

## Soil Moisture Sense to Trigger Irrigation

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**Abstract.** The Soil Moisture sensor (SM) is used as a tool to optimize irrigation and to protect plant stress at the dry or wet ends. Capacitive sensor is used where soil with moisture serves as dielectric, as the moisture changes the capacitance changes, we can also use resistive sensor to sense the moisture content. The sensed data is sent over a wireless network to a remote central receiver (RCR) which will have a database where soil moisture periodically can be stored for different locations and soil pattern are derived and represented graphically. In case soil moisture reaches a critical level farmer is intimidated via sms using GSM modem and as per the feedback from farmer irrigation can be started. Based on moisture sensed and changes in moisture over a period of time soil is classified into different types that shows how fast moisture changes.

**Keywords:** Soil moisture sensor, Wireless network, Soil moisture research database etc.

### 1. Introduction

Precision Farming with new emerging information and communication technologies leads to higher yields and lowering of cost, for running of large-scale commercial agricultural fields. Precision Farming makes use of completely automated machinery. This form of highly automated agriculture requires intensive sensing of climatic conditions at the ground level and rapid communication of the raw data to central repository. At the central server (database), along with the availability of computational power, decision-making and control of farm equipment is also done. Having such information at a real-time interval, automated actuation devices can be used to control irrigation in a large way. Presently system used for irrigation uses sensor for sensing the moisture content of soil this sensor is physically connected by means of wire, this is done without any control system i.e. no feedback is used. This has many problems like: wiring in a mesh network is difficult, and also wire can get cut due the various field processes, Sometimes when there is less or no water stored motor may receive signal to start and hence may overrun and get damaged. Since this is fully automated system there is no proper management of water as the system is never aware about what the status of water will be in time to come To overcome all this system should be designed where a wireless network should be laid so that there is no difficulty to lay a mesh network and also to avoid cutting of wire. Secondly feedback can be taken from farmer as he would know the present status of stored water and also about water availability in time to come. And hence proper water management is established. Sensors designed should be cheap and have better lifespan. Also system should have research database to study how fast the moisture decreases and hence the nature of soil and also which plant it would suite.

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## 1.1 Basic block diagram

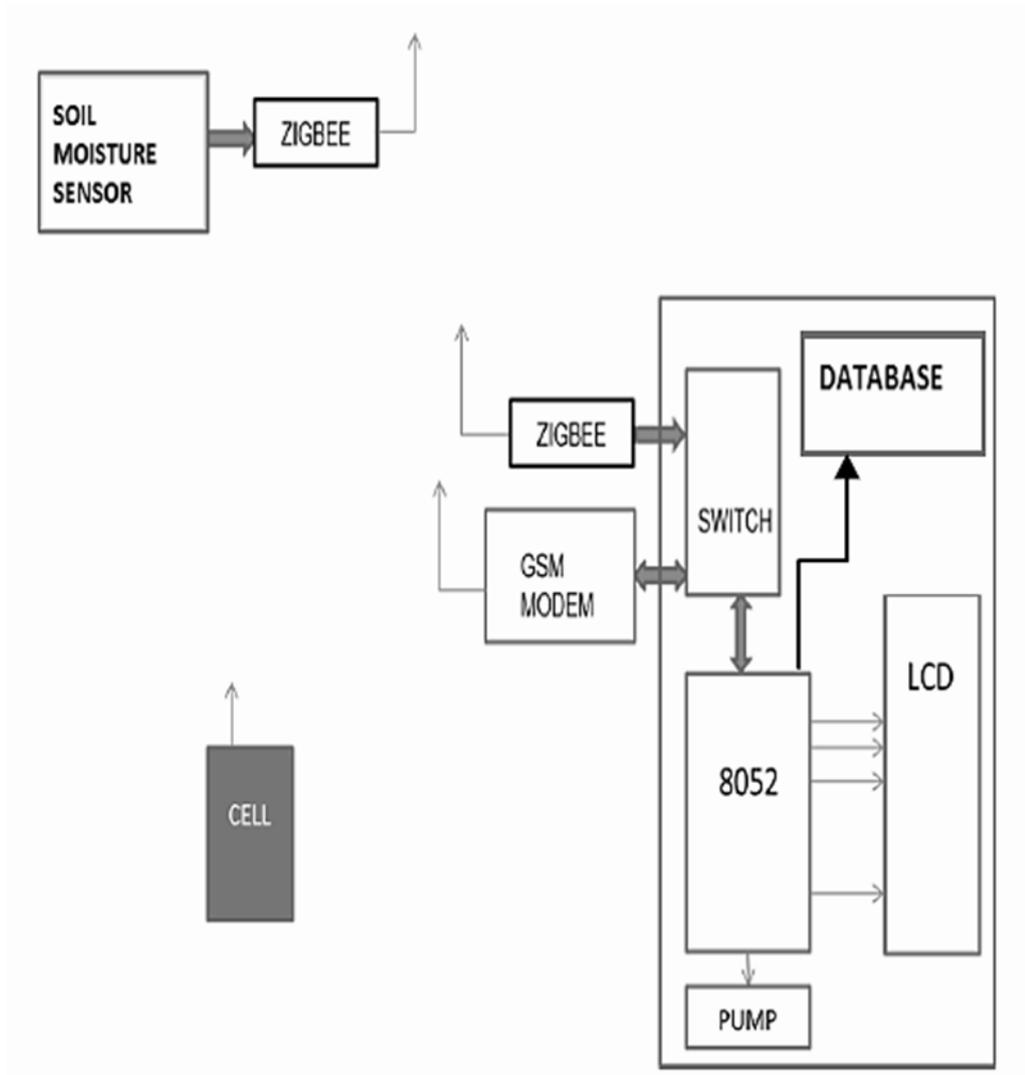


Fig.1

As shown in the figure (fig.1) the soil moisture sensor sends the sensed data along with the location code over a wireless zigbee network to the remote central receiver (RCR) which passes the data to the microcontroller where it is analysed and given to the database on the p.c. for further processing microcontroller also starts the pump as per the feedback received from the farmer via sms.

## 2. Major Components

### 2.1. Soil Moisture Sensor SM

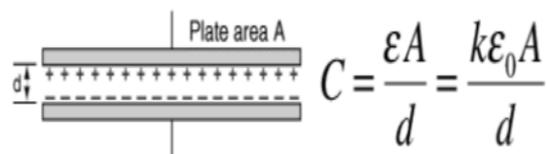


Fig.2

[1][2]

Measurement of soil moisture is not only crucial but also difficult task. There are several techniques which are complex and costly but technique used here is not only simple but low cost and accurate too. Here we design a lossless capacitive sensor (fig.2), as capacitive sensor is the best to measure soil moisture [3][4]. It employs a parallel plate capacitor in which dielectric medium is the soil granules. The basic logic is as moisture of soil will change capacitance will change.[5]

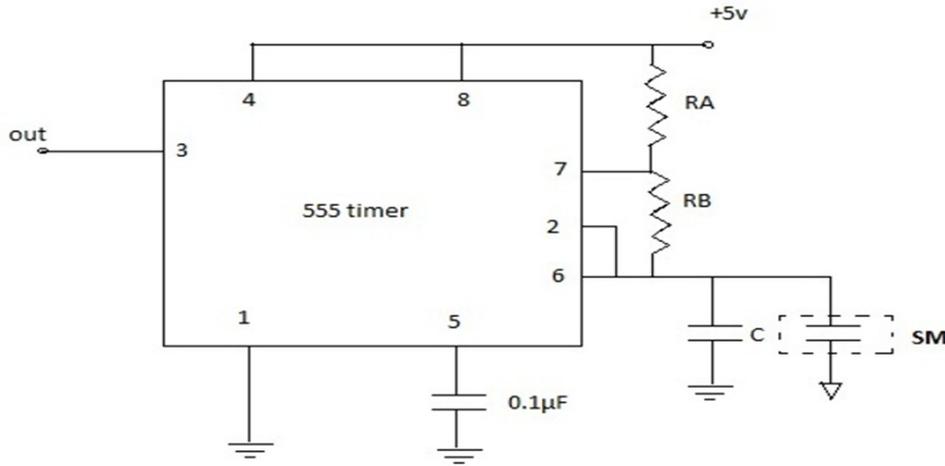


Fig.3

As shown in the figure (fig.3) capacitor c (moisture sensor) is connected to the 555 timer IC connected in astable mode. Resulting in charging and discharging of capacitance C generating a varying frequency. More frequency will be generated for less moisture content and less frequency will be generated for high moisture content. This high to low transition is captured by microcontroller which analyses and processes the received signal in terms of percentages. This is fed to zigbee.

Calculations:

$$TON=0.693(RA+RB) C$$

$$TOFF=0.693(RB) C$$

$$T=TON+TOFF$$

Soil moisture is inversely proportional to capacitance [6]

Higher frequencies are generated for lower moisture content and lower frequencies are generated for higher moisture content this is explained graphically below (fig.4)

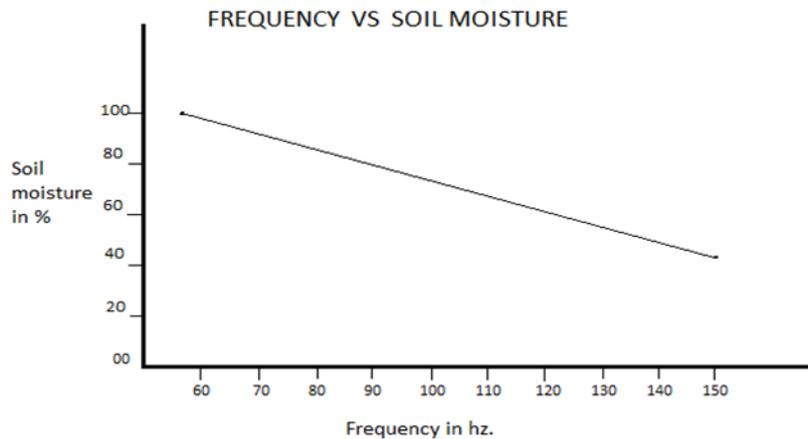


Fig.4

Here the capacitor 'C' plays the major role, which acts as a moisture sensor and is basically a parallel-plate loss less capacitor in which the granule serves as the dielectric medium between the plates. The capacitance of the soil is measured and fed as input to 555 timers (astable mode) to generate varying frequencies. Higher frequency ranges will be generated for lower moisture content and lower frequency ranges for higher moisture content.[7] A high to low transition of these frequencies will be captured as an external interrupt by the 8051microcontroller.8051 analyse and process the signals received and convert it into 'percentage' of moisture content. The ZigBee module attached to the sensor will transmit the data wirelessly to the coordinator ZigBee module attached to RCR.

We can also employ resistive soil moisture sensor here electrical resistance is measured and converted to soil moisture content. The sensor consists of concentric electrodes which are surrounded by granular material which is having good absorbent property like gypsum; cork etc. this material absorbs water (moisture) in soil. When electrodes are excited electrical resistance is measured. The resistance decreases with increasing soil moisture.[8]

## 2.2. Remote Central Receiver (RCR)

Here zigbee receiver receives the signal serially and is converted to digital form by max 232 and given to microcontroller ,which displays it on the LCD and also alerts the farmer in case moisture reaches critical level through GSM modem. If farmer replies yes it turns on the pump for some predefined time period

Here since microcontroller has only one UART and we have to interface GSM module as well as zigbee we make use of switching circuit.

## 2.3 Research Database

This is the database maintained on the system connected to the RCR which maintains and stores moisture at different locations at different times in data format as shown:

L	MOISTURE CONTENT
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Where:

L → stands for location

Moisture content → gives the sensed value

Research database will contain table from which location of the sensor and time can be decoded as follows:-

L	location	time	moisture
1	panaji	2:00 ,2 Dec	50%
2	mapusa	2:00 ,2 Dec	70%

The above table shows the example where L=1 is the code for location panaji and it stores the moisture content at respective time i.e. 2:00 on 2<sup>nd</sup> December. With such tables data regarding moisture content can be stored at specific time with the help of which research can be done to find how quickly moisture decreases and hence the nature of soil and also which plant it would suite. This data can also help farmer enhance his farming. And also spot the correct region for a particular crop growth.

Research database would also contain table for recording moisture content of last 10 readings taken over a fixed interval of time as shown below

L	location	R1	R2	R3	R4	R5	.	.	R10
1	Panaji	40%	33%	66%	67%	57%	.	.	66%
2	Mapuca	64%	75%	83%	48%	97%	.	.	100%

This data can be processed further and depending on the moisture content at different times nature of soil can be found and classified and represented graphically in can give an insight on how fast the moisture decreases and hence the nature of soil and also which plant it would suite. This data can be processed further and depending on the moisture content at different times nature of soil can be found and classified and represented graphically it can give an insight on how fast the moisture decreases and hence the nature of soil and also which plant it would suite can be known

### 3. References

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