Proceedings of the
International Conference on Mechanical Engineeringand Renewable Energy 2015
(ICMERE2015) 26 – 29 November, 2015, Chittagong, Bangladesh

ICMERE2015-PI-257

A PRACTICAL APPROACH TO WIRELESS IRRIGATION SCHEME USING GSM TECHNOLOGY

Md. Mamunoor Islam[1,*], Mehdi Hasan Chowdhury[2] and Md. Anwar Hossain[3]

[1]Department of Electrical and Electronic Engineering, Chittagong University of Engineering & Technology, Chittagong-4349
[2-3]Department of Mechanical Engineering, Chittagong University of Engineering & Technology, Chittagong-4349
[1,*]mcm.mithu@gmail.com,[2] arnob_eee@yahoo.com, [3]anhossain011@gmail.com

Abstract:-*Even in the era of advanced engineering, proficient water management is the foremost concern in agricultural system. The majority of the farmers depend on irrigation with electric water pumps due to lack of sufficient rainfall. In rural areas, constant electricity fluctuation and irregular power availability are daily problems faced by many farmers which have become a major hindrance in the field production. However, proper water management system can maximize the production with provision of saving water. So aim of this paper is to demonstrate the design and instrumentation of wireless irrigation scheme using GSM technology by which farmers can easily control the irrigation of their field from any location. Here, field conditions can be send to the farmer time to time and only a phone call will be needed to take care of the irrigation process. Thus, this system will assist farmers by replacing the manual control of water pump with the wireless automatic control.*

Keywords: DTMF decoder, Wireless control, Irrigation system, Cell phone, GSM technology

1. INTRODUCTION

There have been drastic socio-economic evolutions in the life of both rural and urban people since the introduction of cellular communication. With latest advancements in technology and mass production of cell phones, they have been used in every walk of life which includes automation in every sector. The agriculture industry is no way behind in including these technological advancements [1].

With the blessing of modern technology, the primitive method of agricultural works is now changing and advanced methods are being familiarized in it. Again the human mind always needs information of interest to control systems of his/her choice. In the age of electronic systems, it is important to be able to control and acquire information from everywhere [2]. So, different systems have been invented to assist farmers in agricultural activities.

An approach has been made by Yunseop J. Kim (et al.) about Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network in 2008 [6].

In 2012, Purnima and Reddy has proposed a Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth too [7].

In 2014, S. S.Patil (et al.) has also developed a system which is a smart wireless sensor network for monitoring an agricultural environment [8].The proposed system also allows farmers to upgrade the irrigation system with the help of GSM technology. Using this system, the farmer will be automatically informed about conditions of the field and then the farmer can monitor the irrigation system from any place by which the proper amount of water can be supplied in the field which results in maximization of production.

2. SYSTEM ARCHITECTURE

Previously, farmers were dependent to the rain water. Now with the advancement in agricultural system, they supply water with the water pump in their field. But as electricity crisis is a common affair, frequent power failure is one of the major limitations for irrigation. Again the field is far from residence sometimes. So it becomes difficult to monitor the irrigation system always.

So a wireless irrigation system has been proposed in this paper which is controlled by an electronic device based on DTMF (Duel Tone Multi Frequency) technology. By this, the farmer can control the water pump through cell phone.

2.1 DTMF Technology

DTMF is a universal communication term for touch tone (a Registered Trademark of AT&T).These tones are produced when pressing the different digits of dial pad of cell phone [2]. Pressing any digit generates a unique tone which is convolution of two different frequencies [4]. Generally there is always a chance that an arbitrary

sound will be on the same frequency which will trip up the system. So if two tones are used to denote a digit, the likelihood of a false signal occurring is ruled out. This is the basis of using dual tone in DTMF communication [2]. There are 16 DTMF tones which are demonstrated below in Table 1.

Table 1: Acceleration vs. frequency of vibration

Frequency (Hz)	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Each of the tone is composed of two sine waves of the low and high frequencies superimposed on each other. These two frequencies explicitly represent one of the digits on the cell keypad. Thus generated signal can be expressed mathematically as follows:

$$f(t) = A_H \sin f_H t + A_L \sin f_L t \qquad (1)$$

Where A_H, A_L are the amplitudes and f_H, f_L are the frequencies of high & low frequency range [4].

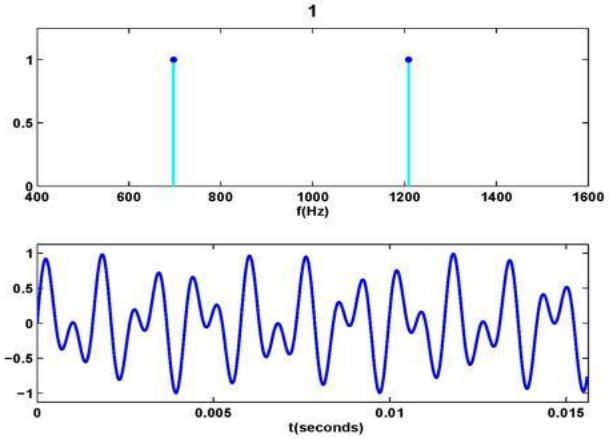

Fig. 1: DTMF signal for key "1" [5]

Fig. 2 displays the DTMF signal for touchtone of key "1". The upper subplot illustrates the two underlying frequencies and the bottom subplot displays the signal attained by averaging the sine waves with those frequencies [5].

2.2 GSM Module

Here, GPRS Shield has been used as a GSM Module. Generally, GPRS Shield (SIM900) is an ultra-compact and reliable wireless module which is compatible with all boards such as Arduino Board.

The GPRS Shield is configured and controlled via its UART or Software serial using simple AT commands. This device also features quad-band low power consumption as well as a compact PCB antenna [9].

Fig. 2: Hardware of GPRS Shield [9]

Table 2: Specifications of GPRS Shield [9]

Parameters	Feature
Compatible Board	Arduino, Microcontroller etc.
Selectable interface	UART, Software serial
Quad band support	850/900/1800/1900MHz
Power supply	5v to 5V pin, 6.5~12v to Vin pin
Communication support	GSM 07.07 & 07.05 and SIMCOM AT Commands
Operation temperature	-40°C - +85 °C

2.3 Water Level Sensor

For detecting the level of water, the transistor switching operation has been used. Here, the base of a transistor has been used as a sensing terminal for level detecting operation. For constructing the water level sensor, transistor BC547 is used. The circuit diagram of the sensing circuit is shown below at figure 4.

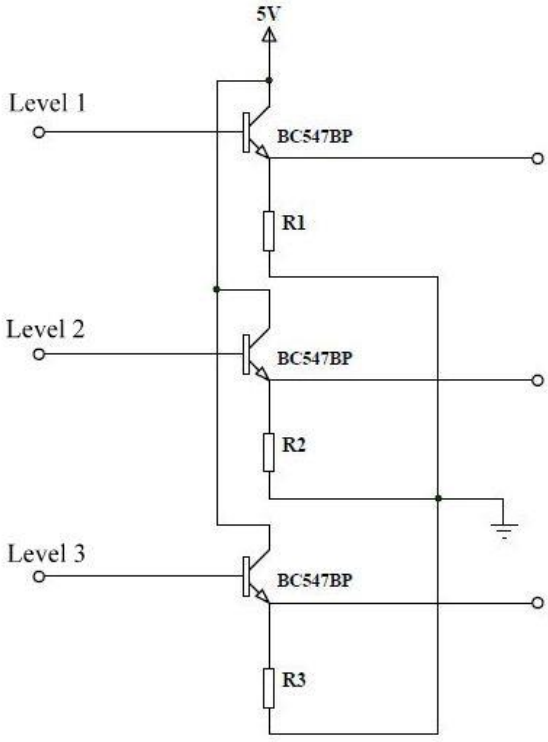

Fig. 3: Circuit diagram of water level sensor

3. METHODOLOGY

The proposed system is based on DTMF technology and GSM technology as previously described. . Here, two cell phones have to be used, one should be kept with the device and another will be operated by the farmer. The water level sensor will be equipped in the field to detect the level of water in the field. When the water level will reduce to the minimum level, a pulse from the transistor sensing circuit will be transferred to the arduino board. Then the arduino will send the message to the farmer via GSM module. When the farmer will be informed about the field conditions through SMS, he just has to call to the mobile attached with the device and press the predefined key to operate the water pump. When the farmer makes a call to another phone, the operation starts with it. Then he presses the denoted button on his phone. It creates tones which is transferred to the other phone and received by the DTMF decoder circuit. To decode DTMF signal, decoder IC MT8870 has been used. The MT8870 is a complete DTMF receiver assimilating both the band split filter and digital decoder functions. The filter unit uses switched capacitor techniques for high and low group filters; the decoder uses digital counting techniques to detect and decode all 16 DTMF tone-pairs into a 4-bit code. The output bits for the different keys are given below in Table 3. The circuit diagram of DTMF decoder has also been shown in figure 5.

Table 3: Output for Different Keys

Key	Low Frequency (Hz)	High Frequency (Hz)	Q_1	Q_2	Q_3	Q_4
1	697	1209	0	0	0	1
2	697	1336	0	0	1	0
3	697	1477	0	0	1	1
4	770	1209	0	1	0	0
5	770	1336	0	1	0	1
6	770	1477	0	1	1	0
7	852	1209	0	1	1	1
8	852	1336	1	0	0	0
9	852	1477	1	0	0	1
0	941	1209	1	0	1	0
*	941	1336	1	0	1	1
#	941	1477	1	1	0	0

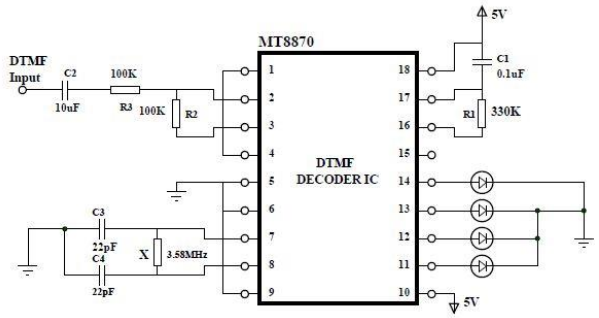

Fig. 4: circuit diagram of decoding operation

The DTMF decoder circuit filters the signal and decodes it into a 4-bit output binary code (Q1, Q2, Q3 and Q4) shown in Table 3. These decoded bits are sent to an 8-bit microcontroller which is pre-programmed to take up decisions for the corresponding input (Pressed key). After that, micro-controller will send the pulse to relay. Now relay will drive the motor. When the water level in the field will reach at maximum level, then this information will be sent by a SMS to the farmer. Then the farmer will turn off the water pump through his phone. In this way, the farmer can easily operate his operation system.

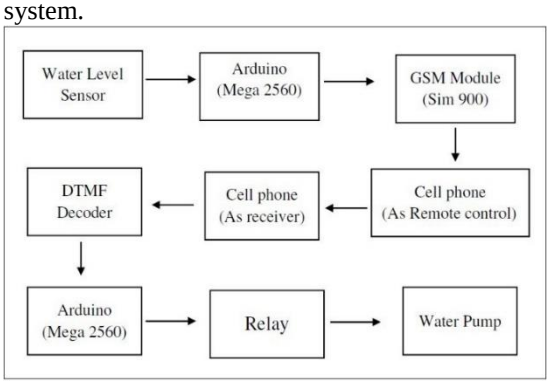

Fig. 5: System Layout

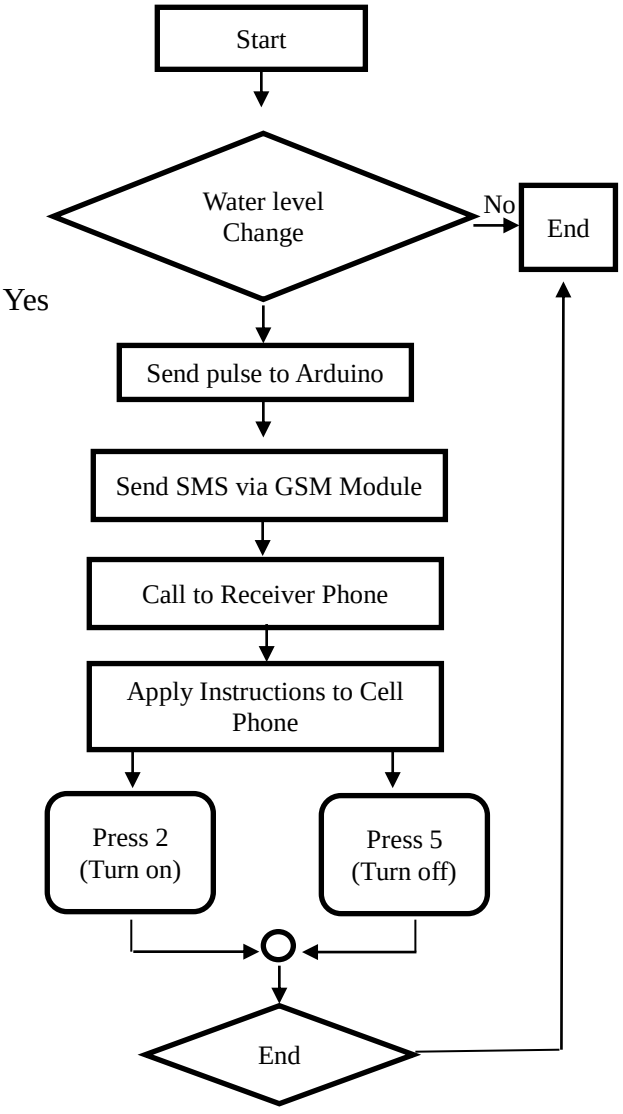

Fig. 6: Flow Chart of Overall System

4. IMPLEMENTATION

The proposed irrigation system has been implemented practically to observe the performance of the system. Several keys have been used for this implementation which is given below in Table 4.

Table 4: Implemented Commands

Pressed Key	Binary DTMF Code	Command
2	00000010	Turn on the pump
5	00000101	Stop the pump

As this device aids to control the motor of water pump wirelessly, so it will help to save the consumption of power. Again it doesn't need to be present to switch on/off the water pump. So no more manual control will exist. As a result, water can be supplied in the field timely with the help of this device, so the production will be much bigger and the farmer will be benefited. The device is based on relay which can operate very high water pumps. Again the cost of this device is very low. So it is quite affordable for the farmer. Thus, the farmer can control the water supply to his field from any place of the world by just pressing a key on his cell phone.

5. FUTURE WORK AND CONCLUSION

The device may be upgraded in future by including moisture sensor, P^H sensor etc. which will provide additional information to farmers. Moreover, the whole system may be converted to a full time monitoring system through a base station from where every activity on field can be monitored easily.

This proposed system provides an option to lessen the work of irrigation with the help of GSM technology. It helps not only to control the irrigation system but also saves time.So, there will be a reduction in overall labor cost. Hence, farmers will be encouraged to use this technology for improving their irrigation system to make maximum turnover as well as to reduce the hardships in irrigation system.

6. REFERENCES

[1] V.Divya,A. Umamakeswari, "Smart Irrigation Technique using Vocal Commands", International Journal of Engineering and Technology (IJET), Vol.No.1, Feb-Mar 2013.

[2] Tuljappa M.Ladwa, Sanjay M.Ladwa, R SudharshanKaarthik, AlokRanjanDhara, NayanDalei, "Control of Remote Domestic System Using DTMF",ICICI-BME 2009 Bandung, Indonesia, page 69-74.

[3] EswaraRao Pandiripalli, Phani Ram Veeramachaneni, SambhaniMadhuBabu, JafarSadik,"Interactive Irrigation System through Mobile with IVR Response", International Journal of Research in Engineering and Technology(IJRET) , Sep 2012, Vol. No.1, page 36-40.

[4] Roshan Ghosh, "DTMF Based Controller for Efficiency Improvement of a PV Cell & Relay Operation Control",International Journal of Engineering Research and Applications(IJERA), Vol. 2, Issue 3, May-Jun 2012, pp.2903-2911.

[5] Touch-Tone Telephone Dialing, http://www.blogs.mathworks.com/cleve.(Retrieved on August 2015)

[6] Yunseop J. Kim,Robert G. Evans, William M. Iversen, "Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network", IEEE Transactions on Instrumentation and Measurement, Vol. 57, No. 7, July 2008.

[7] Purnima, S.R.N. Reddy, "Design of Remote Monitoring and Control System withAutomatic Irrigation System using GSM-Bluetooth", International Journal of Computer Applications,Volume 47– No.12, June 2012.

[8] S. S. Patil, V. M. Davande, J. J. Mulani, "Smart Wireless Sensor Network for Monitoring an Agricultural Environment", International Journal of Computer Science and Information Technologies, Vol. 5 (3), 2014.

[9] GPRS Shield V2.0, http://www.seeedstudio.com/wiki/GPRS_Shield_V2.0. (Retrieved on August 2015)