Implementation of Environment Monitoring and Device Control using ARM Based Embedded Control Sensor Network

MOHD IMRAN¹, HILAL AHMAD MALIK²

¹PG Scholar, Dept of ECE, Shadan College of Engineering and Technology, Peerancheru, Hyderabad,
Email: mohdimran37@gmail.com.
²Assoc Prof, Dept of ECE, Shadan College of Engineering and Technology, Peerancheru, Hyderabad, India.

Abstract: Embedded controlled sensor network is the technology used to implement environmental solutions effectively. The existing systems are bulky, very costly and difficult to maintain. The proposed system is cost effective and controlled by user friendly embedded systems. In the proposed system ARM based microcontroller and wireless sensors are used to control the various devices and to monitor the information regarding the environment using Zigbee and GSM technologies.

Keywords: Embedded Control Sensor Network, Environment Monitoring System.

I. INTRODUCTION

Environment monitoring and device control allows new level of comfort in homes and it can also manage the energy consumption efficiently which in turns promotes the saving. Remote controlling of the devices offers many advantages to senior citizens and people with disabilities which helps them in being more autonomous and increasing quality of life. In addition to remote control, monitoring temperature, flood and carbon monoxide in homes is also a major concern. There is a severe need to monitor temperature or gases as they can be costly and deadly. A monitored low temperature sensor warns about freezing temperatures inside house. Also if the boiler, washer or pipes leaks in the home, it can cause considerable damage. Guangming Song (etc) [2] developed a wireless-controllable power outlet system. Researchers have worked on home automation and environmental monitoring system in the past but in the existing systems cost is high, size is an issue and they are difficult to maintain [3][4][5][6].

The proposed system is cost effective and controlled by user friendly embedded systems. In this proposed system, we have designed one master module which consists of arm7 microcontroller, GSM module and Zigbee module. The slave module is designed using pic microcontroller and Zigbee module. And in addition we have designed a DotNet application to control the devices with the help of a laptop/pc. GSM module is used for long distance control of devices and monitoring the environment. In the master system, we have used ARM7 based LPC2148 microcontroller. LPC2148 is 32/16 bit microcontroller with embedded high speed flash memory of 512 KB. For GSM communication we have used STM300, which is a tri band GSM/GPRS engine, which is very useful for data transfer applications. GSM uses AT commands via its serial interface to control the devices. Zigbee technology is used for wireless personal area networking. Zigbee technology offers simplicity and a cost effective approach to building, construction and remodeling with wireless technology. The circuit diagram of the master network designed using the ARM microcontroller, GSM module and Zigbee module is as shown below in figure 2. In slave module we have used pic microcontroller along with zigbee module and sensors for monitoring the environment.

II. SYSTEM DESIGN

The overall design of environment monitoring and device control system is shown in the following figures.

![Slave circuit](image)

Fig1. Slave circuit.

Fig1. Represents the slave circuit of the environment monitoring system with sensors, which is interfaced with the Microcontroller that controls all the operations and devices. The system also communicates with the master node through serial communication. The project implements the wireless technology which is zigbee for
greater range and free communication. Sensor section monitors the environment and if the values get abnormal it sends the data to the master section through zigbee module. The zigbee module on the other side receives the data and sends it to the Arm7 controller which will reads the data and sends the message to the user. Based on the commands received from the Master unit the devices will be controlled and the readings from the sensors are displayed on the LCD.

Fig 2. Master circuit.

Fig2. Represents the master circuit of the environment monitoring system which uses ARM7 as the controlling unit of the system based on the readings received from the slave circuit the system takes further action in two modes.
1. The master circuit sends the message to the user1 for the appropriate action. If the user1 is busy or not reachable then the message is sent to the user2 to take the required action.
2. The system implements a Dot net application which enables any user to have control over the devices easily.

III. METHODOLOGY

A. Sensor unit
1. Light Dependent Resistor (LDR)
Light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity or vice versa. As the name suggests, LDR is a type of resistor whose working depends upon only on the light falling on it. The resistor behaves as per amount of light and its output directly varies with it. In general, LDR resistance is minimum (ideally zero) when it receives maximum amount of light and goes to maximum (ideally infinite) when there is no light falling on it.
   1. Signal Output
   2. GND
   3. Power

Fig 3. LDR Specifications
- Resistance: 400ohm to 400Kohm
- Sensitivity: about 3msec
- Voltage ratings: I used it on 3V, 5V and 12V

Description
LDR, an acronym for light dependent resistor is a resistor whose resistance is dependent on light. In this when the light falls on LDR, the resistance of LDR becomes low and the entire voltage drop takes place across the variable resistance (VR) (10KΩ). When no light falls on LDR, the resistance of LDR becomes high so almost entire voltage drop takes place across it. The sensitivity of the circuit can be adjusted by varying the preset (VR).

2. Temperature sensor
Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrials applications. A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of environmental temperature.

3. Temperature sensor (LM35)
Pin Definition
The definition of gray-scale sensor pin is

4. Humidity Sensor
Humidity sensor is an instrument used for measuring the moisture content in the environment. Humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. By
calibration and calculation, these measured quantities can lead to a measurement of humidity.

Fig5.

B. Features
- Relative humidity sensor
- Two points calibrated with capacitor type sensor, excellent performance.
- Frequency output type, can be easily integrated with user application system.
- Very low power consumption.
- No extra components needed

C. Performance and Reliability
Each sensor is designed to provide enhanced sensitivity, response time, stability and reliability. Although humidity products are typically standardized and platform-based, they deliver superior performance right out of the box. Sensor construction consists of a planar capacitor with a second polymer layer to protect against dirt, dust, oils, and other hazards. Laser trimmed for stable, low drift performance. Printed circuit board or surface mount terminations provide application flexibility.

IV. RESULTS
A. Sensor section analysis the environment continuously and forwards the information to the master section if the value gets abnormal. Various values as outputs of the sensors are shown in the figure 1.
T: Temperature sensor H: Humidity sensor L: LDR sensor

Fig6. Sensor values.

B. When the sensor section analysis any different values, the outputs on the master circuit is displayed on thelcd is shown in the following figures respectively.

Fig7. Initial message of the master section

Fig8. If LDR sensor gets activated, the following message is displayed on the lcd, and at the same time, the system sends the message to the user and waits for the reply to take the required action to control the device connected to it.

Fig9.

Fig10. If temperature sensor gets activated the following message is displayed on thelcd, and at the same time, the system sends the message to the user and waits for the reply to take the required action to control the device connected to it.

Fig10.

Fig11. If humidity sensor gets activated, the following message is displayed on thelcd, and at the same time, the system sends the message to the user and waits for the reply to take the required action to control the device connected to it.

Fig11.

C. Messages received on the user mobile are shown in thefig12.

Fig12. The system can be controlled with the dotnet application, by directly connecting a laptop to the master section and the devices which are connected to the system can be controlled easily, the output of the system is shown in the figure 7.

Fig12.
V. CONCLUSIONS

This paper implements the advanced designing of embedded controlled sensor networks used for controlling the home devices as well as monitoring the environmental parameters in any application areas. The features of wireless technology which is used in the project like GSM and Zigbee are explored to design the system for long distance as well as short distance. The system show the reliable solution in providing remote control and sensing for indoor environmental monitoring systems. Three commercial sensors had been integrated with the system to monitor and compute the level of existence of Light, temperature and humidity in atmosphere using information and communication technologies.

VI. REFERENCES