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Raspberry Pi based Weather Reporting over IOT

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ABSTRACT: This paper represents the real time monitoring and updating weather conditions over the internet. The system monitors three parameters namely temperature, humidity and rainfall. These values are then displayed on LCD and also updated over the IoT gecko.com. When the area is dry it shows zero value. When the system detects raindrop, it shows the value of the increase in rainfall. When the temperature increases the value gets updated. The user can observe the weather status of a particular area from any remote location.For this purpose we have used ARM based Raspberry Pi 3 board. Raspbian operating system is selected to use with Linux Kernel for Raspberry Pi 3. Python Language is used for programming because IDLE understands Python. By readings, the user can get a fair idea of the weather of a particular area on the monitor. This system proves to be useful for knowing the weather of the localized area.

KEYWORDS: Raspberry Pi 3, Sensors, Raspbian, IoT.

I. INTRODUCTION

Many things affect the weather. And weather also have effect on most of living as well as non-living things. At weather station study of different environmental parameters using some instruments and equipments has been done. Apart from government and non-government organizations the weather forecasted data can also be used for the fields like agriculture, transportation, construction etc. Apart for the scientific and commercial applications, weather forecasting systems can be used for educational purposes.

The data of the measured parameters are not useful if they are not transmitted fast and accurate manner to the users. Therefore, transmitted and processing the measured data is a very important aspect of the modern weather forecast. Transmission of the measured data could be done by a number of means: WI-FI link, GSM/GPRS link, satellite link direct, wired link, etc. Weather forecasting has to be reliable and accurate, regardless of its application. Also, it has to provide simple access to all the measured parameters. The quality of sensors and precision of measurements may vary, and the location of weather forecasting station can determine the accuracy and reliability of the weather data collection.

In general user is limited to the options provided by the manufacturer. Even if a slight change in parameter monitoring or data processing is observed, the commercial devices became inapplicable. For some particular applications it is required to have flexible and configurable solutions. Not to mention that the commercial devices could be too expensive for some applications purposes.

So to meet the goal of weather monitoring we have designed IoT based real time, low cost, portable and high speed weather station using Raspberry Pi 3. At our weather station we are measuring some environmental parameters like temperature, humidity and rain water level. GSM module, Zigbee module, Ethernet module along with ADC and microcontroller are used by many weather monitoring system for environmental parameters monitoring. ARM based Raspberry Pi 3 board can handle many operations and same one is used in this system.

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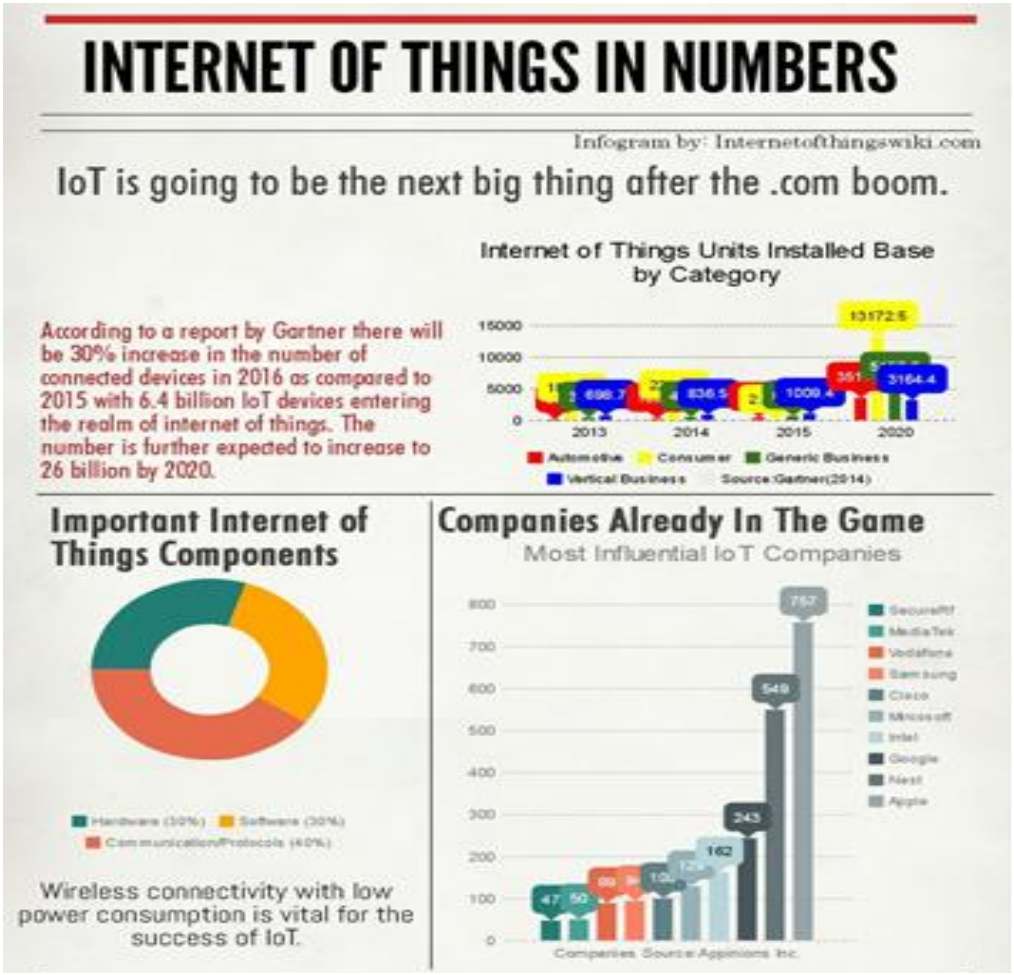
The proposed system uses IDLE text editor where programs can be written in Python. Output data can be seen over IoT gecko.com.

This paper deals with the weather forecasting prototype system developed for particular purposes. Using relatively inexpensive components, the development of a prototype system for measuring air temperature, air humidity, rainfall and soil moisture is achieved, which could be an inexpensive module used in the agricultural land for the weather monitoring and forecasting the data to the server which could be viewed and used for the periodical statistical analysis of the weather data.

IoT means Internet of Things. It provides inter-networking of physical devices, buildings, vehicles and other components like sensors and actuators. By giving network connectivity to systems embedded with electronics, software, sensors and actuators, these objects are able to collect and exchange data. By using IoT, objects to be sensed or controlled remotely through existing network. It gives opportunity to connect physical world computer-based systems. IoT improves efficiency, accuracy, economic benefits along with reduced manpower. IoT frameworks help for the interaction between "things". Also supports for more complex structures like distributed computing and development of distributed applications. Now-a-days most IoT frameworks seems to focus on real-time data logging solutions.



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To put things simply any object that can be connected will be connected by the IoT. This might not make sense for you on the forefront but it is of high value. With interconnected devices you can better arrange your life and be more productive, safer, smarter and informed than ever before.

For instance how easy it will be for you to start your day if your alarm clock is not only able to wake you up but also able to communicate with your brewer to inform it that you are awake at the same time notifies your geezer to start water heating. Or you wearable wrist health band keeps track of your vitals to inform you when you are most productive during the day. These are just few examples but applications of internet of things are numerous.

II.MATERIAL USED

- Raspberry Pi 3
- Temperature Sensor
- Humidity Sensor
- Rain Drop Sensor
- LCD Display
- Cables and Connectors
- IC Sockets
- **Software** : Python
- **OS** : Linux

III.BLOCK DIAGRAM

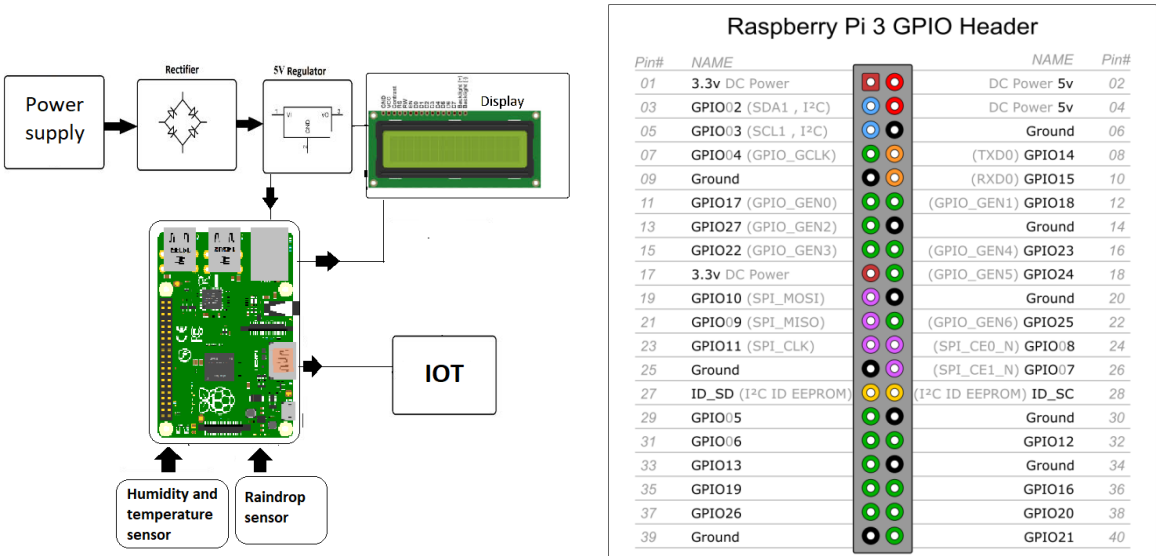

Figure 1: Block Diagram of complete system

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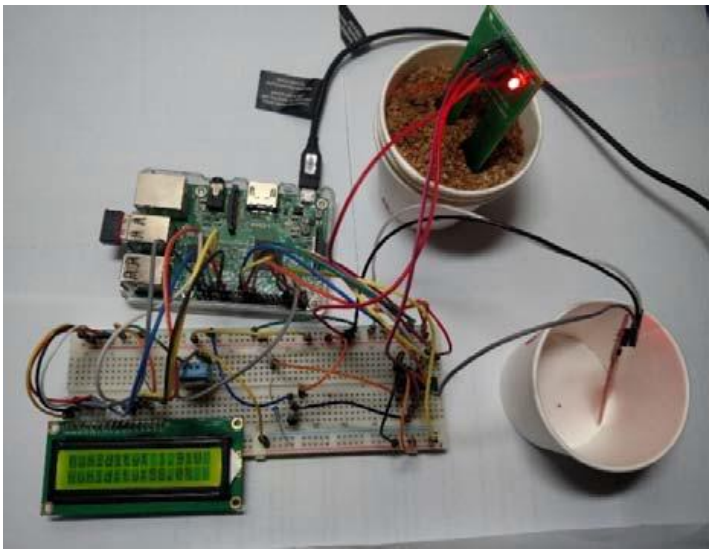

IV. DETAILED WORKING OF BLOCK DIAGRAM

This IoT based weather monitoring system is developed using powerful development platform Raspberry Pi board. Raspberry Pi board is helpful to minimize the system hardware. So here in this project use of any external microcontroller, ADC and communication module is avoided. This system uses Temperature and Humidity Sensor (DHT11), Rain Water Level Measuring Sensor developed using marked scale with ULN2803, and all these sensors are interfaced with GPIO header of Raspberry Pi board. To get real time monitoring of data from sensors Ethernet network is used. Block diagram of complete system is as shown in Figure 1. Module Description of Raspberry Pi board is as shown in Figure 2

This system can be used to monitor and update weather conditions over the internet. The system monitors 3 parameters namely temperature, humidity and rainfall these values are then displayed on LCD and also updated over the IoT gecko. By readings, the user can get a fair idea of the weather of a particular area on the monitor. This system proves to be useful for knowing the weather of the localized area. The system is powered by Raspberry Pi it includes a raindrop sensor, a temperature sensor, LCD and a buzzer. After turning the system on, the system gets connected to the website by using WIFI. The system keeps track of 3 parameters like temperature, humidity, and rain. As the weather changes the system to monitor and updates the status over the IOT when the area is dry it shows zero value. When the system detects raindrop, it shows the value of the increase in rainfall. When the temperature increases the value gets updated. The user can observe the weather status of a particular area from any remote location.

RASPBERRY PI 3 (MODEL B)

The Raspberry Pi 3 is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.
The Raspberry Pi 3 is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016. Compared to the Raspberry Pi 2 it has:

- A 1.2GHz 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1
- Bluetooth Low Energy (BLE)

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The Raspberry Pi 3 has an identical form factor to the previous Pi 2 (and Pi 1 Model B+) and has complete compatibility with Raspberry Pi 1 and 2.

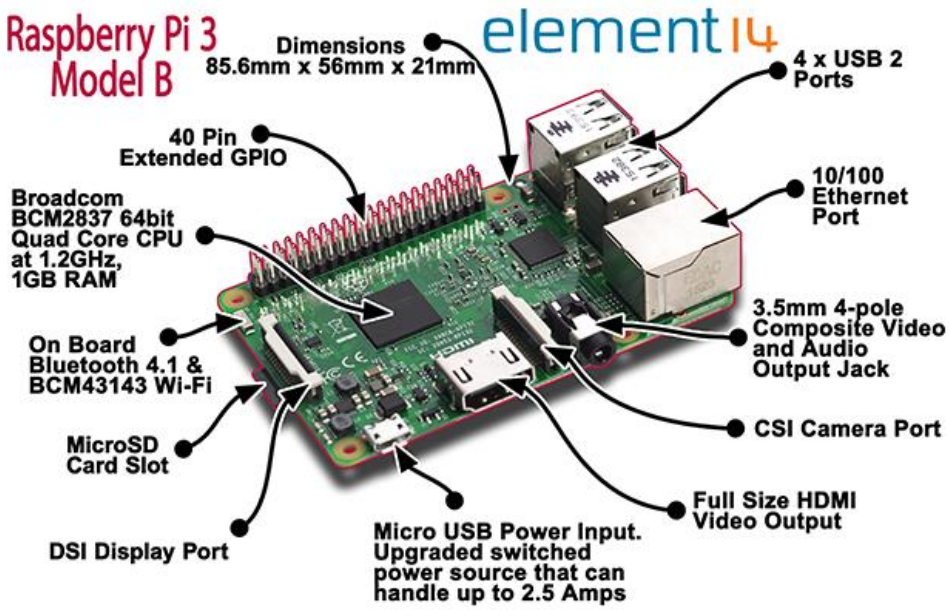

Figure 2: Raspberry Pi 3 Module Description

RASPBERRY PI 3 TECHNICAL SPECIFICATIONS:

SoC – Broadcom BCM2837 64bit ARMv8 quad core Cortex A53 processor @ 1.2GHz with dual core Video Core IV GPU @ 400 MHz supporting OpenGL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

System Memory – 1GB LPDDR2

Storage – micro SD slot

Video & Audio Output – HDMI 1.4 and 4-pole stereo audio and composite video port

Connectivity – 10/100M Ethernet, Wi-Fi 802.11 b/g/n up to 150Mbps and Bluetooth 4.1 LE (BCM43438 module)

USB – 4x USB 2.0 host ports (with better power management, allowing higher power peripherals), 1x micro USB port for power

Expansion - 40-pin GPIO header, MIPI DSI for Raspberry Pi touch screen display, MIPI CSI for Raspberry Pi camera

Power Supply – 5V up to 2.4A via micro USB port

Dimensions – 85 x 56 x 17 mm

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TEMPERATURE AND HUMIDITY SENSOR

The DHT11 sensor comes in a single row 4-pin package and operates from 3.5 to 5.5V power supply. It can measure temperature from 0-50 °C with an accuracy of ±2°C and relative humidity ranging from 20-95% with an accuracy of ±5%. The sensor provides fully calibrated digital outputs for the two measurements. It has got its own proprietary 1-wire protocol, and therefore, the communication between the sensor and a microcontroller is not possible through a direct interface with any of its peripherals. The protocol must be implemented in the firmware of the MCU with precise timing required by the sensor.

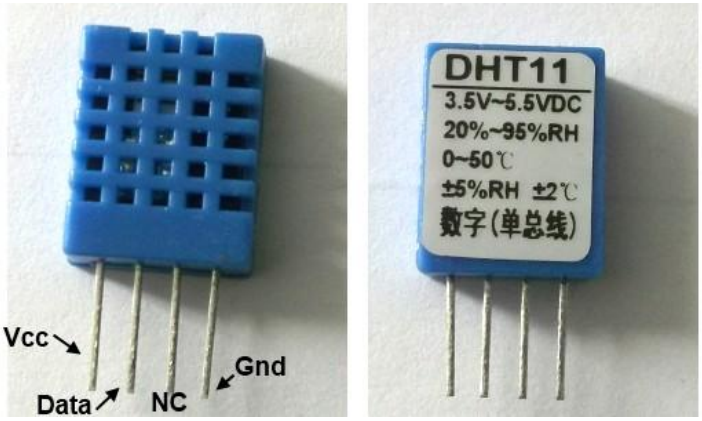

Figure 3: Temperature and Humidity Sensor

RAIN SENSOR MODULE

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer.

Figure 4: Rain Sensor

SPECIFICATIONS:

Adopts high quality of RF-04 double sided material. Area: 5cm x 4cm nickel plate on side, Anti-oxidation, anti-conductivity, with long use time; Comparator output signal clean waveform is good, driving ability, over 15mA; Potentiometer adjust the sensitivity; Working voltage 5V; Output format: Digital switching output (0 and 1) and analog voltage output AO; With bolt holes for easy installation; Small board PCB size: 3.2cm x 1.4cm; Uses a wide voltage LM393 comparator

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PIN CONFIGURATION:

Figure 5: Pin Description

1. VCC: 5V DC 2. GND: ground 3. DO: high/low output 4. AO: analog output

INTERNET OF THINGS COMPONENTS:
The fundamental components that make internet of things a reality are:

- **Hardware**-Making physical objects responsive and giving them capability to retrieve data and respond to instructions
- **Software**-Enabling the data collection, storage, processing, manipulating and instructing
- **Communication Infrastructure**-Most important of all is the communication infrastructure which consists of protocols and technologies which enable two physical objects to exchange data

Raspbian: Raspbian is free and open source software. Raspbian operating system is based on Linux kernel. An SD card is used to install an operating system

Python: Python is used for general purpose programming which is free to use and high level language. Python is a interpreted, interactive, object-oriented and beginner's language. Python can runs on Linux kernel. IDLE (Integrated Development and Learning Environment) is the special text editor software used for programming in python.

V. ADVANTAGES OF THE PROPOSED SYSTEM

- Decreased field damaging conditions
- Improved safety and security
- High quality receiving data
- Less power consumption
- High speed data rate
-

VI. APPLICATIONS

- Industry Monitoring
- Home Automation
- Medical Industry
- Agriculture

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VII. RESULTS

On the system side Raspberry Pi board operates as a data acquisition mode and as a web server mode. It collects data from Temperature and Humidity sensor, Pressure and Altitude sensor, Light intensity sensor and rain water Level sensor. This data is then sent to the client side using HTTP protocol. On client side real-time data can be seen from anywhere in the world on gecko.com. Internet connection to the board is given by using LAN through Ethernet port or by using USB dongle through USB port. On this website one channel is created and all six fields are placed in this channel. Field 6 shows temperature, Field 7 shows humidity, Field 8 shows rain water level.

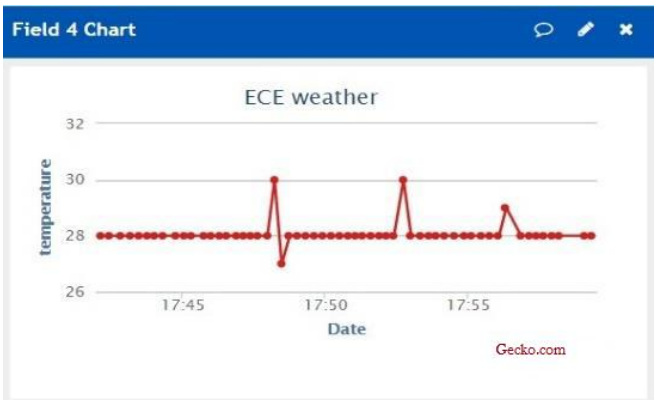

Figure 6: Real-time graph of Temperature in ^{o}C

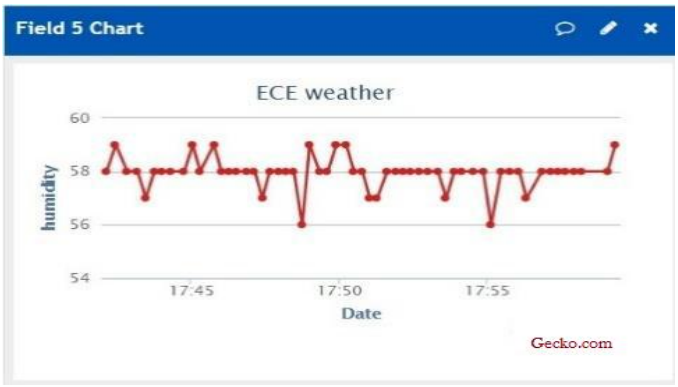

Figure 7: Real-time graph of Humidity in %

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Figure 8: Real-time graph of Rain water Level in %

VIII.CONCLUSION

This IoT based system gives real-time monitoring of environmental parameters. This system monitors temperature, humidity, pressure, altitude, light intensity and rain water level. Data can be seen from anywhere in the world. By using this system the client can continuously monitor different environmental parameters without any interaction with additional server. Raspberry Pi itself acts as a server. This is efficiently carried out by Raspbian operating system. This weather monitoring system is designed using Raspberry pi is having low cost, small size, low power consumption, fast data transfer, good performance and remote monitoring.

For future development improved version of Raspberry Pi board system can be used. More sensors can be added to expand the system also for remote location monitoring solar panel and wind mill can be used for supplying power. Thus in future, modifications can be made on this system to make it serve for other applications too.
We can add the new features like,

- Weather prediction is a very important factor, which forecasts the climate in a region based upon the values of weather parameters. So the calculated results from this system can be made use in forecasting the weather of that locality for a period of time.
- This mini weather can be made much more compact and reliable with the inclusion of miniature components and by increasing the scaling factor.
- As we made use of Raspberry pi3 in this model, immediate alert message or e-mail can be sent to the mobile phone, when the parameters changes are drastic.
- As the applications are limitless, other weather parameters can also be monitored easily with the addition of related sensors to the system architecture.
- The technology changes day by day. Here in this, we make use of raspberry pi 3. In the future there will be more advanced hardware on which we can implement this weather monitoring system.
- By including the sensors of soil moisture, PH values, and other we can use this in agricultural fields. So, that it would be helpful to farmers to take care of crop yield.
- We can also implement an app which supports the android and other operating systems. So, that we can check the data from anywhere at any time by using the internet. It is very easy to install the app and check the data whenever we want. This will be more beneficial for everyone as in every home there is at least one smart phone in these days.
- This mini weather station can be made much more compact and reliable with the inclusion of miniature components and by increasing the scaling factor. Also, it is very economical so that with low cost we can take the readings more accurate.

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X. FUTURE SCOPE

The project can be enhanced by using a sensor to note the soil moisture value such that usage of unnecessary fertilizers can be reduced. A water meter can be added to estimate the amount of water used water irrigation and thus giving cost estimation. Further, it also reduces the investment of farmers.

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