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IoT Based Intelligent Irrigation System Using Intel Edison and Fuzzy Inference System

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***Abstract*—** The most important practice in India from the very beginning of Indus valley civilization era is agriculture on which both farmer and general people are dependent. But the economic contribution of agriculture is gradually declining. One of the major factors affecting agriculture in India is water shortage. It is caused due to use of inefficient traditional methods for irrigation. So an automated irrigation system is essential to avoid this water wastage. In this system the soil moisture is monitored using different sensors and as required watering is done. Here soil moisture and temperature are the main parameters to be focused on. The data collected is then passed on to fuzzy logic to increase efficiency, optimization and precision. The main purpose of this project is to monitor the soil moisture using Smartphone by sending SMS.

***Keywords*—** IOT, FIS, Technology, Agriculture, Irrigation.

I. INTRODUCTION

Existing water system controllers depend on settled timetables. Ranchers, Municipalities and business proprietors of green territories ordinarily set a watering plan that includes particular run times and days, and the controller executes a similar calendar paying little mind to the season or climate conditions. Every once in a while a professional may physically modify the watering plan, yet such alterations are typically just made a couple of times amid the year, and depend on the expert's observations instead of genuine watering needs.

Likewise, In ordinary water system control innovation, water system is done in the manner by which vast measure of underground or surface water is squandered. In existing innovation the office of controlling the procedure physically or naturally are not effortlessly accessible.

The largest demand for water comes from agriculture. More than two-thirds of the water withdrawn from the earth's rivers, lakes and aquifers is used for irrigation. Currently, farmers use traditional approach for irrigation, in which at regular intervals they irrigate the land. This process is very time-consuming and results in a lot of water wastage. Hence, an automatic system was required to monitor and control the need of water in the field. To achieve this we are using both concepts of IOT (Internet of things) and FIS (Fuzzy Interference System). Both are the techniques used in many sectors like artificial intelligence, medical, science and others.

The concept of IOT will help us automate the traditional ongoing irrigation process. Here different sensors are used to read parameters of soil like temperature and moisture. The information gathered using sensors are then passed on to fuzzy logic.

Using fuzzy logic we can use real world linguistics/parameters in computing. And therefore efficiency, optimization and precision has increased and the time required for implementation is decreased.

II. RELATED WORK

Many authors worked with the automatic irrigation system. They worked with different metrics for soil and water composition. They also talked about different sources of sensors and networking of sensors to design the control system. We are also discussed about same. This content on the intelligent irrigation system using IoT and Fuzzy Inference System for rural areas for effective management of water. The paper discussed about different technologies that can be used in the implementation of the system. In this paper, Intel Edison and GPRS implemented to control the system.

III. METHODOLOGY

This system consists of an Intel Edison Board, different types of sensors and a GSM Shield. The sensors like soil moisture and LDR are used and are placed in various locations on land. The data is collected using this sensor and are then sent to the board in analog format. This system monitors the soil moisture of the soil and daylight. A range is predefined for both the parameters, which can vary with type of crop and soil. Whenever the value of soil moisture and daylight diverges from the defined range, the watering motor is turned off/on.

Our system also uses GSM Shield for communication with the administrator through SMS service. As soon as the moisture level goes below the defined range, the system sends a SMS of turning on the motor. The process uses MAX-MIN and Minimum Mamdani for inference and composition and CENTER OF AREA to defuzzification in a continuous universe.

Let R be a fuzzy relation in X x Y, and S be a fuzzy relation in Y x Z.

The Max-Min composition of R and S, RoS, is a fuzzy relation in X x Z such that

$$RoS \leftrightarrow \mu RoS(x,z) = V \{\mu R(x,y) \wedge \mu S(y,z)\}$$

$$= \text{Max.} \{\text{Min.} \{\mu R(x,y), \mu S(y,z)\}\}/(x,z)$$

IV. RESULTS AND DISCUSSION

This system consists of an Intel Edison board with different sensors such as LDR to detect brightness, soil moisture to measure moisture content in soil. Power supply connected using USB cables. The moisture sensor inserted in soil. The values read for both moisture and LDR. The set point for temperature and soil moisture is 500 and 300 respectively. If the soil moisture value is less than 300, an alert message sent to the smart phone to turn the Motor ON.

Once the desired moisture level is reached, a message is again sent to the smart phone to turn the Motor off which will stop the irrigation process. To interface the smart phone and the device created, we used GPRS Shield for sending and receiving message.

In the Center of Area (CoA) defuzzification method, also called the Center of Gravity (CoG) method, the fuzzy controller first calculates the area under the scaled membership functions and within the range of the output variable. The fuzzy logic controller then uses the following equation to calculate the geometric center of this area.

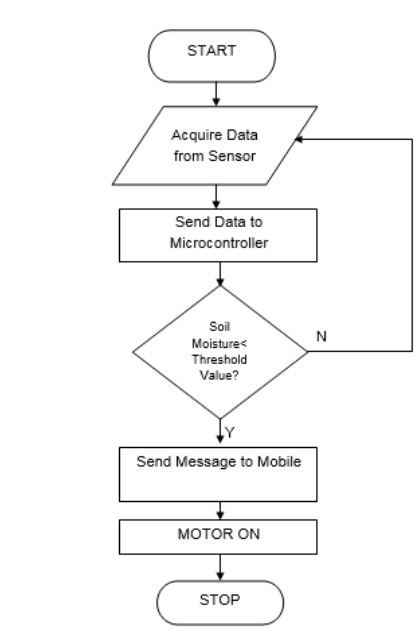
$$CoA = \frac{\int_{x_{min}}^{x_{max}} f(x) * x \, dx}{\int_{x_{min}}^{x_{max}} f(x) dx}$$

where CoA is the center of area, x is the value of the linguistic variable, and xmin and xmax represent the range of the linguistic variable. The Center of Area defuzzification method effectively calculates the best compromise between multiple output linguistic terms

Here while implementing we have measured soil moisture for soils with different weights and different moisture content. The table is as follows:

Table 1: Water Volume (ml) V/s Soil Weight (gm) Analysis

Weight of Soil \ Water Level	0	20	40	60	80	100
100	234	183	199	167	209	211
200	736	684	406	237	317	300
300	745	701	561	332	341	340
400	747	751	673	452	412	450
500	750	760	678	665	492	451
600	751	789	711	671	641	579
700	801	783	767	711	798	781
800	803	801	777	806	801	809



Flow Chart1: Working Principle

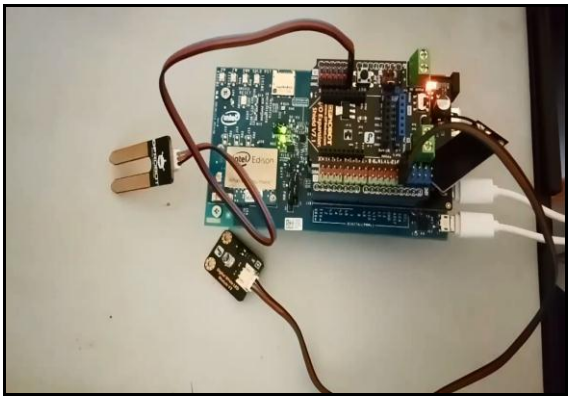


Image 1: Assembly ready for reading values.

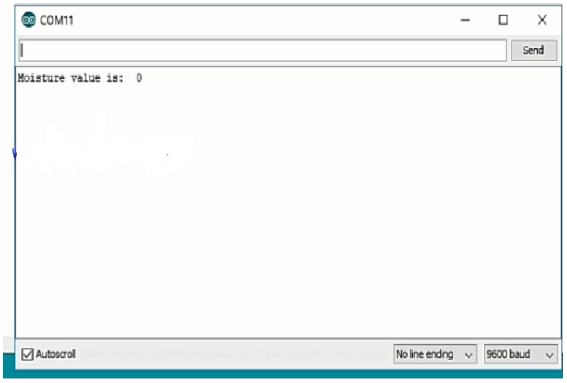


Image 2: Intel Edison + Arduino showing sensing values.

Image 3: assembly sensing wet soil reading

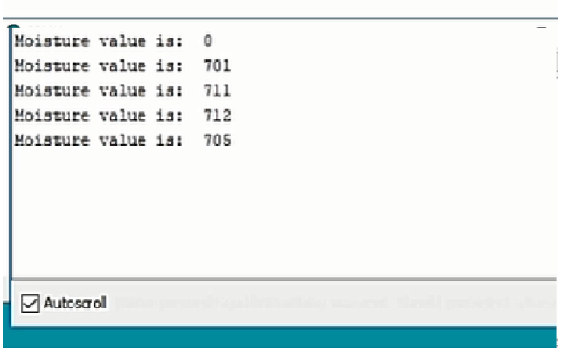


Image 4: wet soil readings

Image 5: assembly sensing less wet soil reading

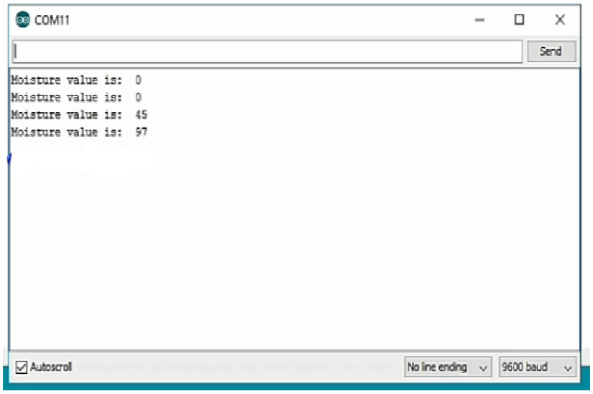


Image 6: less wet soil readings

Image 7: SMS Alert by GSM Shield.

V. CONCLUSION AND FUTURE SCOPE

In this work, a system that can help in an automated irrigation system by monitoring the soil moisture level developed successfully. This system proves useful as it automates and regulates the watering without any human intervention. The main objective of this project was to avoid water wastage. This objective successfully handled here. Also this system turns out to be cost effective, Power efficient, requires less manpower and is easy to use.

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