fig. 4(a) shows the input image of the smart mobile phone. (b) shows the input image converted into gray image. In this case, we used the length function and gray-converted 3 channels of color.rgb1 channel. Fig. 4(c) shows the Prewitt algorithm and Fig. 4(d) shows the result using the dFdx/dFdy built-in function.

The Prewitt edge detector in Fig. 5(C) is a suitable method to estimate the size, Direction of the corner. Differential gradient edge detection requires some time consuming computation to estimate the direction in the x and y directions, but compass edge detection takes direction directly from the kernel as a maximum response. The Prewitt operator is limited to eight possible directions and the edge detector is estimated in eight directions. Fig. 4(d) is a fragment shader function that calculates the partial derivative of the dFdx/dFdy screen in the X direction and Y direction using the built-in function dFdx/dFdy since GLSL1.1.

4.4 Experiment 4

It is an experiment to apply the influence of earthquake or explosion which greatly changes the external environmental factors to the current contents.

When vibration is detected (LED on) in normal condition (Fig. 5(a)) in Arduino, it is transmitted to smartphone using bluetooth in real time and applied to the currently used content. In this case, we apply the technique that we use to create beautiful scenes that shake the background image from the contents of games and animations or show movement like ocean waves. The shader program is one of the many ways to express this natural beauty, and basically it can naturally utilize time-related x- and y-axis data.

$$\cos(uv.x * 25.) * 0.06 * \cos(iGlobalTime) \quad (1)$$

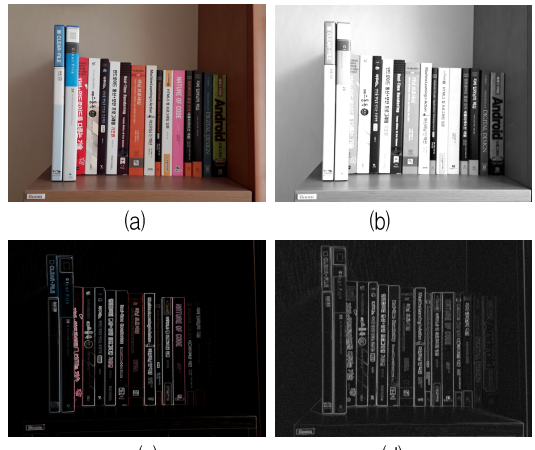


Fig. 4. (a) input image, (b) gray image and (c) Prewitt image (d) the result image using the dFdx / dFdy function

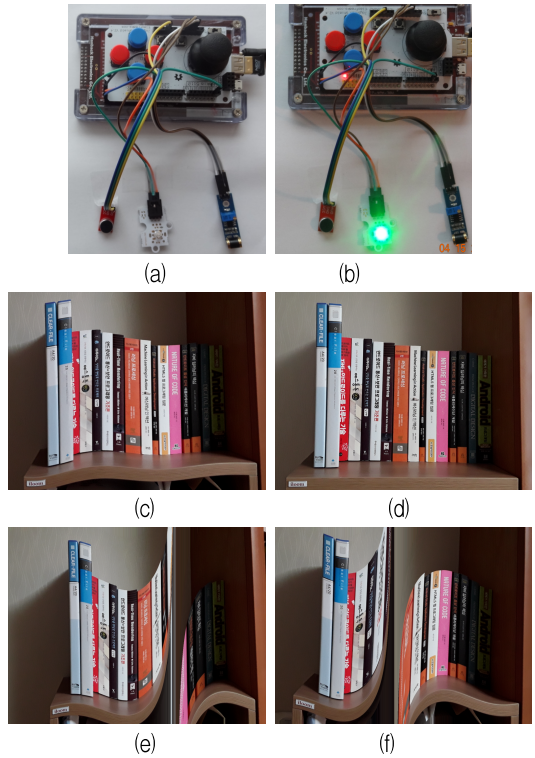


Fig. 5. Arduino vibration sensor detects the vibration and sends it to the smartphone

Multiply uv.x by a large number (25) to control the frequency of the wave[17]. It is then the maximum amplitude because it resizes by multiplying by 0.06. Finally, multiply the cosine of the time and periodically flip back and forth. The above equation can be used to construct various vibration images by using trigonometric functions and making good use of time information, frequency, and amplitude information. Fig. 5(a) shows the input image, and Fig. 5(b) and (c) show the result of changing the time by referring to the above formula. Fig. 5(d), (e), (f) shows the resulting image with varying frequency and amplitude.

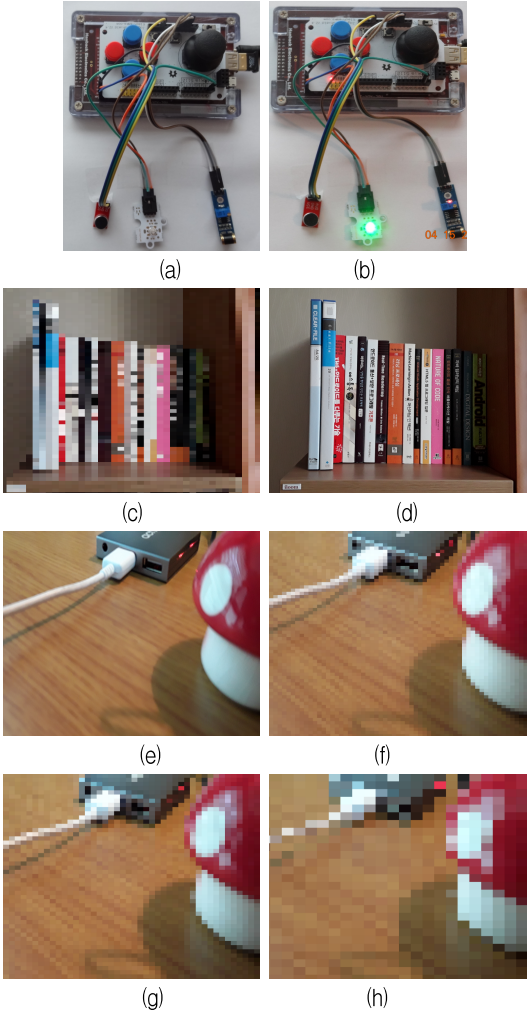


Fig. 6. Mosaic result image according to input image and tile size by external noise

4.5 Experiment 5

Experiment 5 is an experiment in which a large noise from the outside was detected by the Arduino MP sensor and applied to the background image of the AR game contents of the phone.

Fig. 6(c) shows the camera input image and Fig. 6(b) shows the mosaic image. The image of Fig. 6(d) is an image of 60 * 60 size (vec2 tile_num = vec2 (60.0,60.0);) tile changed by shader programming.

Applicable result clear the square form the file and book format are maintained, but the information such as the clear file name, book name, and judge can not be confirmed.

Fig. 6(e) shows an example of another input image. (f) has 60 tiles and (g) has 80 tiles are used. (g) has more object information than the figure (f). However, parts such as the character information of an object can be identified but it can not be read. Figure (h) shows the approximate lubrication of large objects when 30 tiles are used. Therefore, the number of tiles can be adjusted appropriately according to the amount of information that should not be exposed, so that the conversion into a desired image is easy.

Ⅴ. Conclusion

At the core of the smart era is the communication of emotion and technology, and the future information service will become a sensibility-based service in which the value of products and services are determined by touching, feeling, and communicating with devices. In addition, emotional information service technology that can enhance sense of realism and realism by stimulating human senses is essential element technology in various application services. For this purpose, this paper acquires environmental information using Arduino's sensor and makes it into environmental information, and transmits it to the smartphone using bluetooth communication. In the smartphone, the information of the background image

is transformed in real time according to the change of the environment information in the game contents and the like, and the emotional information is considered in the output.

Experiment 2, experiment 3, experiment 4 and experiment 5 were used to detect various external environment changes such as darkness, earthquake, and noise through sensors and to provide various emotional information to the contents in augmented reality. We can propose a new type of digital interface to communicate with augmented reality. With this new form of environmental information recognition and emotional delivery mechanism, the user can receive current and realistic media consumption services by recognizing the current emotion and assisting in purification, sublimation, suppression of emotions. In the future, various researches are needed to collect, analyze and apply various types of external environmental information, and it is necessary to study not only the background but also various types of delivery techniques.

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