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Autonomous underground water detection Robot

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***Abstract*—** India is one of the most water challenged countries in the world. Water demand is continuously increasing day by day, as people's demand of water for different household and industrial purpose is increasing. Due to this, surface water is not able to meet the demands of water supply. Due to this need of underground water has increased. This work is focused to meet the challenge of finding out underground water in a simple way with the help of robot. This Arduino based robot would analyze the surface using Wenner method to find the presence of water body under the earth surface. Global Positioning System (GPS) attached to robot will send location of underground water to operator who is taking note of readings of water level. The data received during analysis will be fed through a program which will follow logic and store the amount of water present at that particular depth. This data will help to plot the map of where underground water is available in sufficient quantity.

Keywords- *ArduinoBoard,wenner method, underground water,dc motor,gps,servo motor*

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I. INTRODUCTION

Water scarcity is a new challenge that is going to dawn upon in the near future. The only way to get over this water problem is by replenishing the underground water table. The current projects of rain water harvesting in metro cities have a limitation on the amount of water that can be processed, filtered and stored. Ground water resource gets recharged through the precipitation in the monsoon season in India. The annual natural groundwater recharge from rainfall in India is about 342.43 km^3, which is 8.56% of total annual rainfall of the country. The annual groundwater recharge from canal irrigation system is about 89.46 km^3 (7).This project aims at finding underground water bodies (1).It involves making a robot which can detect underground water sources (water pockets) in and around water logging areas or in lakes, so that during the onset of monsoon a hole can be drilled in the ground to let all the water being collected (because of the draining from the city or residential areas to be fed directly to the underground storage.

II. METHODOLOGY

The work is going to deploy Wenner method to detect any underground water source (2). The Wenner method is about keeping four electrodes collinear to each other. The four electrodes considered are D1, E1, D2, E2. D1 and D2 electrode will supply current externally at two ends. Between that two electrodes E1 and E2 electrodes are fixed which gives reading of voltage across soil (4).The distance between all four electrodes should be same. The readings are measured by voltmeter connected to electrodes E1 and E2 (5) .This readings are converted in resistance form by ohms law. This resistance is not proper resistance that of the soil. Soil is having heterogeneous layers so for that apparent resistivity is to be calculated. Apparent resistivity is given by simple formula

$$\rho_a = 2*3.14*a*R \quad (1)$$

Where ρ_a is resistivity measured in ohm-cm, 'a' is the space between electrodes; R is the resistance value in Ohm. [(4)] The resistance of soil will change as the spacing between electrodes is increased

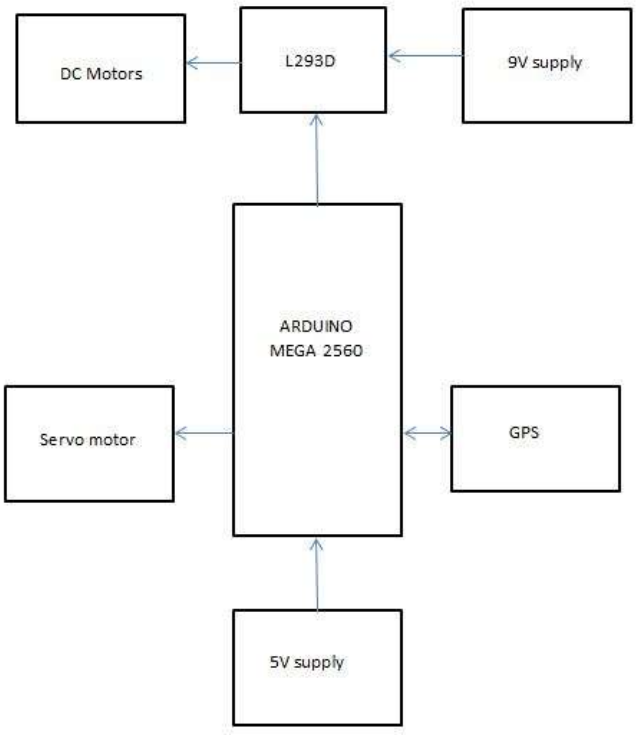

Fig.1 Block diagram

It is having one servo motor fixed at front end of it.Servo motor is programmed for 90 degree rotation. So for 0 degree rod attached to servo motor will stay up in the air and after 90 degree rotation rod attached with servo motors will insert electrodes into soil which are fixed on it .Servo motor has three outputs. One output is connected with pin 9 of Arduino board and other two are connected to ground and Vcc of board. All four electrodes on servomotor are fixed at equal spacing of 'a'

between them. It is working on Arduino Atmega2560 board. This board has 54 I/O pins and 16 analog input pins. Board runs on 5v dc supply. It has one 16 MHz crystal oscillator. It has four sets of serial transmission and receiver pins. Robot is having two 300 rpm dc motors driven by L293D motor driver IC at back end of it. One motor is connected with pin3 and pin6 of driver IC. Other motor is connected at pin 14 and pin 11 of driver IC. Pins 2, 7, 10, 15 of driver IC are connected with 10,11,12,13 pins of Arduino board. This driver IC is provided with external dc supply from 9V battery. A GPS module having internal antenna is attached to the Arduino board. Its receiver and transmission output is connected with transmission 1 and receiver 1 pin of Arduino board respectively. Two electrodes D1 and D2 will be given external supply of current through battery. Another two electrodes E1 and E2 are there, of them one is connected to ground of Arduino and other to the analog input of Arduino which will provide reading of voltage on serial monitor. Supply to GPS will be provided from Arduino board.

III. EXPERIMENTATION

Motors connected with driver IC will turn on as you connect 9V dc battery with driver IC connection. Motors will remain in on mode for 3 seconds, as in programming it is done for 3 seconds. So robot will move ahead for 3 seconds. After 3 seconds robot will stop and servo motor attached in front will turn on and rotate 90 degree. Rod attached with servo motor will insert the electrodes attached with it inside the soil. This electrodes will stay inside till readings are taken and again with that servo motor electrodes will be removed. Along with that GPS location of that particular place where reading is taken is also displayed on serial monitor. After that robot will again move forward and continue the same task. These voltage readings taken by robot will be analyzed and converted into apparent resistivity form by ohms law and apparent resistivity formula. Based on that readings resistivity of soil can be known (3).

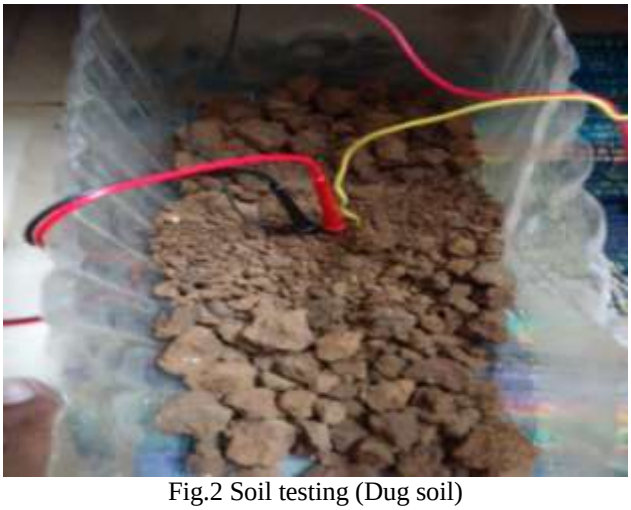

Fig.2 Soil testing (Dug soil)

Fig. 3 Soil testing (Top soil)

Fig. 4 Soil testing (Sand)

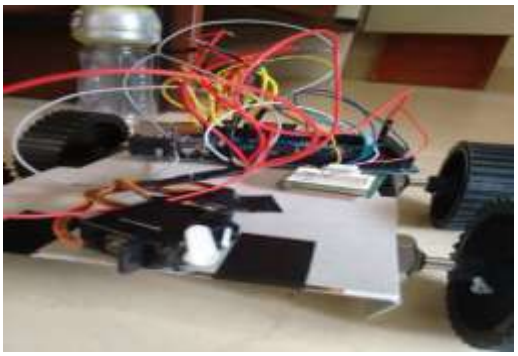

Fig. 5 Robot representation

Fig. 6 Setup

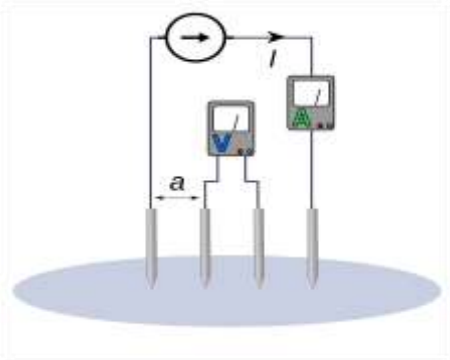

Fig. 7 Wenner array method

Values of resistance at different locations and in different types of soil would vary according to weather conditions, type of soil, and temperature in that area. Height of electrodes inserted into the soil is 10 percent of distance measured for getting voltage.

IV. ANALYSIS AND RESULTS

Soil testing done on different types of soil showed different results. Three soils Top soil, dug soil and sand which was used showed difference in resistance. All the three soils taken are tested by Wenner method (6). Using that resistance in apparent resistivity formula, resistivity of all three different soils was found.

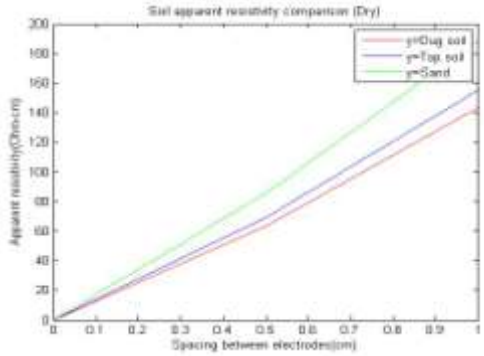

Fig. 8 Apparent resistivity comparison of dry soils

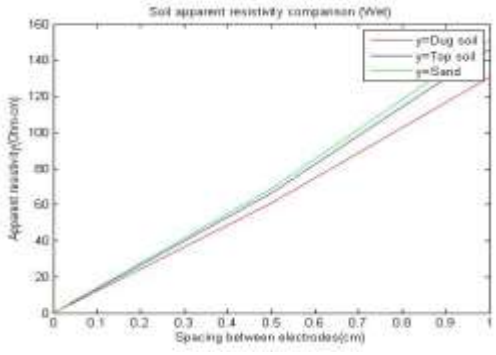

Fig. 9 Apparent resistivity comparison of wet soils

Resistivity obtained was more for top soil. Resistivity for dug soil as it contains moisture, its resistivity was found lesser than that of top soil. For sand resistivity was highest of among all soils. Soil was made wet at some depth and above layer of soil was kept dry. When measured by Wenner method, it showed resistance drop in all soils.As water is good conductor of electricity, resistance decreases in soil and conductivity increases inside soil. So we can know from it that water is their inside soil at the depth electrodes are inserted inside soil. Voltage readings and GPS locations of place where soil testing was done was displayed on serial monitor screen.

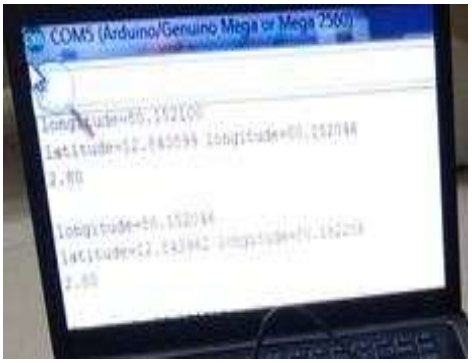

Fig. 10 Latitude and Longitude of location

V.CONCLUSION

This method is more useful for lateral study of resistance of soil. Robot which will do all this reading task itself will be useful for persons getting to do such task of reading voltages of soil. Manual effort will get reduced and more accurate readings can be obtained.

This small robot can be made into big machine type robot which can do soil testing for ground water analysis on its own and can send data on its own to the operator sitting at some another part of world with wireless communication

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