SRI RAMAKRISHNA ENGINEERING COLLEGE

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[Approved by AICTE and Permanently Affiliated to Anna University, Chennai][ISO 9001:2015 Certified and all eligible programmes Accredited by NBA]
VATTAMALAIPALAYAM, N. G. G. O. COLONY POST, COIMBATORE – 641 022.

DEPARTMENT OF ELECTRONINCS AND COMMUNICATION ENGINEERING

20EC291 –Digital Circuits and Microcontrollers laboratory

CAPSTONE

NOVEL SYSTEM TO MONITOR THE BREATH

Regulation: R2022

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Submitted by

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CAPSTONE PROJECT REPORT

NOVEL SYSTEM TO MONITOR THE BREATH

S. No	Name & Roll No.	Abstract (2)	Implementation (4)	Report (4)	Total (10)
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NOVEL SYSTEM TO MONITOR THE BREATH

1. ABSTRACT

The heart rate is one of the important parameters of human cardiovascular system. Heart rate is the number of times the heart beats per minute. The readings of heart rate helps us to know various states of the body such as stress, concentration, drowsiness and the active state of the autonomic nervous system. This paper highlights on the design of heart rate monitor system using 8051 microcontroller. It is designed in such a way that the heart rate is measured at the finger tip based on the change in blood volume. Thus, monitoring of heart rate plays a vital role in providing the status of the health. This project is designed to measure heart beat (pulse count), by using embedded technology. In this project simultaneously it can measure and monitor the patient's condition. This project describes the design of a simple, low-cost controller based wireless patient monitoring system. Heart rate of the patient is measured from the thumb finger using IRD (Infra Red Device sensor).Pulse counting sensor is arranged to check whether the heart rate is normal or not. So that a SMS is sent to the mobile number using GSM module interfaced to the controller in case of abnormal condition. A buzzer alert is also given. The heart rate can be measured by monitoring one's pulse using specialized medical devices such as an electrocardiograph (ECG), portable device e.g. The patient heart beat monitoring systems is one of the major wrist strap watch, or any other commercial heart rate monitors which normally consisting of a chest strap with electrodes. Despite of its accuracy, somehow it is costly, involve many clinical settings and patient must be attended by medical experts for continuous monitoring.

Keywords: Microcontroller, heart rate, patient, sensor.

2. INTRODUCTION

The Heart Rate monitor device is personal monitoring device that allows to measure the heart rate in real time or to save the readings of heart rate for later references. Heart rate measurement is one of the very important parameters of the human cardiovascular system. The heart rate of a healthy adult at rest is around 72 beats per minute. Athletes normally have lower rates than less active people. Babies have a higher rate at around 120bpm. The readings rises gradually during exercises and returns slowly to the normal value after exercise. Therate at which the pulse returns to the normal value will indicate the fitness of the person. There is a s cientific word known as Bradycardia which means the condition where lowerthan the normal heart rate is present and higher than the normal heart rate is known as tachycardia. More than 2 million people are at risk of heart attack. It would be helpful if these people can check their heart rate easily.

Especially for cardiac patients, online long-term monitoring plays a pivotal role. It provides critical information for long-term assessment and preventive diagnosis for which long-term trends and signal patterns are of special importance. Such trends and patterns can hardly be identified by traditional examinations. Those cardiac problems that occur frequently during normal daily activities may disappear the moment the patient is hospitalized, causing diagnostic difficulties and consequently possible therapeutic errors.It is true that costly medical instruments provide very satisfactory service to the patients related to the diagnosis and treatment point of view. Again, it is a fact that many people couldno t access such costly service due to socioeconomic structure of the country. Hence, design and development of low cost device using latest technology should be given priority to facilitate the access for every patient to have satisfactory service.

This device consists of Heart-beat sensor, an Amplifier, 8051 Microcontroller, 16X2 LCD display. Sensor is used to sense the heart rate which is converted into digits using n amplifier which increases the low power heart rate signals from the sensor and sends those signals to microcontroller, where the timers and counters are used in the program to calculate the number of beats per minute.

3. RELATED WORK

Several methods have already been proposed and implemented regarding the design anddevelopment of devices for heart rate monitoring

- Development of precision digital instrument for calculation of heart rate , a beat - to-beat heart rate meter and heart rate meter based on frequency grading have been proposed
- . Nakajima et al. described photo - plethysmographic measurement of heart and respiratoryrates using digital filters.
- Yokoyama et al. and A. Wrong et al. stressed on the measurement of heart rate based on musical data and current steering technique respectively.
- Kang et al. have proposed an electrocardiogram (ECG) and photoplethysmography (PPG) monitoring device worn on wrist. The idea of using the human face for physiological measurements was first introduced by pavlidis and associates in 2007.

4. PROPOSED WORK

WORING OF THE DEVICE

The heart-rate monitor system mainly consists of AT89S52 microcontroller. The main feature of that is it is a low-power consuming, CMOS 8-bit microcontroller. It has an in-system programmable flash memory. This we use to involve the counters, timers and clock that help us calculate the approximate value of the pulse rate. Another important block of this circuit is the sensor that helps us to sense the pulse depending upon the volumeof the blood at the finger tip. The volume of blood at the tip is the same as the pulse rate. LED is used to help an individual know that the pulse is being detected. It t consumes less DC power of 5V. Next is the buzzer which alerts the person in case of abnormal heart-rate. An adult can have pulse rate between 70-100 BPM.Lcd display displays the pulse rate readings on the screen. It has digital numbers that is displayed. The user can decide the next step by knowing the readings.

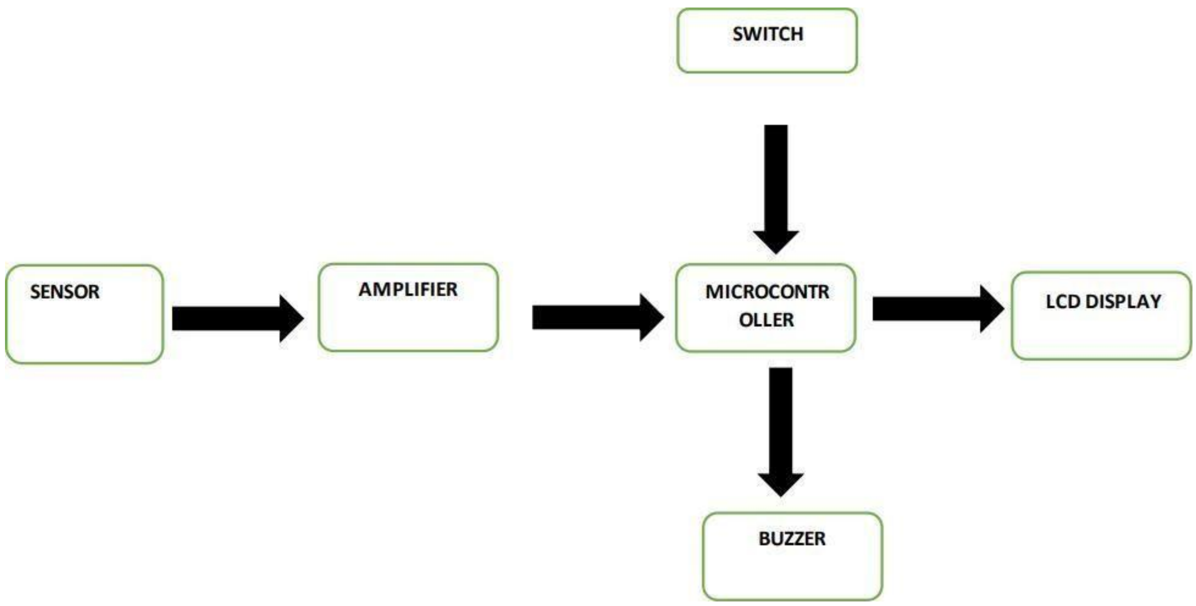

Figure. 1 Block diagram of heart-rate monitor system

SOFTWARE DESCRIPTION

Keil software is used in heart-rate monitor system. This software was introduced in 1992 by two people Gunter and Reinhard Keil. This tool is used to compile and this being helpful in programming assembly code for 8051-Microcontroller. It consists of ANSI C compiler, macroassembler, debuggers, simulators, linkers.

ISP- In system programming

Also called as in-circuit serial programming. It allows to involve both programming and testingin a single phase and helps reduce the cost. It helps one to change the program as required by the user than getting already programmed chips that does not have an advantage of editing them.

The **Proteus Design Suite** is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB (Printed Circuit Board) layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an autorouter and basic mixed mode SPICE simulation capabilities.

The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control,[2][3] temperature control [4][5] and user interface design.[6] It also finds use in the general hobbyist community[7][8] and, since no hardware is required, is convenient to use as a training[9][10] or teaching tool.[11][12]

Support is available for co-simulation of:

- Microchip Technologies PIC10, PIC12, PIC16, PIC18, PIC24, dsPIC33 microcontrollers
- Atmel AVR (and Arduino), 8051 and ARM Cortex-M3 microcontrollers
- NXP 8051, ARM7, ARM Cortex-M0 and ARM Cortex-M3 microcontrollers
- Texas Instruments MSP430, PICCOLO DSP and ARM Cortex-M3 microcontrollers
- Parallax Basic Stamp, Freescale HC11, 8086 microcontrollers

HARDWARE SETUP

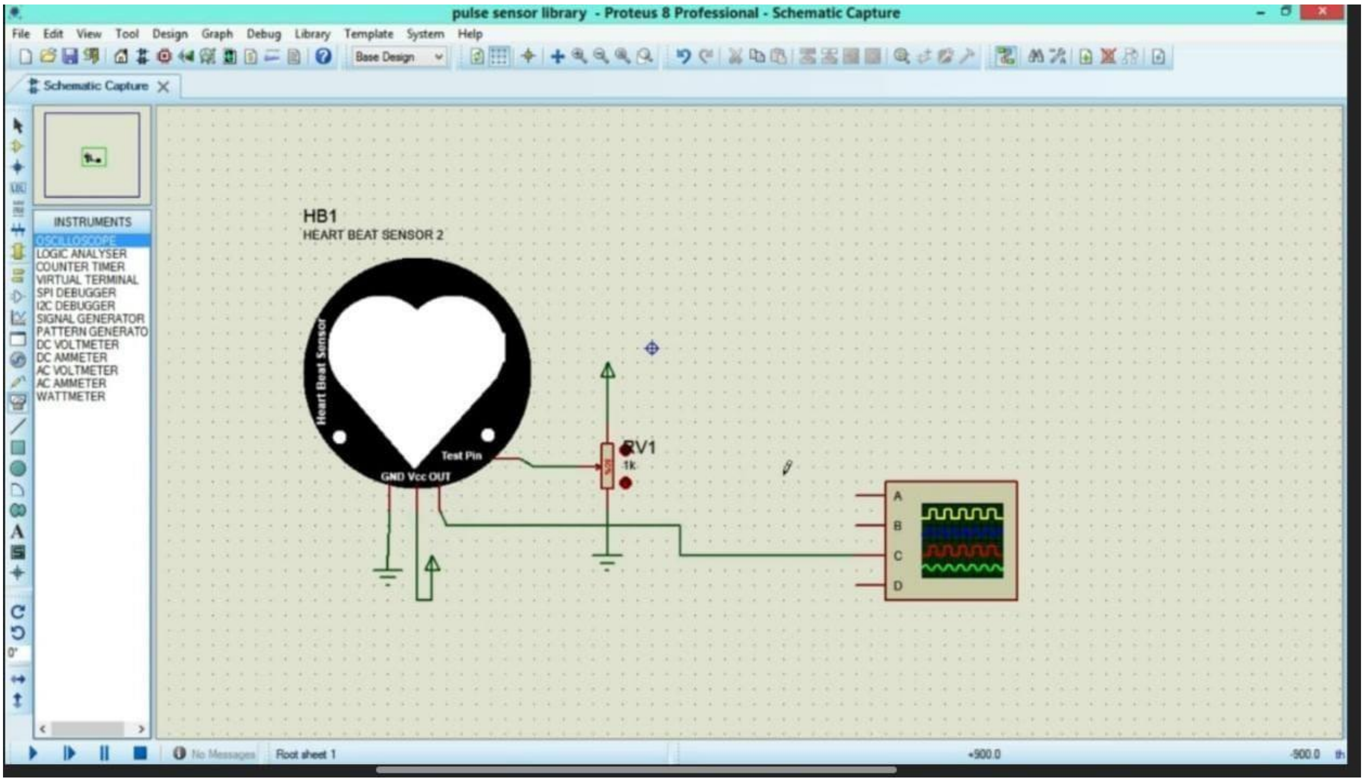

Figure. 2 Proteus hardware setup

HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements	Software Requirements
Heart beat sensor Buzzer 12 V Adapter 16X2 LCD Display Switch 10K Resistor 10µF, 470µF Capacitors	1. Proteus Design Suite Version 8 2. ISP

Table. 1 Hardware and Software requirements

5. PROGRAM:

```
#include<reg51.h>
#define dataport P0
#define key P3
sbit rs = P2^7;
sbit rw = P2^6;
sbit en = P2^5;
sbit relay = P2^0;
sbit heart = P1^0;
sbit bpm = P1^1;
sbit red = P3^0 ;
sbit green = P3^1 ;
sbit buzzer = P3^2 ;
void delay(unsigned int msec)  //Time delay function
{
int i,j ; for(i=0;i<msec;i++)
 for(j=0;j<1275;j++);
}
void lcd_cmd(unsigned char item) //Function to send command to LCD
{
dataport = item;
rs= 0;
rw=0;
en=1;
delay(1);
en=0;
return;
}
void lcd_data(unsigned char item) // Function to send data to LCD
{
dataport = item;
rs= 1;
rw=0;
en=1;
delay(1);
en=0;
return;
}
void lcd_data_string(unsigned char *str)  // Function to send string to LCD
{
int i=0;
while(str[i]!='\0')
{
```

```
lcd_data(str[i]);
 i++;
delay(10);
}
return;
}
void lcd(unsigned char str[10]) // Function to send string to LCD
{
lcd_cmd(0x38);
lcd_cmd(0x0e);
lcd_data_string(str);
}
void main()
{
unsigned int I,m=0,h=0,n=0;
red=green=0;
buzzer=relay=1;
lcd_cmd(0x01);
lcd_cmd(0x38);
lcd_cmd(0x0C);
lcd_cmd(0x80);
lcd(" WELCOME ");
lcd_cmd(0xC0);
lcd(" TO ");
delay(500);
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd(" Heart Beat");
lcd_cmd(0xC0);
lcd("Measuring System");
delay(500);
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd("SENSOR GETTING ");
lcd_cmd(0xC0);
lcd("ACTIVATION TIME");
delay(500);
for( i=0;i<=25;i++)
{
red=1;
delay(50);
red=0;
delay(50);
}
```

```
while(1)
{
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd(" Heart Beat");
lcd_cmd(0xC0);
lcd("Measuring Device");
while( heart == 0)
{
red=1;
delay(10);
red=0;
delay(10);
}
if(heart ==1)
{
lcd_cmd(0x01);
lcd_cmd(0x80); lcd("Check");
lcd_cmd(0xC0);
lcd("Mode");
for(h=0;h<100;h++)
{
if( heart==1)
{ m+
+;
}
delay(10);
}
if(m>=10)
{
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd("keep Your finger");
lcd_cmd(0xC0);
lcd("On The Sensor");
red=1;
m=0;
delay(450);
if(n==0 && heart==0)
{
lcd_cmd(0x01);
lcd_cmd(0x80);
lcd("Heart Beat ");
lcd_cmd(0xC0);
```

```
lcd(" BPM:- (bpm)");
}
}
}
}
```

6. OUTPUT

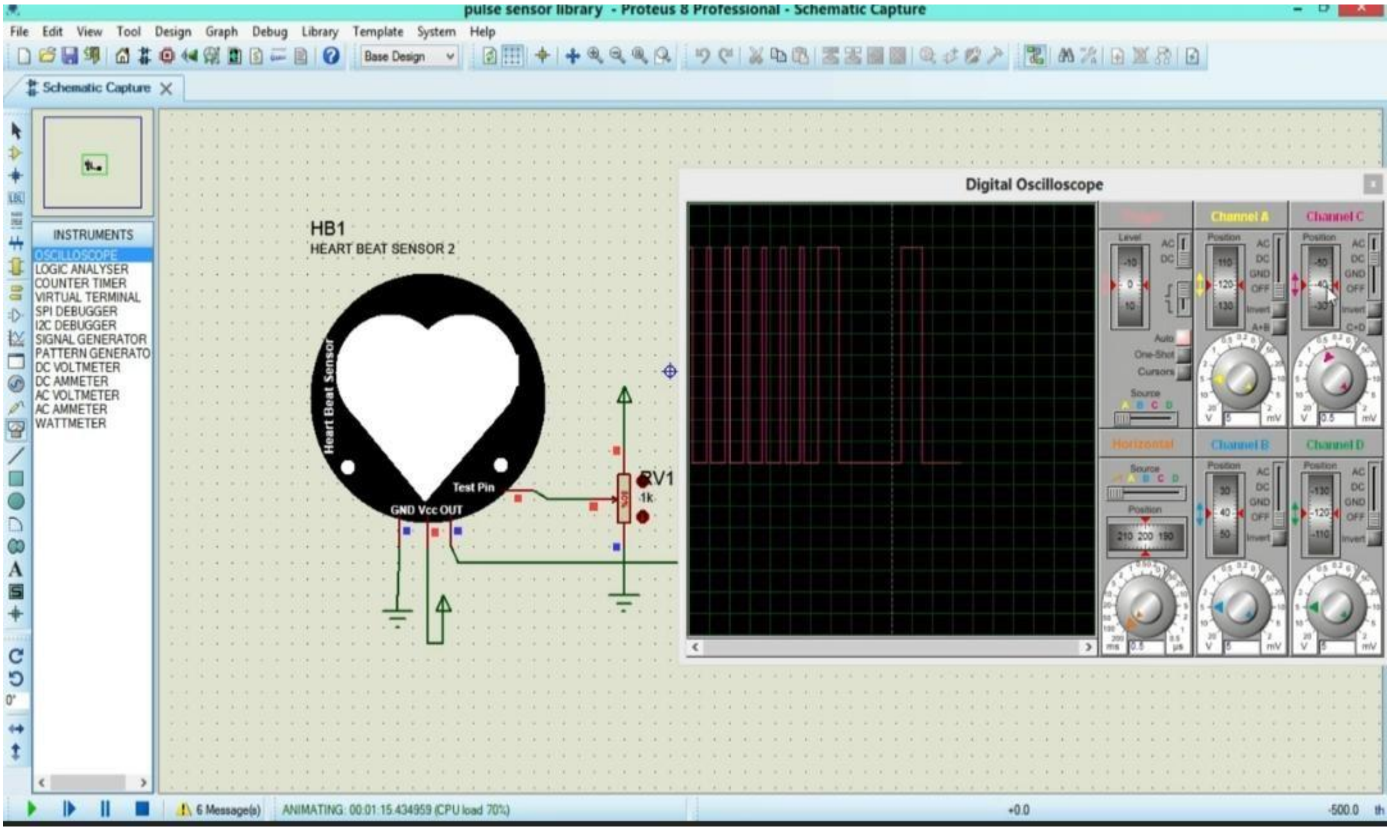

Figure. 3 Output of Heartbeat monitoring system

7. WORKING OF THE HEART RATE MONITOR

LTH1550-01 photo interrupter forms the photoplethysmographic sensor here. LTH1550- 01 is simply a IR diode – photo transistor pair in single package. The front side of the IR diode and photo transistor are exposed and the remaining parts are well isolated. When the finger tip is placed over the sensor the volumetric pulsing of the blood volume inside thefinger tip due to heart beat varies the intensity of the reflected beam and this variation in intensity is according to the heart beat. When more light falls on the photo transistor it conducts more, its collector current increases and so its collector voltage decreases. When less light falls on the photo transistorit conducts less, its collector current decreases and so its collector voltage decreases. Thisvariation in the collector voltage will be proportional to the heart rate. Any way this voltagevariation is so feeble and additional signal conditioning stages are necessary to convert it into a microcontroller recognizable form.

The next part of the circuit consists of a two active low pass filters using opamp LM324. The LM324 is a quad opamp that can be operated from a single rail supply. Resistor R23,R17 and capacitor C5 sets the gain and cut off frequency of the first filter. With the givencomponent values, gain will be 11 and cut off frequency will be 2.5Hz. The gain and cut off frequency are determined using the following equations. Capacitor C15 is used to by-pass noise if any may cause false triggering of the comparator.

Voltage gain $A_v = 1 + (R17 / R23)$

Cut off frequency $F_c = 1/(2\pi * R17 * C5)$

The second low pass filter also have same gain and cut off frequency. The two low pass filters form a very critical part of the circuit as any noise or false signals passing to the microcontroller stage will produce disastrous results. The output of the filter stage will be a voltage level fluctuating between 0 and 0.35 volts and this fluctuation is converted into a 0 to 5V swing using the comparator based on the third opamp (IC1c). The reference voltage of the comparator is set to 0.3V. When ever the output voltage of the filter stage goes above 0.3V, the output of the comparator goes to zero and whenever the output voltage of the filter stage goes below 0.3V, the output of the comparator goes to positive saturation. The result will be a neat pulse fluctuating between 0 and 5V at a rate equal to the heart rate. This pulse is fed to the microcontroller for counting.

8. LCD VERSION OF THE HEART RATE MONITOR.

A simple LCD version of the heart rate monitor is shown below. This is just a modification of theabove circuit.LCD displays are very popular now a most of the embedded system designers prefer them over multiplexed seven segment LED displays. Using LCD displays you can display text, custom characters, graphics and a lot of other stuff and it is a great advantage over the LED counterparts. JHD162 is the LCD display used here. It is a 16X2 LCD display based on the HD44780 driver IC. Go through the following link for knowing more about JHD162 and its interfacing to the 8051 microcontroller. Interfacing LCD display to 8051.

Data/command input pin DB0 to DB7 of the display is interfaced to Port0 of the microcontroller. Resistor network R17 is used for pulling up thePort0. Port0 needs external pull up for proper functioning. Preset resistor R1 is used for adjusting the contrast of the display. R2 limits the current through the back light LED. Other parts of the circuit are similar to the LED version.

9. CONCLUSION

From the above study, it can be concluded that the designed low-cost heart rate monitor system can function efficiently by producing the approximate readings as that of standarddevice. Due to absence of complex features, the designed device can also be handled by any non-medical professionals also. Thus it can be used anywhere, it is portable, lightweight device. But, it must be noted that the proper placement of finger tip over the sensor is veryimportant to get accurate results. The device can be further improved using latest technology such as Arduino and Raspberry pi.

10. REFERENCES

[1] IbrahimD and Buruncuk K.”Heart Rate Measurement From The Finger Using a Low-CostMicrocontroller” .

[2] Yonezawa et al.” A Precision Digital Instantaneous Heart Rate Meter with a Wide Range”,IEEETransactions on Biomedical Engineering, Vol.BME-30, No 9, pp. 42-44,1981.

[3] Yokoyama et al., “Heart Rate Indication Using Musical Data” , IEEE Transactions on Biomedical Engineering, Vol.49, No 7, pp.729-733, 2002.

[4] Wrong et al., “A Near Infrared Heart Measurement IC With Very Low Cut offFrequency Using Current Steering Technique”, IEEE Transactions on circuits and . systems: Regular Papers, Vol.52, No.12, pp.2642- 2647, 2005.

[5] T.Pursche, J.Krajewski and R.Moeller, “Video-based Heart Rate Measurement FromHuman Faces”, IEEE International Conference on Consumer Electronics, ISBN: 978-1-45Z7-0231-0,pp.544-545, 201.