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Non-Contact Temperature Measurement System Based on Embedded

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***Abstract*: Surface-contact temperature measurement technology is very successful, but the research on the non-contact temperature measurement technology is relatively less. This paper designs and implements a non-contact temperature measurement system, which uses embedded hardware platform ARM LPC2148 and the system applies ARM embedded IIC (Inter-Integrated Circuit) bus module's communication procedure and control methods. Experimental results show that the system is of high stability, speed, and precision. The system may be widely used in many applications such as fault diagnosis, performance testing, etc.**

***Keywords:* Embedded Systems; Temperature Measurement System; Non-contact Temperature Measurement; ARM LPC2148; llC Bus.**

I. INTRODUCTION

The temperature measurement system is involved in many applications, with the successful temperature measurement technology. But the wire temperature measurement occupies the market mainly, or in some cases even if the actual temperature is wireless but it is the wireless transceiver with wired temperature measurement system, so it is not really a wireless non-contact temperature measurement.

At present, there are many infrared temperature measurement applied for measuring body temperature. It can measure the temperature directly without contacting the skin, so it can be called non-contact temperature measurement. But such equipment is often very expensive and designed for special purposes, which makes the user cannot do further development according to their own requirements. The paper, based on infrared temperature measurement system, applying a method with ARM LPC2148 IIC interface connection and communication control, developed and designed a non-contact temperature measurement system. Users can design and develop their needed non-contact temperature measurement system by themselves according to their own requirements.

II. DESIGN OF EMBEDDED IIC SYSTEM

A. Design of Embedded IIC 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 temperature measurement system hardware architecture is shown in Figure1.

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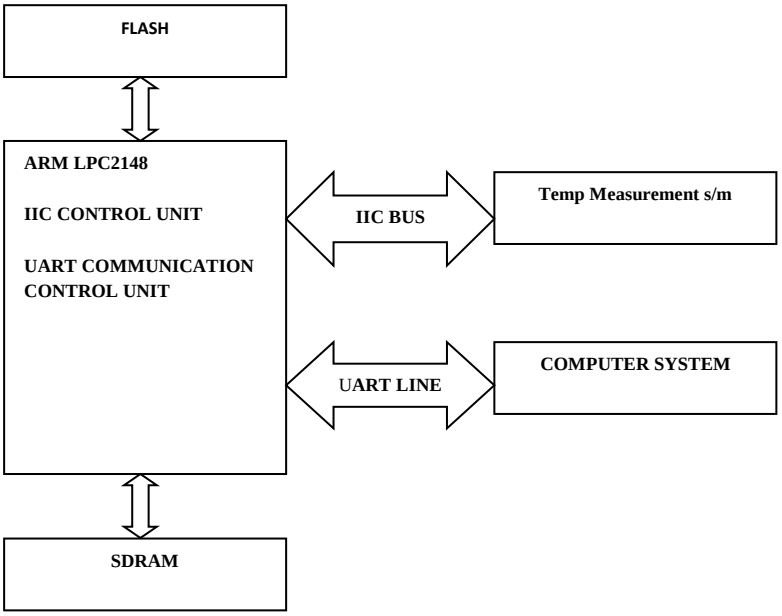

Fig1: Block Diagram of Non contact temperature measurement system

The basic working principle is detection of infrared radiation with a thermopile sensor, which turns incoming radiation to an analogue voltage; Determination of sensor temperature using a thermistor; Further analogue signal processing and conditioning; Calculation of ambient and object temperature using a processing unit; providing the ambient and objects temperature at digital output bus (I2C). The non-ideal filter characteristics have to been considered for the correct measurement distance with respect to the measurement object surface size. To achieve most accurate measurement results, measurement object should at least cover 99% of the sensors field of view.

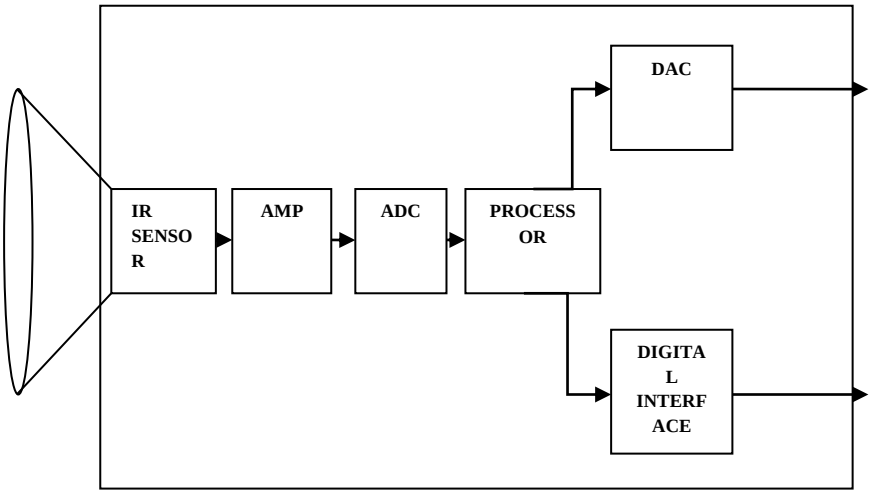

Fig2: Block Diagram of IR system

Digital signal processing transforms the signal into an output value proportional to the object temperature. The temperature result is either shown on a display or may be used as analog signal for further processing. In order to compensate influences from the surroundings a second detector catches the temperature of the measuring device and of his optical channel, respectively. Consequently, the temperature of the measuring object is mainly generated in three steps:

1. Transformation of the received infrared radiation into an electrical signal

2. Compensation of background radiation from thermometer and object

3. Linearization and output of temperature information.

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B. DESIGN OF EMBEDED IIC SOFTWARE SYSTEM:

Software system design, primarily for the IIC interface communication, the system is divided into two phases: the master transmitter mode phase and the master receiver mode phase; the lie communication process is complete by four steps: detecting whether the slave device of IIC is online, transmitting temperature measurement commands, returning the measurement data, finishing the IIC communication. The flow chart of the IIC communication is shown in Figure3.

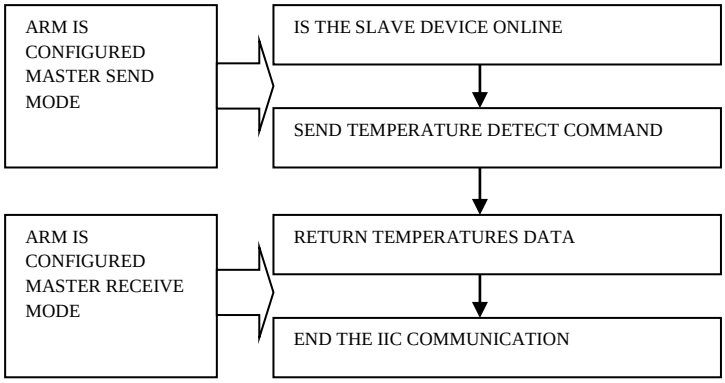

Fig3: Flow chart of the IIC communication

The communication control of IIC is partially completed by internal IIC Bus control section of ARM LPC2148, 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 ARM LPC2148 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.

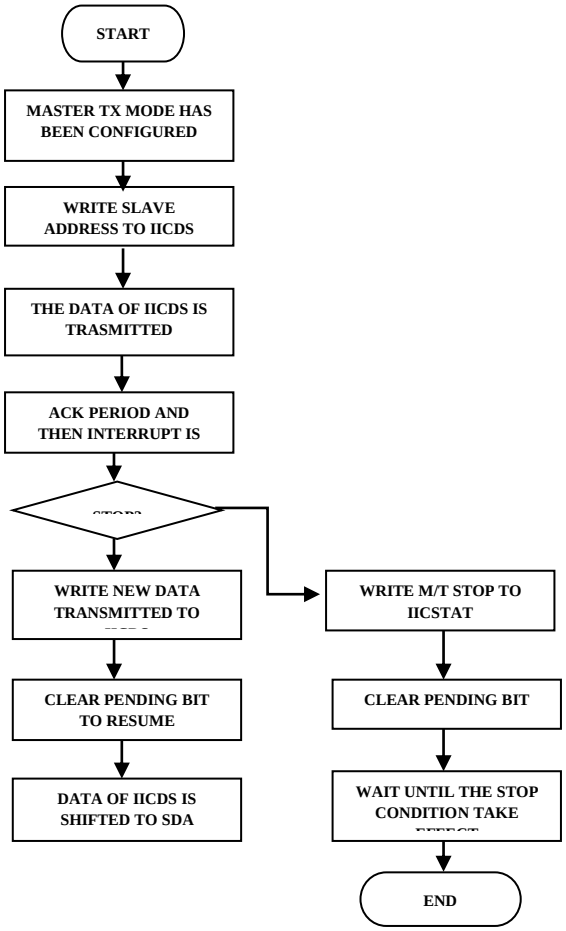

Fig4: Master transmitter mode phase

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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 ARM LPC2148 continues the next communication or finishes this communication. The software operation process is shown in Fig

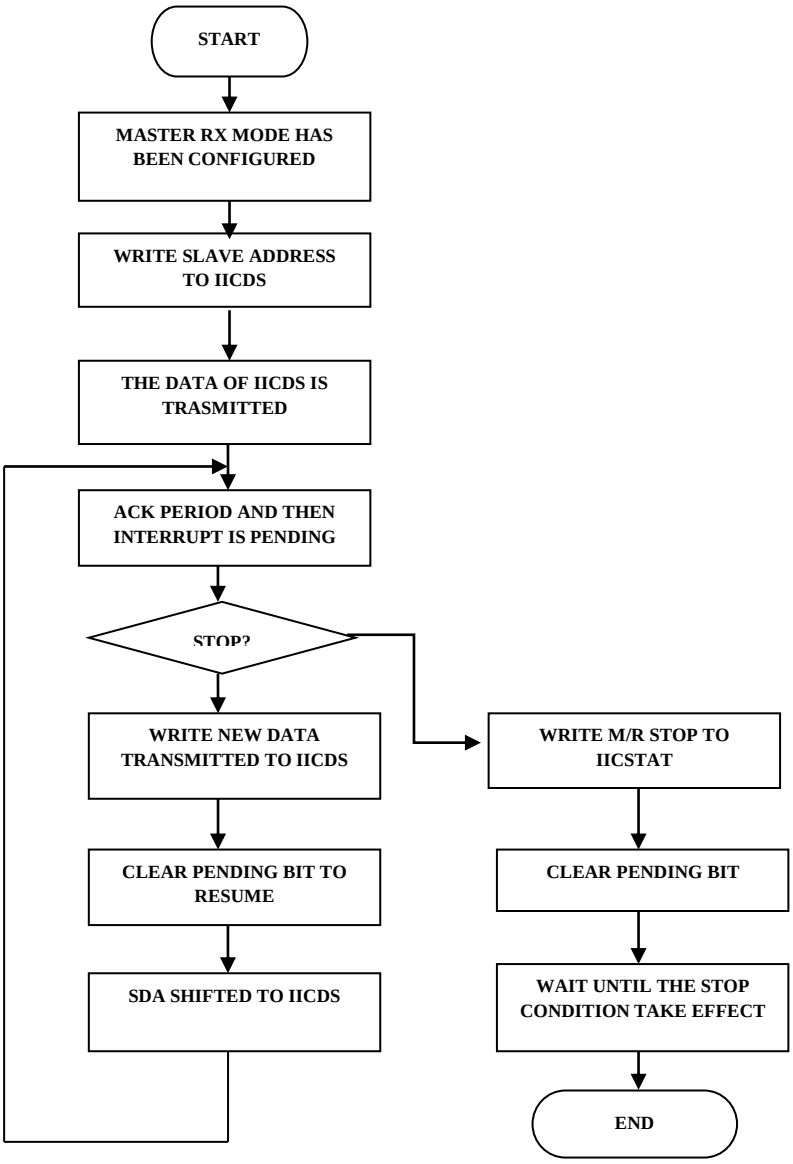

Fig5: Master receiver mode phase

In the four-step operation, testing whether the slave device of the IIC is online and transmitting the temperature command, the two phases are completed in the master transmitting phase. Temperature data returns back from the master receiver phase. End of the IIC communication is effective to achieve at any phase or mode, directly by setting the STOP bit in the IlCSTAT register.

III. CONCLUSIONS

Temperature measurement system can be sampled on a sampling point; can also form into a target array of the measured multi-point sampling by reusing Temperature sensor module. It can pass the information of temperature condition of various collection points to the host system in real time. Detection of the temperature measurement system is with fast speed, high precision and good stability. In the host-side, through the software, we can also optimize the value of the temperature of each collection point, integrating with other parameters of engineering. It can be widely used in fault diagnosis, performance testing, Industrial use and other engineering fields.

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