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IoT Based Water Distribution and Fertilizer Sprinkling System in an Agricultural field

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Abstract: ***Any agricultural field needs proper watering for growing crops. In our country we provide harvested rain water or the water coming from deep earth through shallow-pump manually. The costing of this manual water distribution is very high because either we use a tank vehicle and man power for distribution or we are looking for natural climate i.e rain. Most of the time due to non-suitable weather or lack of rain and high cost, farmers could not manage the cultivation process. In our proposed work, voice enabled IoT based automatic water sprinkling system for any farming land is introduced that can be able to distribute water in the land at particular time of the day as needed by the farmer. As per our proposed work the rain distribution process is ignored if already rains take place on that time on that field. As per the requirement of liquid organic or inorganic fertilizer on that field our system also distributes the same.***
Keywords: IoT, sprinkling, harvested, shallow-pump, fertilizer etc.

I. INTRODUCTION

In an agricultural field for cultivation of any suitable crops manual rain water distribution is traditional approach. To execute the water distribution manually, poor farmers need a huge manual effort because most of them are not capable to bear the cost of water distributing vehicle. Farmers can also suffering with another effort oriented manual task i.e liquid organic or inorganic fertilizer sprinkling over the farming land. Here we can introduce an IoT based automatic water distribution system to solve these two problems. Our system can be able to sprinkle water automatically when the pre-defined day timer can reach it's scheduled time but before sprinkling the water sensors of our proposed system can check whether there is raining or not. If during the schedule time there is no raining then water distribution starts automatically through multiple piping ports over the land. If there is rain then system could not responds. To solve second issue liquid fertilizers are also evenly distributed as per the voice instruction provided by the farmer through our mobile applications.

II. PROJECT REQUIREMENTS

Hardware Components Required

1) *ArduinoUNO-R3 Microcontroller:* Arduino UNO is an open-source board that uses an ATmega328p microcontroller. This board contains set of analogue and digital pins which are used to connect the board to other components. The Arduino UNO has a USB connection that can be used for power supply to the board. It is often used in electrical projects. Arduino microcontroller is an empty brain in which you can upload memory by coding or programming through Arduino IDE software.

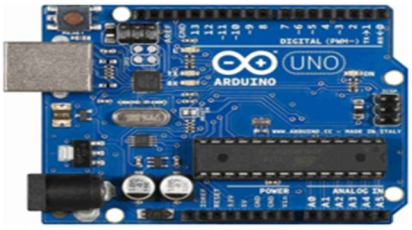


Fig. Arduino UNO-R3 Microcontroller

2) *NODEMCU ESP8266-12E Wi-Fi Module:* ESP8266 contains 8 pins which some different purpose. These pins are defined as the following normally, ground pin as the name suggest is use to provide ground circuit .TX pin Is used to upload program by connecting it to the Rx pin of the programmer.GPIO-2 pin is use to serve the input/output purpose.GPIO-2 pin serves the same purpose as GPIO-2.CH-EN pin used for high voltage. RX Pin or gpio-3 also serves the same purpose of input/output just as GPIO-O and GPIO-2.+3.3v of voltage is supplied through pin.

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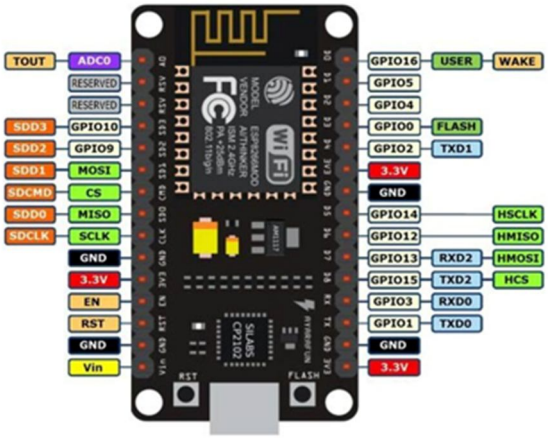


Fig. ESP8266-12E WiFi Module

3) *DS3231 RTC real time clock module:* The DS3231 RTC module is a real-time clock module where DS3231 chip is enabled. The DS3231 IC is a very user friendly, lost cost and accurate RTC with an I2C interface. It's accuracy is very high because it uses an integrated temperature-compensated crystal oscillator (TCXO) along with a crystal. To keep track of time even if the main power source is removed, the DS3231 has a backup battery mounted at the back of the module. The chip automatically switches between main and backup power sources when necessary.The RTC keeps track of each and every seconds, minutes, hours, day, date, month, and year related information. Due to it's special features It can also automatically adjusts for months with less than 31 days and also for leap years. The clock can operate alternatively in 24H or 12H (with AM/PM) formats.

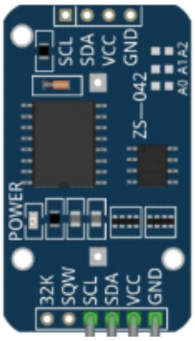


Fig. DS3231 RTC real time clock module

4) *Connecting Wire:* The movement of electricity from one point to another is facilitated by the movement of free electrons. But this electrons needs a medium for movement so, connecting wires use in a circuit provides the required medium to the free electrons for movement and electrical current flow through the circuit. Here we have used M-M, M-F and F-F jumpier wires.



Fig. M-M, M-F F-F Jumper wires

5) *Water Pump :* If 12V pump is powered by 12V power supply, it works. To control a pump, we need to use a relay in between Arduino and pump. Arduino can control the pump via the relay.



Fig. 12V submersible water pump

6) *Relay Module:* Working is simple, we need to make the RELAY Pin (PIN A0) high to make the Relay module ON and make the RELAY pin low to turn off the Relay Module. The 12V pump will also turn on and off according to Relay.

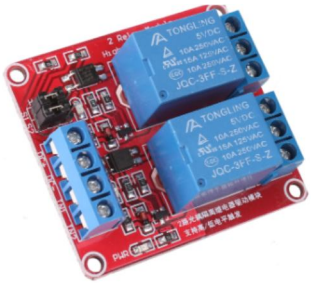


Fig. 2 Channel Relay Module

7) *Rain Sensor Module:* Analog rain sensor can detect the intensity of water. VCC pin will be connected to the +V of Arduino and GND pin is connected to Arduino's ground pin to complete the circuit. And data pin of Sensor will be connected in A0-A7 pin of arduino.



Fig. Rain Sensor Module

III. OUR PROPOSED WORK

A. *General Idea*

In the introduction we have learned about the challenges faced by the farmers due to manual water distribution and fertilizer sprinkling over the agricultural field and how our proposed device will help it to fight against them. The device is made up of Nodemcuesp8266 Wi-Fi module and Arduino UNO micro-controller. A RTC real time clock will be connected in the circuitry to detect the current time(GMT) and as per the watering time it will send the signal to microcontroller for enabling the pump by activating 12v relay module. An analogue Rain Sensor is there to measure the intensity of rain continuously and if the raining time is collide with the water distribution time then microcontroller can stop water distribution during the session of that day by deactivating the relay module. In our proposed system we have created a Wi-fi server in ESP8266 12E nodemcu module and with the help of Mobile enabled app or web interface we can connect the server to provide the instruction for activating the pump and the liquid organic or inorganic fertilizer sprinkling will be started through multiple no of branches of a single pipe. The 12V motor is attached under the fertilizer tank. On other hand Rain sensor module and RTC clock is attached with Arduino board which itself is interfaced with ESP8266 wifi module. The scheduled time signal provided by RTC clock is compared with the intensity of Rain sensor and Microcontroller takes the decision for distributing water over the land.

B. Block Diagram

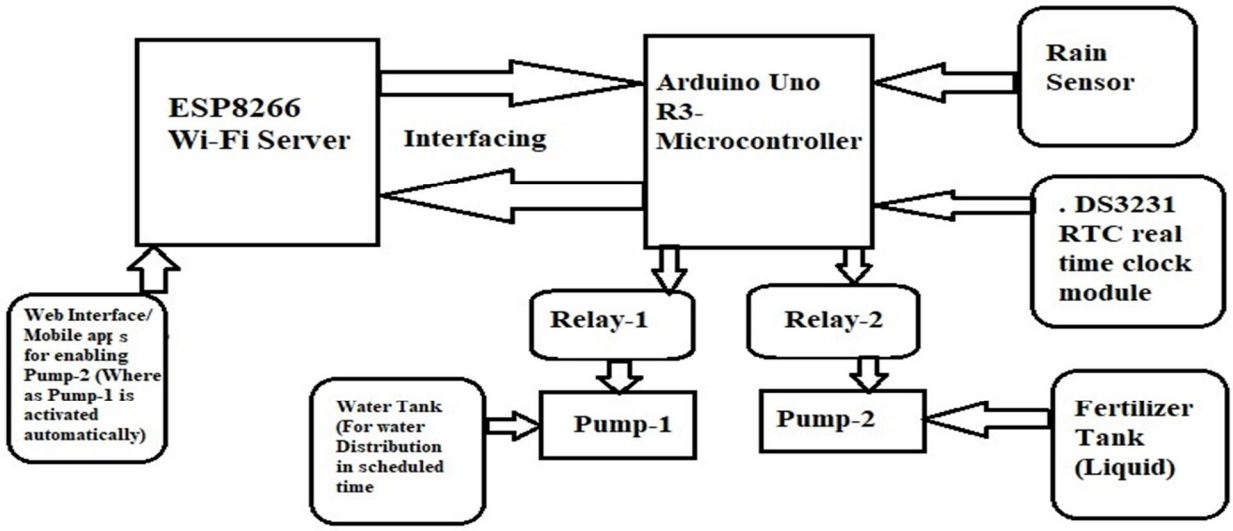


Fig. Block Diagram of our Proposed Work

1) *Step-1:* Setting up a wi-fi server on ESP8266-12E NodeMCU module as an Wi-Fi hotspot/access point.
2) *Step-2:* Arduino UNO can receive the real time data from RTC DS3231 clock Module for activating pump-1
3) *Step-3:* Arduino UNO can also recive the real time rain intensity value from Rain sensor.
4) *Step-4:* The predefined water distribution session mentioned in programming is compared with the real time clock value.
5) *Step-5:* When the clock value is matched with predefined session time start then it will send +ve signal to arduino.
6) *Step-6:* Then Arduino verifies the rain intensity reached to threshold or not (adequate rain) during that predefined session related with RTC clock.
7) *Step-7:* If adequate rain intensity found during the water distributing session then Pump-1 will be turned off otherwise it will be turned on.
8) *Step-8:* On the other hand as instructed through web interface/mobile application farmer can easily turn on Pump-2 for liquid fertilizer sprinkling at any time.

C. Circuit Diagram

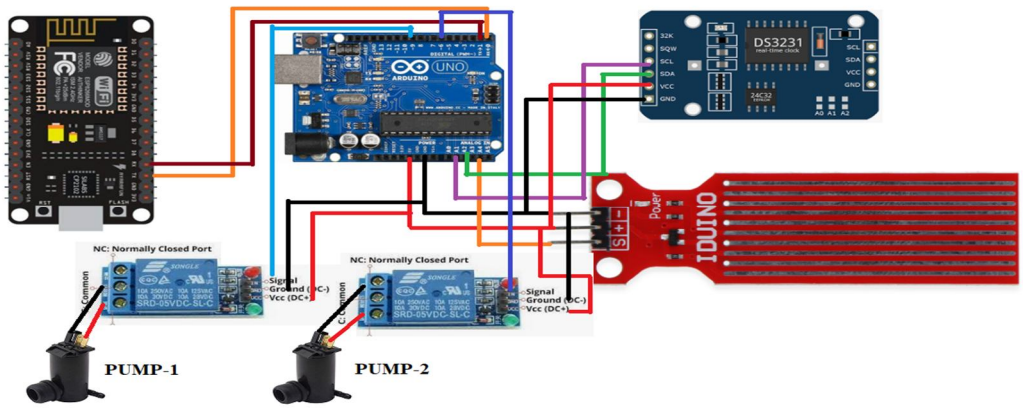


Fig- Circuit Diagram of our proposed work

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D. Explanation of Pin-Out

Node MCU Pin RX and TX is attached with the TX and Rx pin of Arduino uno which can transfer data from ESP8266-12E and Arduino-UNO. Arduino can attached with RTC clock module with pin A3 to SDA and A1 to SCL. +Vcc and GND pin of both Arduino and DS3231 IS attached with each another. Rain Sensor is connected with Arduino via S(Data of Rain sensor) to A4 and consecutively +ve and GND is connected from both end. Relay-1 and Relay-2 Module is connected with Arduino via 1 data pin, +Vcc and GND pin. Pump-1 and Pump-2 also connected with Relay-1 and Relay-2 via +Vcc and GND pin.

IV. RESULT ANALYSIS

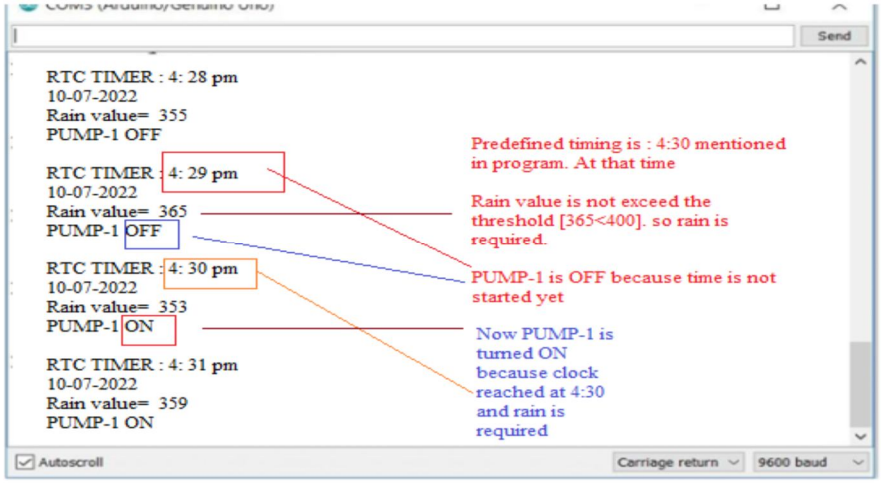


Fig. Output screen with explanation

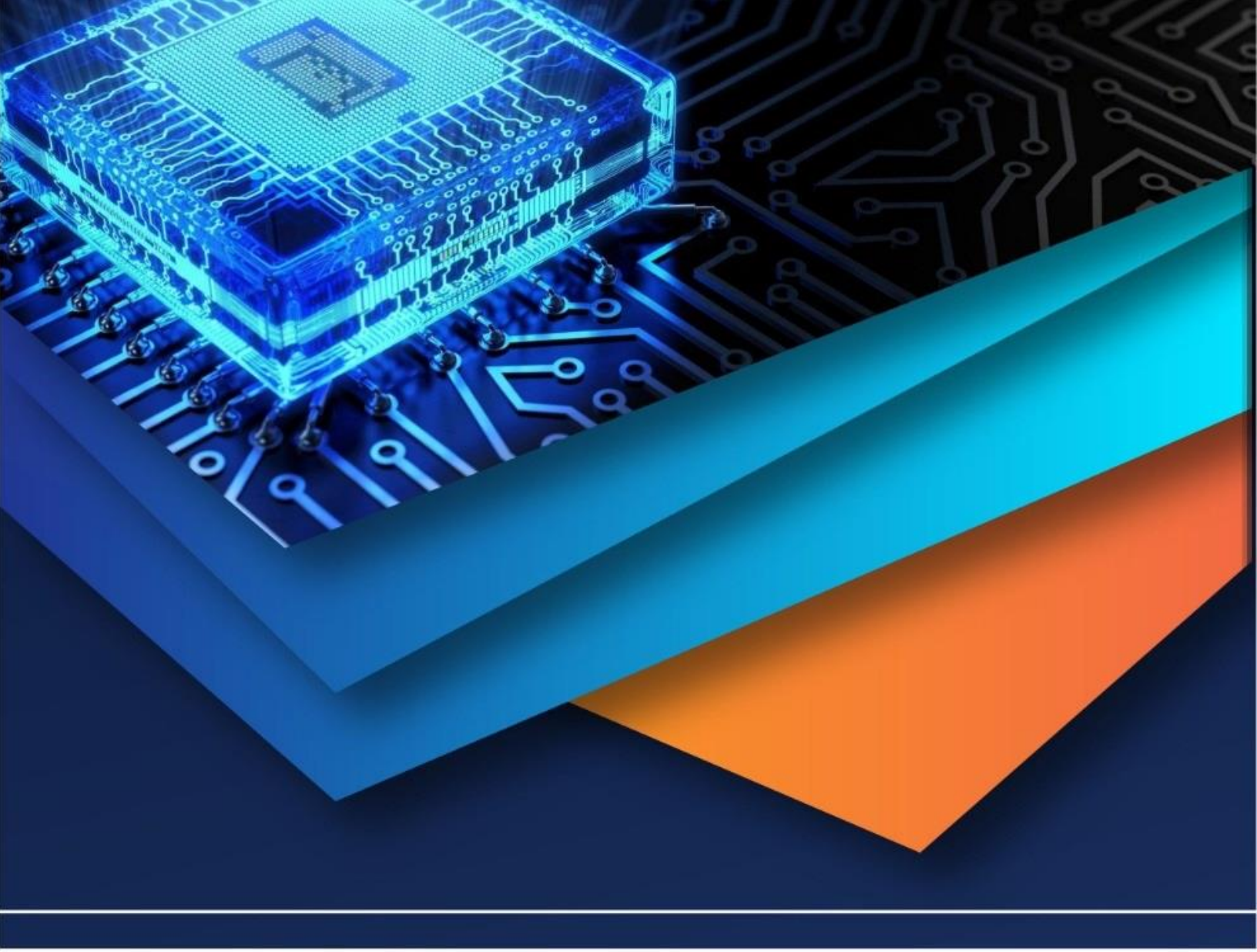
V. CONCLUSION

With the help of our IoT based automatic water distribution system we can be able to solve two problems. Initially Our system can be able to sprinkle water automatically when the pre-defined day timer can reach it's scheduled time but before sprinkling the water sensors of our proposed system can check whether there is raining or not. If during the schedule time there is no raining then water distribution starts automatically through multiple piping ports over the land. If there is rain then system could not responds. It can solve the manpower requirement, high costing and over effort for poor farmers. Also we can provide the solution of second issue where liquid fertilizers are also evenly distributed as per the instruction provided by the farmer through our mobile applications.

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