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Automated Anesthesia Injector for Patient Monitoring System using Unified Technology Learning Platform

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Abstract: ***This work focuses on the level of anaesthesia injected to the patient at a specified time span and to observe the various physical parameters of the patient such as temperature, heartbeat, blood pressure, glucose level, blood level and respiration of the patient in an effective manner. To avoid the death of a patient in the anaesthetic condition during operation, an anaesthesiologist is with the patient at the time of surgery to monitor the patient. In the existing system, for the monitoring of anaesthesia, Anaesthesiologist will accompany the patient until the patient becomes stable. To overcome the above issue, the proposed automated patient monitoring system will hog the limelight in hospitals in the near future. Through automation in the monitoring system with high speed advanced ARM 8 processor which executes large instructions used for the implementation. The automatic anaesthesia monitoring system has capable of monitoring multiple parameters, which is essential for the patient during the anaesthetic condition. The physical parameters are sensed using suitable sensors and transmitted through the Zigbee module over a wireless network to the anaesthesiologist so that the anaesthesiologist can monitor the patient anaesthetic condition and other parameters at their own premises. Also, they can view the results in the monitor screen with the help of a personal computer. The proposed system reduces the risk of severe injury and death during anaesthesia. The proposed system is executed using the Unified Technology Learning Platform and the simulation results against various parameters of the patient are performed using Labview software.***

Keywords: ARM 8 Processor, Anesthesia, Embedded Cont-rolled Sensor Network, Unified Technology Learning Platf orm, Zigbee Module.

I. INTRODUCTION

Currently, there are many innovations and rapid growth in science and technology, which sophisticates human life. The dramatic change in the development of the medical sector is medical automation. It is observed that, supervision of the patient at all time is not possible, which faces a lot of issues to the anesthetist like continuous monitoring, checking the patient health occasionally and need of more anesthetists. At present, in most of the hospitals when any major operation is performed, the patient must be in anesthetized condition. If the anesthetic condition prolongs for a long time, say for instance of about 4 or 5 hours, the total dose of anesthesia injected into the patient cannot be administered in a single stroke, which ultimately may lead to patient's death [1]. If the lower amount of anesthesia is administered, the patient may get disturbed in the middle of the operation. To overcome this situation, the anesthetist administers a few milliliters of anesthesia per hour to the patient. If the anesthetist fails to deliver the anesthesia to the patient at a particular time interval, other allied problems may arise. It is a challenging task to the doctors and the patient to monitor all physical parameters during the anesthetized condition. To curtail the conventional problem of patient monitoring, automation is indispensable in hospitals. Recently Embedded Controlled Sensor Network (ECSN) plays a vital role in the monitoring system which is incorporated by communicating over wireless links without using permanent networked infrastructure microcontroller [2].

The main characteristics of the present embedded systems are functioning integration and rapid development cycle. ECSN is a real-time embedded system that has advanced features and the fast executing microcontroller in which embedded software is used to develop the applications. This system can also be practiced in medical monitoring and be controlling, which gives the best result in real-time operations. In the past, there is dramatic progress in the wireless sensor networks like Bluetooth, Wi-Fi, Wi-Max, wireless mobile Ad-hoc network (WMANET), UMB, and wireless HART [3]. The wireless technology applications like industry monitoring system, agricultural, patient monitoring system, environment and wildlife monitoring.

Implementing the WSN in the hospitals will give the swift response, replaces the wired system, reduced cost, easy replacement and system reliability improves. Energy management is one of the add-on features in hospital monitoring using the WSN. Zigbee technology provides different types of network topology and it has the latent to register 65000 Zigbee devices in the individual network [4]. To overcome the existing problems in hospitals during the operation proposed system provides active with fast wireless data transmission, early warning system, and multiple units monitoring with the storage device.

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With the help of Zigbee the received information about the physical parameters like temperature, pressure, blood level, glucose level, heartbeat rating, respiration and anesthesia level are monitored in the lab view software in mobile phone by the anesthetist from their place, which later can monitor and control the level automatically via the internet [5]. This proposed scheme will attract the physicians to monitor the current position level of anesthesia of the patients from their premises. When the level of anesthesia decreases to the lower level (set value), the alarm will announce an alert signal to the physician in order to refill the anesthesia in the syringe pump [6].

II. SYSTEM DESCRIPTION

The Fig.1 depicts the overall functioning of the module, and the proposed system incorporates Arm 8 based anesthesia injector and a patient monitoring system using the UTLP kit. The proposed system, which is installed at the operation theatre in the hospital consists of three sensors, namely a temperature sensor, a respiration sensor and heartbeat sensor. These three sensors perform three different operations and the input is given to the ARM8 processor. This system also monitors the physical parameters like blood level, glucose level and the anesthesia level and sends the information to the ARM 8 processor. The temperature sensor has to be attached to the patient body to monitor the temperature. If the temperature gets exceed the predefined range, then there is a possibility of getting fits. So the alarm circuit turns on to avoid the fits. This will continuously transmit the signal to the input system and it immediately sends the information to the anesthetist. In the meantime, we can prevent the patient from death. Similarly, respiration sensor also does the same operation as the temperature sensor. Heartbeat sensors placed in the chest of the patient during the process, which senses the heartbeat movement of the patient.

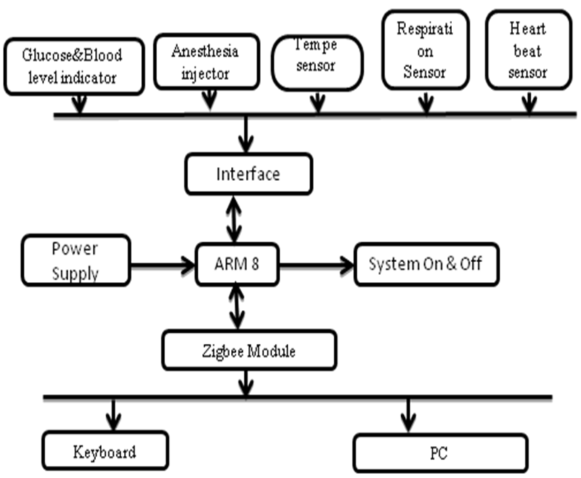

Fig.1 Block diagram of the proposed system

While the patient is in a critical state, the alarm circuit automatically turns on. In case of abnormal breath, respiration sensor senses the respiration and then it gives the input to the arm processor then automatically sends that information to the doctor and emergency precaution taken. Voice alarm turns on during the above said situations for saving the patient life from a critical position. Other physical parameters like blood level, glucose level and anesthesia level are monitored accurately and that information also gathered from this proposed system [7]. If the level of the above said parameters are increased or decreased, then it leads to the patient's death. If a lower level of anesthesia is injected, the patient may get disturbed in the middle of the operation [8]. To avoid this, the anesthetist administers a few milliliters of anesthesia per hour to the patient. If the anesthetist fails to deliver anesthesia to the patient at a particular time interval, other allied problems may arise. To overcome such hazardous issues, the design of the proposed system is more effective. During the entire operation of the automatic mode, each sensor sends its input and also the other physical parameters measured are also sent to the ARM processor. Further, the measured values are transmitted with the aid of the Zigbee module.

The Zigbee transmitter is connected with the system in each transmitting side through wireless network and data are received by the Zigbee receiver, which is interfaced with the ARM 8 processor. The embedded processor will perform different operations according to the given instruction. The ARM 8 processor will display the monitoring parameters value in the PC screen. From the PC screen anesthetist can monitor and control the physical parameters from their destination itself.

III. SOFTWARE MODULE

Unified Technology Learning Platform (UTLP) is an ardent facilitator for aiding engineers and gain hands-on learning and understanding complex and advanced technologies [9]. Eventually, UTLP embraces modern technologies to bridge the gap between academia and industry. It increases individual learning towards subjects and supports and motivates students towards building and integrating concepts keeping in mind organizational practices [10].

UTLP is an integrated learning environment consisting of hardware and software [11]. A specified Embedded C coding is fired in the integrated circuit for anesthetic patient monitoring system. The program coding for various parameters of the patient monitoring is shown below:

Program

```
#include "macros.h"
#include<ulk.h>
intmain(void) PROGRAM_ENTRY;
intmain ()
{
int m,i,BP,Temp,HBR,Respiration,G,Anesthesia;
unsignedlong*base=0x80500000;
{

*(base+is)=0x000000;
}
ulk_scanf_hex(&m);
switch(m)
{
case 1:
ulk_cpanel_printf("Blood Pressure\n");
ulk_scanf_hex(&BP);
if(BP==4)
{           ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
```

```
ulk_fpga_clcd_display_string("normal=100");

ulk_cpanel_printf("BP Normal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0x0000ff;
}
}
else
{
ulk_fpga_clcd_display_string("Abnormal<150");
ulk_cpanel_printf("BP Abnormal level \n");
for(i=0;i<320*240;i++)
{        *(base+i)=0xff0000;
}
}
case 2:
ulk_scanf_hex(&Temp);
if(Temp==3){
ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
ulk_fpga_clcd_display_string("normal level");
ulk_cpanel_printf("Temp Normal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xf000ff;
}
}
else
{
ulk_fpga_clcd_display_string("Abnormal level");
ulk_cpanel_printf("Temp Abnormal

level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xffff00;
}
}
case 3:
ulk_scanf_hex(&HBR);
if(HBR==6)
{
ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
ulk_fpga_clcd_display_string("normal level");
ulk_cpanel_printf("HBR Normal level \n");
for(i=0;i<320*240;i++)                {
*(base+i)=0xf0f0ff;
}
}
else
                {
ulk_fpga_clcd_display_string("Abnormal level");
ulk_cpanel_printf("HBR Abnormal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xfff000;
}
}
case 4:
ulk_scanf_hex(&Respiration);
if(Respiration==8)
{
ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
ulk_fpga_clcd_display_string("normal level");
ulk_cpanel_printf("Respiration Normal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xfff0ff;
}
}
else
{
ulk_fpga_clcd_display_string("Abnormal level");
ulk_cpanel_printf("Respiration

Abnormal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xfff0ff;
}
}
case 5:
ulk_scanf_hex(&G);
if(G==7)
{
ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
ulk_fpga_clcd_display_string("normal level");
ulk_cpanel_printf("Glucose Normal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0x0000ff;
}
}
else
{
ulk_fpga_clcd_display_string("Abnormal level");
ulk_cpanel_printf("Glucose Abnormal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xff0000;
}
}
case 6:
ulk_scanf_hex(&Anesthesia);
if(Anesthesia==5)
{
ulk_fpga_clcd_init();
ulk_fpga_clcd_display_on();
ulk_fpga_clcd_display_string("normal level");
ulk_cpanel_printf("Anesthesia Normal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0x0000ff;
}
}
else
{
ulk_fpga_clcd_display_string("Abnormal level");
ulk_cpanel_printf("Anesthesia Abnormal level \n");
for(i=0;i<320*240;i++)
{
*(base+i)=0xff0000;
```

```
}
}
default:
ulk_fpga_clcd_display_string("Warning");
}
}
```

IV. RESULT AND DISCUSSION

In this scholarly article, the UTLP is effectively utilized. Since after the debugging, we get the results in ULK command window [12].

The command window shows the physical parameters of the anesthesia patient to monitor the blood pressure, temperature level, output of heart beat, glucose level, respiration, anesthesia level of the patient as shown in Fig. 2 to Fig. 7. The entire proposed system is simulated using Labview software as shown below.

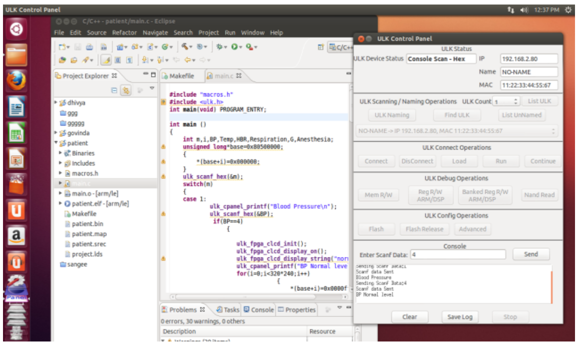

Fig.2. Output of Blood pressure

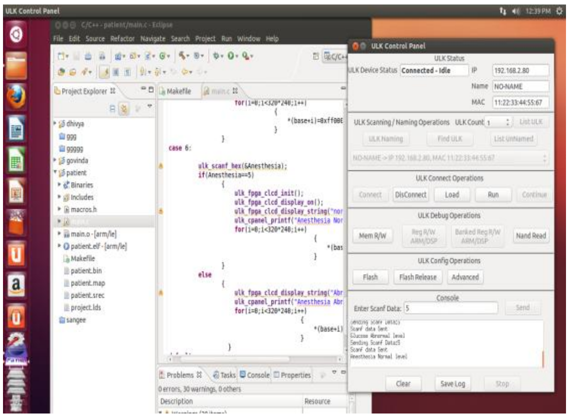

Fig. 3. Output of Temperature level

The command window shows the physical parameters of the anesthesia patient to monitor the temperature of the patient whether the temperature is normal or abnormal.

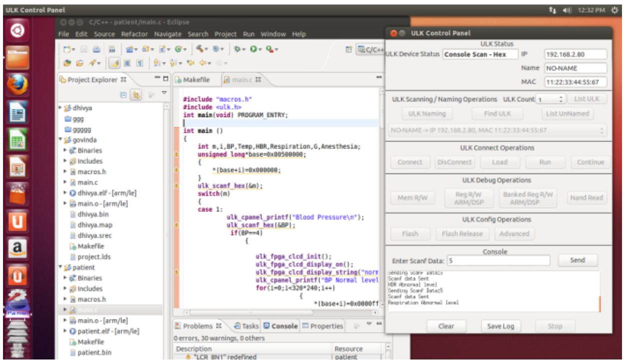

Fig. 4.Output of Heart beat sensor

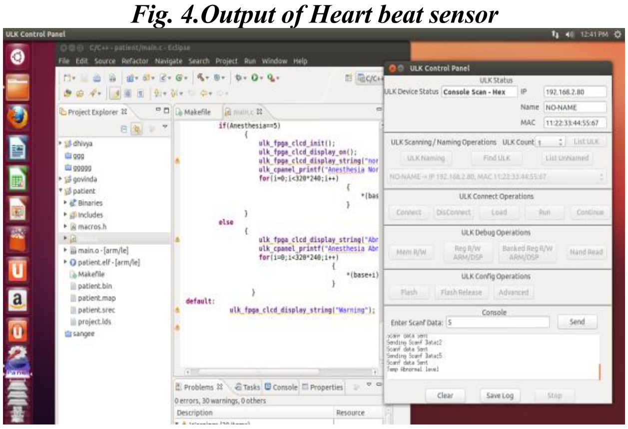

Fig. 5.Output of Glucose level

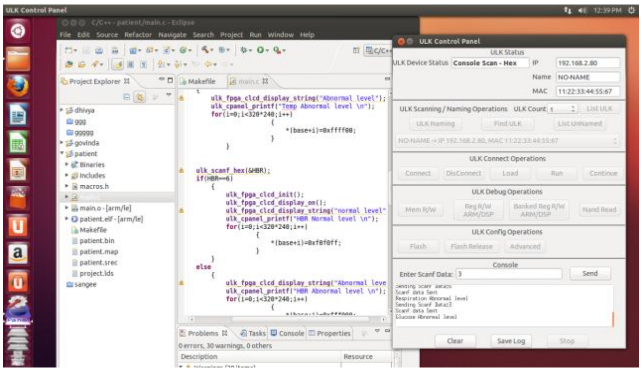

Fig. 6.Output of Respiration sensor

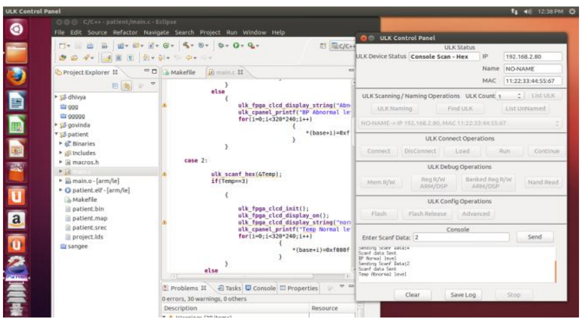

Fig. 7 .Output of Anesthesia level

V. CONCLUSION

A considerably more websites are in vogue to narrate the requirements and issues of physicians.

This work deliberately met the needs of the physicians faced during anesthesia injection to the patients. At present, there are no solutions available for monitoring anesthetic patients. Hence to improve the available smart techniques by controlling the non-electrical quantities, to promote a system that helps physicians to make the surgery more successful hence, this will create a new era in the field of medicine. The research focuses mainly on solving real-time problems in the patient monitoring and controlling system automatically. The various parameters like temperature, blood pressure, blood level, glucose level and anesthesia levels are monitored and the data are retrieved at any time, which ultimately gives the complete protection to the patient. If any problem occurs in any one of the section the faults are easily identified and isolated within a specific period of time and subsequently safeguards the health of the patient. Supplement to it, any malfunctioning in operation will be controlled and monitored automatically. The embedded system aids the implementation of the real-time system. The simulation results are obtained using Lab view software. Later the information is transmitted by Zigbee wireless technology. The enhancement of this proposed work can also be implemented using Wi-Fi or Wi-Max in any other protocols for long-distance communication.

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