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Research paper on Multipurpose IoT based Conservation of Water Resources in Agriculture Fields

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Abstract - *In India groundwater resources are used in agriculture fields, drinking water and remaining for another sector. Groundwater resource water level depends on monsoon that is rainwater. The depletion of the water level depends on the drought situation. This research paperwork on how smartly uses groundwater in different levels using the Internet of things technology. The first level module work on saves water resources using an automatic pump on-off system which says no human interaction. In the second level module in this paper focus on water quality means check water cleanness and turbidity. In third level module study use for intrusion detection which includes securing groundwater resources from theft, wild animals and any hazard, etc. The fourth level module of this paper is that measure the water level of groundwater. This research would be a help to the farmer for saving water, increase food production, save time and cost.*

Key Words: Wi-Fi, Raspberry Pi 3b+, Ultrasonic sensor, PIR sensor, DHT sensor, Water Quality, Turbidity Sensor, PI camera, soil sensor, Relay.

1. INTRODUCTION

In India, 50 % population's work has been depending on the agriculture field. India the ratio of agriculture fields near about 17-18% of total GDP. India ranks second worldwide in farm output [1]. The largest component of groundwater in India used for the water extracted for irrigation. The main resources of irrigation in India are canals, tanks, and wells, including tube-wells. All these sources, groundwater constitutes the largest share. Wells used 61.6% of water for the agriculture field, including dug wells, shallow tube-wells, and deep tube wells, etc. Canals used for irrigation 24.5% in this country [2].In conventional agricultural systems, the farmer has to face lots of trouble to manage the agriculture field such as he has visited the farm frequently to check the water level in well, water quality in available sources, crop irrigation, sometimes uncontrolled pet animal or wild animals accidentally felt in groundwater resources like well. The farmer has to visit and checks crop irrigated or not in this case if the crop has irrigated then farmer does off the motor pump otherwise do on [3]. This research paper tries to solve the above problems using IOT sensors. The first ultrasonic sensor checks the water level in well and gives notification to the farmer. If this level is going beyond the foot valve then the system automatically does off the motor such way it saves excess of water, electricity and sometimes water not available in well, the motor running empty which would cause to burn out the motor pump. Second case soil moisture sensor gives notification about soil condition whether it is dry or wet and respectively do on-off motor pump automatically which is helpful to save water from excessive use. In the third case, this study used the DHT sensor which provides information about the weather in terms of temperature and humidity. In the fourth case PIR sensor used to detect intrusion in fields of water resources. If any intruder detected then system alarm ring and give the alert message to the farmer. In Fifth case Pi camera use to monitoring water resource area and provides a live image with live recording to the farmer. Above these sensors are controls and monitor by raspberry pi 3b+. It has worked as a server and maintains all sensor data in the SQLite3 database. In this case, Ngnix Web Server has installed in raspberry pi for displaying all sensor information on the webpage using the Flask framework. In this way the internet of things technology helpful to the farmer to save water, time, money and electricity in the agriculture field using wife based network.

2. MATERIALS AND METHOD

These materials and method are divided into different sections such as 2.1 Hardware systems 2.2 Software Used 2.3 Methodology Used 2.4 Experimental setup.

2.1 Hardware systems

2.1.1 Raspberry Pi 3 Model B+

The Raspberry Pi is a series of small single-board computer which perform various jobs like the remote controlling, file transferring, run a different application, games and open-source software, etc.

Fig-1: Raspberry pi 3 Model B+

Specification: - The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, faster Ethernet, and PoE capability via a separate PoE HAT. Boasting a 64-bit

quad-core processor running at 1.4GHz, dual-band 2.4 GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE,

2.1.2 DHT11 Sensor

This is a cheapest digital sensor that senses temperature and humidity. It has interfaced with the microcontroller such as Arduino, Raspberry Pi.

Fig-2: DHT11 Sensor

Specification:

1. Supply Voltage: 5v
2. Temp range: 0-50 °c
3. Humidity: 20-90%
4. Interface: Digital

2.1.3. Soil Moisture Sensor

This is an easy to use digital soil moisture sensor. Just insert the sensor in the soil it measure water level content and it it can measure moisture. It gives 0V when the moisture level is low in the soil and a digital output of 5V when the moisture level is high.

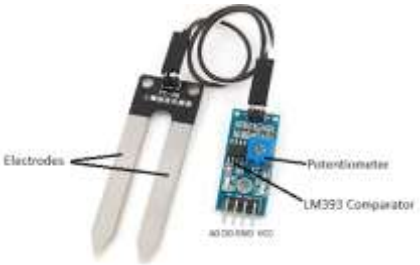

Fig-3: Soil Moisture Sensor

Specifications:-

1. Sensing Probe 1 LM393 PCB + 2 Female 20 cm Jumper Wire
2. Operating Voltage: 3.3V to 5V
3. Sensing Probe Dimensions: 60X30mm Panel PCB Dimensions: 30 X 60mm
4. On-Board LM393 Comparator On-Board Power Indicator LED
5. On-Board Digital Switching Indicator LED

2.1.4 Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. In this sensor transducer do measure role, it send signal up to distance object reverse back to sender.

Fig-4: Ultrasonic Sensor

Specification:

1. Working Voltage: 5V (DC).
2. Output signal: high-level 5V, low-level 0V. Sensor angle: Not more than 15 degrees
3. Detection distance: 2cm-450cm.

2.1.5 PIR Sensor

Passive infrared sensors (PIR sensor) are most often used in PIR-based detectors. An electronic sensor that measures infrared (IR) light radiating from objects in its field of view.

Fig-5: PIR Sensor

Specifications

1. Working Voltage Range: DC 4.5V- 20V; Current drain :<60uA; Voltage Output: High/Low level signal:3.3V TTL output
2. Detection distance: 3--7M (can be adjusted); Detection range: <140°
3. Delay time: 5-200s (can be adjusted, default 5s +-3%); Blockade time: 2.5 S (default)
4. Trigger: L: Work temperature:-20-+80°C
5. Trigger Method: L unrepeatable trigger / H repeatable trigger

2.1.6 PI Camera

The Raspberry Pi Camera Board plugs directly into the CSI connector on the Raspberry Pi. Pi Camera resolution is 5mp for image and recording 1080p.

Fig-6: Pi Camera

Specification

1. Model A and Model B Fully Compatible with Raspberry Pi
2. 5MP Omni vision 5647 Camera Module
3. Still Picture Resolution: 2592 x 1944
4. Video: 720p @ 60fps and 640x480p 60/90 Recording, Supports 1080p @ 30fps,
5. 15-pin MIPI Camera Serial Interface - Plugs directly into the Raspberry Pi Board
6. Weight 3g
7. Size: 20 x 25 x 9mm
8. Many Raspberry Pi cases full Compatible.

2.1.7 Relay Sensor

Channel Relay Module board can be used in driving high power motors. Channel Relay is interface any Microcontroller with Electrical Appliances.4-channel relay output modules, relay output contacts 250A 10A. Input IN1, IN2, IN3, IN4, the signal line LOW effective. VCC, GND power input, can relay a separate power supply relay power input of JD-VCC.

Fig-7: 1 Channel Relay

Specifications

1. 1 Channel Relay can be controlled directly by Microcontroller such as Raspberry Pi, Arduino, 8051
2. Relay status indicator light, release status LED is off
3. Four screw holes, hole diameter 3.1mm
4. Relay Maximum output: DC 30V/10A, AC 250V/10A
5. Weight: 58g.
6. Size: 75mm (l) x 55mm (b) x 19.3mm (h)

2.1.8 Electronics Buzzer

The buzzer made of an outside case with two nodes to attach it to ground and power. When signal is applied to the buzzer it causes the ceramic disk to close or open. Changing the then causes the surrounding disc to vibrate. That's the voice that we hear.

Fig-8: Buzzer

2.1.9 Breadboard

A breadboard is electronics and test circuit designs .which a solderless device for a temporary prototype. Most electronic components in electronic circuits can be connected each other by inserting their terminals into the holes and then making connections through wires where appropriate.

Fig-9: Breadboard

2.1.10 Water Pump

In this research paper, water Pump is used to serve the water to the agriculture field using Raspberry Pi, which detected the water level go down then immediately the water Pump would get started otherwise off. Relay perform role to keep the pump on-off condition.

Fig -10: Water Pump

2.2 Software Used

In these Research project following software were mostly Used.

1. Programming languages
    1. HTML, CSS- Front end development.
    2. Python 3.7- Programming of IoT sensors and Raspberry Pi using this language.
    3. Framework- for webpage designing requires Flask as framework, which is required python language.
2. Database

1. Sqlite3:- This is a Lightweight database for storing and retrieves data easily. SQLite is a local database. This database use single connection and flat-file database solution for application developers.

2.3 Methodology Used

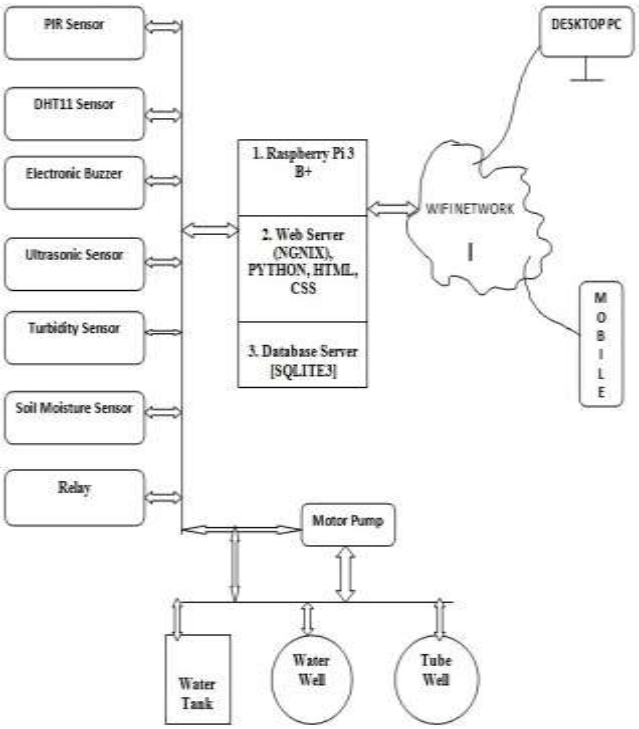

Fig -11: Architecture of system.

The above Fig-11 depicted the overall architecture of the system. This process works on the conservation of natural water resources using advanced technology so-called internet of things. In this case, we had tried to solve Indian agriculture problems facing by the farmer.

It includes water problem, which includes drought, contamination of water and excess used of water are measure crises nowadays. The second problem is that the farmer used to frequently visit the farm to check the status of water resources, soil status, and crop status. These types of problems are tried solve by this project. All information regarding water level, quality of water and soil status data were easily available on farmer mobile phones or PC through website and SMS system. For that system used different sensors among that soil moisture sensor to give data about soil is wet or dry to sent signal to the raspberry pi. According to data received to PI signal get sent to relay, which did motor on or off the. For checking the water level in water resources like a tank, pond, and tub well and well were used ultrasonic sensor, which was provided the actual amount of water available in wells. Third impediment faced by Indian farmers like any accident happened into an area of water resources. That could be a suicide case, accidental death and wild or pet animals unfortunately felt into well, tub well and tank. Such type of hazard gave information to Farmer that incidents happened in the water resources area. For that system used the PIR sensor which detected live entity into an area of water resources. Once a live entity found into this area, system has immediately alerted to the farmer sending SMS or via webpage. Turbidity sensor used in this research for checking the quality of water in water resources. If the water quality goes down the system has sent SMS to the farmer. Raspberry Pi did a significant role in this research to control all the sensors digital input data. Those data were sent website and store in SQLite database. Here WI-Fi network is used to communicate between sensors to user using PC or mobile phones to access all sensor information provided by a raspberry pi.

2.4 Experimental Setup

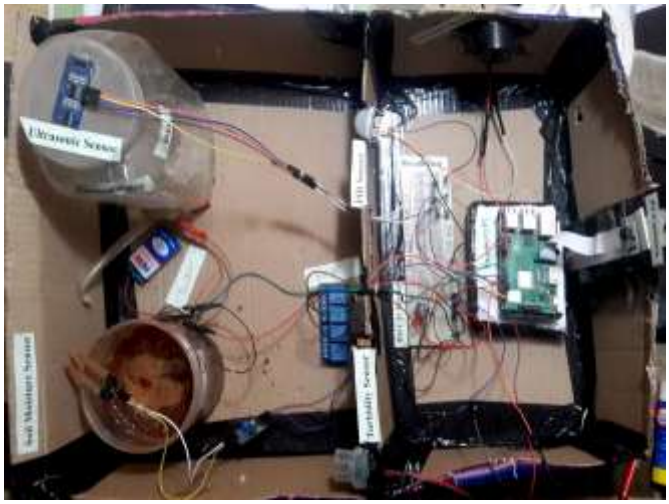

Fig -12: System final Setup

This is a final setup of the project, which showed all sensors are connected to raspberry via Breadboard. This final setup was depended on the initial three modules. This hardware setup works with parallel to the Software design part.

Fig- 13: Web Browser displays the Homepage of this system.

1. Motor on off system module
   In this case, the pump on-off depended on the external environmental factor. Here the following

condition must be satisfied then the only motor has been started. The flow of this module as below.

1. If GPIO.Input=high and water level<=18 and temperature>=25 or humidity<=75
   Pump_on ()
2. Else
   Pump_off ()

2. Intrusion Detection.
   In this case, any alive entity passed in between the PIR sensor range, and then its detected input signal is high and the signal sent to a raspberry pi. The flow of this module as follow.
   1. If GPIO.Input=1
      Intrusion Detected and Buzzer
   2. Else
      No intrusion Detected.

3. Water Quality Test.

In this module quality of water got tested by turbidity Sensor. If GPIO.Input pin high means water quality was not so good. The flow of this module as follow.

1. If GPIO.Input (pin) =1

The quality of water not clear.
2. Else
   Quality of water Clear

In this system, no need for any human interaction because this system has worked automatically. Fig 13 is the homepage, where the user could easily viewed every sensors function that happened previously and the current status of the sensors.

3. RESULT AND DISCUSSION

In above fig-13 shows the homepage of the project, which showed multipurpose of sensor function using a button. So far we called name of research paper as a multipurpose IoT base system. It's like different problems have one solution. Here farmers easily solved many problems faced by before development of this system. Let us solve and discuss these problems first.

1. The data can be access anytime and anywhere in the world using a website.
2. Using this system farmer can save the water, electricity, time and money also.

Fig- 14: Real-time Water_level Soil and Pump On_Off Status.

The above web page showed the result of the pump on-off, Soil status and water level. In this case, the farmer easily seems to know the condition of water resources, soil status and pump status, etc.

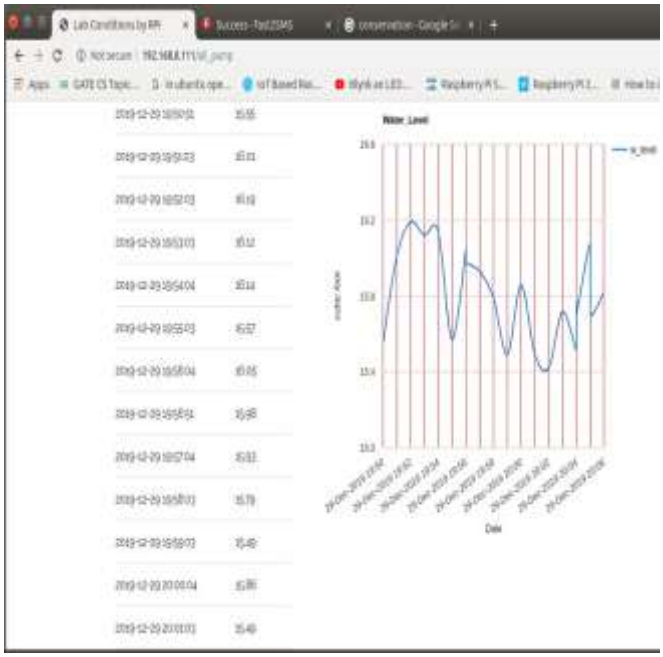

Chart-1: Water Level and Date time

Above chart-1 shows the correlation between the water level in water resources and date-time. The ultrasonic sensor senses the distance in meter and sends it to raspberry pi as input. This plot easily seen by the farmer and understood the status of water level and time date also

Table -1: Record of Soil and Pump

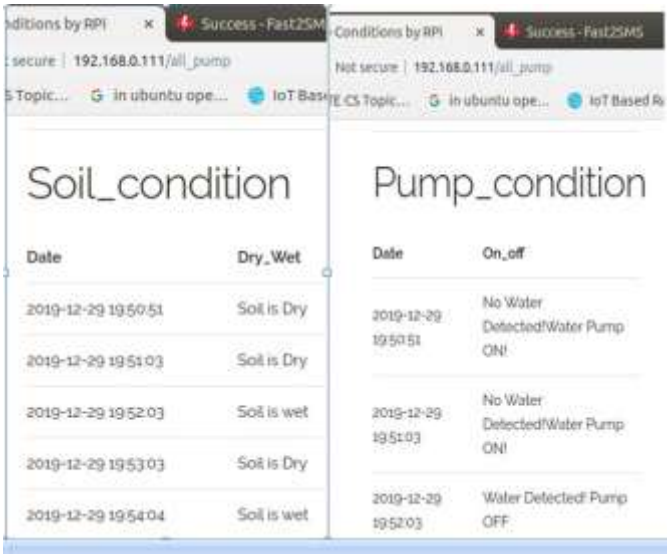

Table-1 easily got by the farmer, which shows the correlation between time, soil status and pump status. In this case soil moisture sensor sense soil status and sent data as input signal in digital form to the raspberry pi.

3. The farmer has checked water quality

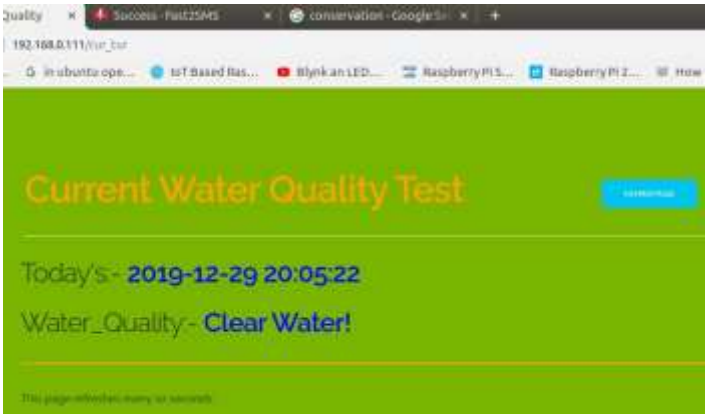

Fig -15: Real-time Water Testing.

Above fig-15 displayed a result of water quality, whether it's pure or impure. Used a single click on homepage users easily got this data**.**

Table -2: Water_Qaulity Records

In this case, table -2 displayed records of water quality and respective time date. The Turbidity sensor senses the water quality and sent analog to the digital input to the raspberry pi.

4. A farmer has detected wild animal and theft using this project.

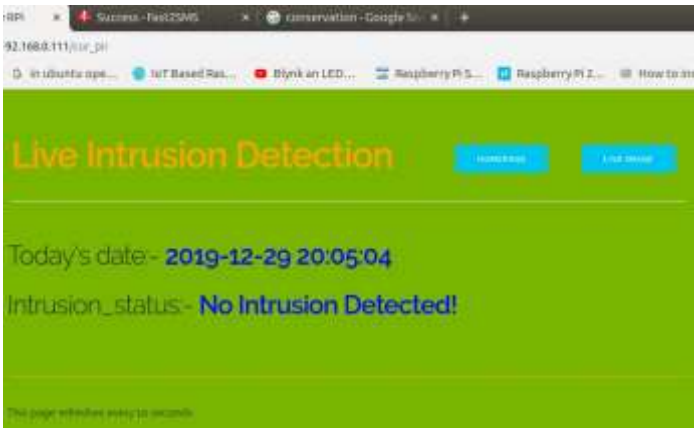

Fig -16: Real-time Intrusion Detection system.

In this case, the farmer easily identified any intruder was accessed the water resources area. He got data that was available on the webpage with alarmed the buzzer.

Table -1: Records of Intrusion Detection.

Above table-3 described the correlation between date time and intruder status. In this case, the PIR sensor sensed the intruders then it sent as data in digital format to the raspberry pi. Final received date sent to webserver, which displayed all data on webpages.All sensors data were stored in SQLite3 database

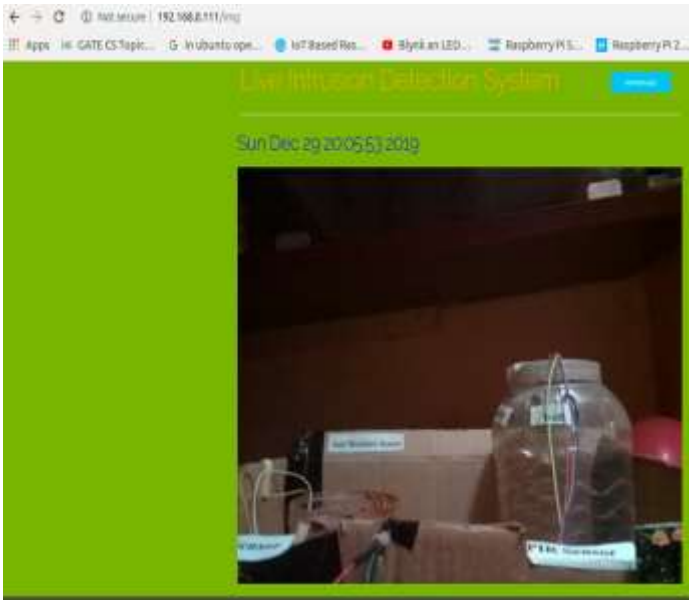

Fig -17: Live Image

In this page live camera button showed live image about an intruder to farmer.

5. This system had given SMS as notification to the farmer on his mobile phone.

In fig -18 displayed the SMS alert to the user. This SMS alert regarding pump no off, intrusion detection, Water Quality, etc.

Fig -18: SMS Notification

5. CONCLUSION

In current day agriculture fields use excess water and there are no any preventive methods. Water contamination measures issued in all over India. Sometimes unauthorized human beings and wild animals were accessed water resources. It could be caused of accidental hazards in the area of water resources.

These crises are solved by using this research study ,which implemented IoT based advanced technology with raspberry pi as a server and SQLite 3 as the database for storing data. Data accessed anywhere or any time using a web browser. In future, we will improve this system providing the advance feature. Next time we will implement this project on an android base system for more users handy.

6. REFERENCES

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