Smart Irrigation System using Raspberry Pi

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Abstract - In India most of people is doing work related agriculture directly or indirectly. An economy of India is mostly affected by agriculture related activities. To check water level of well, farmer have to go to farm and start water pump. Sometimes he has to go in night. If fire is spread in farm how farmer can know? If he know about it, he cannot do anything about it because many plants burned .In this paper, we made one smart irrigation system which will notify farmer on his registered mobile device and email address, if the soil is dry and it need watering, using soil moisture sensor and also notify by glowing bulb and start motor which is attached with main controller. System is also measuring the water level of well and notify the farmer two times a day. For fire detection we used flame detection sensor and if fire is there in farm system will notify the farmer and also bugger will blow.

Key points: Agriculture, Fire Detection, Raspberry Pi, Smart farming, Soil Moisture, Water Level

I. Introduction

One of the key activity smart farming is skills and times. Farmers should know at which time which plant will grow better. Cultivation takes huge amount of time and also money from farmer. So reducing the effort of the farmers is heavy task. It need various resource in large scale. To use modern technologies for farming is reduce human efforts as well as the time require to watering a farm or garden. If we compare traditional system with modern system, wastage of various resources is very high for example water is the important resource for cultivation.

In India, Agriculture is a major part of the GDP of the country. Most of people are doing farming in India. The agriculture field is involves in many industries in India. Let's say to make raw material for clothes we need cotton. So to get a cotton, people need to contact farmer or company that collect cotton from farmers. This is only one example there is many example like this. So basically agriculture is a backbone of the country. To growth of industries depends on the various fields. To make a vast amount of production in agriculture field farmer should know many things like moisture of soil, humidity, temperature, rain fall, etc. To make a cultivation smart we will make a fusion of traditional farming and modern technologies.

Using IoT, we can make communication between devices, machine and also services which based on internet. IoT is also help human to do work very easily. If we have look on policy of Internet of Things of Indian government, they have plan to invest 15 billion up to 2020 in Internet of Things. It is also state that it will help also other industries like agriculture, banking, retail

business, auto mobile, and more by making system automated which are used in it. This will help to increase IoT devices to 2.7 billion. Currently there are 200 million devices which are connected to internet in India. It is assume that India will have share 5-7 % in Global market of internet of things.

In agriculture there are more laborer work is there so using automation we can save laborer work and also reduce the size of human resources in cultivation. It is also improve quality and accuracy, saves lots of energy, material. To make this happen researcher and scientist collaborate with large industries and trying to make automatic system which is very efficient and effective. Using automation machine like fan, fridge, AC, lights can be run automatically i.e. depends on environment. It is makes a great use of available resources, like in home it saves electricity and in agriculture it saves water.

II. Literature Survey

Boselin Prabhu et.al proposed wireless sensor network system which is reduce the evaporation of water by drip irrigation. In this system, collect information from sensor and send it to the base station. Now when sensor send data to base station as packet so to reduce impact a packet author set a sensor in bulk mode. Now if plant need a water so base system start watering that plant using drip irrigation, these will save water as well reduce evaporation of water.

Minwoo Ryu et.al build a system to make a smart farming by connecting farms based on Internet of Things (IoT). In this they are using various sensors like temperature sensor, humidity sensors and CO_2 sensors. Now they are using REST APIs to transfer data, Mobius which is IoT supporting platform and Cube which is a middleware between physical devices i.e. sensor and Mobius. Data which is collected from sensors sends to Mobius using cube and end user send a request for particular farm using REST APIs to Mobius. End user can see result of request can see on Mobile Application

In This Paper [7] author proposed a system with wireless sensor network using RFID. In this system, author put soil moisture on different location in the field i.e. farm or it can be a farm and each sensor has its unique ID. Now sensor sends a data to ZigBee at 2.45 GHz. Now sensor sends that data to base station and if soli is dry then pump station will start sprinkling water only on that portion of the field.

Ravi Kishore Kodali et.al made a smart irrigation system based MQTT protocol. They are using Esp8266 NodeMCU-12E, soil moisture sensor and water pump. In this system Message Queue Telemetry Transport Protocol (MQTT) is used for transfer the data between Esp8266 NodeMCU-12E and the sensor. Soil moisture sends data to Esp8266 NodeMCU-12E, if soil is dry then Esp8266 NodeMCU-12E send instruction to water pump and water pump will start and after

moisture goes up by some value it will off the water pump. They are used LCD to display the current state of soil and water pump.

Sneha Angal build a system for plantation in office and home. In this system raspberry-pi, Arduino, ZigBee and soil moisture sensor is used. In proposed system raspberry pi is main control block and process the instruction send from Arduino. Here soil moisture sensor is connected to Arduino and ZigBee is an intermediate between raspberry pi and Arduino. This is a modular system so if any module is not working so user can change it. To enhancement of this system we can add GSM module to get status of soil and also watering plant by giving miscall on number of GSM module.

Mare Srbinovska et.al made a wireless sensor network system for smart farming based on vegetable greenhouse. In this system they are measuring humidity, temperature and illumination. First stage of this system is measure the capabilities of data transfer and choose the algorithm for data exchange. Second stage of proposed system is make decision on system design and development based on experimental results. And last stage is testing of wireless sensor network, analysis and optimization of results.

In this paper [13] they are focusing on very important issues of agriculture product. They made one system to identify the disease of tomatoes. They made one robot to shoot plant continuously. Now after that they made one algorithm for processing a video. The first phase is highly focusing on identify the tomato plant and the second phase is focusing on identify of tomatoes border to find out about diseases. To identify diseases they are using k-mean clustering algorithm.

Lala Bhaskar et.al build a system to improve the quality of food and improve the productivity. This system measure various factors like temperature, humidity and also water level of soil and notify on LCD. To monitor the data they used monitor and send a message to the farmer to inform about current status about farm via SIM900 module on farmer's register mobile number. They are using sensors like Soil Moisture sensor, Temperature Sensor. This system is useful to those farmers who has a power failure and non-uniform distribution of water due to power failure.

In this paper [5] author focused on a build low cost system because of that poor farmer can use it, make a step towards a smart farming. In this system they used raspberry-pi, soil moisture sensor and GSM Module. Now if soil moisture sense the dry soil then it will notify the farmer's registered device and also sends mail on registered email address. In proposed system author used Local Shortest Path (LSP) to control the wireless sensor network i.e. to get data from sensor using LSP.

In this paper [8] they proposed system which is focused on improvement of farming method, measuring PH rate to find out soil's dryness and also keep looking on temperature and water level. They used raspberry pi, LCD to display current status and GSM Module, soil moisture sensor and temperature sensor. Now when PH rate goes down from certain threshold value it will notify the user to improve farming method and also giving suggestion to farmer based on PH value. To measure temperature of soil they used LM35. In this system, they keep collect data to find water

level but doing nothing. So to improve this system we can we can take action of watering land based on water level of land. For that we can put miserable motor in the system and watering plant.

Ch Sumaliya et.al proposed a system at low cost. In this system they used ATMEGA328 as controller and soil moisture sensor and temperature sensor. They used a raspberry pi and ZigBee as a receiver to show the data into LCD. Now if moisture in soil goes down from specific threshold value it will ring up buzzer and show status on LCD. When moisture goes up from threshold value they start submersible motor and buzzer will off. In this system they don't use wireless connection so to enhance this we can make a wireless system. We can also add temperature sensor to measure temperature and give instruction to miserable motor accordingly.

In this paper [10] they focused on a saving water using smart irrigation system. They are mainly focusing on gardens, plants and park for providing water automatically. They also supplying water based on requirement like which plan need more water and which plan require less water. They are using microcontroller to check the requirements and it is getting data from soil moisture sensor and temperature sensor. To improve this system we can used water level and supplying water accordingly i.e. if water level is law then plant who need watering only that plant can get water.

Md Saifudaullah Bin Bahrudin et.al proposed stayem for fire detection. In this sytem they are used raspberry pi, Arduino Uno, Smoke detector sensor, camera module and GSM module. When smoke is detected system is click a photo and display it to the website. Now it takes a confirmation from user that fire is there or not. If fire is there then it send SMS to fire brigade about fire. Now using this system we can reduce to false positive because camera click the photo and it consume small amount of storage to store image.

In this Paper [3] made a system for Smart irrigation and whether monitoring system. For that they consider certain parameter like soil moisture, humidity, temperature, rain fall, wind speed, radiation, and wind direction. They are measured soil moisture to find out the dryness of soil and rain sensor sense evaporation rate of soil. So if soil moisture goes down from user defines value it start the watering and also sends a message using SIM300. A device called anemometer is used for mapping a wind speed. These data is upload on server and from that they are displaying data on LCD.

III. Component Description

In this system there are many components are used like raspberry pi, GSM module, soil moisture sensor, flame detection sensor, ultra-sonic sensor and buzzer.

3.1 Raspberry PI

Raspberry Pi is nothing but a computer and it has ARM processor which is very powerful and light weight. It also has USB ports, Wi-Fi modules (Raspberry Pi 3 Model B), HDMI port and Ethernet Port. Raspberry Pi has its own OS like Raspbian, Ubantu MATE, Snappy Ubantu, Pidora, Linutop, SARPi, Arch Linux ARM, Gentoo Linux, Free BSD, Kali Linux, RISC OS Pi [18]

Fig 1: Raspberry Pi

It is like small computer it has multimedia application support. It is because of HDMI and graphics support. But it has also some limitation it doesn't have Hard Disk Drive (HDD) or Solid State Drive (SSD) but we can put Micro SD card in it so we can boot the OS of Raspberry Pi.

3.2 Soil moisture sensor

In IoT (Internet of Things) sensor is important part of the system, without it system cannot be working like heart in human body. Using sensor, it takes physical parameter from world and convert it into electronic system and send it to main controller for ex. Raspberry Pi. One of the sensor which this system used is soil moisture sensor. This sensor is used for measuring level of soil. Output of this sensor can be analog signal or it can be digital signal. It has two cooper electrodes which is used for measure moisture from the soil.

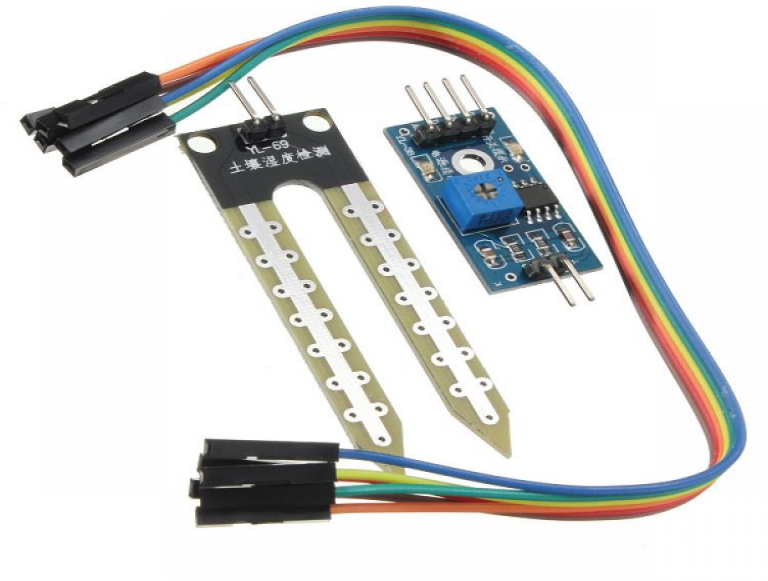

Fig 2: Soil Moisture Sensor

To make cultivation better, farmer have to know moisture level of soil and this sensor is doing same things, so soil moisture sensor is important for farming related application. Actually if farmer knows exact moisture level of soil it will be helpful to saving water and also improve the quality of plant. Because if it take care of plant during its growing stage it will be give good quality product.

3.3 Flame detection sensor

Flame detector sensor is used to detect flame and also responds accordingly. It used for detecting fire. To detect fire there two more sensor is there heat detector sensor and smoke detector sensor. After detection of fire, responding is depends on the how installation is done. For ex. Some installation have alarm or buzzer to notify user, if it is implemented in fuel line then it is deactivating it.

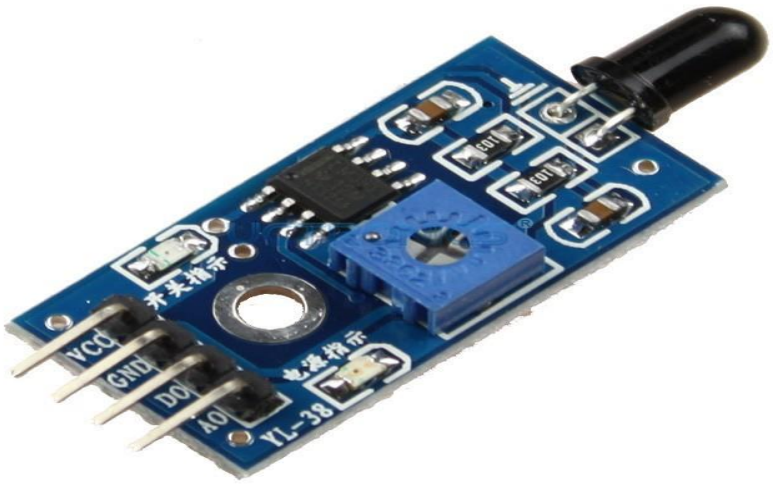

Fig 3: Flame Detection Sensor

In those three sensor for which is used for fire detection, flame detector sensor response faster as compare to smoke detection and heat detection.

3.4 Ultra-sonic sensor

To find the distance between to an object ultra-sonic sensor is used. Ultra-sonic sensor is using sound waves to measure distance. To measure distance first it send a sound wave towards the object at specific frequency and waiting for same frequency signal to come back from object. Now when sound waves arrive back it record the time between sending and receiving sound waves, using time it is possible to find out the distance between objects.

Fig 4: Ultra-Sonic Sensor

3.5 Buzzer

Buzzer is a device which is used for audio signaling device, which may be used anywhere for ex.as an alarm device, as a timer, as a confirmation of a user input such as a mouse click. It is also known as Beeper.

Fig 5: Buzzer

3.6 Servo Motor

Servo motor contains following things: DC motor, position sensing device gear reduction unit and a control circuit. The source of power in motor is battery and it is running at high speed and low torque. The position sensor is used for sense a position and send the information to the control circuit.

Figure 6: Servo Motor

IV. Methodology

In this system, we used raspberry pi, soil moisture sensor, flame detection sensor, ultra-sonic sensor, buzzer and servo motor. Raspberry pi is a heart of the system i.e. main controller of the system. In this system we used raspberry pi b+ which has number of new feature. It has improved IO, also increased connectivity as compare to older version of pi.

Soil moisture is directly connected to raspberry pi. Now when sensor sense data, it will transfer that data to raspberry pi. Raspberry pi reacting as per data received from soil moisture sensor. If soil is dry i.e. sensor isn't detecting moisture it will sends message to farmer's registered mobile number and registered email address and also glowing LEDs and start the motor.

Flame detection is used for detect fire in a farm. Flame detection sensor takes data from field and send it to raspberry pi. Now if fire is there we will send message to farmer's registered mobile number and registered email address. Simultaneously we blow up buzzer.

With ultra-sonic sensor we are measuring water level in well. Now for measure water level in well, we will take depth of and radius of well from farmers. Now with ultra-sonic sensor we will measure the current water level in the well and calculate water level from the bottom of the well and also calculate how much water is there in well. After that we will send it to farmer's registered mobile number and registered email address.

V. Results

Fig 7 is a figure of raspberry pi with attached jumper cable and Fig 8 shows raspberry pi with soil moisture and LEDs.

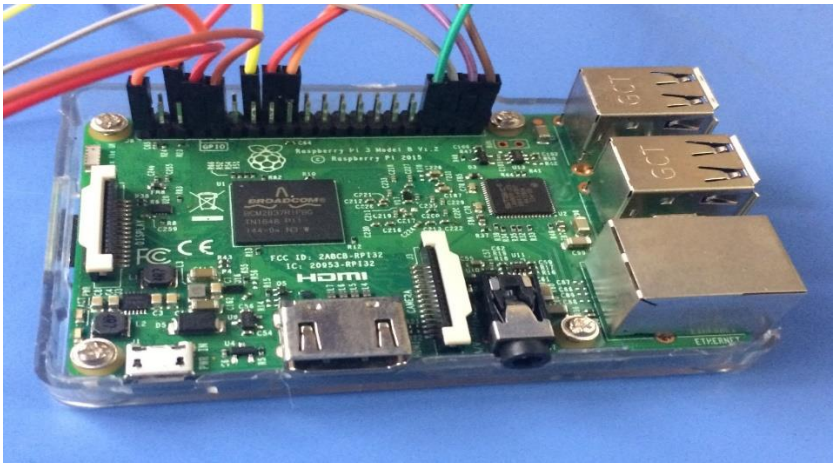

Fig 7: Raspberry pi with jumper cable

Fig 8 shows connection pins in Raspberry pi with sensors and LEDs. We used LEDs instead of water motor. There are five LEDs which are connected at different Pins like 13, 19, 23, 24, 26 and we connect soil moisture sensor at Pin 17 and also connect servo motor at Pin 22. We connected sensor at 3.3 V Pin 1. We are using Wi-Fi module to connect raspberry pi with our computer. We used python for implementation.

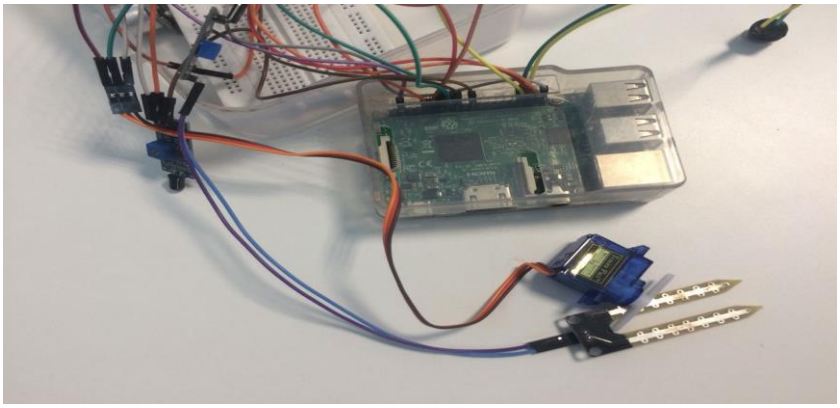

Fig 8: Connection of Soil Moisture and LEDs with Raspberry Pi

In this system we sense moisture of the soil using soil moisture sensor. We take input from pin 17. If it is 0 then sensor doesn't sense moisture otherwise it is sense moisture. Now if sense data is 0 for 3 times continuously, we are sending mail to farmer. Now system will start motor and glows LEDs continuously until sensors sense moisture 6 times continuously.

Fire Detection is the second module of this system. Fire is a most dangerous things for farmer. So if fire is on farm system will send Email as well as message to the farmer. Fig 9 shows connection between raspberry pi and flame sensor.

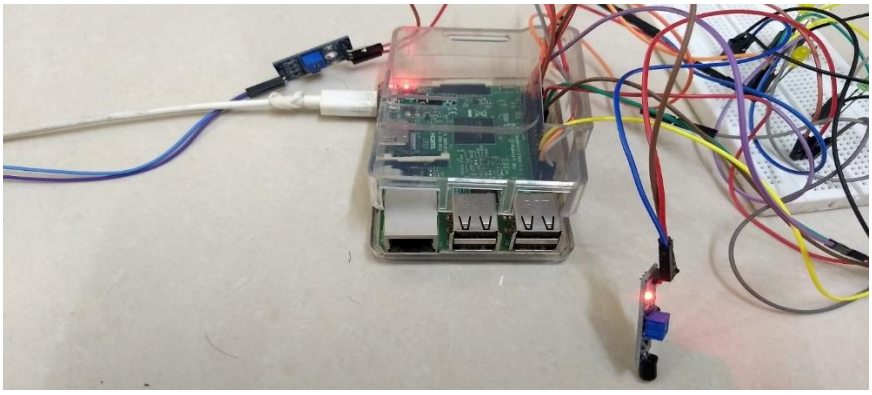

Fig 9: Connection of Flame Sensor with Raspberry Pi

Now, system will continuously keep checking that fire is there in farm or not. If fire is there system will send notifications to the register user. If fire is not there then system will send message "Farm is safe" otherwise system will send "Fire in your farm please call fire brigade"

Generally Ultra-Sonic Sensor is used for finding out the distance. In this system, it is used for finding out how much water is there in well. Fig 10 shows the connection of Ultra-Sonic Sensor and raspberry pi.

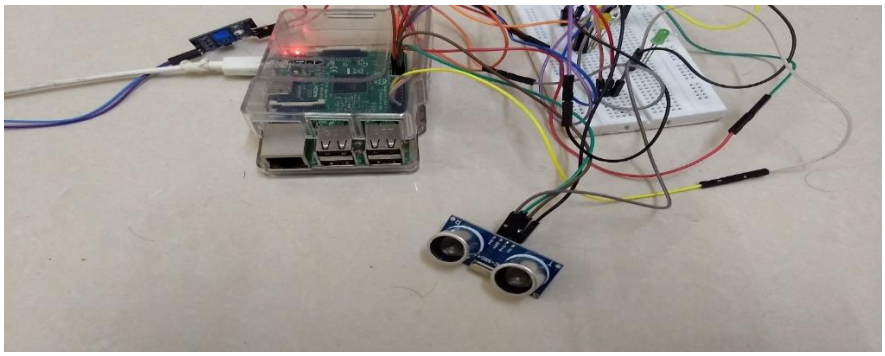

Fig 10: Connection of Ultra-Sonic Sensor with Raspberry Pi

To find out the water level in the well, system will calculate the distance between sensor and water and then minus this distance from actual distance. Now to find out how much water is there we are using one formula, which will give result in a liter.

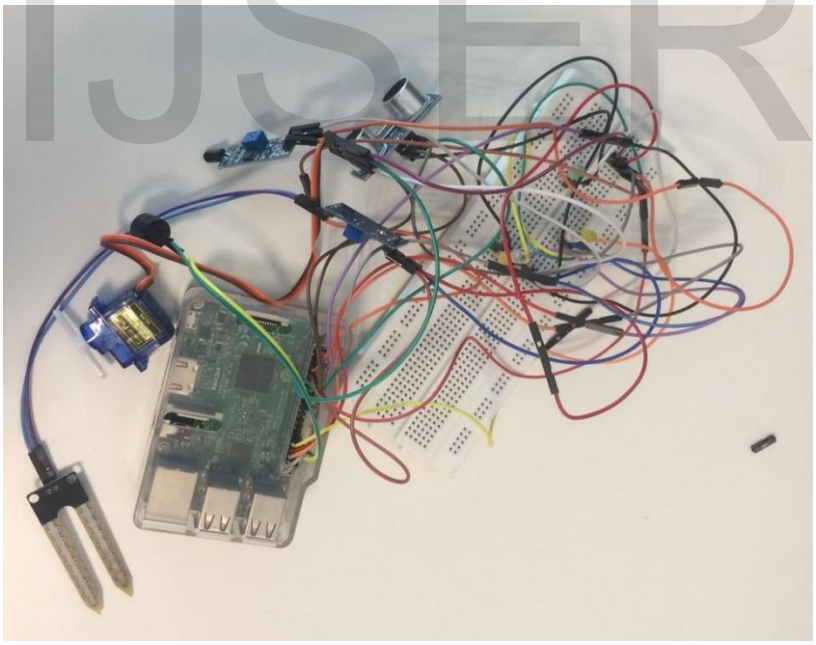

Fig 11: Smart Irrigation System

Fig 12: Results

VI. Conclusion

6.1 Conclusion

Overall, this paper provides a novel approach to save a water usage and make irrigation system better. Raspberry pi is an important part of system which is handle the processing and working. In this proposed system we used many sensors like soil moisture to measure moisture of soil, flame detection sensor to detect fire and also ultra-sonic sensor to find the water level in well. GSM module to notify the farmers about current state of the farms.

If soil needs water we will send message as well as email to farmer about water and water level. To notify the farmer about dryness we set threshold value. If count goes up to that count system will notify the farmer. Now if fire is there in farm, system will also notify famer about it via message and email. System also send notify about water level of well.

6.2 Future Scope

This system is provides very huge future scope. It can be comprehend in many ways. One way is to add camera module to it. When flame sensor detect fire, camera module click picture and put it in website or send it in mail. And take input from user that there is fire or not if it is there send message to fire bridge.

Another way is attach different type of sensor like humidity sensor, measuring fertilizer and also attach temperature sensor to generate more data about soil. Another way is to join water pump to the system and when moisture goes down system will atomically start the motor.

This type of agriculture application of Internet of things in the real world environment is necessary to know the effect of the environment on such system. So is always better to know the risks beforehand.

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