

ARM7 Based Wireless Visual Data Acquisition System

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Abstract- This project is about designing a wireless gas leaking detector using microcontroller system, sensor, RF module and several other devices. The detector is based on the commercial gas sensor, buzzer and LCD alphanumeric display. This system uses ARM controller as a tool to collect input data, process and release output data. The significant of this project is to briefly show how to connect a microcontroller system with input and output devices consists of LCD display and buzzer. This project will be a reference material to the future student or consumer in order to understand usage of a microcontroller and make use of its features. Reprogramming function of the microcontroller is enabled in order to allow user to explore and experience how to program a microcontroller. Output and input device are presented in such interactive way to actually show how microcontroller does the controlling part of the project.

Before the development of electronic household gas detectors in the 1980s and 90s, gas presence was detected with a chemically infused paper that changed its colour when exposed to the gas. Since then, many technologies and devices have been developed to detect, monitor, and alert the leakage of a wide array of gases. Today, booking an LPG cylinder is now just a text message away. Petroleum companies have launched the customer-friendly service called as IVRS (Interactive voice Response) technique for their customers.

Hence the requirement of an efficient system to measure and display the level of LPG is inevitable, which may be used for domestic purposes. Here we intend to propose a microcontroller based system where a gas sensor, MQ6 is used to detect dangerous gas leaks. This unit is incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG leakage. The sensor has good sensitivity combined with a quick response time at low cost.

I. INTRODUCTION

LPG, first produced in 1910 by Dr. Walter Snelling is a mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons. Because of the versatile nature of LPG it is used for many needs such as domestic fuel, industrial fuel, automobile fuel, heating, illumination etc and the demand for LPG is on an exponential raise day by day. The leaked gases when ignited may lead to explosion. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. Thus there is a need for a system to detect and also prevent leakage of LPG.

1.1 Objectives Paper

- 1] ARM7 makes the project to easily handle the multi-tasking, monitoring & controlling of various parameters.
- 2] No need of external elements to be added to the controller for analog to digital and vice-versa. As the ARM has all in-built in it.
- 3] Wireless for faster and convenient communication.
- 4] It covers more than a long distance which is sufficient for small scale implementation.
- 5] As the PLC based or other wireless systems are considered they cost heavy but the

proposed system has most important advantage is it is the cost effective project.

Objective of this paper is design the circuit that can detect leaking gas of natural gas and toxic gas. Circuit will have display to show the concentration of gas and indicate as a warning system if the concentration exceeds safe concentration.

II.SYSTEM DEVELOPEMENT

The basic circuit diagram of the ARM based visual data acquisition system is shown in Figure 1.

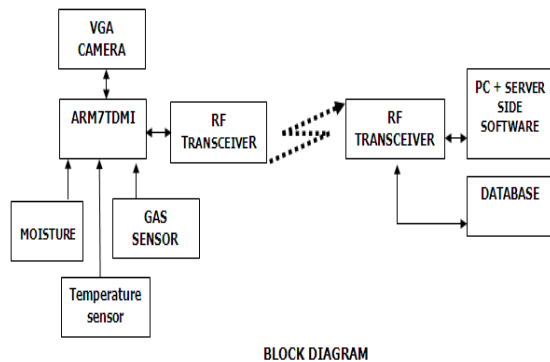


Figure 1. ARM based visual data acquisition system

2.1 HARDWARE IMPLEMENTATION

This project implements a Visual Data Acquisition System with RF Networking capability using ARM microcontroller. It implements an interface to a VGA camera, a gas sensor, and a 2.4 GHz RF Transceiver. The Gas level in the area will be continuously monitored via the gas sensor. The gas levels will be logged at predefined intervals and will be transferred to the main station via the wireless link; optionally images can also be logged after certain interval as well as after the set point of gas is crossed. As long as the gas level is within set limits no action signal would be raised. As soon as the level increases beyond the set limits, an signal would be raised, optionally a valve can be operated which will cut off the gas supply for the specific area. The VGA Camera attached to the system will take a picture of the area and transmit it to the main station. In case if anybody

intentionally tries to tamper the gas pipes, the person can be caught using the picture data transmitted to the main station.

On the main station the data will be captured and will be stored in a database for further gas analysis (gas level records) and in case if any leakage is detected and signal will be raised on the PC for urgent attention.

GAS sensor (MQ-6):

MQ- series are available for various gas sensing. But MQ-6 is a sensor designed for the sensing of LPG, propane, iso-butane.

Temperature Sensor:

The temperature sensor which could give a proper linear output of sensed temperature of the location for monitoring and controlling.

Moisture :

The moisture sensor helps to get a proper idea for the water contents in the atmosphere and avoid the unwanted leakage situation.

2.2 SOFTWARE IMPLEMENTATION

The software section is composed of four soft wares involved namely PRPTEUS 7.6, KEIL μ VISION , FLASH MAGIC, MICROSOFT VISUAL STUDIO 2008.

PROTEUS 7.6: Many CAD users dismiss schematic capture as a necessary evil in the process of creating PCB layout but we have always disputed this point of view. With PCB layout now offering automation of both component placement and track routing, getting the design into the computer can often be the most time consuming element of the exercise. And if you use circuit simulation to develop your ideas, you are going to spend even more time working on the schematic.

ISIS has been created with this in mind. It has evolved over twelve years research and development and has been proven by thousands of users worldwide. The strength of its architecture has allowed us to integrate first conventional graph based simulation and now - with PROTEUS VSM - interactive circuit simulation into the design environment. For the first time ever it is possible to draw a complete circuit for a micro-controller based system and

then test it interactively, all from within the same piece of software. Meanwhile, ISIS retains a host of features aimed at the PCB designer, so that the same design can be exported for production with ARES or other PCB layout software.

For the educational user and engineering author, ISIS also excels at producing attractive schematics like you see in the magazines. It provides total control of drawing appearance in terms of line widths, fill styles, colours and fonts. In addition, a system of templates allows you to define a 'house style' and to copy the appearance of one drawing to another.

KEIL μ VISION: μ Vision3 is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. It encapsulates the following components:

- A project manager.
- A make facility.
- Tool configuration.
- Editor.
- A powerful debugger.

μ Vision3 adds many new features to the Editor like Text Templates, Quick Function Navigation, Syntax Coloring with brace highlighting, Configuration Wizard for dialog based startup and debugger setup.

FLASH MAGIC : NXP Semiconductors produce a range of Microcontrollers that feature both on-chip Flash memory and the ability to be reprogrammed using In-System Programming technology.

Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices. These features include:

- Erasing the Flash memory (individual blocks or the whole device)
- Programming the Flash memory
- Modifying the Boot Vector and Status Byte
- Reading Flash memory
- Performing a blank check on a section of Flash memory
- Reading the signature bytes
- Reading and writing the security bits
- Direct load of a new baud rate (high speed communications)
- Sending commands to place device in Bootloader mode

Flash Magic provides a clear and simple user interface to these features and more as described in the following sections.

Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is loaded.

MICROSOFT VISUAL STUDIO 2008: It is a VB .NET which helps in programming and generating the required GUIs for enhancing results.

Table 1. Specification of various components

Sr. No	Component Name	Specifications	Advantages
1	ARM7TDMI-S (LPC 2138)	<ul style="list-style-type: none"> • Pipelined architecture • RISC instruction set • On-chip SRAM - 32KB • On-chip Flash memory - 512 KB • Two 32-bit ports available- port0 and port1. 	<ul style="list-style-type: none"> • Multitasking • High Operating Speed • Bidirectional and multifunctional pins
2	Temperature sensor (LM35)	<ul style="list-style-type: none"> • o/p is linearly proportional to temp ($^{\circ}$C) • temp range- (-55$^{\circ}$C to 150$^{\circ}$C) • sensitivity= 10mV/$^{\circ}$C • i/p current= 60μA 	<ul style="list-style-type: none"> • No need of converting the temp ($^{\circ}$C) to ($^{\circ}$K) • Low cost • Low self- heating • Calibration is easy • ARM has i/p v_{cc}= 3.3V, so i/p from sensors should be small for proper power rating.
3	Moisture/ humidity sensor (SY-HS-220)	<ul style="list-style-type: none"> • I/P voltage= 5.0V DC • I/P Current= \leq 3.0 mA • Operating range= 30- 90 %RH • Accuracy= \pm 5% RH 	<ul style="list-style-type: none"> • At 25$^{\circ}$C= 60%RH standard • o/p in from of voltage= 1980mV for std condition.
4	Gas sensor (MQ-6)	<ul style="list-style-type: none"> • V_{cc}= 5V AC or DC • R_s= 10KΩ- 60KΩ (1000ppm) • Range= 1000ppm- 4000ppm 	<ul style="list-style-type: none"> • high sensitivity to LPG, iso-butane, propane • fast response, stable & long life • simple drive circuit
5	RF transceiver (Si4432)	<ul style="list-style-type: none"> • Freq range=240- 930 MHz • Data rate= 0.123 - 256 kbps • Power consumption= 18.5mA (Rev) 85 mA (transmit) • Distance covered= more than 100m 	<ul style="list-style-type: none"> • Ultra Low power shutdown mode • Auto freq calibration • TX & RX 64byte FIFOs

III.PERFORMANCE ANALYSIS

The simulation give a satisfactory results for :

- a) Results for measurement of temparture and displaying it on LCD:-

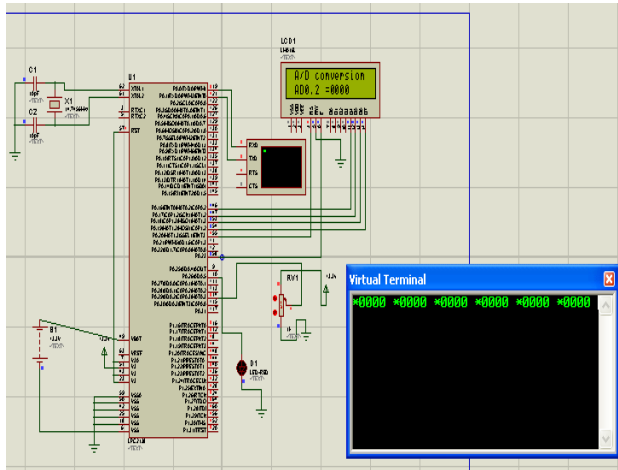


Figure 2. Results for displaying measured temperature.

b) Results for the action signal for the crossing the set point of LPG and same can be done for set point of temperature:-

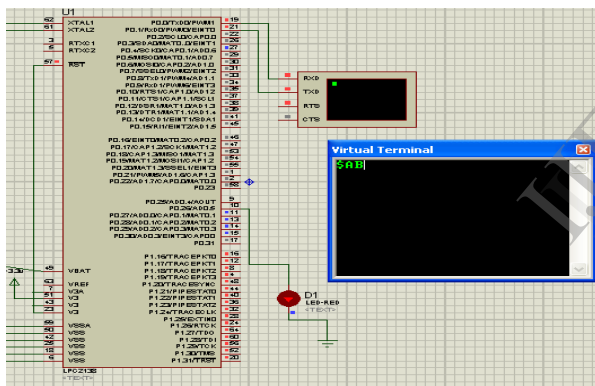


Figure 3.a) signal generated after crossing the set point of LPG.

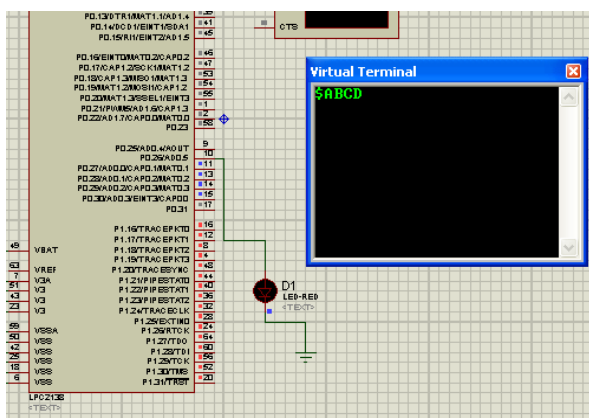


Figure 3.b) signal generated when is within the set point of LPG.

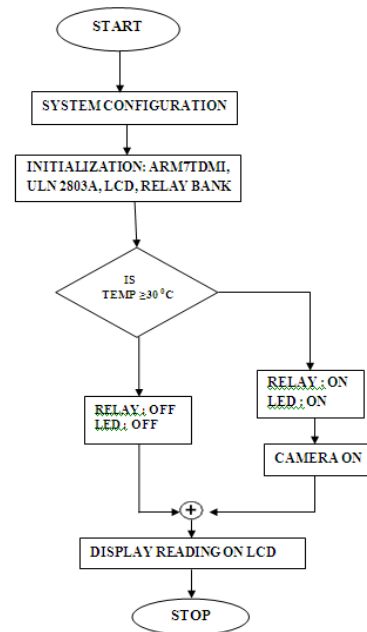
Figure2. gives the simulated results for interfacing LCD with ARM for displaying the measured parameters.

Figure 3.a) is the simulated output for controlling action. LPG and temperature will have the set points given for setting a limits. If the measured of the parameters crosses the limit , the valve or fan/coolant gets signal and it activates.

These all controlling action is taken for prevention and avoiding the accidents happening.

FLOWCHART:

SYSTEM FLOWCHART:



IV.CONCLUSION

- 1] The system helps the user to get the efficient and cost effective system for monitoring and controlling hazardous gas like LPG.
- 2] It helps to monitor and control the parameters in a place where human inference is difficult.
- 3] No need of any technical person for control or monitoring.
- 4] Number of parameters can be added in the system as we have used ARM7.

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