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Wireless Automatic Plant Irrigation System

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Abstract- This paper discusses the design and implementation of farm automation system using microcontroller PIC 16F877 and RF module. The main aim of this project is real time monitoring of farm considering the parameters of soil, water, and sunlight intensity. This system includes micro-controller PIC 16F877, CC2500 Transceiver RF module, soil hygrometer humidity detection module, water level controller circuit, LDR as sensor for sunlight intensity, relay module switching on and offfor pump,16*2 LCD display, and DC motor for wind speed measurement.

Keywords *– PIC 16F877,CC2500 Transceiver RF module, 16*2 LCD display, LDR, water level circuit,Single channel relay module.*

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I. INTRODUCTION

Irrigation for plants, fruits and vegetable gardens and farms has been the need of mankind from early days of history. Wireless Automatic Irrigation System is a modern and effective method of irrigating the fruits and vegetable, landscape and garden areas as against the conventional method, which uses large number of manpower and time with uncontrolled water quantity.

Various methods of irrigation are being used in various parts of the world. These methods are mainly on irrigating the fields and other and other area with river or well water. Dames are barrages are constructed across the river to store the river water upstream and distributing it to various areas through a network of canals. In case of well, the water is lifted by pumps and other mechanical means.

During the past 50-60 years, irrigation like many other fields has been atomized by using unmanned electrically operated irrigation system for agriculture and landscaping purpose. This field is still in the process of development and more and more products are entering in the market. The pressure and flow figures etc. ascribed to various irrigation equipment in the following paragraphs are only for guidance purpose and may vary with time and from manufacturer to manufacturer. Automatic irrigation system is a widely used in USA, Europe and Middle East countries. However, it is not so common in Asia and African countries.

Smart controller for irrigation work on a simple principle: provide the appropriate watering schedule, adjust for weather changes and irrigate based on the needs of the landscape.

There are a variety of weather based "smart" controllers available for various applications. Whether it is real-time, on-site weather data or historical weather data, the new "smart" controller have very less probability of error. With smart controllers installed on your property, it avoid over watering and excessive run-off by scheduling the amount of irrigation based on the type of landscape and current weather conditions. You can protect your landscape investment and improve the health and look of your landscape.

Statistics show that as much as 50% of commercial water is used for irrigation. With many cases of over-irrigation, excessive run-off and poor landscape planning, water agencies are tapping common sense and technology to improve water conservation efforts and enhance the health and beauty of our landscapes[1].

II. LITERATURE SURVEY

There is existing project on plant irrigation using 8051 microcontroller. This project has a disadvantage that it uses 8051 whose signal processing ability and operating speed is not good as PIC 16F877. Also it has limitation on memorythis controller has only one serial port therefore interfacing more sensors become difficult [1].There is another project by name automatic plant irrigation it is quite similar to our project but it has disadvantage that it does not display any parameter values remotely, but just controls the pump action [2]. Then one project discusses Automation System for irrigating plants that they have used two wires for moisture sensing. This kind of arrangement does not give accurate result compared to soil hygrometer humidity detection module[3].There are lot of other small scale demo projects for indicating automatic plant irrigation system using arduino ,but they are not capable and feasible enough to be implemented practically as they all have one or the other minor issues such as insufficient pump driver power, limited reservoir capacity, etc. [4].Yandog Zhao has researched on water saving irrigation automatic control system based on internet things. The paper discusses that user can use mobile phones or wireless PDA to control farm irrigation. But, in INDIA many farmers are illiterate and have no access to advance technology.

From this papers the conclusion is that the cost of the system is little bit high. In addition to it the system is not robust because of the microcontroller architecture used.

Our proposed system is low cost wireless automation system using PIC 16F877 microcontroller to control farms, garden or landscape using RF transceiver for communication[5].

III. IMPLEMENTATION

1. *DESIGN:*

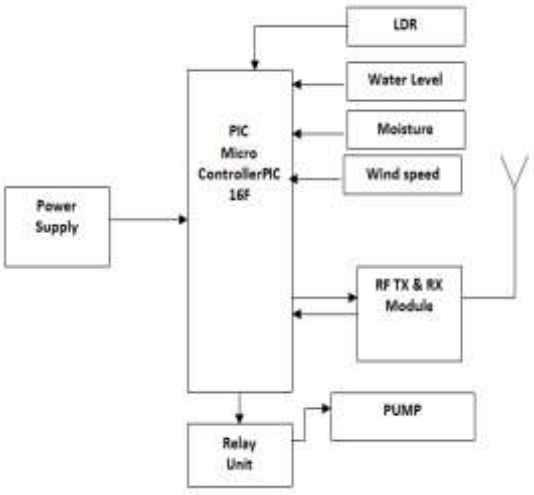

Figure 1.Transmitter Block Diagram of Wireless Automatic Plant Irrigation

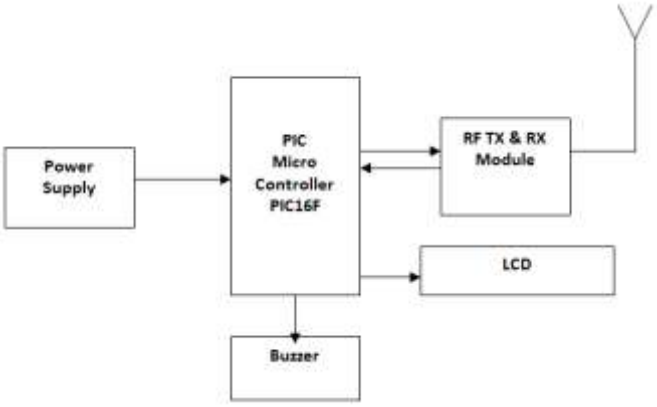

Figure 2.Receiver Block Diagram of Wireless Automatic Plant Irrigation

The main aim of this project is to provide automatic irrigation to the plants which helps in saving time, money and water. The entire system is controlled using PIC micro controller which is programmed accordingly that it monitors the parameters and sends these parameters at receiver which is farmer's house via air medium. Temperature sensor, water level sensor, DC motor for wind speed and humidity sensor are connected to internal ports of micro controller via comparator, when the moisture level in soil is less, light intensity of sun is high and water level in tank is high then only pump will get started otherwise if any one of these is not satisfied then pump will not get started. There is transmitter section consisting of power supply unit, PIC microcontroller with its PORT A connected to soil hygrometer humidity detection module, LDR for light intensity and water level controller circuit. These parameters are constantly processed by microcontroller and these data is send serially by CC2500 RF Transceiver module. Receiver section consisting of power supply unit, PIC microcontroller, CC2500 RF Transceiver module which wills serially receiver data send by transmitter section. These data is constantly processed by microcontroller and its parameters are displayed on 16*2 LCD display as LI: light intensity WI: wind speed WL: water level MO: moisture level. Values are displayed in 8 bit ranges from 0 to 255. Each parameter is set to certain threshold level. While processing if three conditions are satisfied as discussed above then microcontroller will generated interrupt signal which will turn ON relay unit due to which pump will get started. Unsatisfying any of these conditions will turn OFF pump automatically.

A. *ALGORITHM:*

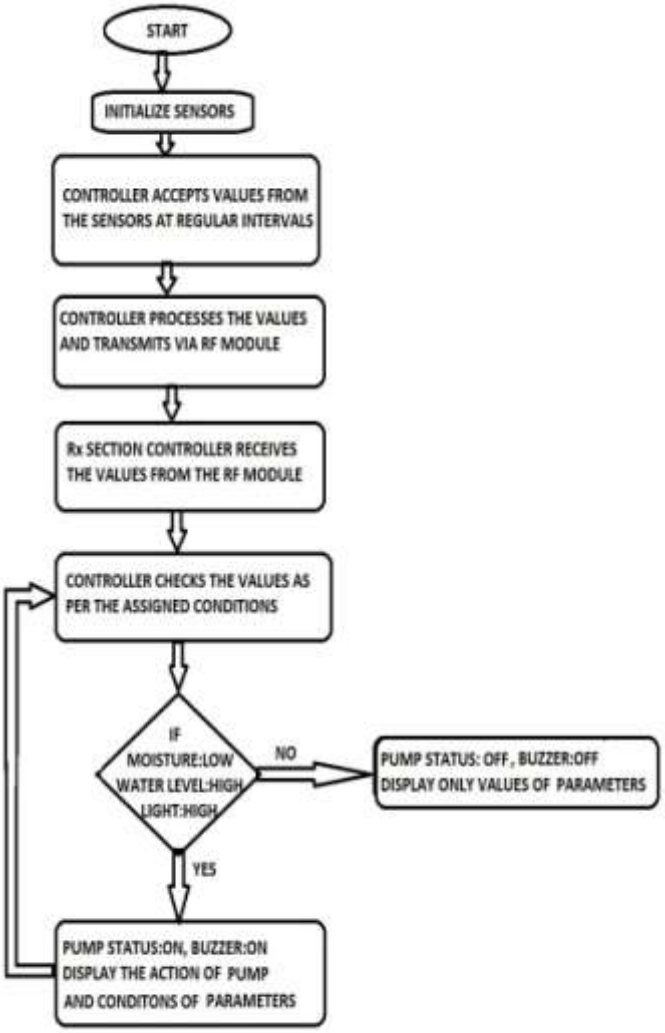

Figure 3 Wireless Automatic Plant Irrigation System Algorithm

B. *SOIL HYGROMETER HUMIDITY DETECTION MODULE:*

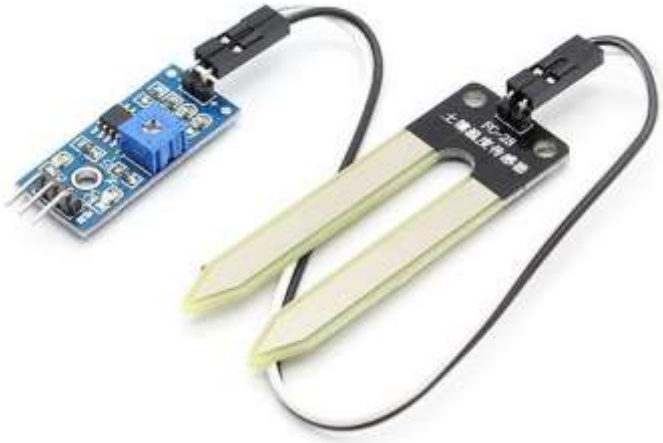

Figure 4.Soil Hygrometer Humidity Detection module[7].

It is a simple water sensor can be used to detect soil moisture, when soil is dry module output a high level and vice versa output low. Module has two parallel plates thus if soil becomes wet then it will act as short circuit and current starts flowing through it. When the soil is dry it will acts as open circuit. Module operating voltage is between 3.5V to 5V. It has adjustable sensitivity knob which can be adjusted according to different soil type.

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C. *WATER LEVEL CONTROLLER (CD4093):*

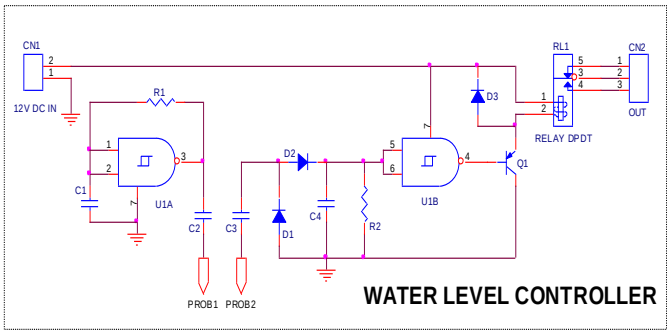

Figure 4.Water level controller circuit.

An annoying drawback of many liquid level sensors is the effect of electrolytic reaction between the sensors and the liquid. Metal electrodes are prone to corrosion and consequent loss of effectiveness (reduced conductivity), so they have to be replaced at frequent interval. One solution to this problem is to ensure that there is an AC, rather than DC potential between the sensor electrodes. The constant polarity reversal of electrode drastically inhibits the electrolytic process, so that corrosion is reduced effectively.

How it works:
The actual circuit of the water level sensor is extremely simple. The circuit around N1 forms an oscillator. If the two sensors are immersed in a conductive solution,C4 will be charged up via the AC coupling capacitors (C2 and C3) and the diodes. After a short time, the output of N2 is taken low and the relay is pulled in. Relay is used to start a pump,it controls the level of the liquid when a conductive path between the two sensors no longer exists. C4 discharges via R2. With the result that the output of N2 goes high and the relay drops out [2].

D. *LIGHT DEPENDENT RESISTOR:*

The photo resistor are simple resistor that altar resistance depending on the amount of light place over them. More light means less resistance. Photo resistor is probably the most common, affordable option and easiest way to implement. To use it has sensor, voltage drop across it is measured with is given to PORT A of PIC controller.

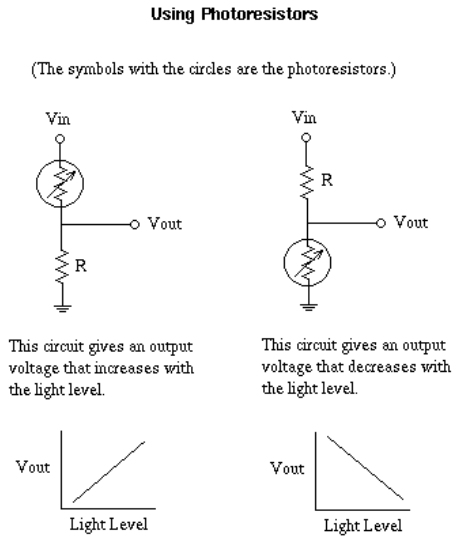

Figure 5.Photo resistor biasing [7].

E. *CC2500 RF TRANSCEIVER MODULE:*

Figure 6.RF Transceiver module [7]

CC2500 RF module operates on 2.4 GHz bandwidth having 30 meter range. It is half duplex module and as LED indications for transmitting and receiving data. Soil, water and light wind parameters are constantly calculated by microcontroller and transmitted serially through RF module. These data is received by RF module of receiver side and these are processed by controller. Thus, there is only one way communication.

IV. RESULTS AND DISCUSSION

Aim of project is to irrigate plants automatically. When the project is powered LCD display at receiver side shows condition of soil, water, light intensity, and wind speed.

Figure 6.LCD showing real-time measuring values

PARAMETERS	LOW	HIGH
Moisture level (MO)	009	255
Light level (LI)	000	255
Water level (WA)	000	255
Wind speed (WI)	000	255

Table 1.Results observed after testing

Moisture level and Water level is shown as LOW or HIGH. Wind speed and Light intensity varies according wind speed and light intensity.

Moisture level (MO)	LOW	009
Light level (LI)	HIGH	180 and high
Water level (WA)	HIGH	150 and high

Table 2.The only condition needs to satisfy for plant irrigation

When these conditions are satisfied relay will be switch on pump get started and buzzer will buzz to alert farmer or user that pump is stared.

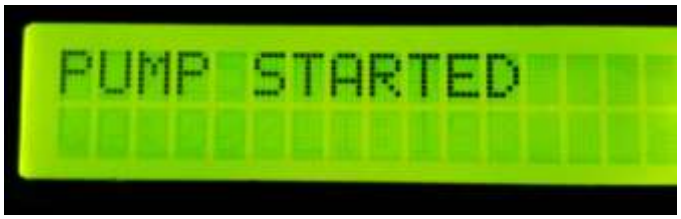

Figure 7.Displays status of pump

Wind speed is not related with conditions this is only for indication purpose.

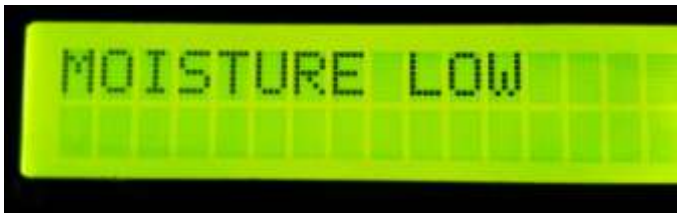

Figure 7.Displays status of soil moisture

Figure 8.Displays status of light intensity

Figure 9.Displays status of water level in tank

V. CONCLUSION

This paper presents automated system for irrigating plants which benefits in several ways such as saving water, time, and manpower. The results were within the expected range and quite accurate. There was some delay in receiving data from transmitter but it can be overcome by using high quality transceiver.

VI. FUTURE SCOPE

1.The performance of the system can be further improved in terms of the operating speed, memory capacity, number of channels so that more sensors can be interfaced by using advanced versions of controllers.

2.The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data in the form of Graphs with respect to time

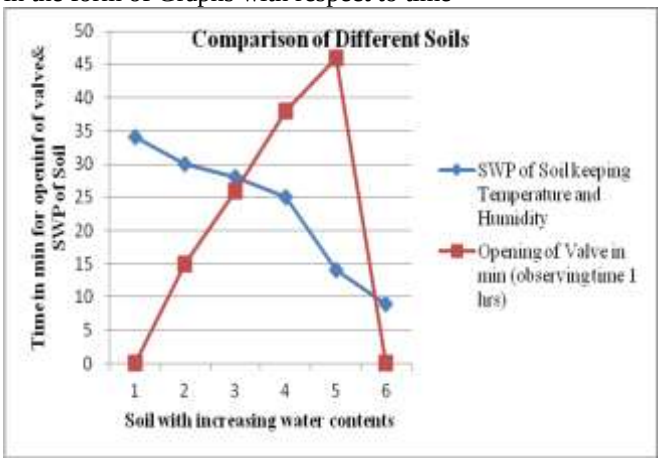

Figure 10: Indication of Graph of values monitored continuously [7]

3.This system can be connected to communication devices such as cellular phones or satellite terminals to facilitate the remote collection of data and alarming of certain parameters.

Figure 11: Proposed idea of interfacing the system with mobile devices [7]

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