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Smart irrigation system with GSM module using DC-DC converter with Regenerative Snubber

Authors
P R Sivaraman[1], C Kamalakannan[2]
[1]Research Scholars, Department of Electrical and Electronics Engineering,
St. Peter's University, Avadi, Chennai, Tamil Nadu-600 054,
[2]Professor, Department of Electrical and Electronics Engineering,
Rajalakshmi Engineering College, Chennai, Tamilnadu-602 105, India

Abstract
To reduce the man power for irrigating the field. To minimize the wastage of water used for irrigation. To save the electricity cost by operating the water pumping motor by utilising solar power. At power supply unit, Z-Source converter is used to supply regulated supply with snubber to reduce the voltage drop due to leakage inductance and to achieve less switching loss. The simulation is done with MATLAB and hardware prototype is developed and tested successfully. The irrigation process is completely automated by using the Arduino Mega microcontroller with GSM module for sending the current status to the farmer. Solar is the major renewable source in India, is converted into electrical energy for supplying the entire system. Various sensors are used to measure the physical parameters in order to control flow of water to the field. The sensed signals are sent to the Arduino Mega to ON/OFF the DC motor pump set. GSM will give us information about the current status of the motor pump set i.e. whether the motor is in ON or in OFF state. In this proposal the water flow to field is improved by sensing the rainfall by using rain sensor. When the rain fall happens, the motor-pump set is switched off to save, both the water and electrical energy.
Keywords: Z-source converter, Arduino Mega, GSM module, water level sensor, rain sensor, GSM relay.

1. Introduction

This project is proposed to save the water and energy in the agricultural field for irrigating the fields. The usage of water is optimized by using Arduino, GSM and sensors. For example, when the moisture content in soil is low, temperature of the soil is high and the rain fall is adequate, the motor pump set is turned off. A GSM based irrigation system has two major technologies, primary being the GSM and secondary is the controller [1, 2]. The idea was developed for improving the irrigation system and reducing its cost. Sensors are placed in the farm and they senses the various parameters. This information is stored at Arduino and also passed to data collection interface and then gets transmitted to the GSM Module. Using this information system, the farmer gets the current status of the irrigation system [3].

GSM is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses the variation of time division multiple access [TDMA] system and it is the most widely used of the three digital wireless telephony technologies [TDMA, GSM, & CDMA] [4, 5].

1.1 Block Diagram

The block diagram shown in Fig. 1, shows various blocks involved in smart irrigation system with renewable energy. It includes description of each block and detailed study of the working of various module used in this system. The values of the circuit parameters are listed in Table 1.

a. Power Supply Unit:

In this proposed module, solar energy is the main source where the solar energy is convertered into electrical energy to drive the entire system for irrigating the land. DC-DC converter is designed to supply constant voltage to run the motor-pump set.

Table 1:
Parameters in the converter circuit

S. No.	Table Column Head		
	Components	***Symbols***	***Values***
1	Impedence Network	L1=L2	1µH
		C1=C2	300µF
2	Duty Cycle	Switch 1	50%
		Swtich 2	50%
3	Voltage Stress Across Swtich 2	Without Snubber	60v
		With Snubber	40v

b. Coupled Inductor Fed Z-Source Converter

In coupled inductor fed Z-Source Converter, diode is replaced to overcome the reverse recovery problem and the input supply can be decided using the duty cycle[6, 7]. This gives reliability good performance of the converter. Generally it has two states namely active state and shoot through state. It can boost the input voltage by utilizing extra switching state. [9, 10].

c. Regenerative Snubber Circuit

Snubber circuit is designed to reduce the swithching loss which employed in converter circuit is shown in Fig. 2.

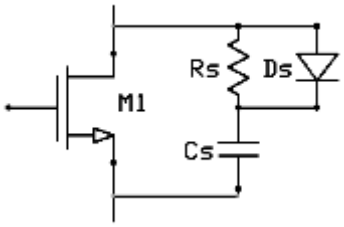

Fig. 2. Regenerative Snubber Circuit

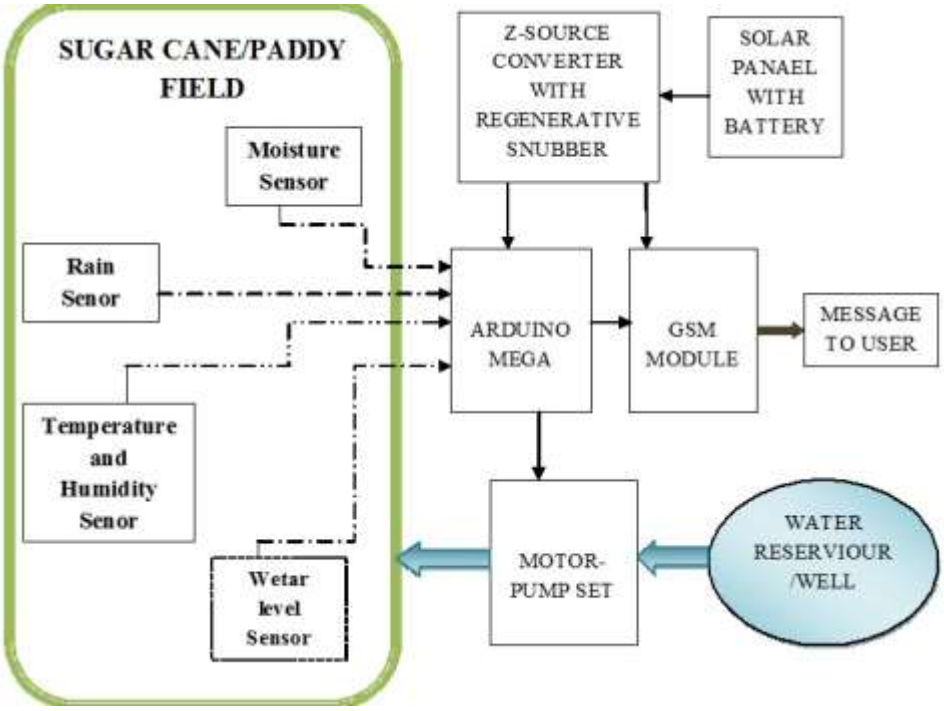

Fig. 1. Block Diagram of Smart Irrigation System Using GSM Module

d. Converter with R Load in Closed Loop Control

The converter is designed with PI controller is provided to control DC supply to the module [14] is shown in Fig. 3. The converter circuit shown in with regenerative snubber to reduce the switching loss across the switch to improve the converter output, is fed to Arduino Mega and GSM module. In this proposed system, the Arduino gets the sensed information's from the sensors and based on the values it controls the ON/OFF status of the motor-pump set.

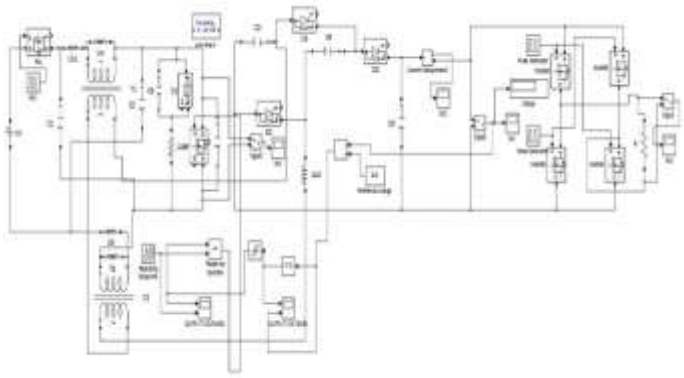

Fig. 3. Z-source Converter with Regenerative Snubber

e. Soil Moisture Level Sensor

The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany and biology.

f. GSM Module

In the GSM module the messages regarding the sensed parameters are transmitted to the farmer frequently to know the status of the motor - pump set. The unmanned irrigation is achieved with this communication system at very reasonable cost.

2. WORKING MODULE

The hardware prototype is developed and tested successfully is shown in Fig. 4.

3. CONCLUSION

Thus the system so proposed is very helpful for the farmers in saving the water and reduce their time to reach the field to operate the motor. The farmer can monitor from the remote area regarding the water flow to the field. The system is more economical and less complex for the farmer to handle. This system can be found much simpler than previously proposed system. We can control the flow of water and thereby reduce the wastage.

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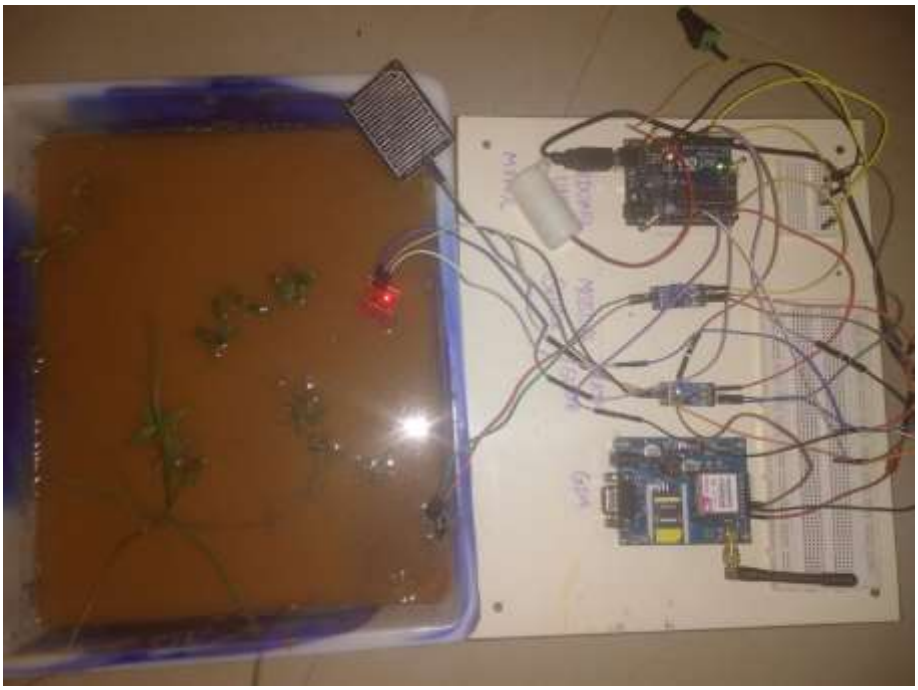

Fig. 4. Hardware Setup of Smart Irrigation System

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