INTERNATIONAL JOURNAL OF ENHANCED RESEARCH IN SCIENCE TECHNOLOGY & ENGINEERING
VOL. 2 ISSUE 2, FEB.-2013 ISSN NO: 2319-7463

Sensor network based dyeing industry Monitoring and Control System

Santhosh Kumar V[1], Shanmuga Sundaram C[2], Vasantha Kumar P[3], Silambarasan K[4], Sivasubramanian. K[5]
[1,2,3,4] B. E., Electronics & Communication, K. S. Rangasamy College of Technology, Tiruchengode, Namakkal, India
[5]Assistant Prof., Electronics & Comm., K. S. Rangasamy College of Technology, Tiruchengode, Namakkal, India

Abstract: Dyeing is the process of adding color to textile products like fibers, yarns and fabrics. Dyeing is normally done in a special solution containing dyes and particular chemical material. After dyeing, dye molecules have uncut chemical bond with fiber molecules. The temperature and time controlling are two key factors in dyeing. The main aim of this project is to monitor and control the parameters like temperature, humidity and CO2 of Dyeing Industries using PIC microcontroller. In this project, the sensor values has to be monitored and displayed in LCD and whenever it exceeds the reference level then it will automatically send SMS to the respective number through PC and it will also alert through mail. Here, the data are stored in PC as a database unit. The data will be passed through RF communication. Here, RF transmitter will gather the information and pass to the RF receiver which will be placed at the receiver end and interconnected with PC. Parameters like temperature, humidity are monitored and controlled and passed through PC via serial communication.

Keywords: Dyeing industry, chemical material, Wireless sensor network (WSN).

1. INTRODUCTION

It is a crime that numerous factories deliberately inject untreated effluents directly into the ground, contaminating underground aquifers. Samples of groundwater were collected from many places and tested for concentrations of some known pollutants. All samples had high levels of the heavy metal mercury, which caused the Minamata disaster in Japan in the 1950s. One sample had more than 268 times the mercury than is considered safe. Groundwater in the industrial areas of India is unfit even for agriculture. Water in addition to serving as the basic requirements for humans and Ecosystems, water also acts as a sink, solvent and transport vehicle for domestic, Agricultural and industrial waste, causing pollution. Industrial development has caused pollution of water through history and this is very much the reality in the town of Tiruppur in southern India. Cleaning technology has not kept pace with the use of toxic chemicals in the many textile industries in and around the city. Over 700 bleaching and dyeing units, the two most water and chemical consuming industries in the textile production chain, let out virtually all effluents into the Noyyal river which flows through Tiruppur. Deteriorating water quality in the Noyyal River influences water usability downstream, threatens human health and aquatic ecosystems and increases competition for Water. Industrial carbon dioxide can be produced by several methods, many of which are practiced at various scales. In its dominant route, carbon dioxide is produced as a side product of the industrial production of ammonia and hydrogen. These processes begin with the reaction of water and natural gas (mainly methane). Although carbon dioxide is not often recovered, carbon dioxide results from combustion of fossil fuels and wood as well fermentation of sugar in the brewing of beer, whisky and other alcoholic beverages. It also results from thermal decomposition of limestone, $CaCO_3$, in the manufacture of lime (calcium oxide, CaO) directly from natural carbon dioxide springs, where it is produced by the action of acidified water on limestone or dolomite. A variety of chemical routes to carbon dioxide are known, such as the reaction between most acids and most metal carbonates. For example, the reaction between hydrochloric acid and calcium carbonate (limestone or chalk) is depicted below:

$$2HCl+CaCO_3 \rightarrow CaCL_2+H_2CO_3.... \quad (1)$$

The carbonic acid (H_2CO_3) then decomposes to water and CO_2. Such reactions are accompanied by foaming or bubbling, or both. In industry such reactions are widespread because they can be used to neutralize waste acid stream.

2. PROPOSED SYSTEM

The proposed system is consists of PIC Microcontroller, LCD, Power Supply, Sensors (Temperature, Humidity, Gas Sensor), PC Server Unit, RF Transmitter and Receiver and Serial Cable Interface. These parameters are used to collect all the information and display the result in the LCD display. The prime use of a micro controller is to control the operation of a machine using a fixed program that is stored in ROM and that does not change over the life time of the system. The architecture and instruction set of the micro controller are optimized to handled data in bit and byte size. A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. The buzzer is used to provide the sound, if any signals are reached above the reference values means it will start to produce beep sound. The sensors are used to sense the value in terms of temperature, humidity and gas sensor. The relay unit gets signal from PIC16F877. The relays are connected with the power supply line of the trains. If it gets 5 volts

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signal from PIC16F877 the relay works. To drive relay used BC 547 transistor as a switch, for ON and OFF the relay. The power supply circuits built using filters, rectifiers and then voltage regulators. Starting with a AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain a desired fixed DC voltage. The regulation is usually obtained from an IC voltage regulator unit, which remain the same if the input DC voltage varies or the output load connected to DC voltage changes.

The pin configuration and details are shown below about 16F877A.

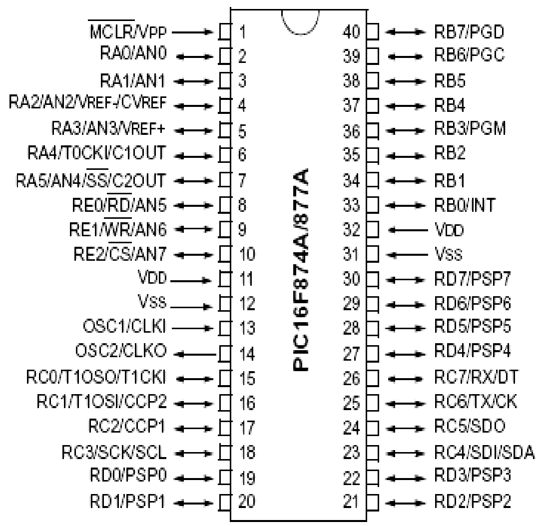

Figure 1: Pin Diagram of PIC 16F877A

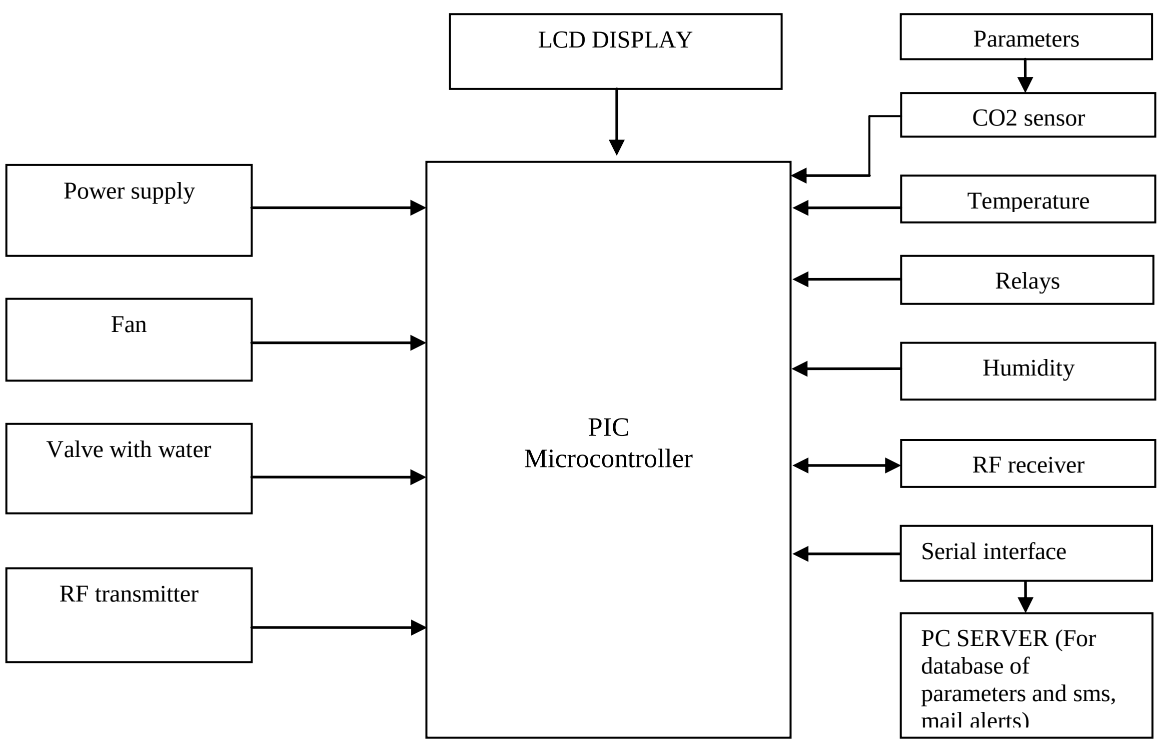

Figure 2: Block Diagram of Sensor Network Based Dyeing Industry Monitoring and Control System

3. RELATED WORK

Marcello Cinque, [2012] proposed Wireless Sensor Networks (WSNs) are widely recognized as a promising solution to build next-generation monitoring systems. Their industrial uptake is however still compromised by the low level of trust on their performance and dependability. Whereas analytical models represent a valid mean to assess nonfunctional properties via simulation, their wide use is still limited by the complexity and dynamicity of WSNs, which lead to unaffordable modeling costs. To reduce this gap between research achievements and industrial development, this paper presents a framework for the assessment of WSNs based on the automated generation of analytical models. The framework hides modeling details, and it allows designers to focus on simulation results to drive their design choices. Models are generated starting from a high-level specification of the system and by a preliminary characterization of its fault-free behavior, using behavioral simulators.

Brock E. Horton, [2011] proposed an inductively coupled, wireless sensor was fabri- cated for remote measurement of pH. The sensor consisted of a planar spiral inductor connected to a surface mount varactor, which was a voltage controlled capacitor, forming an inductive-capacitive (LC) resonant circuit. The pH electrodes, made of a thick-film antimony/antimony oxide sensing electrode and a thick-film silver/silver chloride reference electrode were connected in parallel to the varactor. A voltage change across the electrodes due to the pH variation in the test medium would change the capacitance of the varactor, shifting the resonant frequency of the LC circuit. By inductively coupling the spiral inductor with a detection coil, the resonant frequency of the LC circuit was remotely monitored, allowing measurement of the pH. The advantage of the described pH sensor is its wireless and passive nature, which allows for long-term pH monitoring in inaccessible area. The sensor will be useful for remote monitoring of pH during industrial or food processes. When miniaturized, the sensors can also be used for biomedical applications such as remote tracking of gastric or esophageal pH on patients suffering from gastroesophageal reflux disease.

Ahmed M. Abdelgawad, [2010] proposed remote measuring for sand in pipelines using wireless sensor networks by installation of a system to monitor and quantify sand production from a well would be valuable in optimizing well productivity and to detect sand as early as possible. He presented a framework for sand detection and sand production rate measurement. This framework combines two modules:

- A wireless sensor data acquisition module and
- A Central Data Fusion Module.

This framework is designed to collect data from oil pipeline using acoustic sensors, flow analyzer, and differential pressure transmitter in real time. A test bed is established from ten acoustic sensors mounted on a closed loop pipeline. The flow rate and the differential pressure are monitored as well. The sand is injected in the test bed with the constant flow and pressure. The output of the acoustic sensor is analyzed in order to calculate the sand production rate.

Shuenn Yuh Lee, [2010] proposed a method for a low-power RFID Integrated Circuits for Intelligent Healthcare Systems such that it provides a low power radio frequency identification (RFID) technology with attention to power efficient communication in the body sensor network, RF power transfer was estimated and the required low power IC's which are important in the development of a healthcare system for a miniaturization and system integration are discussed. To analyze the power transformations this adapts a 915 MHz industrial scientific and medical RF with a radiation power of 70mW to estimate the power loss under the 1-m communication distance between an RFID Reader and a transponder.

Carl Alberto Boano, [2010] proposed that wireless sensor networks are considered for use in industrial process and control Environments. Unlike traditional deployment scenario for sensor networks, in which energy preservation is the main design principle, industrial environments mainly stress worker safety and uninterrupted production. To fulfill these requirements, sensor networks must be able to provide performance guarantees for radio communication The Temperature directly affects the sensor nodes communication and that significantly less transmission power is required at low temperatures. It is possible to save up to 16% energy during nights and cold periods of the year, while still ensuring reliable communication among sensor nodes. In View of the experimental results the elaboration of how the temperature influences both the design and deployment of wireless sensor networks in industrial environments.

Christoph Sosna, [2010] presents a new temperature compensation technique for thermal flow sensors that are operated in a constant temperature difference (CTD) mode by means of a simple analog circuit. The resistive heater of a thermal flow sensor is maintained at a constant temperature some tens of Kelvin's above fluid temperature with the help of Wheatstone bridge circuit. In case of a change in media temperature and adjustment in the heater temperature is necessary. Otherwise the temperature difference falls\rises with respect to the temperature change and the sensor output signal deviates from the calibration. Temperature Compensation can be performed by the use of an additional resistive temperature sensor. The circuit includes a potentiometer that is capable of changing the resistance of the temperature sensor and its temperature coefficient of resistance for an easy adjustment of temperature compensation This gives freedom for any material to use such as platinum, aluminium, alloy, tungsten for the temperature sensor, regardless of its resistance value and TCR with respect to heater of a thermal flow sensor.

Michael B. Frish, [2010] proposed trace gas sensing and analysis by tunable diode laser absorption spectroscopy(TDLAS) has become a robust and reliable technology acceptable for industrial process monitoring and control, quality assurance environmental sensing plant safety and infrastructure security. Sensors incorporating well packaged wavelength stabilized near IR (1.2-2.0 um) laser sources, sense over a dozen toxic or industrially important gases. Recently developed mid IR lasers, particularly quantum cascade devices, spanning wavelengths of 3-12 um can sense in real time sub parts per million concentrations of many hydrocarbons. A large emerging application for TDLAS is standoff sensing of chemical vapors. TDLAS sensors that combine a laser source, sampling section and detector on a mountable monolithic semiconductor materials system substrate.

Fabiano Salvodari, [2009] proposed that the advances in wireless communication, microelectronics and digital electronics and highly integrated electronics and the increasing need for the more efficient controlled electric systems make the development of monitoring and supervisory control tools the object of study of many researchers. This paper proposes a digital system for energy usage evaluation condition monitoring and diagnosis and supervisory control for electric system applying wireless sensor networks with dynamic power management. The system is based on two hardware topologies responsible for signal acquisition, processing and transmission. Intelligent sensor modules and Remote Data Acquisition units are used based on the Soekris architecture, which is responsible for receiving the data collected and transmitting it to the supervisory controller. To extend the lifetime, sensor nodes implement the DPM protocol. The basic characteristics are easy implementation, Low Cost, Portability and Extended Life time.

Eric Pinet, [2006] proposed a simple design involving a birefringent porous glass oriented between two crossed polarizer’s serves as the foundation between an optically sensitive broad spectrum chemical sensor. Volatile organic compounds such as acetonitrile vapours can be readily detected at concentrations a low as 50 ppm. Changes are observed in polarized light transmitted by anisotropic porous material constituting the sensor upon the exposure to VOC bearing air as intensity changes in spectral content detectable by the eye. The optical effects resulting from the exposure to various vapours are reversible and may result from adsorption of solvent vapours with attendant reduction of anisotropy. The micro porous structure as well as the surface chemistry of the sensor may be controlled for tuning the response of VOC’s for industrial applications. Miniaturization of the sensor using the low cost materials such as plastic or glass optical fibers, Polaroid films and birefringent porous glass is demonstrated. The sensor described uses ambient light as source and the eye as detector or electronically controlled light emission and detection for better sensitivity and real time monitoring. Such intrinsic explosion proof sensors could be used to safely monitor VOC levels in remote environments.

Plamen G. Stoyanov, [1998] proposed a new type of continuously operating in situ remotely monitored sensor is presented. The sensor is comprised of a electromagnetically coupled soft ferromagnetic thin film structures, adhered within a thin polymer layer. The polymer is made so that it swells or shrinks in response to the chemical analysis of interest which in this case is pH. As it swells, the magnetic coupling between the magnetic elements change, resulting in the changes of magnetic switching characteristics of the sensor. Placed within a sinusoidally magnetic field, the magnetization vector of the coupled sensor elements reverses directions generating magnetic flux that can be remotely detected as a series of voltage spikes in approximately placed pickup coils. One preliminary sensor design consists of four triangles, initially spaced 50 um apart arranged to form a 12 mm * 12 mm square with the triangle tips centered at a common origin.

O. M. Conde, A. M. Cubillas, P. Anuarbe and J. M., M. Gutierrez and V. Martínez [2009] proposed system used to obtain a spectral correction coefficient between the measured and synthesized spectra of dyeing industries is greater than the both transmission and absorption spectra. The proposed system using the multivariate calibration techniques to provide the good performance and also reducing the manufacturing cost. Then automatically combining the absorption and transmission spectra of the dyeing industries and also provide the online colour correction.

Keith R. Beck, Warren J. Jasper, Ralph McGregor, Gordon K. L Lee, C. Brent Smith[2009] here the proposed system used to improved and expanded the capability of flow injection analysis(FIS) in the dyeing industries. The FIS system used to monitor the exhaustion of reactive dye, exhaustion of direct eye, exhaustion of disperse dye cellulose acetate and polyester.

4. RESULT & DISCUSSION

The simulation result is done by in the MATLAB software and Simulink model. The proposed system process are given by, The Step down transformer used to converts the input of 230V AC into 12V AC. Output of step down transformer is given to the Bridge Rectifiers are used in the module to convert AC to DC voltage. Output of bridge rectifiers is given to the Voltage regulator which regulates the voltage to 5V. BC 547 is used to drive the 12V Relay. A 4MHZ Crystal oscillator is used to generate the clock pulse which is given to the PIC Microcontroller. 16X2 LCD display is interfaced with PIC Microcontroller through ports B and D.

In temperature sensor, initially 27 centigrade is displayed in the LCD display. We have changed the temperature value; the changed value (38 centigrade) is sensed by the temperature sensor and displayed successfully in LCD. In humidity sensor, initially room moisture 160 is displayed in the LCD display. We have given the some amount of moisture, the changed value is successfully sensed by the humidity sensor and the sensed value changed from 160 to 168 moisture level is displayed in the LCD. In Gas sensor, if there is any leakage of carbon- dioxide gas, sensor senses the gas successfully and displayed in the LCD as gas leakage. In voltage sensor, it senses the direct ac voltage and displayed in the LCD as 230V successfully. The proposed system is absorbed the values that is displayed in LCD display.

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5. EXPERIMENTAL RESULTS

Transmitter Module

The Step down transformer used to converts the input of 230V AC into 12V AC. Output of step down transformer is given to the Bridge Rectifiers are used in the module to convert AC to DC voltage. Output of bridge rectifiers is given to the Voltage regulator which regulates the voltage to 5V, BC 547 is used to drive the 12V Relay. A 4MHZ Crystal oscillator is used to generate the clock pulse which is given to the PIC Microcontroller.16X2 LCD display is interfaced with PIC Microcontroller through ports B and ports D.

Figure 3: Transmitter Module

Figure 4: Microcontroller Module

Figure 5: LCD Display

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CONCLUSION

RF Transmitter module has been designed. The value is sensed by the sensors are displayed in the LCD display. For transmitting the sensed value through RF transmitter, we have to design TWS-434 module which transmitting the sensed value in the frequency range of (0- 433) MHZ. Further we have to design the receiver module with same frequency and baud rate of transmitter, to avoid noise. The sensed value is to be sent to the personal computer via RS232 cable is to be designed also we have to write programming in .NET language in order to maintain the sensed value as a database.

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