
LabVIEW Interfaced PC-Based Fishpond Monitoring System

By

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ABSTRACT

In this paper, the environmental condition of fishes was monitored through a LabVIEW interface to guarantee safety and survival by providing a natural water environment with adequate favorable conditions. Fishes are cold-blooded animals as such their growth depends closely on the environmental situation which includes water level, water quality, temperature as well as feeding schedules. Monitoring the situation of the pond is challenging to fish farmers. In this work, LabVIEW interfaced PC-Based fishpond monitoring system have been designed using Arduino Uno which is capable of monitoring and controlling the activity of fishpond in terms of water level, temperature and feeding time. The Arduino board was interfaced to the LabVIEW LINX with all sensors (LM35 and Potentiometer), valve switch's (pumping and discharge) of the water in the fishpond and the motor (solenoid shooter) which serves as the central lock attached to the feed storage. The environmental conditions of the pond system were monitored between 24°C to 34°C temperature, 0.7m to 2.5m depth and high/low button condition for feeding.

Keywords: LabVIEW, Solenoid Shooter, Valve Switch, Arduino Uno, Measurement and control

INTRODUCTION

Fish is one of the most traded aquatic commodities and among the best and cheapest source of animal protein. Fishes are one of the most important group of vertebrates serving as food for human. They possess a great economic, nutritional, medicinal, industrial, aesthetic and religious values as well as providing employment for millions of people in the world. Most of the world's population (56 percent) derives at least 20 percent of its animal protein intake from fish (FAO, 2002). Fish is the preferred source of animal protein compared to

poultry, beef, mutton or pork. It is cheaper and acceptable in all phases of live with little or no for human consumption which gives it advantage over other proteins sources (Chen et al, 2011). The most important form of aquaculture is pisciculture or (fish farming), where the fishes are commercially produced (Nasir et al.,2016). Hence, there is a need of pisciculture to increase the production of fishes in order to meet the global demand requirements. Due to the constant improvement and awareness to the farmers on aquatic products quality, aquaculture is gradually changing from the traditional way

to the large-scale, intensive, diversified farming while the breeding technology level is also increasing rapidly (Li, 2007). It is known from biological knowledge that pond water temperature, illumination, dissolved oxygen, ammonia nitrogen and PH are important factors for the growth of fish, but it is difficult for fish farmers to accurately and timely manipulate these factors (Beena and Khaja, 2015), (Li, 2007).

Fishes can survive in natural water under favorable conditions. The body temperature depends closely on the temperature of their environment. Therefore, water temperature influences the survival and mortality rate of fishes. It is assumed that natural waters have natural temperature regulator (Beena and Khaja, 2015). Fishes find it difficult to survive or fertilize in harsh weather conditions like cold seasons. The temperature range tolerance of fish varies from species to species and their natural habitat. Some fishes have a very narrow range of tolerance in cold, warm, or hot seasons. The preferred temperature required by most fishes like sunfish, tilapia and cat fish to grow well generally lies within the range of 24°C to 34°C (Chen et al, 2011).

Temperature changes also have an adverse effect on both the health and life of a fish. A very high temperature increases the metabolism, respiration and oxygen demand of a fish, and reduces the solubility of dissolved oxygen in the pond which may lead to the fish's death. However, a low temperature slows down the body metabolism of the fish because it can neither eat nor digest its food substances (Huang *et al.*, 2013). In order to effectively monitor the condition of fish environment, several automated systems have been developed with the use of micro-chips like

microcontroller and sensor. In (Yang et al., 2015), ZigBee wireless communication technology is used in a system to monitor and regulate the water quality parameters in fishpond. It incorporates the LPC2131 as the main controller of the monitoring system while information is transmitted to the monitoring and control center in a host computer.

In this work, Arduino Uno is used in the development and implementation of an automatic monitoring and control of a fishpond. The system is capable of monitoring the water temperature, water level and feeding time with LabVIEW interface at low cost, low power consumption and high productivity of fishes.

MATERIALS AND METHOD

Description of System Operations

The crucial water qualities of the fishpond such as temperature, water level is measured using temperature sensor (LM35) and water level sensor (potentiometer) respectively.

These sensors are connected to the input of Arduino Uno board and the board is connected to a system (National Instrument's LabVIEW product) which acquires the data from each sensor separately and compares with its desirable range required for pisciculture. All the controlling units like outlet water pump, inlet water pump, and solenoid shooter are connected at the output of Arduino board using relay. The relay is used to switch ON/OFF the appropriate controlling component required to set the environmental parameter in the desired range as shown in table 1.

Table 1: Desirable range of environmental parameters in the fishpond and control action taken

Serial No:	Measured parameters	Unit	Desirable range		Measured Values	Action Taken
			Minimum Values	Maximum Values		
1	Temperature	Degree Celsius (°C)	24°C	34°C	< 24°C	Outlet water pump is turned ON & then inlet water pump is turned ON
					> 34°C	
2	Water Level	Meters (m)	0.75	2.5	< 0.75	Inlet water pump is turned ON
					>2.5	Outlet water pump is turned ON
Serial No:	Measured Parameter	Feed Button Status		Action Taken		
3	Feed	High		Switch ON Solenoid Shooter		
		Low		Switch OFF Solenoid Shooter		

DESIGN AND SIMULATION

Design

Software Design: A well-defined program flow chart was first drafted. The program is achieved by constructing a block diagram on the block diagram window of the toolkit with the information from the flow chat which is a representation of the desired function of the system and then it is uploaded to the arduino board via the LINX firmware wizard.

The front panel which is the display window of the toolkit is designed to display the measurement obtained in a required pattern for better understanding of the operation by any one in charge of the

operation. A representation of the real physical system is designed in the front panel and with the representation of other measuring instruments diagrammatically displaying the results of the measurement as well as the real system. If both the programming and the circuit simulation yield a positive result, then the hardware process can be implemented else the above-described process will be repeated. The software programming is done using LabVIEW2013.

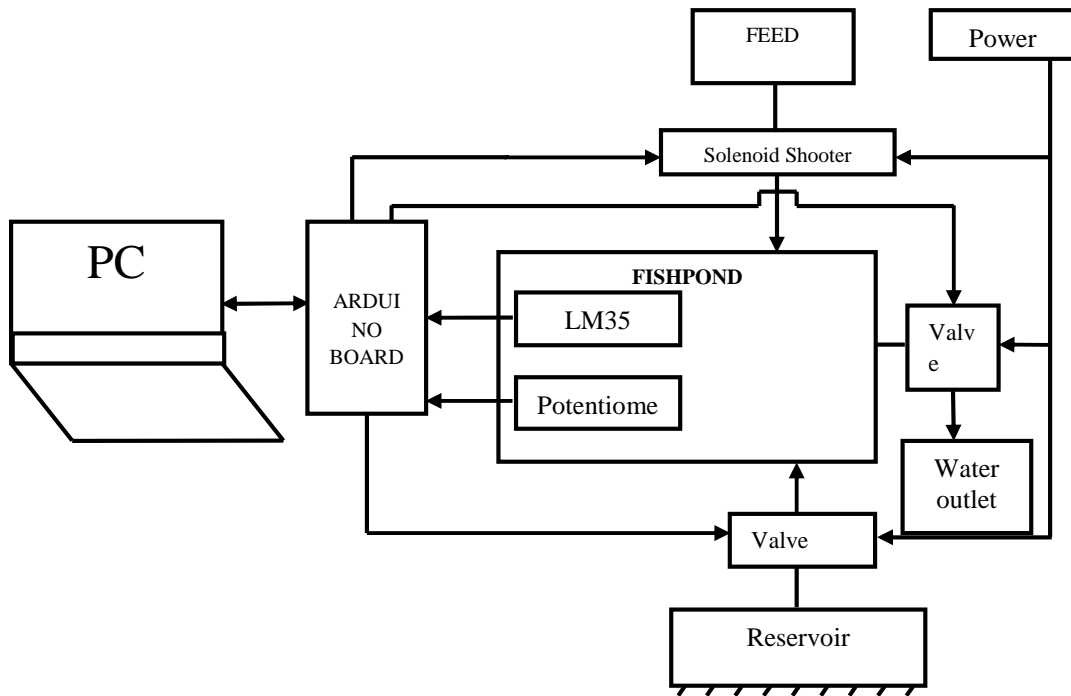


Figure 1: System Block Diagram

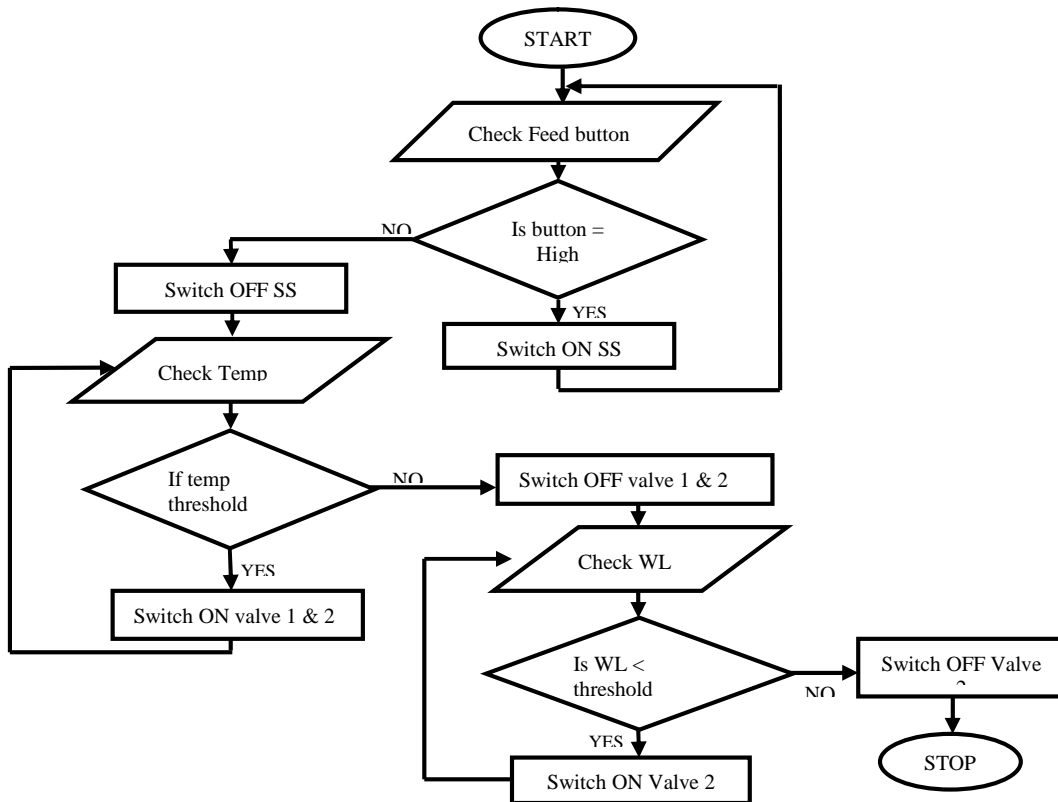


Figure 2: Program Flow Chart

Hardware Design

The components used in the hardware realization includes 240V Transformer, Arduino Uno, LM35, Potentiometer, Resistors, Capacitor, IN4007 Diode, Relays, C945 Transistor, 12v Valve Switch, 12v Solenoid Shooter, Vero Board, Bread Board, Jumper wire and LEDs. The Hardware implementation was first assembled on Bread board, where the whole circuits were wired and tested. All test results have been recorded before dissembling. Then the circuit was transferred to the Vero Board and soldered. Finally, a

good casing was constructed to house the circuit as a prototype.

System Simulation

This project constitutes both hardware and software sections for successful operation. The software is used to program the arduino board, with a view to achieving logical decision and control of the water level with automatic temperature control and indicator. Besides, this software can be used to monitor the operation of the system as it is programmed. The Proteus design suite for the circuit diagram is shown in figure 3.

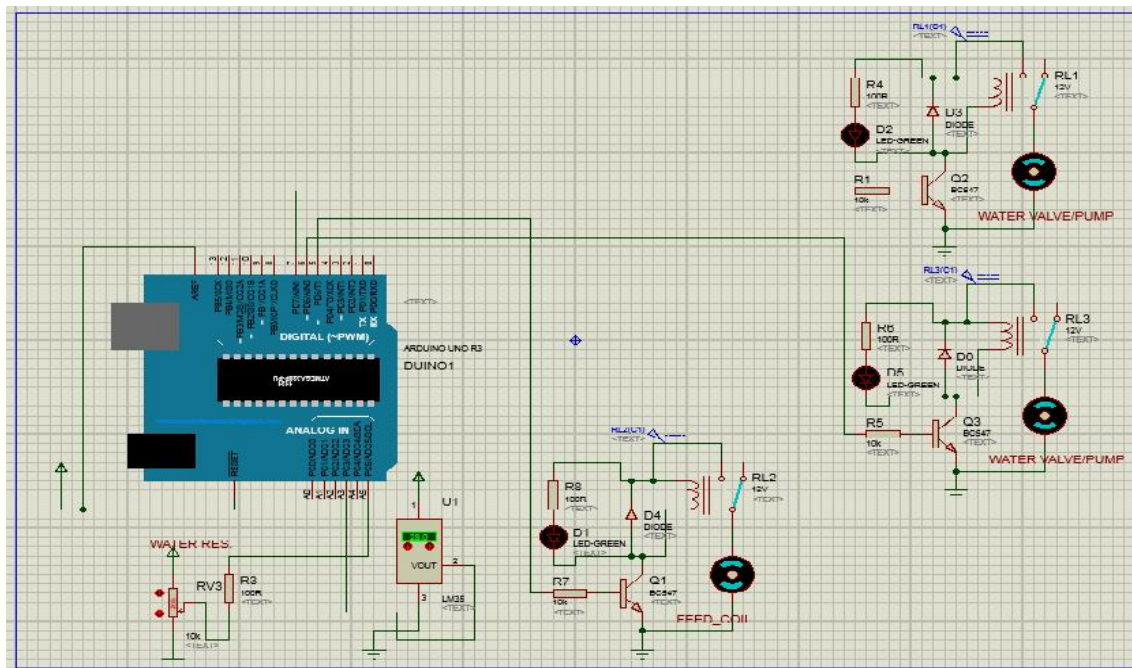


Figure 3: Circuit Diagram in Proteus Design Suite

System Performance Analysis and Testing

In carrying out the experiment, a feed in a plastic container and portable water in a bigger plastic container were used to act as a mini pisciculture system. The temperature and water level sensors are installed in the plastic artificial fishpond as

shown in figure 6. The outlet water pump is also fixed within the fishpond through which the water in the pond can be pumped out. The inlet water pump is fixed into another container containing fresh water in order to pump in the fresh water into the fishpond. All wiring connections were done from each

component to the arduino board using relays, LED's and main power supply. The arduino board is connected to the computer through USB cable and the COM port number of the computer to which the arduinoboard is connected in the host program of the application software. When the computer is switched ON, the mini pisciculture system starts working and the front panel of the system was displayed on the computer screen which contains the feed button and the measurements of water quality parameter (temperature and water level), working of the controlling component (outlet water pump or inlet water pump)

when the respective sensor readings go beyond its desirable range.

Computer Interface

This interface allows the farmer to monitor the real time change in the values of the parameter and the control action to be taken. The predefined values of the parameter can also be changes using the setting tab of the front panel. Figure 4 shows the front panel of the system while the test result in the excel format is presented in figure 5.

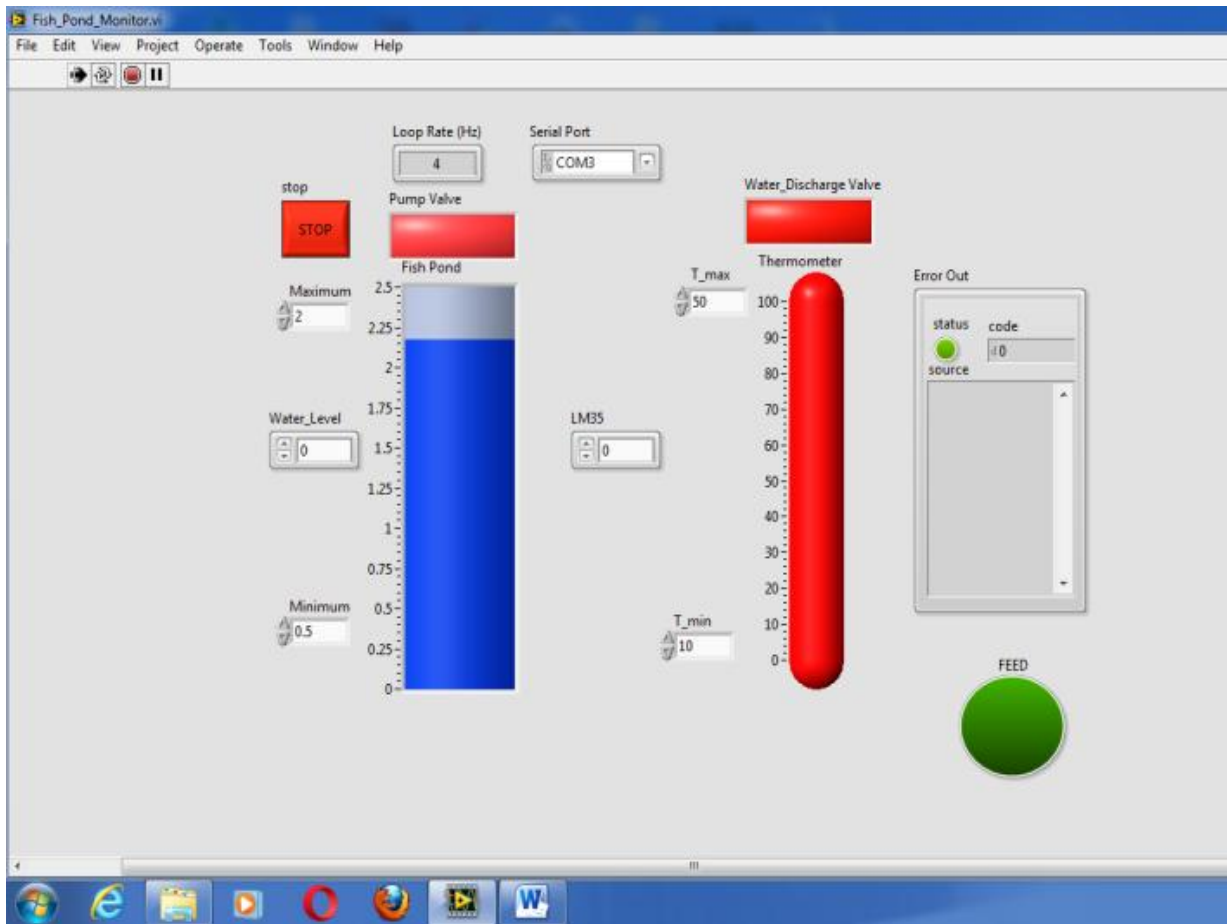


Figure 4: Front Panel of the Lab VIEW Environment

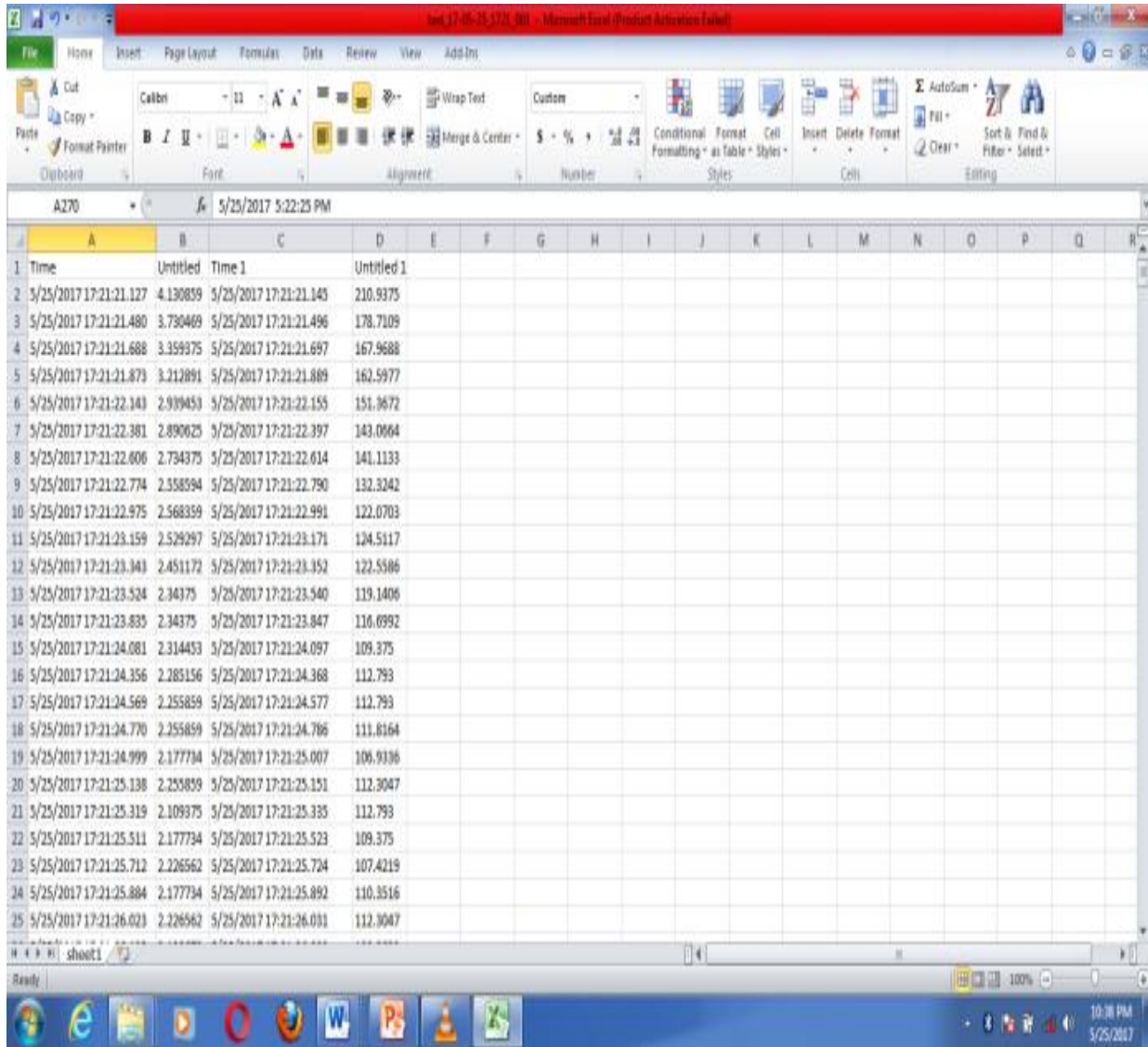


Figure 5: Test Result in excel format

However, for verification of efficient monitoring of the water level, temperature and feed for the fishpond, various tests were carried out. Each component was carefully tested, when the system is turned on and the water flow, it level at all times is seen on the

designed front panel of the LabVIEW environment. All the subsystem were put together to form the whole system. Figure 6 shows the complete system of the finished prototype



Figure 6: Overall System of the Finished Prototype.

CONCLUSION

In this study, a prototype fishpond was designed and successfully tested, and the arduino board was successfully interface with LabVIEW LINX with all sensors (LM35 and Potentiometer), valve switch's (pumping and discharge) of the water in the fishpond and the solenoid shooter of the feed which was used as the central lock of the feed were successfully connected and executed perfectly. Hence, with this system, farmers will be able to effectively monitor the pond

water level, temperature and feeding system to enhance favourable environment.

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