<u>**Short Communication**</u>

CONTROLLING AND MONITORING OF TEMPERATURE SYSTEM FOR LIVESTOCK

M. Saleem Khan[*], Z. Ahmed, M. W. Ashraf, S. Yasmeen, M. Imran, F. Baig, N. Yaseen and S. Jabeen

G C University Lahore, Pakistan.
[*]Corresponding Author E-mail: mskgcu@yahoo.com

ABSTRACT

In this modern era, every passing day reveals a new invention to the world. Every invention gives us new school of thought and with every invention challenges also increase. We can observe and control the system by using the invention of remote control. To control a system automatically, monitoring is mandatory for efficient control. According to changing setup, control is possible by remote monitoring and controlling in livestock, agriculture and food industry. This work is also a part of this chain. We designed and implemented a temperature control and monitoring system for poultry farm at a specific desired temperature. This system consists of temperature sensor LM35, ADC 0804, microcontroller 89S51, fan and LCD for efficient and accurate results of control and monitor as simulation on proteus as well as hardware. This will be feasible for any livestock environment specially poultry farm.

Key words: Livestock, controlling and monitoring, data acquisition and temperature control.

INTRODUCTION

Increasing numbers of livestock farmers, food industry and agriculture demands an efficient and effective control and monitoring of different physical parameters for growth and food safety. Due to its revolutionary invention electronics has major role not only controlling and monitoring of environment but also acquires different physical status of animals like temperature, heart rate and other receptors. A lot of research and system design has been done on these aspects. For this purpose control system based on digital electronics, data acquisition system, embedded system and computer aided system play the vital role in food industry and agriculture. These systems are based on the information collected from various sensors and used to generate the control environment for the specific tasks. Here the proposed system uses microcontroller to work with the control environment is an efficient, less error and low cost system.

An electronic technique was described to control food by introducing e-noses in their work. Authors explained three food sensors instead of classical gas sensor for handling, detection and data processing of e-noses. Advantages and utilization of this system in food were also discussed for controlling and monitoring of food (Peris *et al.*, 2009).The biosensors were used as diagnostics tools for monitoring, control, high sensitivity, speed and accuracy for measurements of antibodies, enzymes, cell receptors and nucleic acid as sensor receptors. This work also explained the advantages and development of biosensor in agricultural market (Tothill *et al.*, 2001). The development and application of wireless sensor and wireless communication in the field of agricultural and food industry were explained. In

agriculture and food industry usually precision agriculture, process control, environmental monitoring and M2M-based machine etc are discussed for growth market and automation facility of food and agriculture industry (Wang *et al.*, 2006).

It was reported a review on near infrared (NIR) for monitoring, quality and controlling of food in food industry by introducing in/on line technique. NIR Spectroscopy was discussed as most advanced and efficient method of controlling and monitoring in food processing industry by using different observations and experiments (Huang *et al.*, 2008).

A monitoring system was presented for livestock with their advantages and efficiency. They proposed integrated system based on data base, sensor information, mathematical modeling and knowledge was enabled for monitoring of temperature, heart rate and other physical factors of animal (Frost *et al.*, 1997).

System of measuring an electrical or physical processes for instance voltage, current; temperature, pressure or sound with PC is regarded as Data Acquisition. DAQ consist of sensors, values taken with hardware and a computer with programming software (Maithil 2013). Real world physical phenomenon are sampled and converted into digital numeric values that can be processed by a computer. These systems (DAQ) convert analogue signal into digital values for manipulation (Gray, 2003). Data Acquisition applications were structured by software programs settled using several programming languages as BASIC, C, FORTRAN, Java, lisp, Pascal. DAQ based on PDA for dairy system was introduced to save manpower, improve work efficiency and to solve the problems of management for effective information collections and technical support (Zong *et al.,* 2010).

Main features of Data Acquisition are: sensors connected to the system or plant will give value to the analog to digital converter (ADC), ADC converts the analog values in to the digital values, ADC's output will be given to the microcontroller 8051, these values will be the input of microcontroller. Microcontroller will decode all the values according to the programming. Microcontroller will be attached to the LCD and all results will be shown on LCD. Sensor is a device that measures a physical measure and converts it to digital signal which can be read by an onlooker. (Lin *et al.,* 2011).

Sensors could be active and need external power (Dargie *et al.* 2010) or passive and doesn't need external power (Reck *et al.*, 2006).

SMS based framework for livestock was developed specially to apply case study of catfish industry. They proposed a fastest communication system between catfish farmer and customer which will facilitate to get information to reduce time and cost both by using SMS service on mobile and it will reduce the unawareness of farmer from advance technology which is useful for them to keep update with market demand (Aziz *et al*., 2011).

In this paper we have proposed a monitoring and controlling of environment temperature of livestock especially for poultry farm by using microcontroller. We have designed and implemented a temperature control and monitoring system for poultry farm at a specific desired temperature. This system consists of temperature sensor LM35, ADC 0804, microcontroller 89S51, fan and LCD for efficient and accurate results of control and monitor as simulation on proteus as well as hardware

Design Methodology

Simulated Hardware: Hardware used to execute this project includes LM35 (sensor), ADC (for conversion of analog signal into digital), Micro controller (for manipulation of data), Motor driver (L293D) (interface between controller and fan), LCD (for display).

LM 35 temperature sensor is integrated circuit temperature sensors, whose output is linearly proportional to the Celsius temperature. Its working principle is; Its internal resistance changes as temperature changes and gives proportional voltage. For further detail See "Temperature sensor LM35" data sheet (http://www.magics-notebook.com).

LM35 gives output of 10 mV (0.01 volts) per degree Celsius.

At 20°C we will get 20x0.01= 200mV, or 0.2volts output

At 100°C we will get 100x0.01= 1.0 volts out. At 50°C we will get 50x0.01=0.5volts output

It pulls only 60 **μA** from its supply having very low self-heating less than $0.1°C$ in still air. LM35 is designed to function over a $-55°$ to $+150°C$ temperature range.

Analog-to-Digital converter converts a physical quantity (usually voltage) to a digital numeric values that characterizes the quantity's amplitude (Kester *et al*., 2005). The digital numeric outputs vary from 0 to maximum of 255. We can adjust step size by setting reference pin 9. The step size is 19.53mV at 5V provided (5V/255). With rise of every 19.53mV output changes by 1unit (Daihong *et al.* 1998). Microcontroller is integrated circuit on a single chip that comprises of programmable external I/O ports, RAM, ROM and processor. It's like a mini computer integrated on a single chip. It is a low power and high performance device. There are a number of microcontrollers with different in numbers and functions as well. Intel Corporation presented an 8 bits microcontroller called the 8051 (Mazidi *et al. (2009)*). Microcontroller is 40 pins IC with 32 input output pins.

"L293D is the dual H-bridge motor driver circuit IC" (Aziz *et al.,* 2011). The H-bridge circuit reclined on the idea of transistor as switch. This alignment runs the motor clockwise or anti-clockwise in H-bridge. The operation of L293D can be held by giving the logic input 1,0.

Liquid Crystal Display is abbreviated as LCD. The image on an LCD screen is displayed by inserting an electrically reactive substance between two electrodes. Its color can be changed by increasing or decreasing the electrical current. LCD screens are laid on the principle of blocking light (rather than discharging it). Simulation has been done by using proteus (Electronics GCU Lab.) which is shown in simulated hardware diagram in figure1.

Whenever there will be change in environment temperature of livestock specially poultry farm, LM35 will sense the change of temperature and will give a voltage proportional to this change. It will change physical signal to electrical signal. As signal is in analoge form, there is a need of digital signal for data to be manipulated as microcontroller read digital signal. So ADC converts it into digital. After being converted by the ADC discrete values of data are put into the microcontroller. Referenced values are set inside the microcontroller and actions, fan or heater on or off, will be performed according to these set values.
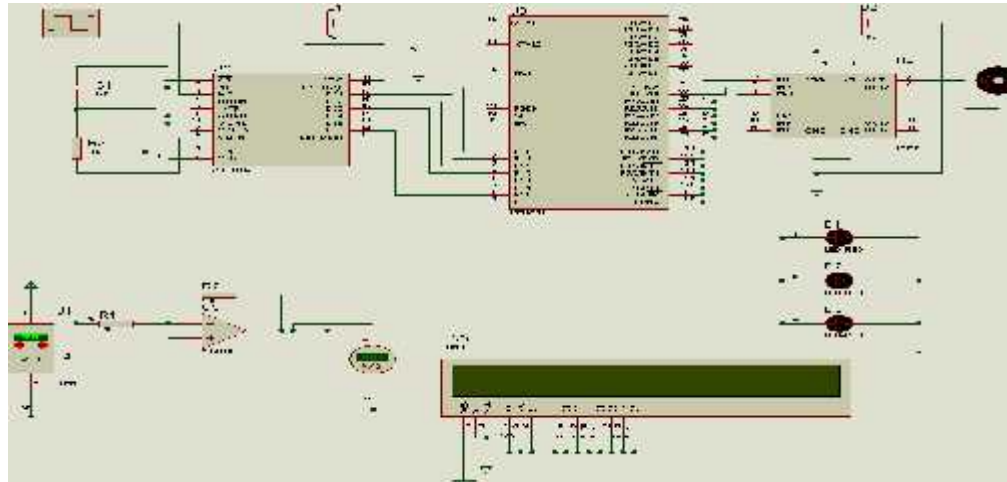
Figure 1; Simulated Hardware

Moreover, this system not only monitors the temperature environment of poultry farm but also control the temperature automatically according to the set point of user's desire.

This system has ability to change your set point of temperature according to the weather condition required for livestock. In future this system can be enhanced by using adoptive control system like artificial intelligence and fuzzy logic as machine learning technique for immense effective and efficient results of monitoring and controlling of livestock to fulfill the increasing need of food and agriculture.

Programming Algorithm: Programming algorithm for this system is shown in figure 2. In this figure programming of designed system has been discussed by using a systematic way which is easy and significant way to a person which has no awareness about technical parameters of electronics tools. After start of this program, users can decide three ranges of desired temperature:

Low temperature range
Desired temperature range
High temperature range

Here in this study 20-32C lower range, 33-35C set point of temperature and 36-45C is high temperature range. So when temperature of environment is in low range then first part of algorithm will be true then it will turn on heater, for set point range middle part of algorithm will turn off both heater and fan and similarly for high temperature heater will be turned off and cooling fan will be on which is shown in third flow of algorithm. In this algorithm lights has been used for heating and cooling elements indication as shown in figure 2.
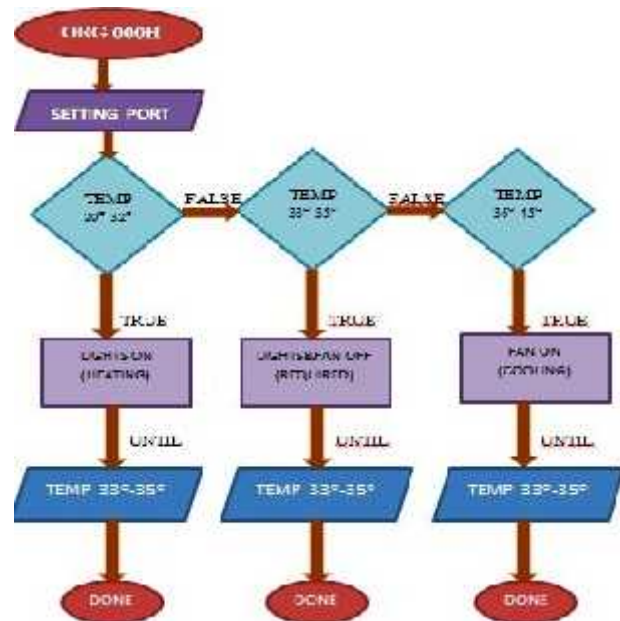

Figure 2 Programming Algorithm

RESULTS AND DISCUSSION

Results of this designed system with hardware implementation are discussed below. After initialization, programmed port is set as input. If and If condition is used. If temperature is within 20°-32°C lights, which are used as heating elements will be on until temperature reaches the desired value 33°-35° C. If temperature is within 36°-45° C fans which are used as cooling elements will be on until temperature reaches the desired value 33°-35° C. If temperature is already within desired value, all elements either heating or cooling will be off. Fan on and light off stage is shown in figure 3.

As fan is on which depicts that temperature is beyond desired value which is considered as error. In

order to overcome this error fan will be on until temperature of livestock area is within desired temperature range. Light on and fan off condition is shown in figure 4. This hardware set up has been implemented in analog electronics lab (CASP) GCU Lahore.
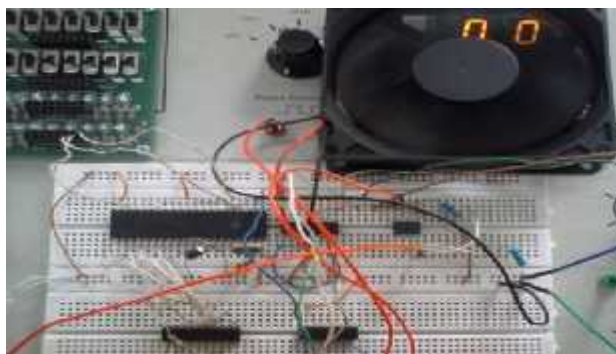

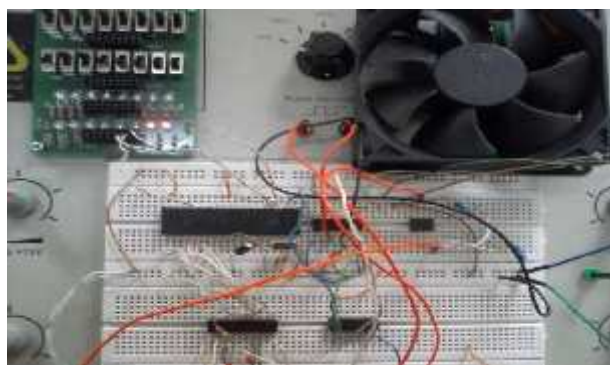**Figure 3 Hardware (Fan on, lights off)**

Figure 4 Hardware (light on, fan off)

Conclusion: Hardware results and simulated results are nearly in agreement according to set point of low, desire range and high range of temperature. Normal temperature of the local area is 33ºC to 35º. When temperature increases or decreases from normal value, control elements i.e. cooling fan or heater will operate accordingly, value of the temperature is displayed on the LCD; desired temperature has been adjusted efficiently. Thus, we are able to maintain temperature of a localized area according to desire of poultry farm. This system not only feasible in poultry farm but can be installed in livestock career to save life of animals.

In future by using different types of sensors ,this system can be enhance to control and monitor other environmental parameters like humidity etc. 3G and GSM technology can be used to send and receive the changes in these parameters. It will make our system more reliable in near future which is a dire need of food and agriculture industry for its growth.

REFERENCES

Aziz N. F. A., Y. Yahiya and M. Mukhtar (2011). Short Messaging System (SMS) Framework Development: A Case study of catfish industry in Malaysia. International Conference on Electrical Engineering and Informatics, Bandung, Indonesia.17-19.

Daihong F., C. D. Kenneth, H. L. Stephen. andJ. H. Paul (1998). A Digital Background Calibration Technique for Time-Interleaved Analog-to-Digital Converters. IEEE J. Solid-State Circuits. 33 (12):1904 – 1911.

Dargie W. and C. Poellabauer (2010). Fundamentals of Wireless Sensor Networks: Theory and Practice,Wiley publisher, USA.

Frost A. R., C. P. Schofield, S. A. Beaulah, T. T. Mottram, J. A. Lines, and C. M. Wathes (1997). A review of livestock monitoring and the need for integrated systems. J. Computers and Electronics in Agriculture, 17: 139-159.

Gray N. (2006). ABCs of ADC: Analog-to-Digital Converter Basics National Semiconductor: The sight and sound of information. California, USA.

Huang H., H. Yu, H. Xu and Y. Ying (2008). .Near infrared spectroscopy for on/in-line monitoring of quality in foods and beverages. J. Food Engineering.87: 303–313.

Kester, Walt, ed. (2005).The Data Conversion Handbook. Elsevier: Newnes. ISBN 0-7506-7841-0.

Lin H. and C.T. Sun (2011).The Role of Onlookers in Arcade Gaming: Frame Analysis of Public Behaviours.The International J. Res. into New Media Technologies.17(2):125–137.

Maithil P. New electronics. 1. 12. 2000. 8 5 2013 <http://www.newelectronics.co.uk/electronics-technology/data-acquisition-system-enhances-images-for-digital-x-ray-and-mri/56793/>.

Mazidi M. A.,. J. G. Mazidi and R. D. McKinlay (2009). The 8051 microcontroller and embedded systems using assembly and C .

Peris M., and E. G. Laura (2009). A 21st century technique for food control: Electronic noses. J. Analytica Chimica, Acta, Elsevier, 638: 1–15.

Reck E., Miranda, Marcelo and M. Wanderley (2006) "New Digital Musical Instruments: Control and Interaction Beyond the Keyboard" A-R Editions, Inc. USA.

Tothill I. E. (2001). Biosensors developments and potential applications in the agricultural diagnosis sector. J. Computers and Electronics in Agriculture. 30: 205–218.

Wang N., Zhang N. and M. Wang (2006). Review: Wireless sensors in agriculture and food industry—Recent development and future perspective. J. Computers and Electronics in Agriculture. 50: 1–14.

Zong Q. and W. Bao (2010).The dairy cattle data acquisition system based on PDA. IEEE World Automation Congress (WAC), Kobe: 65 – 69.