



Full Length Research Article

MICROCONTROLLER BASED WATER PURIFIER CONTROLLER SYSTEM IN ZIGBEE TECHNOLOGY

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ABSTRACT

In normal colleges and office campus different types of water cooler systems are being employed. The problem with these water coolers is that the absolute temperature of water set inside the container is not maintained properly and there is no fault indication system. Though the students pay for all these facilities but they do suffer from not having the guaranteed cold water by the authorities and moreover there is no complaining. The aim of this project is to automatically control the temperature of cold water in cooling system. Microcontroller based an embedded technology is used to develop the desired control mechanism. Besides measuring the temperature and control, the system also indicates the water level and purity of water with Zigbee technology is described in this paper. This is a very cheap and economically suitable system to save power consumption as well as give desired temperature control in cooling machine. A timely alarmed fault can thus, with the help of this technology could be quickly responded and removed.

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INTRODUCTION

This system is based on a central controlling of ARM microcontroller. This system uses LM-35 temperature sensor [1], to detect the present temperature of the cooler water. Water level indicators are also used to detect the water volume in liter inside the tank. The compressor is automatically switched on through relay circuit for when cooling is required. Automatic fault detection and alarming is also provided. LCD display is present showing current temperature [2], water level and the pH value of water. Multi color LED and buzzer are used to clearly denote a major fault in cooler. Safe and pure water can be easily harnessed from cooler machine with all vital parameters automatically controlled. Wireless technologies should provide these same type and quality of services to industrial users as the traditional, wired technologies do. However, wireless technologies differ in a number of ways from wired ones. These differences present significant challenges for the design of network architectures, protocols, and tools for industrial and automation applications. A lot of devices and machine can be controlled and data can be received and sent at the same time by wireless technology [6]. So, system operation can be achieved without any trouble. In that literature, several methods have been presented for monitoring, controlling and detecting faults in water purifier.

The microcontroller based controlling system is described for electrical parameters [3], but these have not been displayed on a screen. Normal water cooling system with water purification and sanitation equipped. Continuous water cooling with non-stop compressor operation. Unnecessary compressor running beyond cooling point. No fault indication under emergency situation. Large variation in water temperature from set point. Low lifetime of functional parts.

Wireless Protocols

ZigBee is designed for reliable wirelessly networked monitoring and control networks, while Wi-Fi is directed at computer-to computer connections as an extension or substitution of cabled networks. The ZigBee (IEEE 802.15.4) is a new technology that permits the implementation of Wireless Personal Area Networks (WPAN) [6] [7]. It is very suitable for wireless sensor networks due to the very low power consumption. This is one of the reasons why it is chosen for the implementation of the system presented in this paper. Summarizing, the main advantages of ZigBee in comparison with other technologies such as Bluetooth or Wi-Fi are as follows:

- Flexible network architecture;
- Low cost;
- Low power consumption;
- Large number of nodes (≤ 65.536);
- Compatibility of equipments from diver producers;

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In the structure of ZigBee networks the devices can be of three types: ZigBee Coordinator, ZigBee Router and the ZigBee End Device [6].

ZigBee Coordinator (ZC) – has the function to initiate the network structure by configuring the channels and establishing an ID for that network. It stores the security keys and is capable to bridge the devices from its own network to other networks.

ZigBee Router (ZR) – act as an intermediate device, its main function is to participate in multi-hop / mesh routing of network messages. It maintains a routing table and manages local address allocation.

ZigBee End Device (ZED) – does not participate in routing. It contains only the functionality to communicate with its parent node (the network coordinator or a router).

Proposed System

ARM-microcontroller based cooling water temperature control system. LM-385 temperature sensor to sense the present water temperature and feedback to PID-controller [2]. Relay circuit (15 Amp) to quickly switch ON the compressor at hot conditions and turn it OFF when cooling temperature is reached. Timer based system is implemented to check whether the compressor is working or not. Water level indicator are used to verify whether tank is empty. LCD display system to portray i/p power, line voltage, tank capacity, actual & set temperature point, compressor ON/OFF etc [3]. Adding of Zigbee device is to communicate digital signal controller to personal computer through RS 232 serial communication. All parameters can be monitored and transferring to PC in order to checking their updated values in it.

Components and Description

LM-35 Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, Whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

Typical Applications

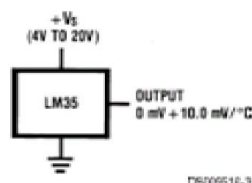


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor 0.5°C
- accuracy guarantee able (at +25°C)
- Rated for full -55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts.

Float Sensor

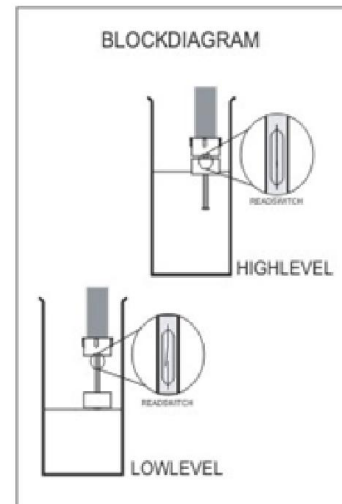


Figure 2. Float sensor working Diagram

The principle behind magnetic, mechanical, cable, and other float level sensors involves the opening or closing of a mechanical switch, either through direct contact with the switch, or magnetic operation of a reed. With magnetically actuated float sensors, switching occurs when a permanent magnet sealed inside a float rises or falls to the actuation level. With a mechanically actuated float, switching occurs as a result of the movement of a float against a miniature (micro) switch [2]. For both magnetic and mechanical float level sensors, chemical compatibility, temperature, specific gravity (density), buoyancy, and viscosity affect the selection of the stem and the float [3].

pH Sensor



Figure 3. pH meter

Use the pH sensor just as you would a traditional pH meter with the additional advantages of automated data collection, graphing, and data analysis [4]. Typical activities using our pH sensor include:

- Acid-base titrations.
- Studies of household acids and bases.
- Monitoring pH change during chemical reactions or in an aquarium as a result of photosynthesis.
- Investigations of acid rain and buffering.
- Analysis of water quality in streams and lakes.

LCD Display

Liquid crystal display (LCD) has material which combines the properties of both liquid and crystals [3]. They have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together

in an order form similar to a crystal. For an 8-bit data bus, the display requires a +5V supply plus 11 I/O lines. For a 4-bit data bus it only requires the supply lines plus seven extra lines.

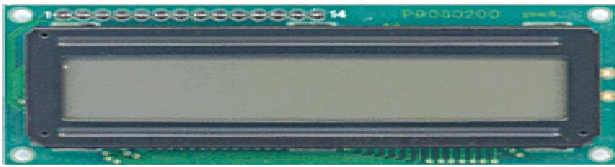


Figure 4. LCD Displaying Unit

When the LCD display is not enabled, data lines are tri-state which means they are in a state of high impedance (as though they are disconnected) and this means they do not interfere with the operation of the microcontroller when the display is not being addressed.

GSM SIM300 module



Figure 5. GSM Circuit Diagram

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone [3]. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

Features

- GSM/GPRS Modem using SIMCOM-300Module.
- RS232 interface DB port.
- voice communication port.
- on board voltage regulator.
- power / single led indication.
- sma connector for antenna connection.

Block Diagram

The above block diagram represents the automatic cooler control mechanism. Each of the functional unit is represented in a block. The basic function of the whole of the system is to control the water temperature inside the cooler tank accurately at the specified value given by the user or programmer. The main control unit of the circuit is the ARM microcontroller whose description is given before.

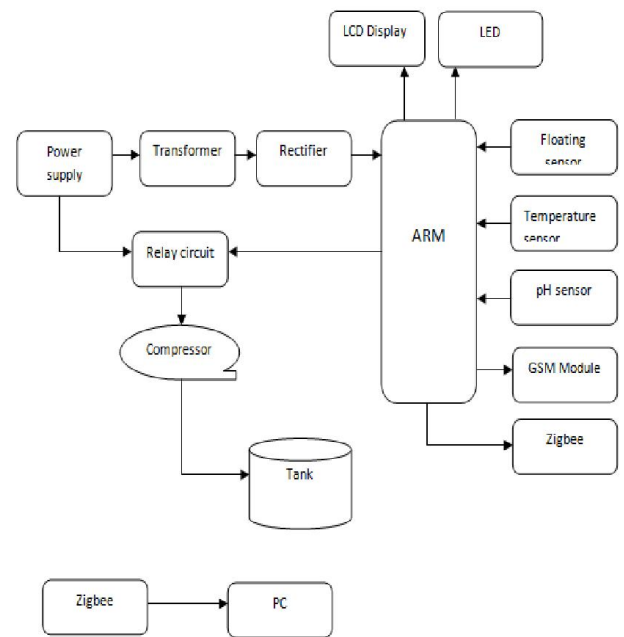


Figure 6. Block diagram

The LM-35 temperature sensor sense the water temperature and gives analog voltage input to microcontroller A/D port, similarly the “float sensor” also sense the water level and passes the voltage signal to controller. The A/D converter converts the analog signal into digital signals which are compared with standard values by controller to check the temperature and output the water level. The microcontroller works on a voltage of rating 5V so it is fed from supply through a step-down transformer and a bridge rectifier [2]. Whenever the temperature is above std. value e.g. 20°C then the compressor is switched ON and kept running till temperature is brought below 20°C and then supply is cut OFF [3]. If the temperature is above desired value and remain so after a dedicated time then buzzer and LED are made ON to indicate a fault in the cooler.

Hardware Output



Figure 7. Hardware Output diagram

Above Fig 7 shows that actual result of this paper and displaying a several parameter value outputs in LCD Display unit.

RESULTS

It is observed upon testing that the new technology implemented with commercial water cooling tanks is more efficient and reliable in maintaining and dispensing pure and cold water. Also the cost added due to this added modification on the coolers is comparatively less while compared to lifetime of service, accuracy, and easy maintenance with wireless technology. The modern coolers with all this high end facilities come in high prices and also for household use mostly.

Application

- Hospital, IT industries, colleges, schools, where a large no. of drinking water coolers are implemented and to be maintained at the same time.
- In big hotels and public water distribution sectors, or at factories which produce purified packaged water.

Future Enhancement

- PLC based controlling for multiple controls are possible.
- SCADA monitoring system can be used with HMI (Human Machine Interface) system.
- Instead of LM35 we can use RTD (resistance temperature detector) as used with boiler.

Conclusion

When we try for doing something new and innovative it is as usual and common that the times always fall short and work

increases each day. With the rapid evolution in technology in different fields like electrical, mechanical, communication, aeronautics etc. The competition also grows high. The invention of new methodologies is only for the goodwill of mankind. It is found from the project on "Microcontroller Based Water Purifier Controller using Zigbee technology" has formed a compact and cheap device to control the water cooler come purifier.

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