



ISBN	978-81-929866-6-1
Website	icsscet.org
Received	25 – February – 2016
Article ID	ICSSCET054

VOL	02
eMail	icsscet@asdf.res.in
Accepted	10 - March – 2016
eAID	ICSSCET.2016.054

# Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems

N Suresh Kumar<sup>1</sup> and Dr K Keerthivasan<sup>2</sup>

<sup>1</sup>Assistant Professor, Nehru Group of Institutions

<sup>2</sup>Professor, Karpagam Institute of Technology, Coimbatore

**Abstract-** This paper presents the implementation of a remote monitoring and control system based on the CDMA 1X technology. CDMA (Code division multiple access) is the popular technology where the channels are defined with codes and use spread spectrum signalling. In this proposed system an embedded controller collects the data from various sensors. Collected parameters are matched against the preset parameters. The error signal will be sent to the system to meet the appropriate requirement. PIC controller is used for control surface. The proposed system can be adapted to many types of applications such secure remote monitoring systems in both industrial and home environments, security systems, factory automation systems, and remote metering systems. This paper also discusses the hardware architecture and software details of the system.

**Keywords:** DSSS, PIC, CDMA

## I.INTRODUCTION

Most of the conventional monitoring systems which have been already introduced use wired networks. Wired networks are almost always faster and less expensive than wireless networks.

A real-time remote monitoring system adopts the RF (Radio Frequency) module. However, there are some problems with RF such as small communication area, large power consuming characteristic, low robustness to noise, interference with other RF modules, and limited communication frequency band. On the other hand, the PCS (Personal Communication Service) using CDMA technologies can offer various services, cover actually unlimited communication range, and consume less electric power. And it may not be affected by noises. Moreover, it guarantees safe communications because the transmitted data are encoded. Based on the observation of the various wireless communication devices, the paper presents a CDMA-based real-time remote monitoring and control system

## II.CDMA based Wireless System

The CDMA based wireless system is a data collecting system using wireless communication technologies. Various sensors are used to collect the data from their corresponding systems. These data are stored in microcontrollers and transmitted through wireless channel. The control actions are taken by the available control system, whereas the preset parameters will be set by microcontroller at the Control station.

## III.CDMA 2000 1X Technology

CDMA (Code Division Multiple Access) is a kind of cellular concept which uses the spread spectrum technologies. It has good wireless

This paper is prepared exclusively for International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016 [ICSSCET 2016] which is published by ASDF International, Registered in London, United Kingdom under the directions of the Editor-in-Chief Dr T Ramachandran and Editors Dr. Daniel James, Dr. Kokula Krishna Hari Kunasekaran and Dr. Saikishore Elangovan. Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage, and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honoured. For all other uses, contact the owner/author(s). Copyright Holder can be reached at copy@asdf.international for distribution.

2016 © Reserved by Association of Scientists, Developers and Faculties [www.ASDF.international]

**Cite this article as:** N Suresh Kumar, Dr K Keerthivasan. "Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 291-296. Print.

channel utilization ratio and can provide stable mobile data channels at high speed (normally amounting up to 80-100k bps). Compared with GPRS (General Packet Radio Service) network, CDMA network security protocols rely on a 64-bit authentication key and the mobile ESN. A fresh SSD can be generated when mobile returns to the home network or roam to a different system.

#### IV. Hardware Architecture

As shown in Fig 1 the above block diagram is broadly classified as Remote station and Control station. Remote station consists of motor, boiler and their corresponding sensors, embedded controllers with CDMA modem. This controller will receive the data from its system and convert it into digital value, whereas this CDMA modem already received the preset parameters from the Control station. Now the error signal will be calculated and appropriate action will be taken by the control circuits.

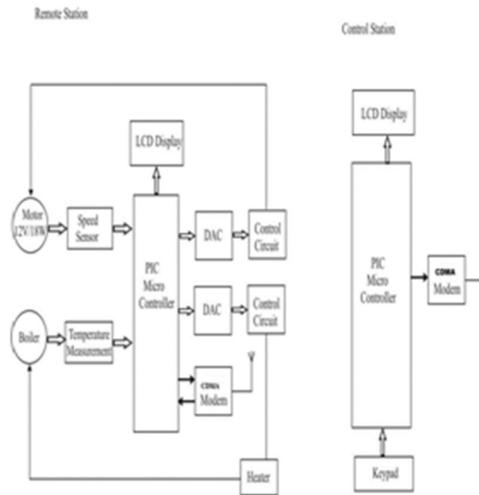


Fig.1 Hardware Architecture

Again the correct parameter of motor and boiler will be sent to the Control station. Control station may also consist of a Controller with LCD display and CDMA modem. The block diagram shows the CDMA modem

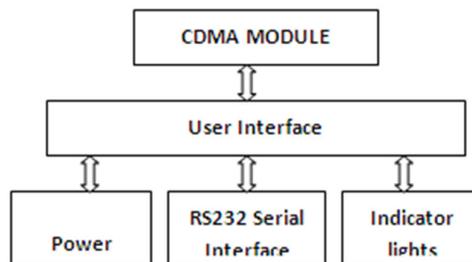


Fig 2. CDMA modem block diagram

In the HyperTerminal, while we type 'AT', the modem will respond with "OK". (We can give AT commands for all functions according to our requirement). For example to call a mobile, just type 'ATD +mobile number'. This command will be serially transferred to the modem via RS232 cable. Then the particular mobile will be called. The following diagram shows CDMA modem



Fig 3. CDMA modem

**Cite this article as:** N Suresh Kumar, Dr K Keerthivasan. "Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 291-296. Print.

## V. Microcontroller with Modem

The microcontroller is now connected with the PC using COM port .The Embedded C program is dumped into the microcontroller. By changing the microcontroller's program mode into an execution mode, and pressing the reset switch the same program is transferred to the modem through the RS 232 cable. Now the microcontroller communicates with the modem without the help of PC.

## VI. Hardware Details

The screenshots shows hardware architecture of control station. The LCD display shows the set temperature is 29 C and the set speed is 1000 rpm



Fig 4. Control station



Fig 4.1 LCD display at remote station

The above screen shot shows hardware architecture of Remote station. The LCD display shows the Temperature is 31C, Speed is 1020 rpm and received set speed 1000 rpm and Temperature is 30C



Fig 5. Remote station

**Cite this article as:** N Suresh Kumar, Dr K Keerthivasan. "Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 291-296. Print.

The above figures show the hardware configuration of the proposed system .PIC microcontrollers are used in the control circuits. Control station will send the control data to the remote station through the CDMA network .PIC microcontroller will be interfaced with the modules will extract the data and commands and will do the corresponding actions.

## VII. Software Details

The programming language used in the PIC microcontroller is Embedded C. MPLAB IDE is used for PIC programming, MPLAB IDE is a Windows® Operating System software program that runs on a PC to develop applications for Microchip microcontrollers and digital signal controllers and also PIC C compiler is used to test to the interphase function .Mat lab is used for simulation.

## VII. Simulation Results

### Simulation Result for Motor

In order to regulate the motor's speed, a proportional integral & Derivative (or PID) controller will be implemented. The first step in designing the controller was to characterize the motor's transfer function for modelling in Mat lab. A motor can be modelled using the generic transfer function:

$$P(s) = \frac{K}{s^2 + \zeta s + 1}$$

Where K is equal to the gain of the motor and  $\tau$  is equal to the motor's time constant  
The below screenshot shows that the output response curve for the speed control of DC motor

$$K_P=7 \quad K_I=10 \quad K_D=2$$

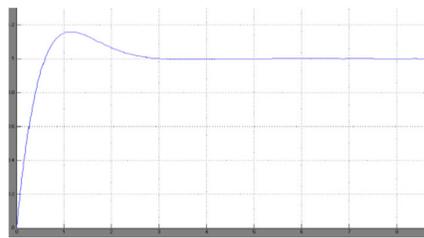


Figure 6. Output response curve for Motor

### Simulation Result for Boiler

Just rise water temperature with a heater. Outlet temperature must be equal to the set point temperature (80°C). Proportional-Integral-Derivative (PID) control is used. Inlet water temperature is equal to 20°C. Water flow is equal to 10 m<sup>3</sup>/hr.

Sensor temperature lags slightly behind Boiler temperature. PID control gives best control with no offset and quickly damped oscillation

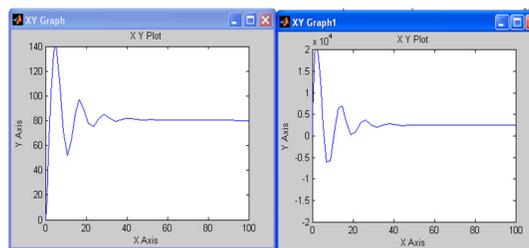


Fig 7. Response Curve for Sensor & Boiler Temp

## CDMA 2000 1x Forward Fundamental Channel Simulation

The key components of the physical layer are the transmitting base station, channel, and mobile receiver. The transmitting base station in turn includes the encoder and transmitter, while the mobile receiver includes the decoder and receiver subsystem.

**Cite this article as:** N Suresh Kumar, Dr K Keerthivasan. "Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 291-296. Print.

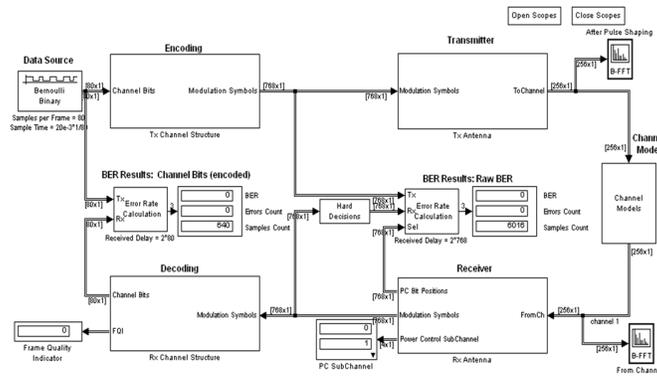


Fig 8. CDMA 2000 1x Forward channel

### Output Response Curve

The below Screenshot shows that the output response Curve of CDMA signal before pulse shaping & after pulse shaping

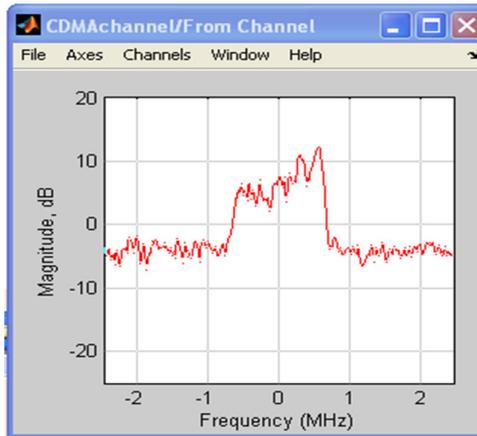


Fig 9. Transmitter output

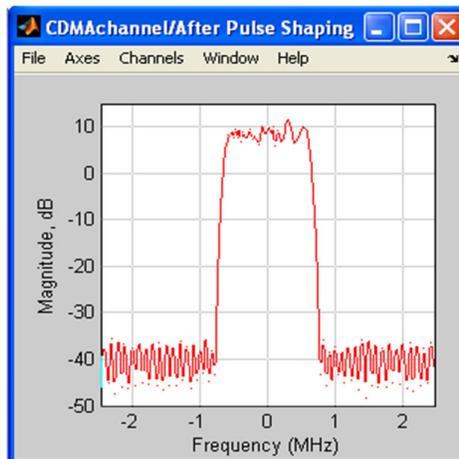


Fig 10. Channel model output

**Cite this article as:** N Suresh Kumar, Dr K Keerthivasan. "Design and Implementation of Effective Digital Technology for Controlling Industry and Home Systems". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 291-296. Print.

## VII. Conclusion

In this paper, we present an application-oriented wireless monitoring and controlling system based on CDMA2000 1X technology. The system is basically composed of two parts remote station and Control station. Remote station consists of various sensors and those values will be stored in a controller. Correct values will be set by Control station. CDMA 2000 1X modem is used to send and receive the data from control station. In addition, the paper introduces the hardware block diagram, simulation results for motor, boiler and CDMA 2000 1X system. The proposed system can be adapted to many types of applications such as industrial and medical remote monitoring systems, security systems, factory automation systems. In practical application of the monitoring and controlling system, the information transferred via the wireless network include such parameters as speed of the motor, boiler temperature

## References

1. Hsiao-Hwa Chen, "On next generation CDMA technology for future wireless networking", IEEE Global Telecommunications Conference, pp. 120-129, 2004.
2. Design and Implementation of a CDMA-Based Remote Monitoring and Controlling System Li Cai, Wenya Zhang, En Li, Zize Liang, Zeng-Guang Institute of Automation, Chinese Academy of Sciences, Beijing, China SICE Annual Conference 2007
3. A CDMA-based Mobile Embedded Tele medical System for Healthcare2007 IEEE/ICME International Conference on Complex Medical Engineering Beijing Institute of Technology. Beijing, China
4. Design of a CDMA-Based Wireless Data Transmitter for Embedded Sensing Robert X. Gao, Senior Member,IEEE, and Philipp Hünerberg IEEE transaction on Instrumentation and measurements, Vol. 51, No. 6, December 2002
5. DC Motor Speed Control Methods using MATLAB/ Simulink Saffetay asun, Dept. of EEE, Nigde univ, Turkey 2008 IEEE
6. CDMA based wireless transceiver system Matlab simulation and FPGA implementation, Zohaib Mahtab, Suhaib Jalis Ahmed, Syed Sameem Hussain, Sarwar Hasan N.E.D University of Engg. & Tech. Karachi 2004 IEEE