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DESIGN OF A PRESURGICAL INVESTIGATION BY THE COMBINATION OF VR, AR&MR TECHNIQUES

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Abstract: Virtual reality(VR), Augmented reality(AR) and Mixed reality(MR) are finding new application in clinical investigation. This study uses VR, AR & MR techniques for pre surgery applications on three platforms windows PC, Apple IPad & Mobile. Virtual reality creates a digital environment that replace the user real world environment. Augmented reality overlays digitally created content into the user real world environment. Mixed reality experience which combines elements of both AR and VR, real world and digital optics interact.

Key Words: AR, VR, MR, Pre-surgery

1.INTRODUCTION

Doctors read medical data such as MRI or CT scans on a monitor and they must analyze and mentally compose what is shown on the screen to the patient. This mental model of the patient's anatomy will serve as a basis for health care in routine examinations or time-critical situations. An important question arises: what is the best way to visualize a patient's relevant information so that physicians may be able to complete a medical procedure properly. This study uses VR, AR, and MR techniques for pre-surgery applications that implemented on three platforms: Windows PC, Apple iPad, and Mobile Phone.

The proposed system is used for physician discussion and training before a surgical operation. A typical 3D data set is a group of 2D slice images acquired by a CT, MRI (one slice every millimeter) and usually have a regular number of image pixels in a regular pattern. In the proposed system, MRI scans, and CT scans can now be turned into a 3D model. Before surgery, the patient is scanned and their CT, ultrasound, and MRI scans taken by the doctor, the doctor will venture inside patient's organs to identify potential pitfalls and plan how these would be avoided error during surgery.

The proposed technology will aim to help physicians imagine directly by their eyes through the DICOM model in front of them, A Leap Motion sensing device is used to control the input control and to accept hand gestures using a VR system. This study combines a Unity3D Engine and VR, AR, MR displaying devices for volume rendering. The contribution of the proposed work: First, the main of the system is applied the volume rendering algorithm loads the MRI or CT slices into the Unity3D engine, with the environment of Unity3D Engine, the VR, AR, and MR techniques can act through the tool-kit developed of each own.

2. PROPOSED METHODOLOGY

Mixed reality combines virtual reality elements with human vision. Head-mounted devices use clear screens to give users an unobstructed view, but various technologies can be used to project images onto the screen. For doctors, MR provides a means of viewing images and data far more convenient than charts or screens.

Furthermore, MR can provide new ways of interacting with patients by projecting information onto medical charts or even directly on the patient. As medical schools and other organizations continue to explore MR, experts will devise novel uses for MR technology. First time in Technology MR Vision system utilizes for the real-time update and track of people. The Images based output and tracking with MR vision system.

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BLOCK DIAGRAM

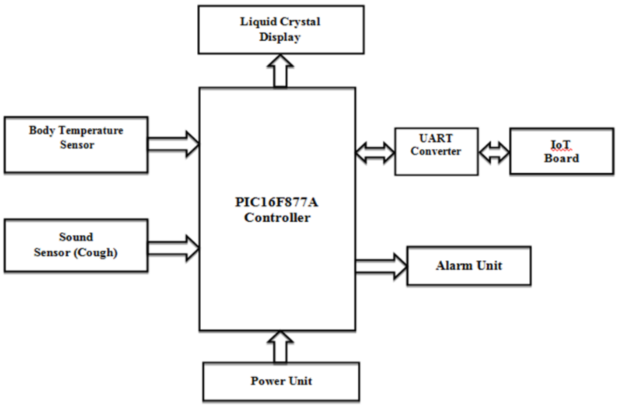

Figure 3.1 Block diagram of the Proposed Wearable Sensor unit

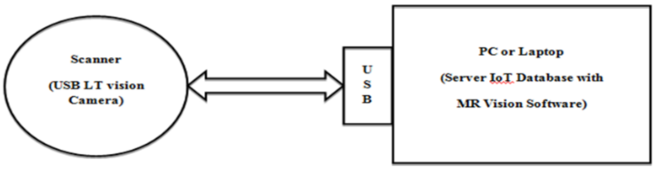

Figure 3.2 Block diagram of the Proposed Scanning and Server unit

3.HARDWARE DESCRIPTION

TEMPERATURE SENSOR

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

SOUND SENSOR

A sound sensor is defined as a module that detects sound waves through its intensity and converting it to electrical signals.

LCD

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

POWER UNIT

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power

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supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

UART

A universal asynchronous receiver-transmitter (UART) is a computer hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable. It sends data bits one by one, from the least significant to the most significant, framed by start and stop bits so that precise timing is handled by the communication channel. The electric signaling levels are handled by a driver circuit external to the UART. Two common signal levels are RS-232, a 12-volt system, and RS-485, a 5-volt system. It was one of the earliest computer communication devices, used to attach teletypewriters for an operator console. It was also an early hardware system for the Internet.
A UART is usually an individual (or part of an) integrated circuit (IC) used for serial communications over a computer or peripheral device serial port. One or more UART peripherals are commonly integrated in microcontroller chips. Specialised UARTs are used for automobiles, smart cards and SIMs. Early teletypewriters used current loops.

UART CONVERTER

This is a USB to Serial UART converter module. It is allow you to connect your computer through USB port and use it as a regular serial communication. All USB protocol is handled within the module. There is no other device or programming required. This board features innovations that set it apart from other USB to Serial Converter boards. Innovations feature like 256 byte receive buffer and 128 byte transmit buffer utilize new buffer smoothing technology to allow for high data throughput. Also, 6MHz clock output signal options for driving external MCU or FPGA. The TX and RX pins from the USB-SER can be connected directly to RX and TX pins of your preferred microcontroller or serial application for a simple serial cable replacement connection.

The USB-SER board is perfect for embedded systems that require a serial connection to a computer. The board attaches directly to the USB bus via a standard type mini B receptacle connector. It shows up on any Windows computer as a standard serial COM port. Any applications that talk to this COM port is automatically convert to USB and back to UART to your target board. Drivers are available for Windows 98, 98SE, ME, 2000, Server 2003, XP, Vista/Longhorn, XP Embedded and CE.NET 4.2 & 5.0. Mac OS8/9, OS-X and Linux 2.4 and greater are supported.

This module designed to be easy to plug into a breadboard directly. It is self-power by using power from USB port. You may use this voltage to power your project board up to 500mA.

IOT BOARD

Particle Photon Board consists of an STM32 microcontroller, Wi-Fi, Switches, and LEDs. Simple to use, powerful, and connected to the cloud. Powered by a Cypress Wi-Fi chip alongside a powerful STM32 ARM Cortex M3 microcontroller, it is ideal for prototyping IoT projects.

Features:
- Processor: STM32F205 120Mhz ARM Cortex M3
- Real-time operating system (Free RTOS)
- Memory: 1MB flash, 128KB RAM
- Open source design
- On-board Wi-Fi module
- On-board RGB status LED.
- 18 Mixed-signal GPIO and advanced peripherals
- Soft AP setup
- B802.11b/g/n Wi-Fi
- roadcom BCM43362 Wi-Fi chip

ALARM UNIT

An alarm device is a mechanism that gives an audible, visual or other form of alarm signal to alert people to a problem or condition that requires urgent attention.

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PIC CONTROLLER

PIC is a family of microcontrollers made by Microchip Technology, derived from the PIC1650. originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller, and is currently expanded as Programmable Intelligent Computer. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

Early models of PIC had read-only memory (ROM) or field-programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions.

VISION CAMERA

A machine vision camera captures image data and sends it uncompressed to the PC. This is the reason why pictures look less “pretty” than the ones from cell phones. In consumer cameras the image data gets compressed and smoothed out which looks good, but doesn’t provide the quality needed for flaw detection and code reading. Network cameras or IP (Internet Protocol) cameras record video and compress it. Their advantage is their robustness and resistance to vibration and temperature spikes. They are also tolerant to poor lighting conditions and direct sunlight. IP cameras are mainly used in surveillance and in Intelligent Traffic Systems (ITS) applications, for example, for road tolling and red light detection.

4.SOFTWARE DESCRIPTION

MPLAB IDE

The MPLAB X IDE is the new graphical, integrated debugging tool set for all of Microchip’s more than 800 8-bit, 16-bit and 32-bit MCUs and digital signal controllers, and memory devices.
It includes a feature-rich editor, source-level debugger, project manager, software simulator, and supports Microchip’s popular hardware tools, such as the MPLAB ICD 3 in-circuit debugger, PIC kit™ 3, and MPLAB PM3 programmer. The Object-HEX Converter creates Intel HEX files from absolute object modules.

5.RESULT AND DISSCUSION

The implementation of realization of **“DESIGN OF A PRESURGICAL INVESTIGATION BY THE COMBINATION OF VR, AR&MR TECHNIQUES”** is implemented successfully. Without any interference between different modules in the design, the communication is properly implemented. It is designed to meet all the specifications and requirements as well.

The performance of the device has been verified in both software simulator as well as hardware design. The total circuit is verified functionally and it is following the application software. Conclusions are that the design implemented in the present work provide portability, flexibility and the data transmission is also done with very low power consumption.

The output images can be seen as shown below:

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The intended objectives were successfully achieved in the prototype model developed. The developed product is easy to use, economical and does not require any special training.

6. CONCLUSION

The proposed technology allows a physician to visualize the inside of the patient's body and to interact with the 3D body in a hands-free operation. The CT and MRI datasets for the patient are viewed, read and defined concurrently during surgery in the operation room.

FUTURE WORK

MR applications need an appropriate strategy to handle dynamic effects, such as sudden environmental changes and the movement of objects. The improvement of MR applications requires further research related to proposing a new computer graphic algorithm to handle automatic environment construction and large data visualization with a focus on close-to-reality simulation of an important scene. Large-scale MR needs to incorporate security mechanisms owing to the presence of different levels of information such as organizations, social network data, virtual objects, users, and environmental sensors.

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