Doctors Assistive System Using Augmented Reality for Critical Analysis

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***Abstract*- Surgeons are regularly on the lookout for technologies that will enhance their operating environment. They are often the early adopters of technologies that allow their field to offer a better surgical and patient experience. The continuing enhancement of the surgical environment in the digital age has led to a number of innovations being highlighted as potential disruptive technologies in the surgical workplace. Augmented reality (AR) are rapidly becoming increasingly available, accessible and importantly affordable, hence their application into healthcare to enhance the medical use of data is certain. Whether it relates to anatomy, intraoperative surgery, or post-operative rehabilitation, applications are already being investigated for their role in the surgeons. AR is the addition of artificial information to one or more of the senses that allows the user to perform tasks more efficiently. we propose a system in which important information for the doctors are displayed on semi-transparent glasses included in an AR-headset and therefore are mixed with the real-worldview.**

Index Terms- Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Mixed / augmented reality; Human-centered computing—Human computer interaction (HCI).

I. INTRODUCTION

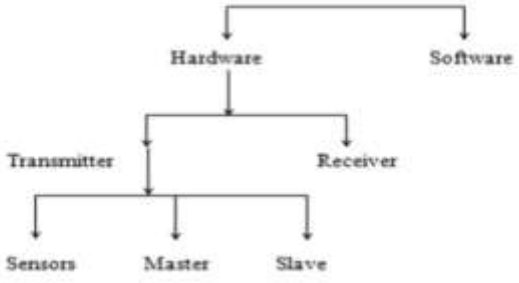
Head-up display (HUD) is a transparent display that can present information in front of users' eyes so that users can see the information without moving sight away. AR-HUD is a special kind of HUD which can provide driving related information directly in the driving environment through windshield, such as overlaying a navigation path on the road, marking pedestrians with surrounding rectangles, or sticking labels on interesting buildings. It is challenge to keep virtual image registered accurately with real world objects with on vehicle AR-HUD due to the complex optical paths introduced by freeform reflectors in the system, such as the windshield. There are some researches on the calibration for AR-HUD. Wu et al. [4] built an indoor system prototype to simulate the actual driving situation on the road. They mainly focused on the distortion correction with fixed viewing angle and fixed head position. They projected a pattern and built a function to avoid the windshield distortion based on pre-warped points and interpolation. It provides primitive idea of augmenting the reality by 2D overlaying but lacking 3D registration of virtual world in the real world, which makes it unpractical for real car AR applications. Wientapper et al. [3] decomposed the calibration into two phases: view-independent geometry of the virtual plane and view-dependent image warping which is similar to the display-relative calibration method proposed by Owen et al [1]. For correcting the distortion, they employed a higher order polynomial function of 5 parameters. They used vision-based tracking method by attaching textured patterns on the windshield to achieve accurate camera registration with the help of Structure from-Motion techniques. The setup was cheap but time-consuming during the preparation. Kaho Ueno and Takashi Komuro [2] took the diversity of road surface and practical face tracking into consideration.

Wireless patient monitoring system became vital in day to day life because of fast growing diseases in human life and this reflects in rapidly increasing demands in hospitals. This whole system measure the physical parameter of the patient's body and this real time data transmit to the central PC, which is kept at doctors cabin. Recently there are two methods in practice that is wireless ECG monitoring and alarm system using ZigBee and other is heartbeat

monitoring alert via SMS. This paper includes physical parameter monitoring sensor circuits with ZigBee module as transmitter at bed and as receiver at central PC. To ensure the successful transmission of all health parameters, there is visual basic software used on central PC.

In this project, the real time data of patients in hospital collected by the sensors attached to patients once the sensor measured the values then it is processed and send to doctors augmented reality glass through wireless and alert if abnormal condition occurs. The doctor can take appropriate action based on the patients current health condition.

II. SYSTEM REPRESENTATION



Overall system consist of mainly two parts i.e. hardware and software. Whereas hardware part consist of two sections i.e. transmitter and receiver, in which transmitter developed by four sensors, Master and Slave type combination. In master circuit four input sensors viz. O2 level, temperature, heartbeat and saline level are connected to the controller ATmega328. This controller will give the output on the LCD and also on doctor's AR via Zigbee transmitter, whereas there is a Zigbee receiver model at doctor's AR Glass. Range of this Zigbee module is 100mtrs.

A. Block Diagram

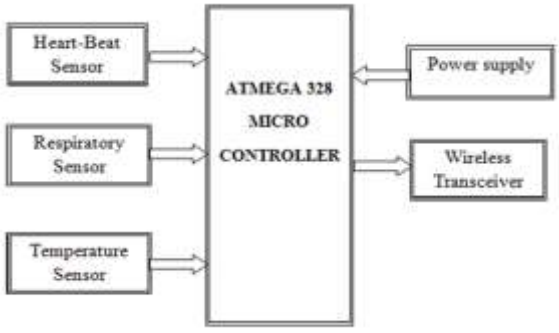
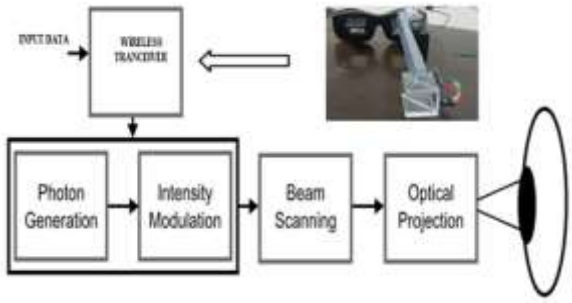


Fig- Main Block Diagram

B. Augmented Reality



III. COMPONENTS DESCRIPTION

A. Controller (ATMEGA328)

Controller is heart of our system. This controller following features: 32Kbytes of in-system programmable flash with read-while-write capabilities, two 8-bit Timer/Counters, 23 programmable I/O Lines, and operating Voltage is 1.8 - 5.5V, Temperature Range -40°C to 105°C, three flexible Timer/Counters. Pin configuration of ATmega328 IC consists of 28 pins. There is Port B, Port C & Port D an 8-bit bi-directional I/O port with internal pull-up resistors.

B. Heart Beat Sensor

The pulse rate sensor is basically used to keep track on the pulse rate of the person. In programming the maximum and the minimum set point are provided for the pulse rate. If the pulse rate goes below or above the set point then the alert will be immediately issued by the m Sensor is the essential part of any instrumentation system. Sensing is the first stage of any process in the instrumentation system. Sensors are required to sense the variations in the physical quantities. According to the variations in the physical quantities sensors give the output, which is electrical in nature

Fig- Heartbeat Sensor

C. Temperature Sensor

Temperature sensor senses the temperature of body. It can sense the temperature of human body. It is an analog sensor and gives the output into form of analog signal. This signal is feed to ARM controller and ADC will convert it into digital form. Once converted into analog form the controller can process the digital temperature signal as per the application.

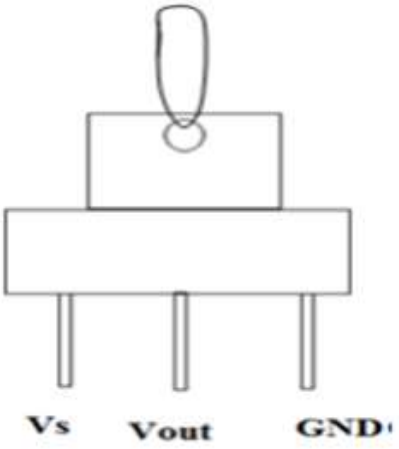


Fig- Temparature Sensor

Temperature sensor senses the temperature of body. It can sense the temperature of human body. It is an analog sensor and gives the output into form of analog signal. This signal is feed to ARM controller and ADC will convert it into digital form. Once converted into analog form the controller can process the digital temperature signal as per the application.

D. Oxygen Sensor

Structure and configuration of MQ-6 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-6 has 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current

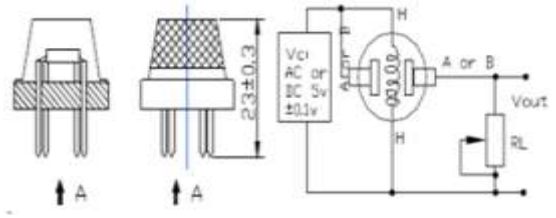


Fig- Oxygen Sensor

E. LCD

The 16/2 LCD display is used to visualize the output of the application. It issued to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role to see the output and to debug the system module wise in case of system failure in order to rectify the problem display device is required only at the coordinator end. To know what is going on the sensing node. The data must be shown on the display. This data can also be recorded and kept safe for the analysis. Health status of the human can only be known by observing the data. That's why the display is must for the presented application. For the presented work, LCD is used as a display device. LCD is the short form of the liquid crystal display. LCD displays utilize two sheets of polarizing material with a liquid crystalUnits

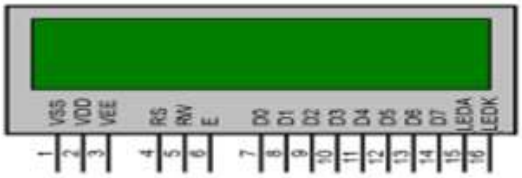


Fig- LCD Display

F. POWER SUPPLY

There are several components used at the sensing node and coordinator end. These components have different operating voltage such as controller operates at 3.3 – 5v. ZigBee transceiver operates at 1.8 V to 3.8 V, LM 35 and LCD display operates at 5 V. To meet these requirements of different operating voltage ranges a proper arrangement of power supply is required. The 7805 voltage regular is used to provide 5 V regulated power supply.

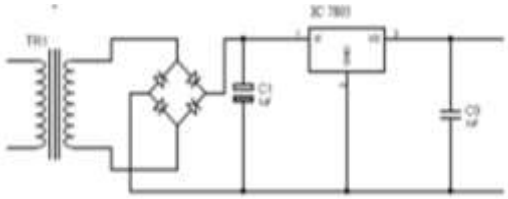


Fig- Power supply

IV. CALIBRATION PROCESS

In this work, we use Microsoft HoloLens1 as the calibration tool. We implement our calibration process with Unity3D2. The first step is to calibrate the HoloLens' coordinate system with the vehicle coordinate system. We use ICP algorithm to calculate the transformation between HoloLens spatial mapping and our reference model.

Next step is taking mappings by HoloLens' front camera at different viewpoints to form the training data set. Normally 500 samples that approximately cover the feasible range are enough. Finally we train the model using Matlab3 nonlinear regression toolbox.

V. OPERATIVE BENEFITS

AR and VR have the potential to impact on surgery in a number of novel ways as discussed above, especially in the arena of surgical training in the virtual surgical environment (Figure 7). However, real-time enhancement of the surgical procedure remains a slightly tentative application. It is not yet validated that surgery can be enhanced with AR and in some instances, it could be distracting. Some features may be useful of systems like GG where with voice activation the operator could communicate beyond the theatre environment, retrieve images and test results without breaking scrub. Real-time updates regarding the progress of the trauma list would reduce unnecessary fasting of patients in the event of a delay in theatre. Real-time augmentation of surgery usually involves the blending of acquired 3D imaging with surgical reference points. Novel applications of AR include use to project optimal port placement on the abdomen for laparoscopic surgery (42); using AR to identify the position of sentinel nodes with 3D freehand single photon emission computed tomography (43,44); and using this with near infra-red spectroscopy to provide visual guidance in lymph node dissection in cancer surgery (45). Specialised near infrared (NIR) devices have been developed for the detection of tissue vascularity using indocyanine green (ICG) dye (46). The use of ICG in lymphatic surgery is already well developed to help identify vessels and check for their patency hence the move from microscope to HMD is a likely future development (47). AR technology would also be able to seamlessly project diagnostic images intraoperatively for surgical planning to guide surgeons with optimal incisions and approach (39).

Several studies have demonstrated the use of AR to guide surgeons through intricate anatomy during minimally invasive surgery. Su et al. [2009] demonstrated the use of pre-operative imaging with intra-operative 3D overlay to guide robotic laparoscopic limited partial nephrectomy. Minimal access limited partial nephrectomy has been an area of interest for AR guided surgery (48). AR guidance allows for projection of 3D imaging onto the laparoscopic image to mark surgical incisions within the laparoscopic view (49). AR has been used extensively in neurosurgical procedures. Use of pre-operative imaging to detect suitable vessels for extracranial-intracranial bypass allows for image injection into the operator's microscope to guide intraoperative dissection. Similar techniques for AR have been utilised for intracranial arteriovenous malformation surgery.

VI. RESULTS

The analog processing circuitry and the sensors were assembled on PCBs which were placed within the wrist strap. Fig 3 shows the flowchart of the system & Fig 4 shows the prototype hardware. The prototype was powered with a 9 V battery. The RF transmission using Zigbee has been tested to operate successfully at 30 meters range through obstacles such as concrete walls. When in operation, the wrist unit consumes 20 mA of current at 3.3 V power supply.

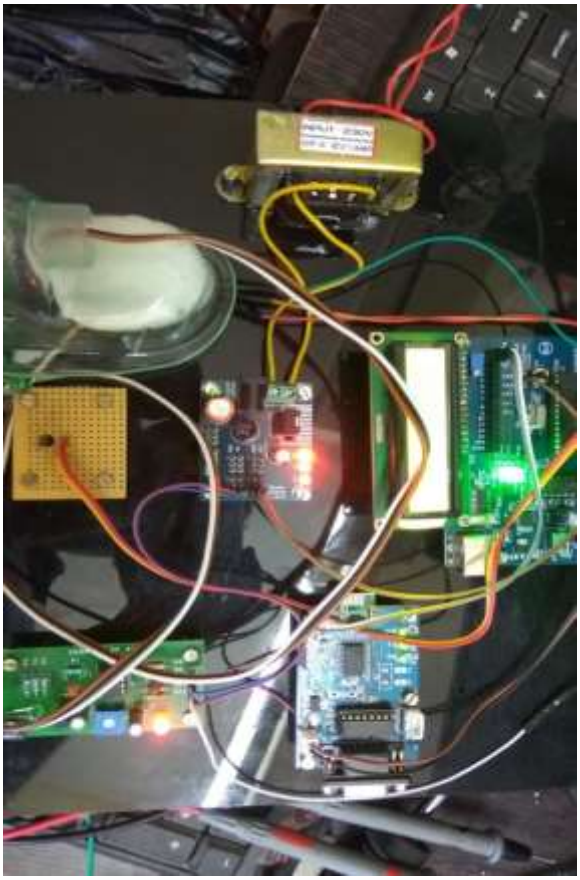


Figure2: Prototype Design

Figure 2:AR Glass Setup

VII. CONCLUSION

Thus the zigbee based wireless Heartbeat and Temperature monitoring system is designed and implemented using microcontroller atmega 328, in which all signals directly measured from the human body and all parameters values displayed on LCD on the transmitter side. This data is transmitted to the receiver wirelessly through ZigBee. The received signal send to pc via AR Glass window display patient's Physiological Parameters.

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