ISSN No:-2456 –2165

Using FPGA for Remotely Controlling the Industrial Devices Against Environmental Hazards and Streetlight Illumination

Manisha B. Kamthe
Department of Electronics and Communication
G.H. Raisoni College of Engg. and Mgmt.
Pune, India

Prof. Pravin N. Matte
Department of Electronics and Communication.
G.H. Raisoni College of Engg. and Mgmt.
Pune, India

Abstract—Now a day's industry in every area of engineering has increased. We need more manpower to control the industrial operations. Taking into consideration the risk of humanlife,eventhough more manpower is available(smart & educated workers)we need to control the industrial operations remotely.In this paper I present the idea of Industrial Safety and Light energy saving by using GSM(Global System for Mobile)and Bluetooth technology.For sensing the environmental conditions we use different sensors.In the proposed system we sense temperature and CO2 for taking industrial precautions.For processing data we need ADC to convert analog data into digital form.This data is processed and necessary control action is taken by FPGA(Field Programmable Gate Arrays)which is the heart of the system.I have also presented the idea of controlling streetlights remotely.For sensing the light intensity we use LDR(Light Dependent Resistor).We also use PIR(Passive Infrared Sensors)for detecting human presence.By using this technique we can save electrical energy required illuminating the streetlights more than usual technique.Whenever the emergency situations occures in industry the proposed system will take necessary action and sends SMS to the operator.

Keywords—GSM, SMS, FPGA, PIR, LDR, Bluetooth.

I. INTRODUCTION

Taking into consideration the risks in industry (in all type of engineering industries),we need to control some of industrial processes without human intervention.In existing system it is inconvenient to modify the system according to need of customer or if the surrounding situation changes.We need more flexible system.There are many options available.We can highspeed microprocessors ie.computer based techniques.We can use ASIC technique ie.Application Specific Integrated Chip.In this technique we can use different chips such as different types of microcontrollers available in market PIC,AVR.Different types of RISC and CISC processors.These are cost effective but not flexible.In this proposed idea I use FPGA as the main processor. It is cost effective and flexible as compared to other processors. We can change the programme without removing device from the process.For prototype purpose we are using SPARTAN III kit. Other part of this prototype is remotely controlling the streetlights in the industrial area.The lamps available these days in market are sodium vapour lamps,neon lamps which require more energy as it has to focus on larger area.In home we use upto 100watt lamps which do not require much of electrical energy.For this purpose we use LDR (light dependent resistor)to sense the light intensity,so only in night lamps will glow. New idea introduced in addition to existing system is to detect human presence and then only glow the particular lamp.For this purpose we are PIR(passive infrared sensors) to detect the human presence.For remote operation we are using GSM (Global System for Mobile) technology. We are also Bluetooth technology for in room operation.

II. RELATED WORK

Earlier a lot of work has been done in the area of automation. It may be home automation or industrial available SMS based control,email based control,telephonic control. All these are remote control techniques. We can employ Bluetooth technique for in room operation.PLC i.e. Programmable Logic Controllers are more popular in industry.They are having longer life and easy to programme. Main disadvantage of this system is that if we want to change the programme we have to remove the PLD from machine and then programme it.Also the size of PLD is large as compared to other devices.Microcontroller and microprocessor based techniques has been employed but they did not gain more popularity as they are not flexible and reliable.Reducing the electrical power consumption is the main problem these days.Here I present the idea of reducing the power consumption by employing remote control technique to illuminate the streetlights. Earlier analog circuitry using LDR ie. Light Dependent Resistor is used for illumination of streetlights.but it was having manual control.Now a days remote control techniques has been invented.Using Zigbee devices we can remotely control streetlights.Here we use PIR ie. Passive Infrared Sensors with LDR ie. Light Dependent Resistors to remotely control streetlights. PIR sensors detect the presence of livingbeing so only that lamp will glow where the presence of livingbeing is detected.

III. SYSTEM ARCHITECTURE

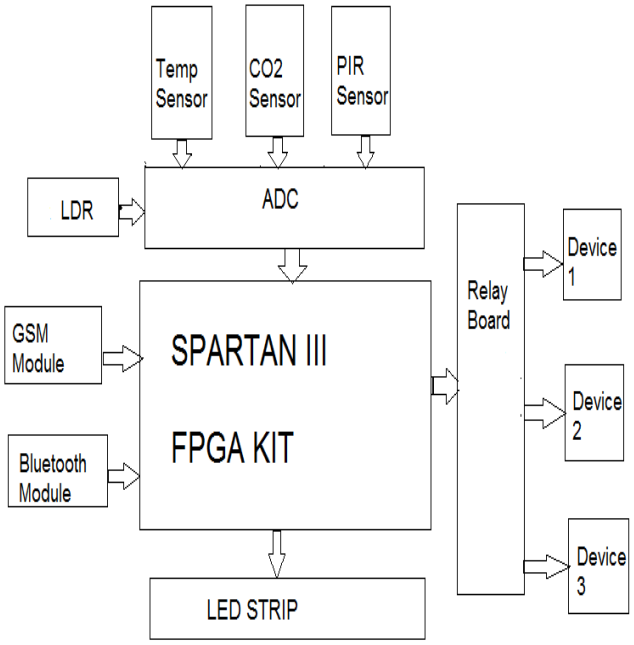

Fig.1 Block Diagram of System

The prototype consists of SPARTAN III FPGA kit for processing the analog data collected from different sensors.The processor requires digital data.For this purpose we use analog to digital converter(ADC).Various sensors used to sense different parameters are temperature sensors,CO2sensors,PIR sensors,LDR.Relay board is used to switch ON or OFF the devices connected to it.LED strip is used to demonstrate the streetlight illumination.GSM module is used in which SIM card is fitted.Bluetooth is used for short distance communication.

IV. DESCRIPTION OF VARIOUS COMPONENTS USED FOR THE PROPOSED SYSTEM

A. Spartan III FPGA Kit

The FPGA kit used here is named ElbertV2.It uses Xilinx Spartan-3AFPGA-XC3S50A.It is in TQG 144 package.Board features are as follows.

- FPGA: Spartan XC3S50A in TQG144 package.
- Flash memory: 16MB SPI flash memory.
- USB2.0 interface for onboard flash programming.
- FPGA configuration via JTAG and USB.
- 8LEDs,6Push Buttons and 8 way DIP switch for user defined purposes.
- One VGA connector.
- One Stereo Jack.
- One Micro SD card adapter.
- Three seven segment displays
- 10.39 IOs for user defined purposes.
- On board voltage regulators.

It is mostly used in product prototype development,home networking,signal processing,wired and wireless communication,educational tools for schools and universities.

B. ADC 808/809

For processing the data collected from sensors we require to convert the analog data into digital form.For this purpose we are using ADC ie. Analog to Digital Converter. Here we are using ADC 809.It uses successive approximation technique for conversion.It is a 8 channel A/D converter.It can be easily interfaced to all the processors.Some of the features of this ADC are as follows.

- Supply voltage is 5Vdc.
- No zero or full scale adjustment is required.
- It is a 8 channel multiplexer with address logic.
- It is available in 28 pin DIP package.
- Its conversion time is 100µs.
- Its resolution is 8 bits(digital data available at the output is 8 bit form).

C. Temperature Sensor LM35

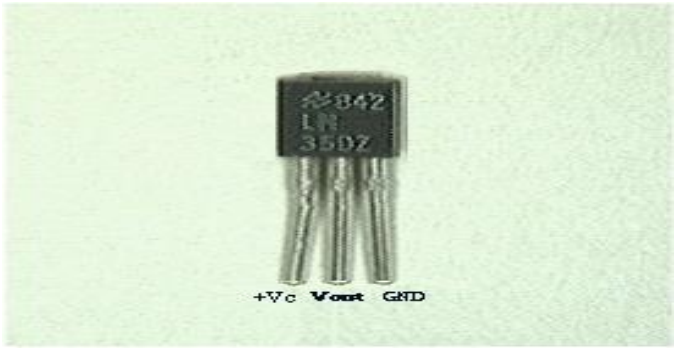

Fig.2 LM35 Temperature Sensor

There are various temperature sensors available in market.Thermistors PTC and NTC,thermocouples and others.But here we require quick response and accuracy.So we are going to use LM35 to sense the temperature.The reason to choose LM 35 is its linearity.Its output voltage is linearly proportional to change in temperature.It has got low cost and its accuracy is +/-1/4ºC.It can be used with single or dual power supplies.Its temperature range is -55ºC to +150º

D. Gas Sensor MQ7

Fig. 3 MQ7 Gas Sensor

ISSN No:-2456 –2165

In Industrial area to detect the presence of fire or smoke we use smoke sensors.They detect the presence of CO & CO2 in the atmosphere.Here we are using gas sensor MQ7.It has high sensitivity to carbon monoxide.Also it is stable and has got long life.It operates on +5Vdc.This sensor is composed of micro AL2O3 ceramic tube and SnO2 sensitive layer.The output changes as the level of CO or CO2 in atmosphere changes.A variable pot is provided for adjusting sensitivity to CO2.

E. LDR-Light Dependent Resistor

Fig. 4 Light Dependent Resistor

The resistance of LDR is dependent on the intensity of light.With increase in light intensity its resistance decreases.In dark a photoresistor can have a resistance as high as several megaohms while in light it can Sulphide),InSb(Indium Antimonide).

F. PIR-Passive Infrared Sensors

Fig.5 Passive Infrared Sensor

PIR sensors are used to detect the presence of humanbeing.They are sensitive to IR emission.The PIR sensor has two slots made up of special material that is sensitive to IR emission.Also it is fitted with Frensel lens which covers larger IR emission.When there is no livingbeing both slots detect same amount of IR emission.When a livingbeing passes by it intercepts area of two slots causing a positive differential change for first slot and a negative differential change when it intercepts second slot.These changing pulses are detected.The sensor is fitted into hermatically sealed metal can to improve noise,temperature,humidity immunity.There is a window made of IR-transmissive material that protects the sensing element.Behind window there are two balanced sensors.

G. Bluetooth Module

There is HC series of Bluetooth Serial Interface module such as HC-03,HC-04,HC-05,HC-06.They can be operated in master and slave mode.The mode of odd numbered Bluetooth module can be changed.Here we use HC-05 module which is more flexible.We can also change the baudrate.It is 34 pin.AT commands are used to programme it.

H. GSM-Global System for Mobile Communication

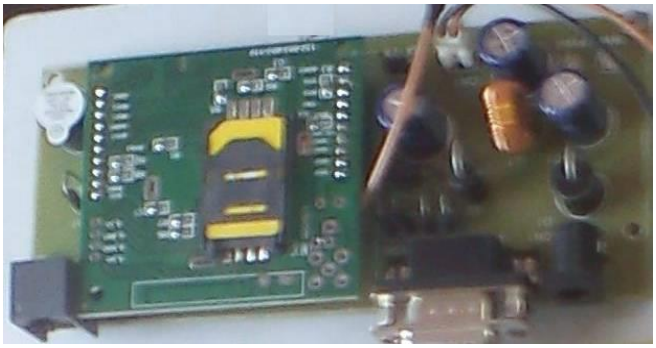

Fig.6 GSM Module

The Global System for Mobile Communication was first introduced in 1991 and standard frequency range is 1800 MHz.2G network uses frequency band 1900MHz.3G network uses frequency band of 2100MHz.This allows eight full rate or sixteen half rate speech channels per radio frequency.These eight radio timeslots are grouped into TDMA frame.The channel datarate for all 8 channels is 270.833kbit/s and frame duration is 4.615ms.Using this system we can make voice calls and also send text messages. In this system we are using this system for sending text messages.

V. RESULTS

The software for this prototype is written using HDL Verilog.The Xilinx ISE suite is used for simulation of the software.Different modules are written to simulate the software.The results of different modules are given as follows.

A. ADC Clock Generation

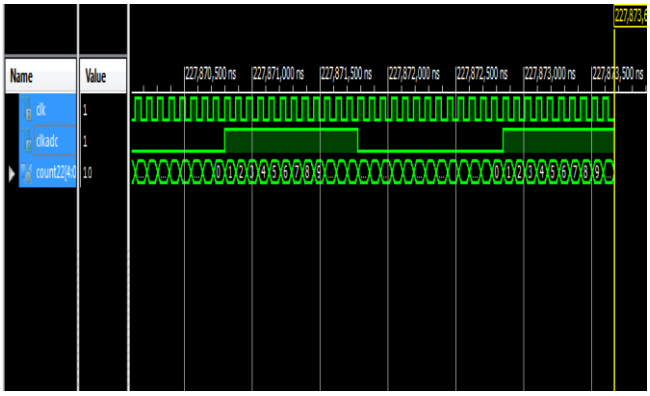

Fig. 7 Clock Generation for ADC

The crystal provided with SPARTAN III FPGA kit generates the clock frequency of 33MHz.For ADC 809 used the clock frequency required is ½ of the frequency.So we have to scale it down.A programme is written for that.The output of programme is given below.

B. Output of ADC

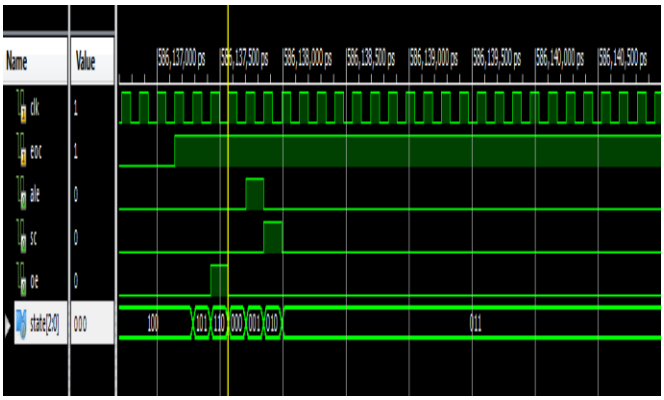

Fig.8 Output Waveform of ADC

The analog data collected from sensors is required to convert into digital one for processing.ADC is used for that.The conversion time of ADC is 100µs.After 100µs the EOC (End of Conversion) signal is generated.The digital data is latched by generating the ALE(Address Latch Enable)signal.The output for this programme is given below.

VI. CONCLUSION

In this paper I presented the idea of a prototype which can be used for controlling the industrial devices.The controlling can be made remotely.Whenever we want to switch ON or OFF the device we can send SMS.Also in emergency situation like fire or rise in temperature the device can be switched off.The streetlights can be controlled remotely.Along with the usual technique of LDR for switching ON or OFF the lights we can use PIR sensors so that only when presence of livingbeing is detected the lights are switched ON.Energy conservation is achieved in this way.

VII. ACKNOWLEDGMENT

I am thankful to my project guide Prof. P. N. Matte for his guidance for writing this paper.

REFERENCES

[1]. Dr. K.Babulu, P.S.S.M.Kalyan "Design And Development Of Activation And Monitoring Of Industry Automation SystemVia SMS Through FPGA" www.ijird.com January, *2013* Vol 2 Issue 1.

[2]. Yadav Vajrangshakti. Ramdayal, K. Srinivasa Rao "An Adaptive Industrial Automation Application Design Using Asic" IJRRECS/October 2013/Volume-1/Issue-6/1093-1099.

[3]. S.V. Tresa Sangeetha, Dr. S. Ravi and Dr. S. Radha Rammohan "Embedded System Based Industrial Process Automation and Remote Data Logging Using GSM with Web Technology" International Journal of Applied Engineering Research, ISSN 0973-4562, Vol. 8, No. 20 (2013).

[4]. Supriya Rai, A. P. Thakare " Implementation of Reliable Wireless Real Time Automation System Based on Android Mobile Phone and FPGA" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064.

[5]. N.Chintaiah, K. Rajsekhar,V.Dhanraj "AUTOMATED ADVANCED INDUSTRIAL and HOME SECURITY USING GSM and FPGA" (IJCSIT) International Journal of Computer Science and Info]rmation Technologies, Vol. 2 (4) , 2011, 1598-1602.

[6]. Sridutt Tummalapalli, M V D Prasad "ZIGBEE Operated FPGA Based Nodes in Wireless Industrial Automation Monitoring and Control" International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue5- May 2013.

[7]. Archana M, Mahalahshmi.R "E – Street: LED Powered Intelligent Street Lighting System with Automatic Brightness Adjustment Based On Climatic Conditions and Vehicle Movements" International Journal of Advanced Research nElectrical,Electronics and Instrumentation Engineering Vol. 3, Special Issue 2, April 2014.

[8]. Deepak Kapgate" Wireless streetlight control system" http://www.researchgate.net/publication/225007897.

[9]. Isah Abdulazeez Watson, Oshomah Abdulai Braimah, Alexander Omoregie" Design and Implementation of an Automatic Street Light Control System" www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 3, March 2015).

[10]. S. Sugapriya, Prof. A. Natarajan" Intelligent Wireless Street Lighting System" International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol.2, Special Issue 1, March 2014.

[11]. Richu Sam Alex, R Narciss Starbell "Energy Efficient Intelligent Street Lighting System Using ZIGBEE and Sensors" International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-4, April 2014.

[12]. Sharath Patil G.S, Rudresh S.M, Kallendrachari. K,M Kiran Kumar, Vani H.V " Design and Implementation of Automatic Street Light Control Using Sensors and Solar Panel" Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 5, Issue 6, (Part - 1) June 2015, pp.97-100.