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Design of Device for Industrial Safety and Light Energy Optimization Using FPGA

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Abstract:
Nowadays industrial security is most important. As the industries has increased the possibilities of accidents are also increased. More manpower is required to take care of the various devices on the plant. Also there is need to conserve the light energy available. In this paper I am going to discuss the a idea of a device which will control the industrial devices as well as the streetlights in premises of industry. The system uses the latest technological components. It offers a complete low cost, powerful and user friendly way of 24 hours of real time monitoring and remote control of industrial devices. The system is based on GSM (Global System for Mobile). It sends a SMS (Short Message Servicing) to the operator in case of emergency. The operator can control the device by sending a SMS or by manually after reaching that place. It also works as automatic and immediate reporting to the fire brigade and police station according to activated sensor to decrease the time required tracking action. The design has been described using Verilog and implemented in hardware using FPGA. For energy optimization we are controlling the streetlights in the premises of industry using LDR and IR sensors.

Keywords: *FPGA, GSM, SMS, LDR, IR sensor, remote control*

1. Introduction

With the growth and widespread reach of cellular network its application has extended to process plant. Industrial safety is achieved by automating the process parameters monitoring and controlling the devices since it requires minimum human presence in the vicinity of process setup. The aim of this paper is to design a device which is cost effective and control the industrial devices remotely as well as control the streetlights in the campus of industry. This system provides ideal solution to the problems faced by industrial owners in daily life. The system gives the feedback to user about the condition of the industrial appliances according to the user needs and requirements. The technology and processes associated with manufacturing have undergone a major change during the last few decades. The demand for high production rate coupled with strict quality norms can be achieved with less and less direct human interaction and an increasing degree of automation.

The prototype of device proposed is based on GSM technology. It provides the benefit that the system is accessible in remote areas as well. The basic elements involved are sensing, processing, monitoring and communication. Different sensors are employed to sense the different parameters e.g. temperature, leakage of any harmful gas, smoke detectors. After processing if there is any threat detected it is conveyed to the operator. The prototype uses LM35 sensor for sensing temperature, MQ6 to sense harmful gases. MQ7 for sensing the smoke. It uses Spartan 3E FPGA as a controller. LDR to sense the light intensity. IR sensors to sense the presence of human being. The analog output is converted to digital with the help of ADC809.Theoutput of ADC is given to the FPGA board for processing. The FPGA used here is Spartan 3 which uses FPGA XC 3S50AN IC. The output of FPGA board is given to SPDT relay to which various devices are connected. It also uses GSM and Bluetooth for remote communication.

2. Proposed FPGA based Architecture

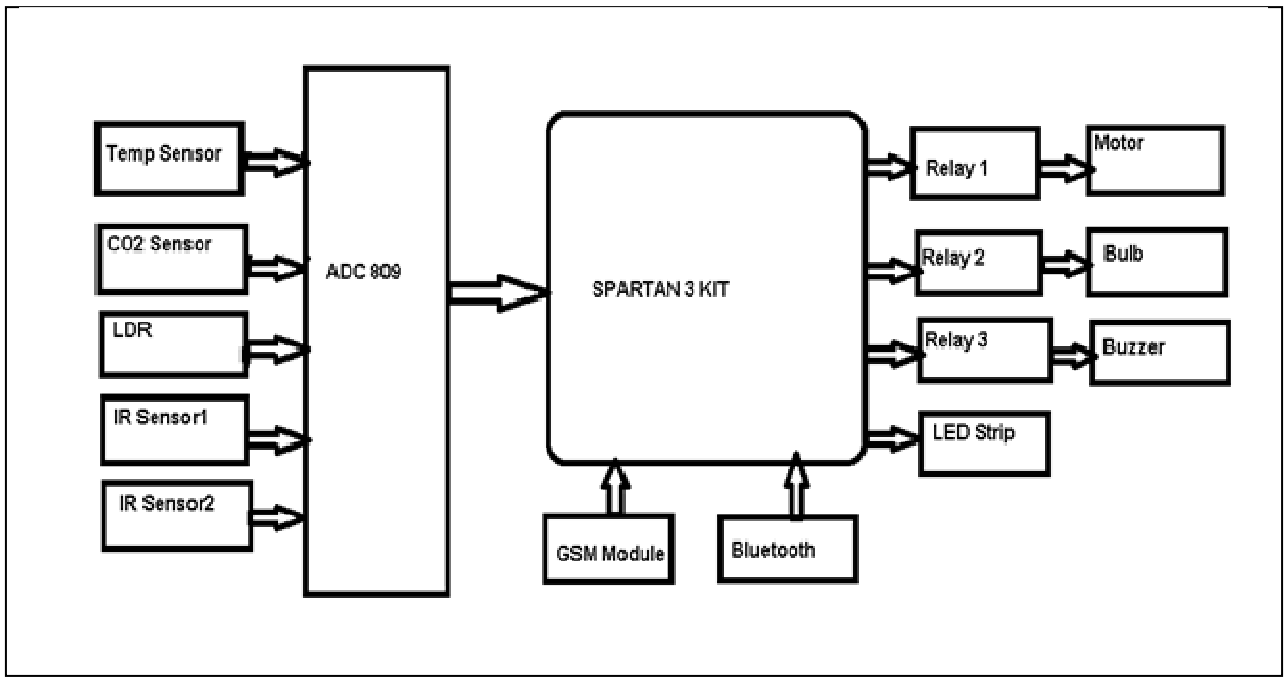

Figure 1

As shown in the block diagram the system uses different sensors to sense the industrial parameters. LM 35 is used to sense the temperature.MQ6 is used to detect the presence of any harmful gases.MQ7 is used to detect the presence of smoke in case of fire.LDR is used to detect the intensity of light. The IR sensors are used to detect the presence of human being. The analog output is converted to digital with the help of ADC 809. The output of ADC is given to the FPGA board for processing. The FPGA used here is Spartan III which uses FPGA XC 3S50AN IC. The output of FPGA board is given to SPDT relay to which various devices are connected. It also uses GSM and Bluetooth for remote communication. The details of all the modules are listed one by one below.

2.1. Temperature Sensor LM35

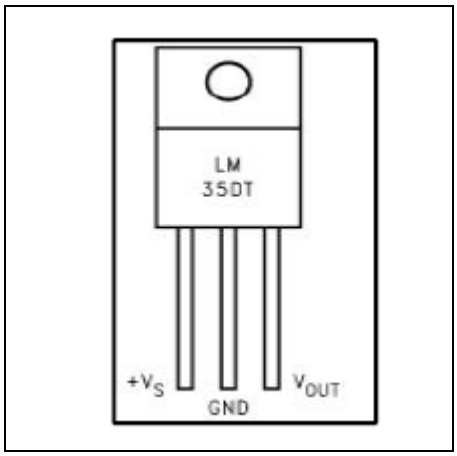

Figure 2

LM35 is a precision temperature sensor. The output voltage is linearly proportional to change in temperature. The sensor is calibrated in centigrade and not in kelvin so it does not require any conversion from Kelvin to Centigrade temperature range of LM 35 is -55C to +150C. It gives 10mv change for every degree of rise and fall in temperature. The sensor is calibrated in centigrade and not in kelvin so it does not require any conversion from kelvin to centigrade. Temperature range of LM 35 is -55C to +150C.It gives 10mv change for every degree of rise and fall in temperature. It provides typical accuracies of +/- 1/4C at room temperature and +/-3/4C over a full -55C to +/- 150C temperature range. It has got low output impedance, linear output and precise inherent calibration. It makes interfacing to control circuitry especially easy. It can be used with single power supplies or dual power supplies. It draws only 60µA from its supply. It has very low self heating less than 0.1C in air.

2.2. Gas Sensors

2.2.1. MQ6

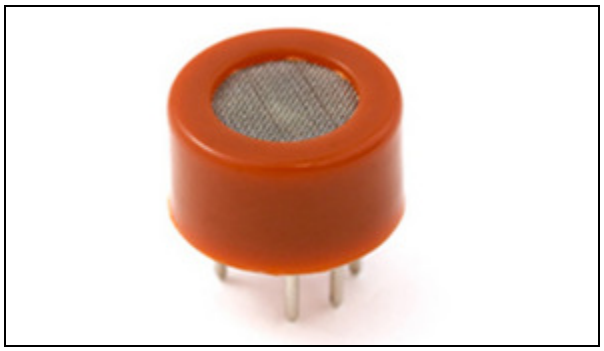

Figure 3

A gas sensor is an element which detects the presence of verified gases inside a section, typically as a part of a security system. This sort of device is very important as there are several gases which will be harmful to organic life, like humans or animals.MQ6 is a simple sensor which is used to sense liquefied petroleum gas, Isobutene, propane, LNG. The sensitivity may be adjusted by the potentiometer.

2.2.2. MQ7

MQ7 is a carbon monoxide detector which detect the presence of CO in smoke in case of fire. The sensitivity may be adjusted by the potentiometer.

2.3. LDR

LDR i.e. Light dependent resistor is used to sense the intensity of. The output of LDR is used to control the intensity of streetlight.

2.4. PIR Sensor

Passive infrared sensors are used to detect motion of human being. It senses the heat emitted by a living body. These are often fitted to security lights so that they will switch on automatically if approached. The PIR is simply sensitive to the infrared energy emitted by every living thing.

2.5. GSM Module

GSM module is a wireless module that works with a GSM wireless network. The main difference between the dial up and wireless module (GSM) is that wireless module sends and receives data through radio waves.

The GSM module can be an external device or it can be fitted in PC card. A GSM module requires a sim card from a wireless carrier in order to operate. A number of SMS messages can be processed by a GSM module per minute. With the help of GSM module, you can do reading, writing and deleting SMS messages. We can send SMS messages. We can also monitor the signal strength. We can read, write and search phonebook entries.

2.6. FPGA

FPGA board used is Spartan III which has following features. The IC used Spartan XC3S50A in TQG144 package. It has 16MB flash memory. It also has USB 2.0 interface for on-board flash programming. FPGA configuration via JTAG and USB.

3. Conclusion

In this paper I presented an idea of a device which will remotely sense the process parameters and streetlights in the premises of industry. The device uses GSM and FPGA. The system is suitable for real-time monitoring. The system is GSM based. It sends SMS to operator in case of emergency. The software part of the is written in Verilog. The Spartan 3E kit is used to simulate the design.

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