Non-Contact Temperature Measurement Embedded System

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Abstract - The most chronically measured physical quantity is Temperature. Now a day in the market the temperature measurement system used is wired system. Even if we say the temperature measurement is wireless, it is the transceiver which is wireless with wired temperature measurement system, so it is not really a non-contact wireless temperature measurement.

The proposed system gives an idea of a non-contact temperature measurement system designs and implementation based on MLX90614, which uses embedded hardware platform ATmega328. And the system applies ARM embedded IIC (Inter-Integrated Circuit) bus module's communication procedure and control methods.

Keywords— *Temperature Measurement System, ARM Embedded IIC bus, Non-contact Temperature Measurement System, MLX90614, ATmega328, Embedded Hardware*

I. INTRODUCTION

In recent years to dry or heat materials an infrared ovens and systems are used in continuous web form or sheets running edge to edge using automatic (closed loop) control systems have become more practical. The temperature of the moving material is deliberately measured with a radiation non-contact thermometer known as a radiation pyrometer, and the reading correlated with a stabilized voltage giving the desired temperature, or set point. Any difference between the two voltages is boosted and applied to a thyristor solid state controller to correct the infrared intensity, and hence keeping the temperature of the product constant.

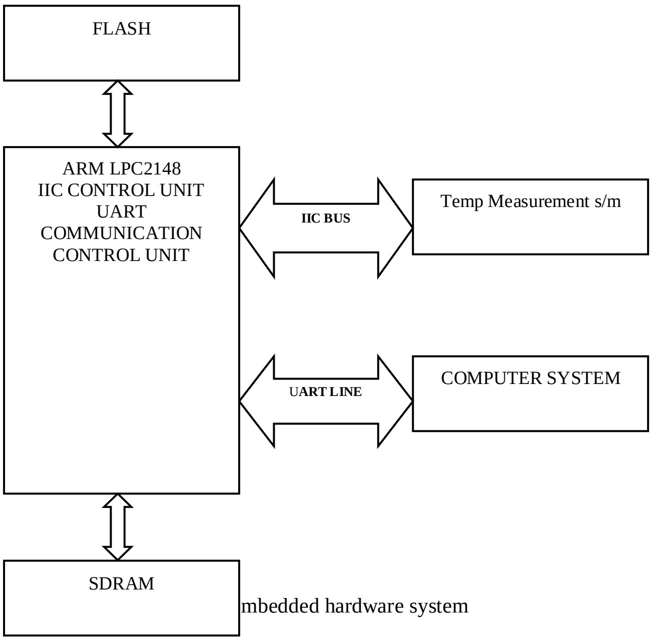
Above the absolute zero temperature of -273°C all bodies emit infrared radiation. To determine the surface temperature of a body, measurement of this emitted radiation taken into account. A sensitive instrument containing an optical system receives the transmitted radiation. An optical system is used to focus the radiation onto a sensor which generates a small electrical signal related to temperature. Non-contact thermometry works on this principle. The great popularity of heating field applications are in the range of 50°C to 600°C.

Even though the temperature ranges from 50°C to 600°C the signals generated are of the order of just a few micro-volts per degree centigrade. Theoretically the distance of viewing between the hot body and the instrument is sensible, provided an adequate size of area of target required by the optical system to fulfill the viewing inlet. As the water vapor or carbon dioxide absorbs infrared radiation at certain wavelengths these should not be present in between the air space of the product and the thermometer.

II. DESIGN OF EMBEDDED IIC SYSTEM

A. *Design of Embedded Hardware System*

The controller of whole temperature measurement system is ARM LPC2148, and the temperature sampling device of that is Temperature measurement system which contains IR sensor and signal processing unit. Temperature measurement system can also pass the temperature of the samples collected information to the host system through the serial port by using the serial communication function of ARM LPC2148 so that it is convenient for users to make observation and statistics. The Embedded hardware system architecture is shown in Figure1.



mbedded hardware system

Based on MLX90614, this paper surveyed and analyzed a non-contact temperature measurement system, which uses embedded hardware platform Atmega328 and the system applies embedded IIC (Inter-Integrated Circuit) bus module's communication procedure and control methods. The system may be widely used in many applications such as fault diagnosis, performance testing, etc.

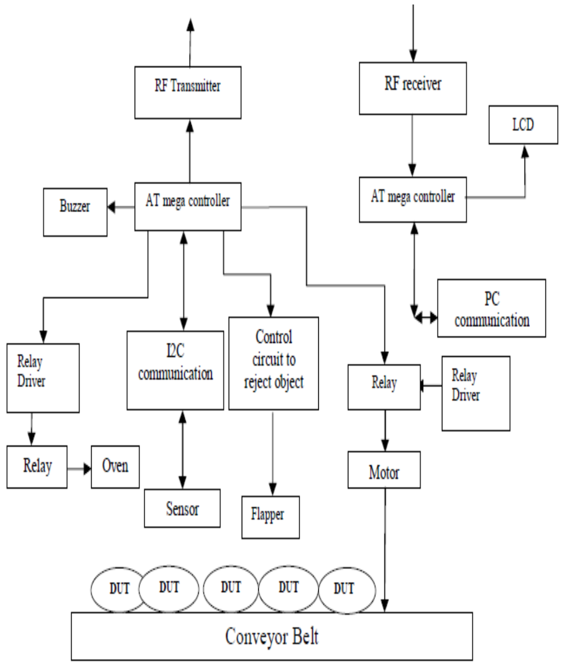


Fig.2: Block diagram of Temperature Measurement System

B. Design of Software

For the IIC interface communication, Software system design is primarily used. The system has mainly two phases: the transmitter mode phase and the receiver mode phase. The communication process is complete by three steps:

1. Detecting the status of slave device of IIC i.e. whether slave device is online
2. Transmitting commands for temperature measurement,
3. Returning the data of measurement

The communication control of IIC is partially completed by internal IIC Bus control section of ATmega, involving IIC bus controller IICDS transmit / receive data shift register, IICCON control register, IICSTAT status register. The following introduction based on the method of each phase's operation.

Before starting communication of ATmega IIC module, the starting mode is set to the master receiver firstly, and then the slave device's address is written to the IICDS register, and we write OxFO to the IICSTAT register to start an IIC communication. At this time the data from the IICDS register is sent one by one, and wait the response from the slave device. After receiving a response, the master device ATmega continues the next communication or finishes this communication.

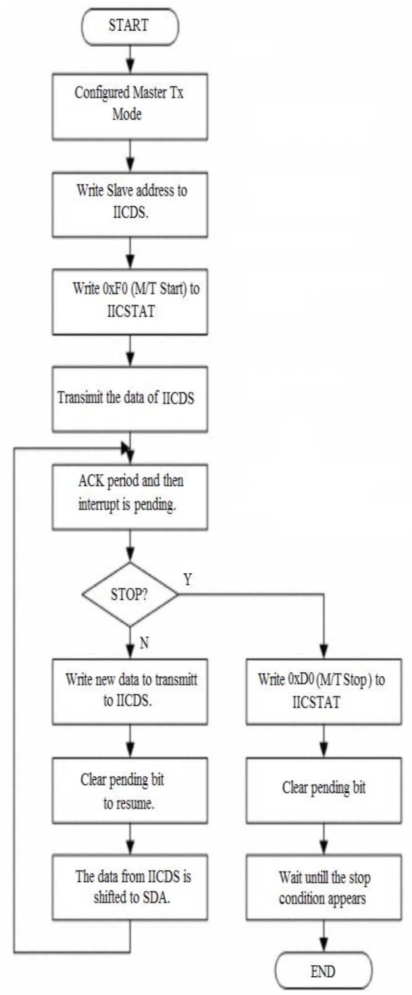


Fig.3: Master transmitter mode phase

The second mode is the master receiver mode phase: Similarly, the starting mode is set to the master receiver firstly, before starting communication of ATmega 0' s IIC module, and then the address of slave device is written to the IIC register, and to start an IIC communication we write 0xB0 to the IIC register. The data from the IICDS register is sent one by one, and wait for the response from the slave device. The master device ATmega continues the next communication or finishes this communication after receiving a response.

In the four-step operation, the two phases are completed in the master transmitting phase i.e. checking the online status of slave device of the IIC and command transmission for the temperature measurement. The master receiver phase returns back the temperature measurement data. End of the IIC communication is achieved at any phase or mode, directly by setting the STOP bit in the IICSTAT register.

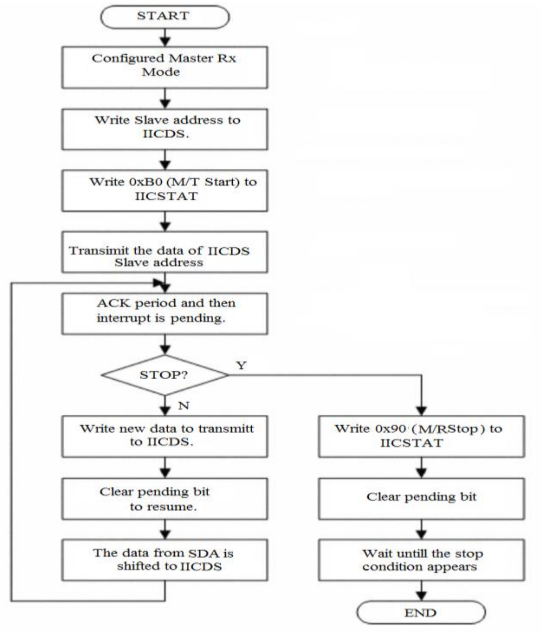


Fig.4: Master receiver mode phase

III. RESULTS

Table 1. Samples of the Human body temperature and the boiling water temperature

Actual temperature	Measured Temperature	Temperature Deviation
30.7	30.15	-0.55
	30.40	-0.30
	30.60	-0.10
	30.90	0.20
	30.02	-0.68
100.05	99.90	-0.15
	100.25	0.20
	100.35	0.30
	100.30	0.25
	99.95	-0.10

IV. CONCLUSION

The information of temperature conditions of various points can be passed in real time to the host system. The temperature measurement system detection can be with fast speed, high precision and good stability. We can also optimize the value of the temperature, integrating with other engineering parameters through the software at the host-side. Application of this system is in fault diagnosis, performance testing, Industrial use and other engineering fields.

V. REFERENCES

[1] V. K. Bitukov and V. A. Petrov, "Noncontact Temperature Measurement on Dielectricsand Semiconductors",Rus-sian Microelectronics, Vol. 33, No. 6, pp. 329-341,2004

[2] Francisco Javier Meca Meca , Manuel Mazo Quintas, Francisco Javier Rodriguez Sanchez, Pablo Ramos Sainz,"Infrared temperature measurement system using photoconductive PbSe sensors without radiation chopping" ,Sensors and Actuators A I0 0,pp.206-213,2002

[3] Slavko Pokorni," Error Analysis of Surface Temperature Measurement By Infraed Sensor" ,International Journal of Infrared and Millimeter Waves, Vo1.25, No. 10, October 2004

[4] Wan Han, Gao Xiaopeng,"ArmSim: a Complete System Simulation Environment of the ARM Embedded System" Fifth International Conference on Information Technology: New Generations, pp. 1261-1262,2008

[5] Timothy A Shedd and Benjamin Wanderson, "An automated non-contact wall temperature measurement using thermoreflectance", Measurment Science And Technology, pp. 2483-2488, November 2005.

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