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AUTOMATED WATER LEVEL CONTROLLING SYSTEM FOR PADDY FIELDS

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ABSTRACT

Paddy cultivation is the main life pattern of ancient Sri Lanka since began of human being. Hence, water irrigation was a vital requirement for sustainable life even during ancient times. Accordingly they always strived to maintain water provision for the cultivation continuously throughout the year. The paddy cultivation have pre-defined epoch upon rice varieties. Rice is held as national crop and excellent varieties of rice, standardized fertilizers and pesticide applications, improved water management have all assured a high and stable productivity of rice. Accordingly water level must be maintained for each epoch in order to receive optimum harvest. But, with the weaknesses of the current irrigation systems and also due to absence of a well patterned rainfall system, it is not easy to manage the required levels of water during different cultivation stages. By the way, the water is wasted in vain. That high wastage of the water irrigation system is emerged as the necessity of a water level sensing and controlling system. In this study, water level of the paddy field is precisely sensed and maintained while controlling the irrigation canal and drainage canal which are the input and output gates of the design respectively. Water level of the paddy is measured by using an ultrasonic sensor and a LCD display is used to display water level height in centimeters. According to the required level of water, irrigation canal and drainage canal are controlled by the system with gates. Furthermore, canals are exclusively controlled by using Radio Frequency (RF) module through RF communication. The systems will automatically proceed until the desired water level for each required epoch (in days) is maintained. This system, water level data is successfully displayed remotely, therefore this prototype can be used as a part of the bigger system, such as, river flow management system which controls the stream to minimize the flood.

Keywords: *Water level height, Irrigation canal, Ultrasonic sensor, RF module*

1.0 INTRODUCTION

Paddy field uses large quantities of water usually under ponded condition. They are artificially controlled by hydrological conditions, namely irrigation. According to the rice growing calendar, consecutive height of the water level is required to receive optimum amount of harvest. However, water is lost through evaporation from free water surface, transpiration from the crop, seepage and percolation through the soil, bunt leakages and runoff from the field.Bunt leakages and runoff from the field is totally under the farmer's control. Therefore, the main determinants of water requirement are evapotranspiration, seepage and percolation rates. Hence the water balance equation of paddy field can be expressed as follows[1].

$$R + Q_i = ET + P + Q_o + \Delta S \qquad (1)$$

Where R is precipitation, Qi is irrigation water, ET is evapotranspiration, P is the percolation and ΔS is change in storage[2].

The water level controlling system gives optimum solution through eliminating abovementioned issues. In designed system, water level is continuously measured by using ultrasonic sensor that can be appeared on 16×2 LCD display. According to measured height of water level, microcontroller makes the decision which canal should be activated either irrigation canal or drainage canal. RF module is used in order to retain communication between microcontroller and both canals. Also, canals are operated using servo motors with gates. Ultimately entire system consists with consecutive transmitter module and two receiver modules.

2.0 EXPERIMENTAL

The following figure illustrate sketch of the design in paddy fields.

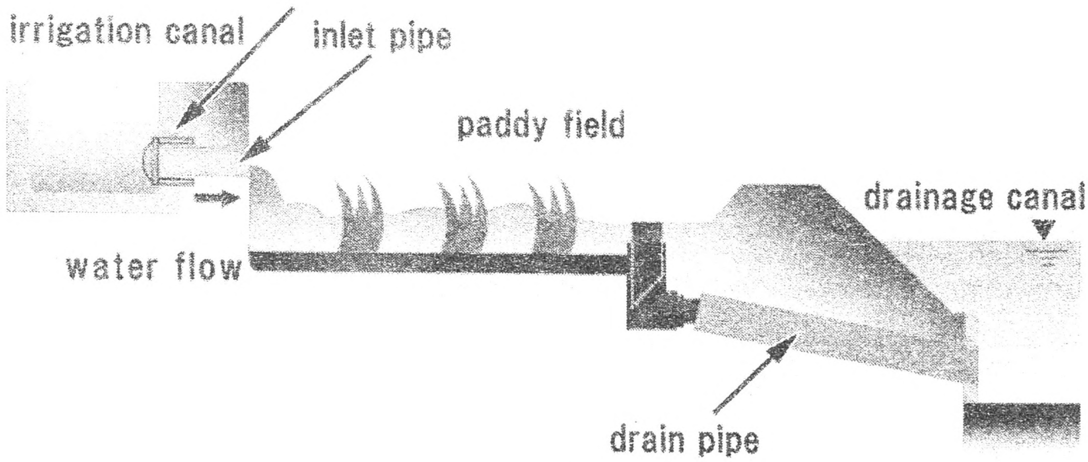

Figure 1: Sketch of design in paddy field

The block diagram of water level controlling system is shown in Figure 2.

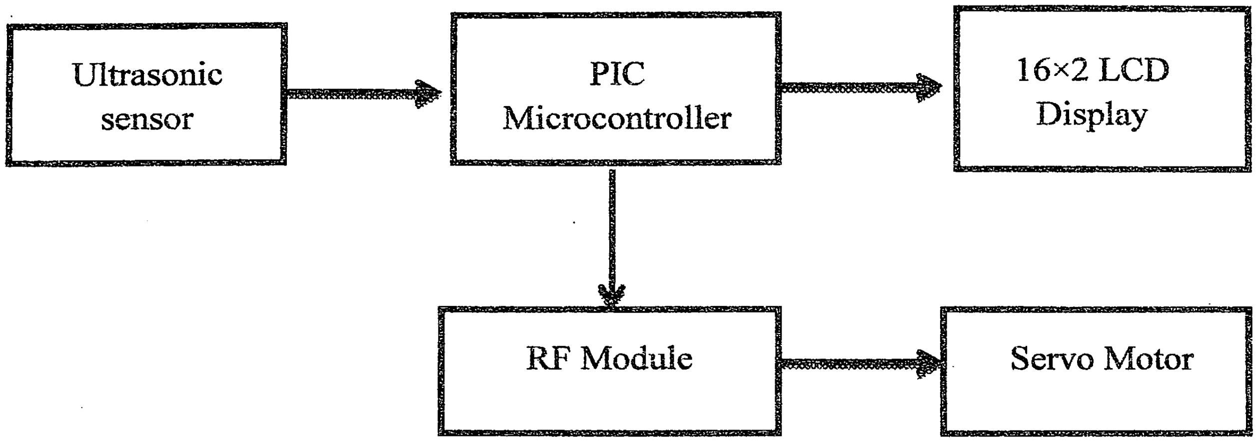

Figure2: Block diagram of water level controlling system

The ultrasonic sensor was connected to the microcontroller using relevant pins. Then the microcontroller was programmed using mikroC language to get thehypotenuse distance. In order to get accurate height of water level, ultrasonic sensor is located on top and underneath of the PVC pipe of a high diameter and that PVC pipe should be established in paddy field according to water level is changed. Thus, it gives distance between sensor and water surface precisely. Hence height of water level should be as follows.

Height of water level (H) = Height that ultrasonic sensor is located (h) – Measured value from ultrasonic sensor(x) (2)

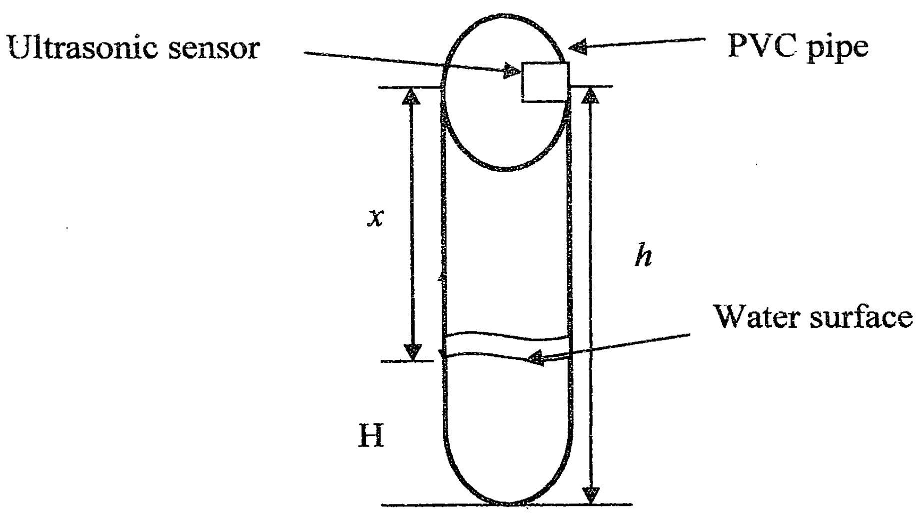

Figure 3: Representation of accurate water level in Paddy Field

Measured distance is appeared on 16×2 LCD display in centimeters. The required water level is configured in the PIC microcontroller upon each pre-defined time epoch of the rice cultivation. According to the configuration of the program, microcontroller determines which canal should be activated. The system is using RF modules with two consecutive frequencies in order to activate canals remotely while avoiding frequency interference.

2.1 Ultrasonic Sensor

This ultrasonic module measures the distance accurately which provides 0cm – 400cm with a gross error of 3cm.The module can easily be interfaced to microcontrollers where the triggering and measurement can be done using two pins.The modules include ultrasonic transmitters, receiver and control circuit. They contain 5 V supply, 0 V ground, trigger pulse output and echo pulse output. The basic principle is using IO trigger for at least 10 μs high level signal, the Module automatically sends eight 40 kHz and detects whether there is apulse signal back, the distance is measured by spending time of pulse signal that reflected from obstacle and to reach the receiver of sensor[4].

2.2 Microcontrollers

Microcontroller is a computer on a chip that is programmed to perform almost any controlling, sequencing, monitoring and displaying the function. Because of its relative low cost, it becomes the natural choice to the designers.Its great advantage is no other external components are needed for its application because all necessary peripherals are built inside. Thus, time, space and money can be saved which are of prime importance for practical applications[5].

2.3 RF Transmitter/Receiver Modules

The RF module operates at radio frequency (RF). The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).Transmission through RF is better than IR (infrared) because of many reasons.This RF module comprises of a RF Transmitter and a RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 433 MHz and 315 MHz most commonly. A RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at one pin[6].

3.0 RESULTS AND DISCUSSION

The system is operated in following manner when the height of water level of paddy field is fluctuating.

- If required height of water level is 5 cm and also value appears on LCD display is 5 cm, both of irrigation canal and drainage canal are closed.
- If required height of water level is 5 cm and also value appears on LCD display is less than 5 cm, irrigation canal is opened while drainage canal is closed.
- If required height of water level is 5cm and also value appears on LCD display is greater than 5cm, drainage canal is opened while irrigation canal is closed.

Hence required height of the water level of the paddy field is continuously maintained until the harvest is collected without any involvement of the farmer. The system is monitoring water level every moment and that will be displayed. As a result, water level is imminently maintained while water level changes due to environmental conditions.

4.0 CONCLUSION

Prototype water level controllingsystem for paddy field has been tested and reasonably good performance is shown based on the test result. The main contribution for this performance is the ultrasonic sensor calibration by adjusting the calculation of distance based on an actual data.The water level data is successfully displayed locally or remotely andhence this prototype can be used as a part of the bigger system, such as, river flow management system which controls the stream to minimize the flood. The receiver acts as a water level data feeder that can transmit data remotely.

When comparing the price of existing system of water level controller for paddy fields, the designed system is constructed as a low cost design. Most of the existing systems are controlling only irrigation canal or drainage canal. But, the designed system controls both canals efficiently and effectively.

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