MAGNETIC INDUCTION BASED COMMUNICATION ON THE AGRICULTURAL FIELD USING WIRELESS UNDERGROUND SENSOR NETWORKS

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Abstract: **This paper introduces the concept of wireless Underground Sensor Network (WUSN). WUSNs are widely used to observe the conditions of soil such as properties of soil, toxic substances of environment monitoring, landslide monitoring, etc. Dissimilar existing technique of observing underground condition, which demands on buried sensors connected through wire to the soil, the wireless communication produce efficient values whereas the wired communication does not, due to some leakage in the system. Each and every device holds sensor, transmitter, receiver and a power source. This builds their deployment much simple as compared to other existing methods. Wireless communication is challenging as the communication medium is no longer air as the underground consists of heavy substances like rock, soil etc. In this proposed system advance channel models were created to characterize the underground wireless channel considering the characteristic of the propagation of EM waves in soil and their relation with the frequency of these waves, soil moistures are obtained and is sent to the centralized server. It is based on EM propagating principle.**

Index Terms - **Wireless underground sensor networks, magnetic induction, electromagnetic, soil moisture.**

I. INTRODUCTION

Underground wireless communication provides an extensive variety of application which consists of earthquake prediction, border patrol and security, sports field turf management etc. [1]. Although, underground is a challenging medium for wireless communication ,[2] the propagating medium is no longer air, rather soil, rock etc. as the terrestrial communication do not work well. WUSNs have several benefits than the WSN such as concealment, ease of deployment, timeliness of data and coverage density. Conventional method in wireless communication using electromagnetic (EM) waves causes three major problems in underground communication: high path loss, dynamic channel condition, large antenna size [2]. Initially EM waves have a high attenuation due to absorption of soil in the underground. Then the path loss is reliant on the properties of soil such as water content of soil which can change with respect to time. Similarly, the bit error rate of the system varies with respect to time and position. There exist conflicts in the design of antenna while using electromagnetic waves. The size of the antenna is expected to be small to make the deployment operating frequencies in MHz as it is essential to attain the practical transmission range [1]. Magnetic Induction (MI) is an alternative for underground wireless communication. It solves the problem experienced while using electromagnetic waves such as dynamic channel condition, large antenna size, dense medium such as soil and water make little variation in the attenuation rate of magnetic field from that of air, as the magnetic permeability of the material are similar [3],[4]. This assures that the MI channel condition remain constant. The MI communication fixes the problem of antenna size since the transmitter and receiver are implemented using small coil of wire and the magnetic permeability of soil are similar[5][6] .however mi communication is not suitable for terrestrial communication since the magnetic field strength falls as compared to the EM waves[9],[10].So MI is underground communication as compared to electromagnetic waves in this paper we provide the sensed information from the soil is transmitted from the transmitter to receiver by using soil as the communication medium through magnetic induction and the sensed information is provided to the centralized server .The WUSNs has a wide range of advantage as compared to WSN. The WUSN provide real time data as compared to WSN. There is a lot of signal losses due to high RF signal while transfer of data whereas in WUSNs the data loss is less as signal transformation take place in underground. The WUSN has a vast range of application like coal mine monitoring, volcanic eruptions[8], glaciers movement monitoring[7], monitoring of underground infrastructures like pipes etc, mine field monitoring , locating people in case of building collapses etc.

II. EXISTING WORK

Sensor network are develop as a great aid to improve agriculture nature of beast, productivity and resource optimization. To estimate environmental specification such as humidity, temperature, moisture, flame, NPK (Nitrogen, Phosphorus and Potassium), etc. sensor network are used. Currently many researchers are working on wireless sensor network (WSN). Many new technologies in wireless sensor network have become available to develop the agriculture quality. Agriculture is a field which provides one of the most suitable scenarios for the deployment of wireless sensor network (WSNs). The specific characteristics of agriculture environments

- May vary significantly with location
- Make wireless sensor networks a key technology able to provide knowledge to farmers.

This learning represents a valuable resource because it enable real time decision making with regard to issues such as establishing water saving policies while providing adequate irrigation and choosing the right time to harvest the fruit based on its maturity. Due to development in technologies and reduction in size, sensors and their networks are successfully used to get numerous benefits.

III. PROPOSED WORK

WUSN has been examined in many contexts recently. Analyses on WUSNs in agriculture are few. This paper mainly depends on monitoring the soil properties which are essential in the day to day agriculture. The design component involves digital sensors, LM35, FC-28, LM 393 to obtain the soil temperature, moisture, flame values. The advantage of using this sensor is that it does not require any external calibration and irrigation can be managed effectively. The soil region may be distinct in terms of soil texture and water content.

- The top soil region, which denotes to the first 30cm of the soil or the root growing layer which is shallower.
- The sub soil region refers to the region below the top soil i.e., the 30 to 100 cm region.

WUSN is a special kind of WAN that mainly focuses on the use of sensors at the subsurface region, whereas the WUSN transmitter transmits the sensed values using the magnetic induction.

IV. BLOCK DIAGRAM

A.TRANSMITTER MODULE

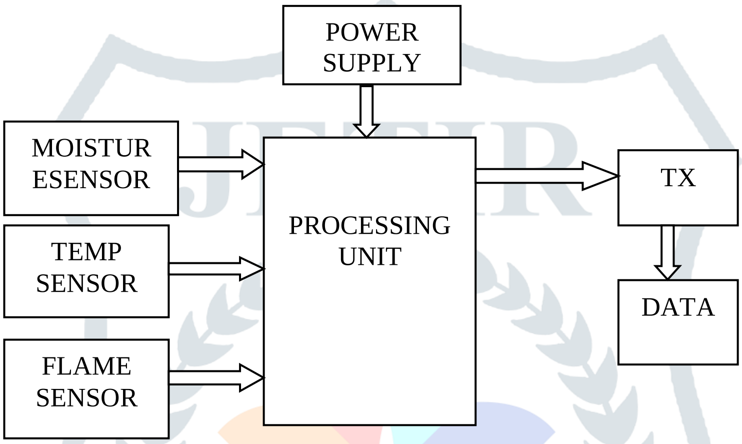

Fig 1 : Block diagram of Transmitter side

B.RECEIVER MODULE

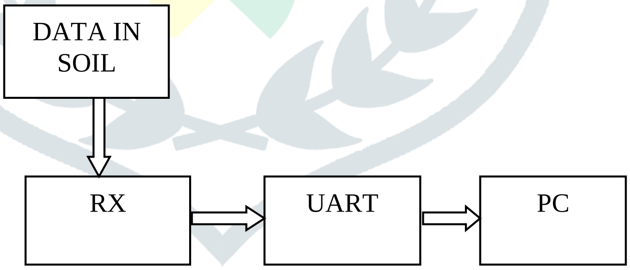

Fig 2 : Block diagram of Receiver side

PIC means Peripheral interface controller. The PIC16F877A is a low power, high speed CMOS 8-bit microcontroller with 8k bytes of flash program memory 8 bytes of data memory to 8bytes of EEPROM data memory. The device is manufactured using microchip technology. The series are 12-series, 14-series, 16-series,18-series. In this project we are using 16-series PIC microcontroller. a voltage regulator as pictured in fig 4 also used to maintain the output voltage at constant value.

C.CIRCUIT DIAGRAM

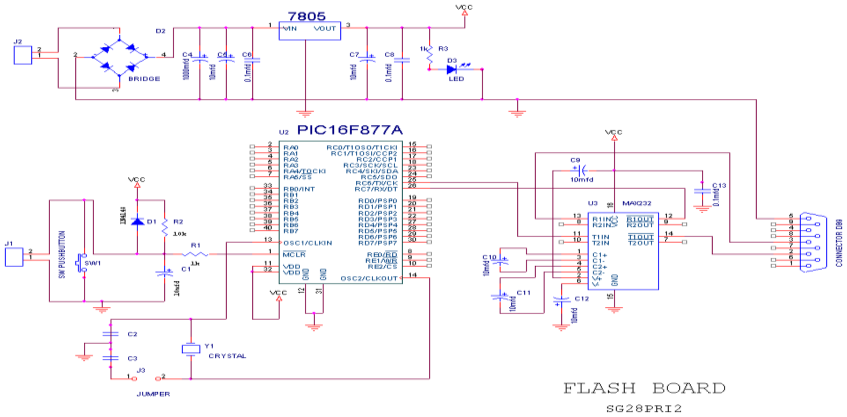

Fig 3 : circuit diagram

In this circuit diagram we use PIC16F877A . It is a 40 pin PIC microcontroller and is used mostly in Embedded projects and applications . Software tools are development tools – MPLAB IDE v7.42 , Hardware compiler , PIC flash and Hardware simulation tool.

D.COMMUNICATION CHANNEL OF WUSN

Fig 4: Communication Channel of WUSN

- Underground-to-underground (UG2UG) Link: The transmitter and the receiver together are deployed below the ground and they communicate via the soil. This form of communication is used for multi hop information delivery.
- Underground-to-aboveground (UG2AG) Link: The sender is deployed and the receiver is above the ground. Monitoring data is send to aboveground relays or sinks via these links.
- Aboveground-to-underground (AG2UG) Link: Aboveground sender node transfers messages to underground nodes. This link is employed for management information delivery to the underground sensors.

V.RESULTS

The values are sensed by the sensors and it is send to the transmitter as shown in the above fig.3 and then it is transmitted to the receiver by using soil as the communication medium. The values are transmitted at 9600 bytes per scathe values that are obtained during the demonstration is given in table1.

Table 1 : Soil analysis report

Soil analysis	Time 1	Time 2	Time 3
MOISTURE (%)	243	220	249
TEMPERATURE (°c)	29	25	24
FLAME (v)	0	0	6

Fig 4 :Transmitter

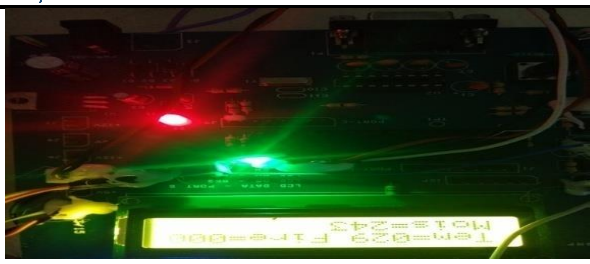

Fig 6: PIC microcontroller

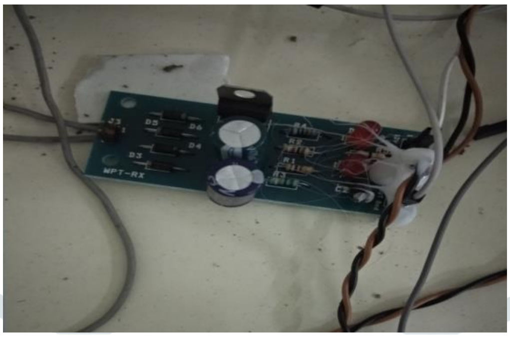

Fig 7: Regulator

VI.CONCLUSION

In this work we provided the concept of WUSNs in which sensors are buried under the ground. We demonstrated it by monitoring the soil conditions such as temperature, moisture, flame using pic16f877a microcontroller. This concept is mainly used in the agricultural field for monitoring the soil conditions. The results show that the underground communication is the potential technology for WUSN.

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