CHAPTER: 1

INTRODUCTION

INTRODUCTION

Solar energy is the best promising natural-renewable energy source for a green future, it has a lesser ecological impact as compared to other usual energy sources. Oil, Coal, Gases are conventional but nonrenewable sources of energy, they will run out very soon if exploited at .Currently, photovoltaic (PV) solar energy characterizes as the third largest source of renewable energy equator hydro and wind. The global investment in photo- voltaic solar systems increased because of transformation in favorable government policies and a reduction in the cost ofthe PV component. These aspects give rewards for investment in solar systems which is more motivating. PV system faces some problems after installation like dirty surface, damaged connections, and junction box failure results in a reduction in all-over system performance. IOT is a topology of the linked smart sensors and software that allows the things to assemble and transmit data using the internet. IOT based appliance is very supportive for monitoring the system at cheap cost.Solar panel's energy is affected by environmental conditions. Using sensors we can directly collect details about environmental conditions like humidity and temperature of that location. The real-time monitoring system using IOT shows the current status of generated energy, humidity, temperature, a fault at the panel level and details of dead panels . A defect can be detected by collecting and analyzing each sensor's data. Electrical parameters observation generally creates a huge quantity of data. The collected data used by artificial intelligence for power forecasting principles. Electrical solar power production is decentralized in nature and it's difficult to monitor a large amount ofdata. Real-time research of solar system is a very complicated task, as it demands a precise PV emulator that may specifically reproduce then on-linear character of PV cells.

It also conflicts realization cost, accuracy, efficiency, complexity, sensitivity with varying environmental conditions .According to author Arun G. Phadkeet by Wide Area Monitoring (WAM), it is possible to assemble dimensions remotely from different places of power systems. Monitoring PV panels perform supervision along with faultrecognition. The fault finding process assists for the recognizing diagnosis of the solar plant system, which depends on the study of voltage and current factors anticipated from monitored data of a PV .

CHAPTER:2

LITERATURE SURVEY

LITERATURE SURVEY

Purusothaman, SRRDhiwaakar, etal*:** Explain about the focus is on the DGagents, gridagent and Muagents.DGagentslikethe distributed energy resources (DERs), load, storage and the grid agents. The Mu agent acts as the communication channel between the DG agents to the higher level agents such as the control agent. The imple mentation of the system using an Arduino microcontroller .Author Kabalci ,Ersan, Alper Gorgun ,and Yasin Kabalci:*** **Introduces** Aninstant monitoring in frastructure of a renewable energy generation system that is constituted with a wind turbine and solar panel arrays. The monitoring platform is based on current and voltage measurements of each renewable source. The related values are measured with the developed sensing circuits and processed by an18F4450 microcontroller of Microchip. The processed parameters are then transmitted to a personal computer (PC) over universal serial bus (USB) to be saved in a database and to observe the system instantly. The coded visual interface of monitoring software can manage the saved data to analyze daily, weekly and monthly values of each measurement separately. ***Jiju, K., et al*:** Describes the development of an online monitoring and control system for distributed Renewable Energy Sources (RES) based on Android platform. This method utilizes the Bluetooth interface of Android Tablet or Mobile phone, as a communication link for data exchange with digital hardware of Power Conditioning Unit(PCU). *Goto,Yoshihiro,* explained about an The system Is used to operate and maintain more than 200,000 telecommunication power plants, of the system are the integrate the management and remote monitoring functions, into one system and improved user interfaces, which use information and communication technology such as web technology. ***Suzdalenko, Alexander, and Ilya Galkin:*** Identify the problem of the non-intrusive load monitoring method of Shashank Shetty, Sanket Salvi. This introduces the SAF-Sutra: A Prototype of Remote Smart waste segregation and garbage level monitoring system, which can remotely monitor and is built at a very minimal cost. Therefore, the dustbin is integrated with the ***Nkoloma, Mayamiko, Marco Zennaro, and Antoine Bagula:*** Describes recent work on the development of a wireless based remote monitoring system for renewable energy plants in Malawi. The main goal was to develop a cost effective data acquisition system, which continuously presents remote energy yields and performance measures. The project output gives direct access in remote rural sites can be evaluated efficiently at low cost .***Nkoloma ,Mayamiko, MarcoZennar.***

CHAPTER:3

REQUIREMENT ANALYSIS

REQUIREMENTANALYSIS

➢ Hardware Requirements:

NO.	COMPONENTS	QUANTITY
1	ESP32devboard	799/-
2	Solar panel	2250/-
3	wires required (as per requirement)	150/-
4	A lithium battery(7.4vpreferred).	80/-
	Active Wi-Fi connection	00/-
5	Temperature sensor for the solar panel	125/-
6	Capacitor, resistor	30/-

➢ Software Requirements:

1. Active Wi-Fi connection
2. Thing Speak (IOT)
3. Arduino (1.8.19.window)

CHAPTER:4

METHODOLOGY

METHODOLOGY

In this section we present the system design of the Solar Energy Monitoring System.

System Design*:* The proposed system is for monitoring of solar energy using IOT. Solar panel helps to store the energy in the battery. Battery has the energy which is useful for the electrical appliances. Battery is connected to The ESP32 is a microcontroller which is used to read the sensor values. Current sensor and voltage divider are connecting to the Solar circuit and solar panel. The data from the ESP32 is display on the webpage through Thingspeak .The monitoring data upload to the cloud through arduino as shown in the Fig1..

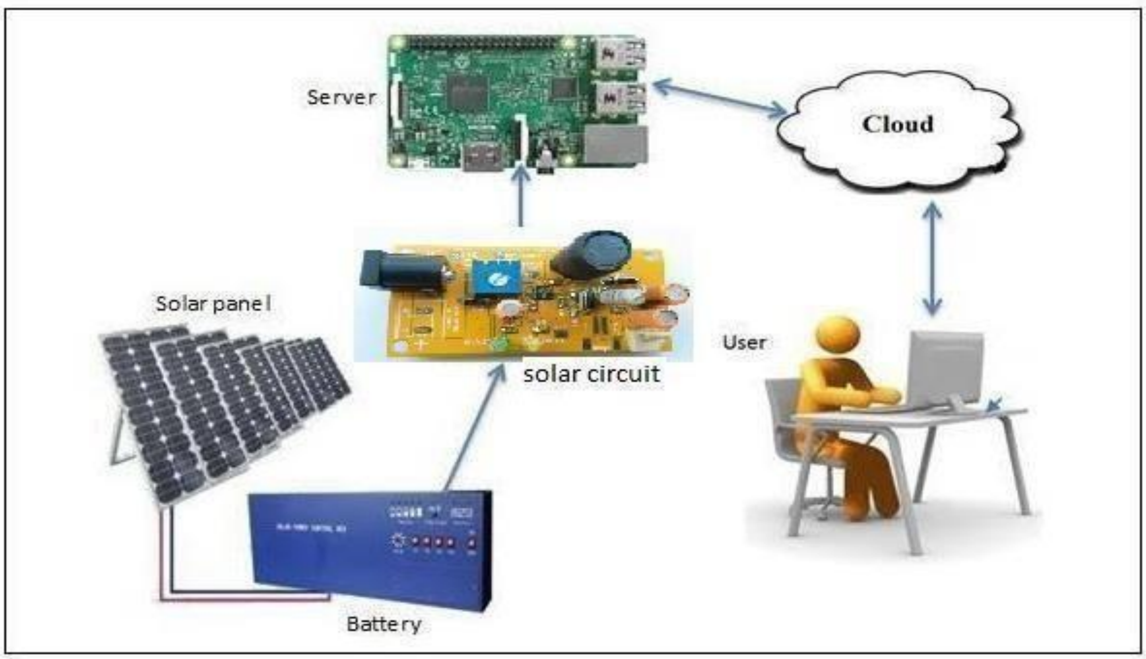


Fig1.SystemDesign

CHAPTER:5

BLOCK DIAGRAM

BLOCKDIAGRAM

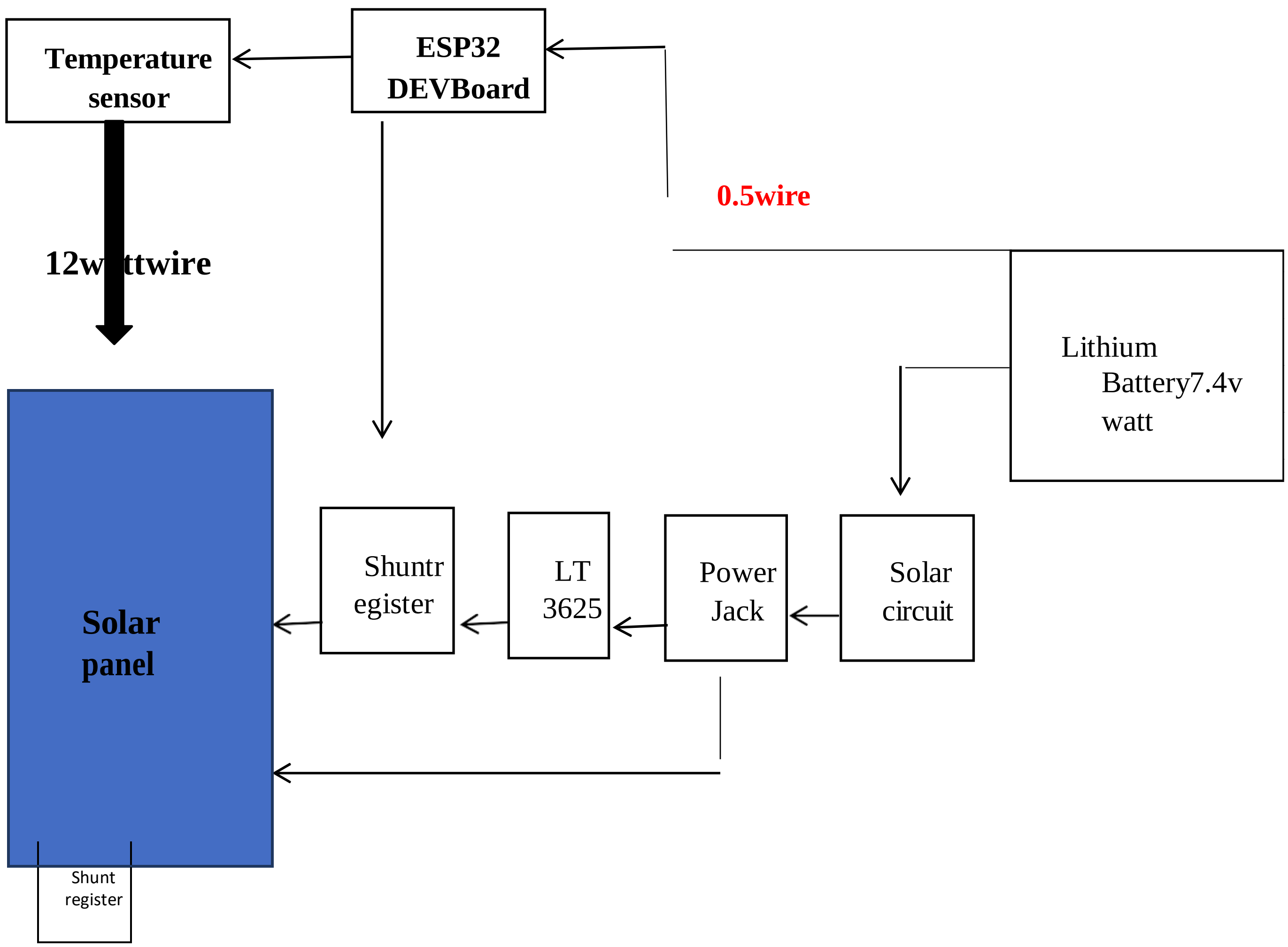


Fig2.BLOCKDIAGRAM

CHAPTER:6

DETAILS OF DESIGN,WORKING AND PROCESS

DETAILS OF DESIGN, WORKING AND PROCESS

ESP32:-

Is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi anddual-modeBluetooth.TheESP32seriesemployseitheraTensilicaXtensaLX6microprocessorin both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low- noise receive amplifier,filters,andpower-managementmodules.ESP32 is created and developed by Espressif Systems,aShanghai-Based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a success or to the ESP8266 microcontroller.

❖ FeaturesOfESP32:-

- Processors:
  - CPU:Xtensadual-core(or single-core)32- bitLX6microprocessor,operating at 160or240MHzand performing at up to 600 DMIPS
  - Ultralow power(ULP)co-processor
- Memory:320KiBRAM,448KiBROM
- Wireless connectivity:
  - Wi-Fi:802.11 b/g/n
  - Bluetooth:v4.2BR/EDRandBLE(shares thera dio withWi-Fi)
- Peripheral interfaces:
  - 34×programmableGPIOs
  - 12-bit SARADCupto18channels
  - 2×8-bitDACs
  - 10×touchsensors(capacitive sensing GPIOs)
  - Infrared remote controller(TX/RX,upto8 channels)
  - Motor PWM
  - LEDPWM(upto16channels)

- Security:
  - Secure boot
  - Flash encryption
  - 1024-bitOTP,upto768-bitforcustomers
- Power management:
  - Intern allow-drop out regulator
  - Individual power domain for RTC
  - 5µAdeepsleepcurrent

- **Voltage Divider:-**

A voltage divider is an essential part of the Solar panel voltage measurement. One should choose a voltage divider that will divide the voltage as per the microcontroller I /O voltage input

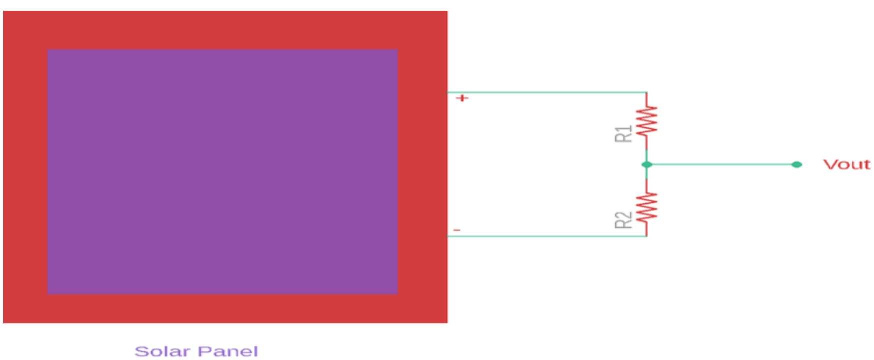


Fig3.Voltage Divider

Choose the above resistors in such a way that the voltage divider output voltage should not exceed the microcontroller maxim I/O voltage (3.3V for ESP32).However, it is advised to use a potentiometer because it will provide flexibility tochooseanysolarpanelhigherorlowervoltageratingandcaneasilysetthe voltage using a multimeter. In our case, we have a potentiometer in the MPPT board circuit that acts as a voltage divider. We set the voltage divider with adivisionfactorof6V.Weconnectedtwomulti-meters,onein theinputand

- **Temperature sensor:-**

Temperature Sensor for the Solar Panel Solar panel power output has a direct connection with the temperature of the solar panel. Why? Because as a solar panel's temperature starts increase the output current from the solar panel increases exponentially while the voltage output starts to reduce linearly. As per the power formula, Wattage is equal to voltage times current (W = V x A), decreasing output voltage alsodecreasesthe solar panel output power even after the increase of currentflow.Now,thenextquestionthatcomestoourmindis,howtomeasuresolartemperature? Well, it is rather interesting as solar panels are generally exposed to the heat environment as it is exposed to direct sunlight and for obvious reasons. The best way to measure solar panel temperature is by using a flat surface temperature sensor. It is also suggested to use a K type thermocouple placed directly in the solar panel. Forour application, we have used a thermistor -based temperature sensor module, whichis shown below.

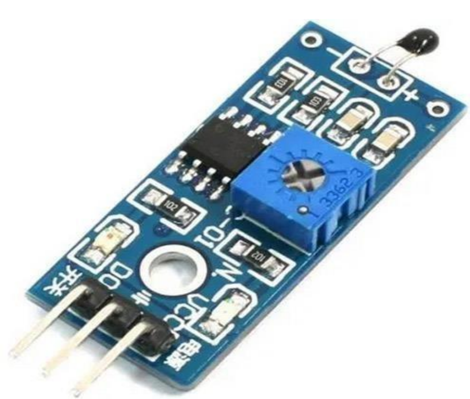
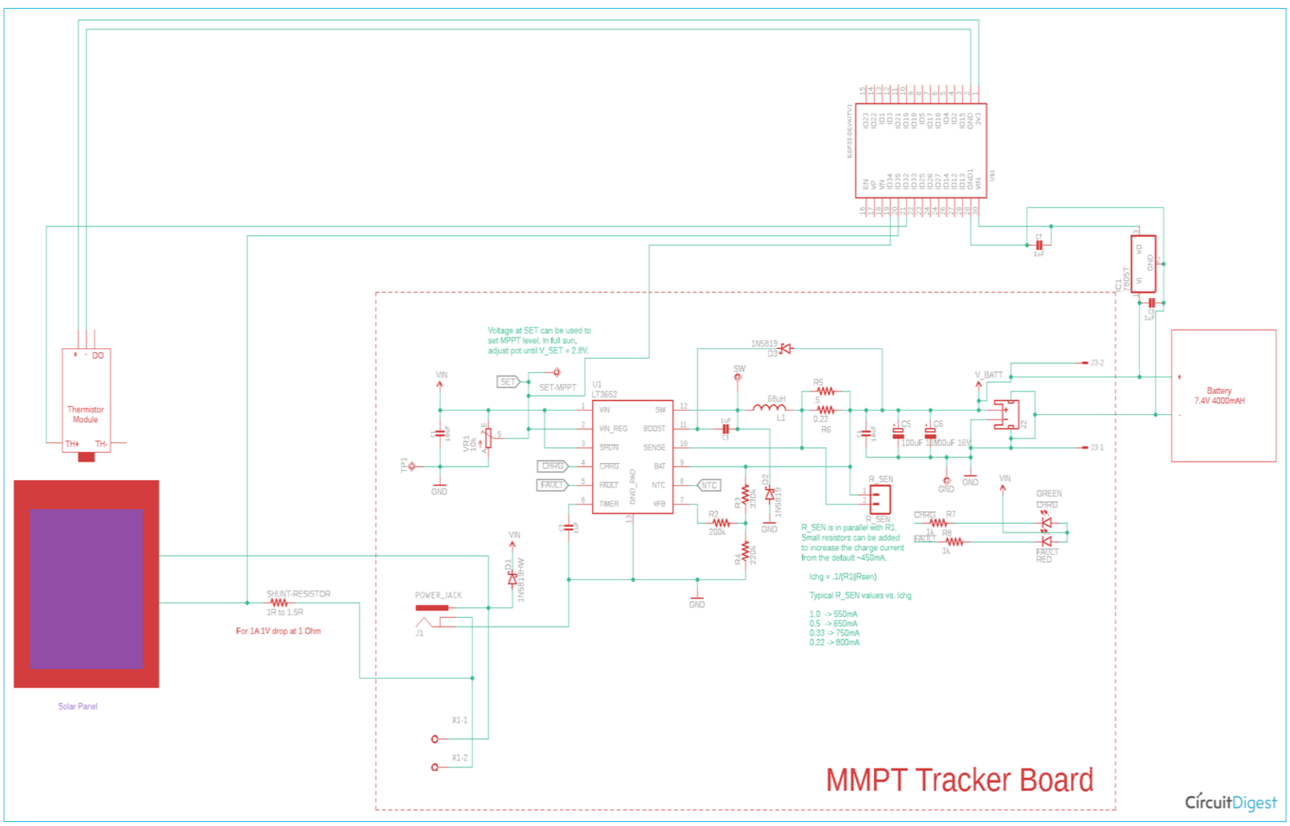


Fig4.Temperature sensor

CIRCUITDIAGRAM

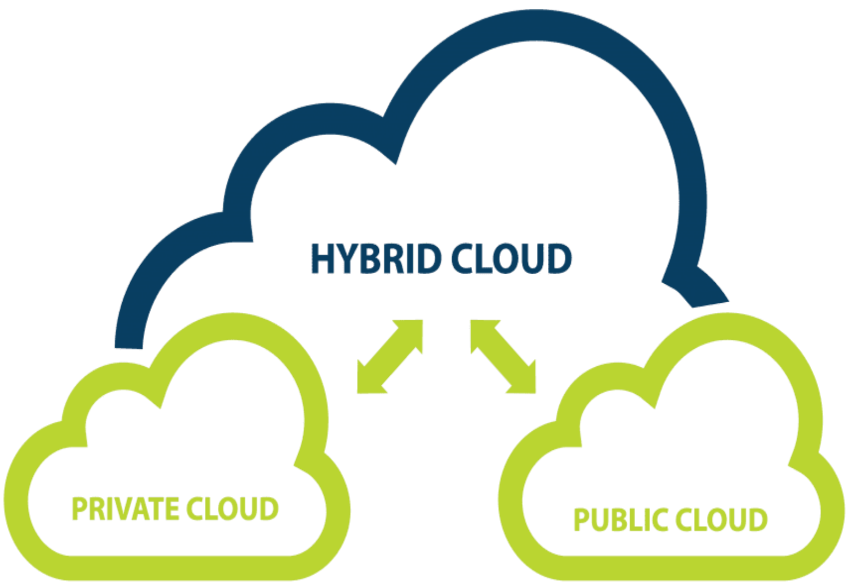


`

Fig5.Circuitdiagram

➢ **Cloud Setup:-**

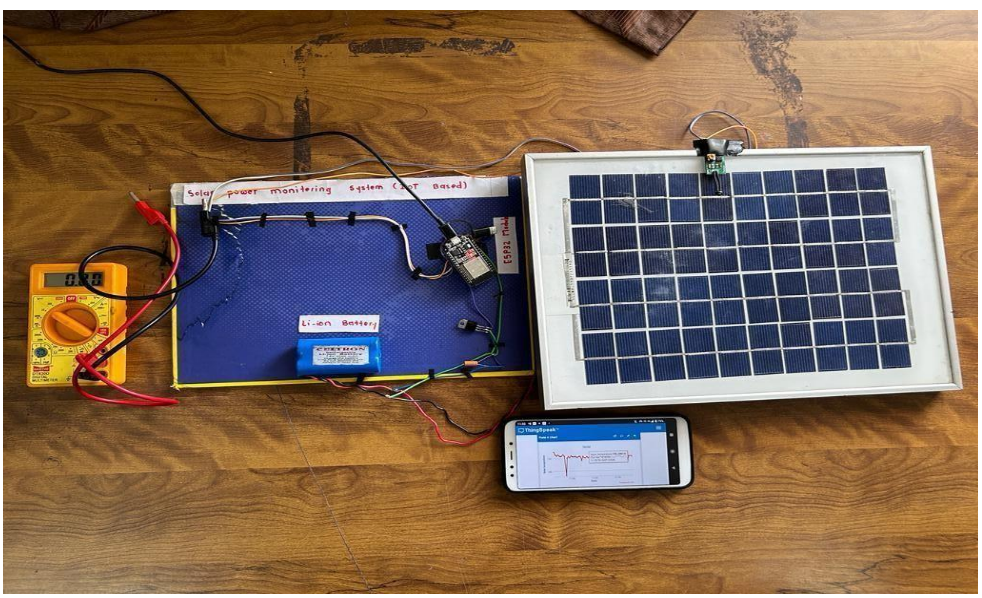
Thing Speak is an open source IOT application and API to store and retrieve data from things using the HTTP protocol over the Internet or viaa Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates. The user should create the account first. The account contains channels which are separate for different projects. Channel has the fields which the monitoring system. After assigning the parameter the system upload the values to it. The cloud has built-in functions in itwhich represent the values in the form of graphs.



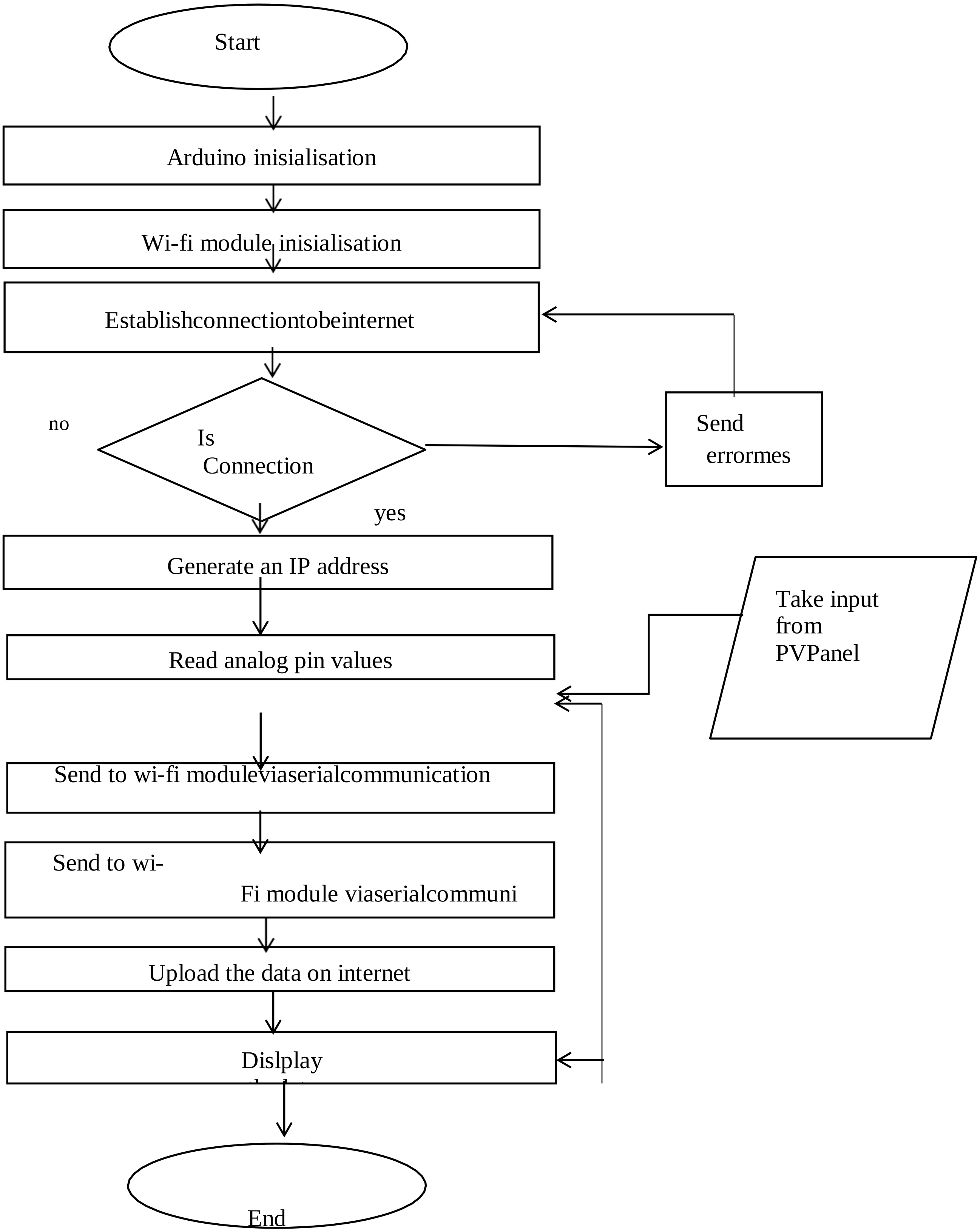
- **HARDWARESETUP:-**

Fig:6:o/p1^{st}-3^{rd}daydataanalyzed

Hardware setup and output



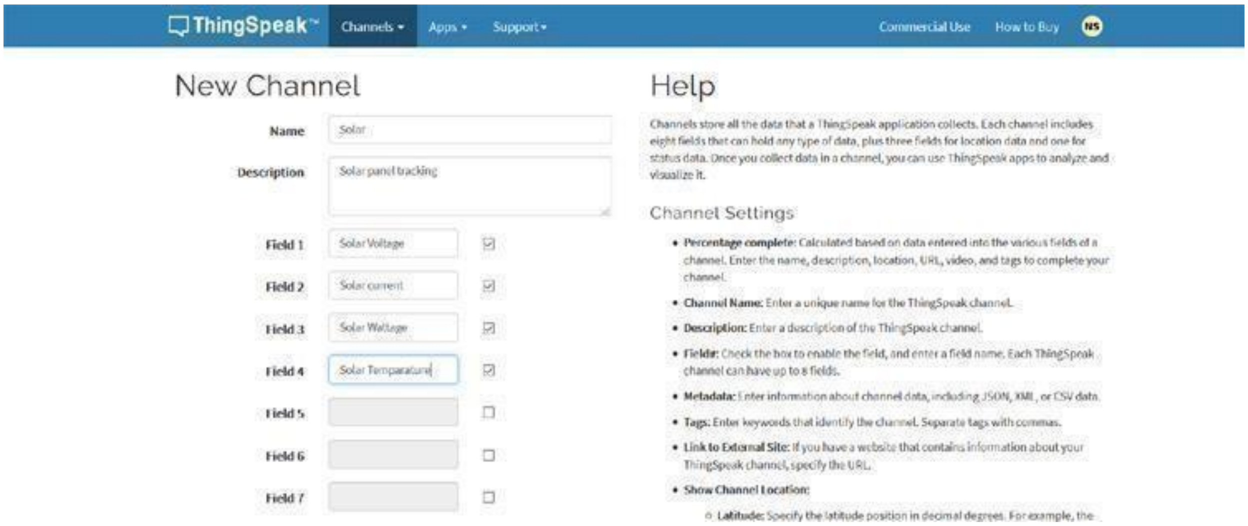
- **FLOWCHART:-**


Start
Arduino inisialisation
Wi-fi module inisialisation
Establishconnectiontobeinternet
no
Is
Connection
Send
errormes
yes
Generate an IP address
Take input
from
PVPanel
Read analog pin values
Send to wi-fi moduleviaserialcommunication
Send to wi-
Fi module viaserialcommuni
Upload the data on internet
Dislplay
End

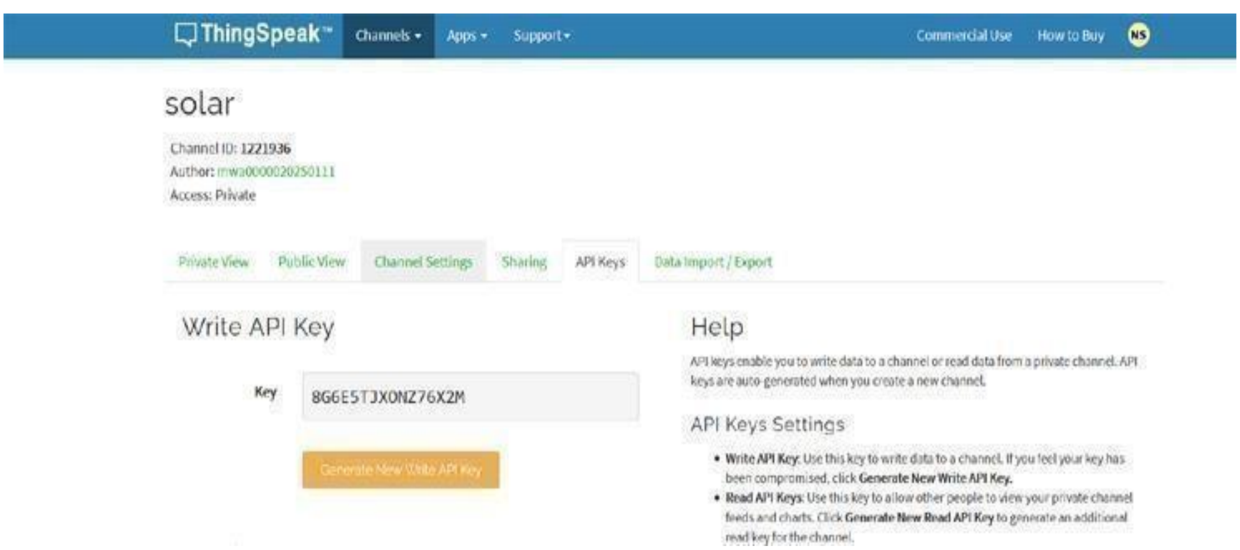
- **Step1:InstallingThingspeakNecessary**

Setting up the Thing Speak Create an account with Thing Speak and go to the “my channel” option, then click on the New Channel.

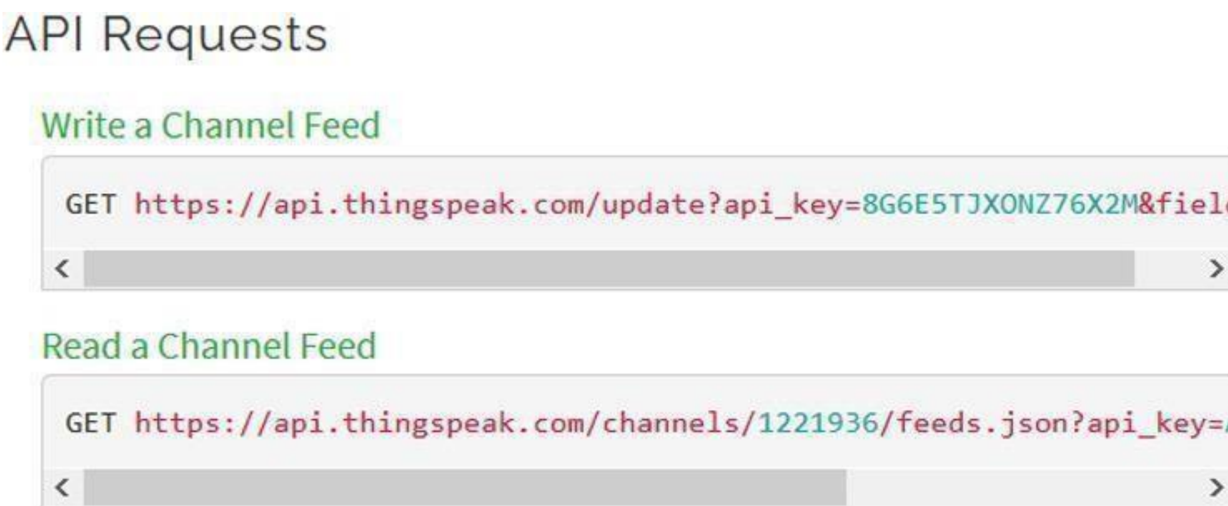
Createanewchannelwiththefieldnames.Fig4.Temperaturesensor



- Thing Speak Setup
- Now after setting the field, go to the API Keys field where the Write API Key is available. This key needs to be provided in the code as well as the channel ID.



- The ThingSpeak address can be found on the same page.
- ThingSpeak API Request



- With the above steps, you can set up ThingSpeak very easily. If you want to learn more about ThingSpeak and its setup process, you can check out our previous articles on the topic.

Step2:ArduinoCodeforSolarPowerMonitoringusingESP32:-

- ThecompleteESP32solar power monitoring code can be found at the bottom of this page. The code begins with defining your SSID, Password, and a few other constant parameters.
- In this field ,the SSID and Password need to beset.
- The thermistor nominal ohms is provided at the nominal temperature. Set this value depending on the data sheet of the thermistor. coefficient and series resistor value of the thermistor. The PINs aredefined over
- Put the thing Speak Address, channel ID, Write Feed API Key. The rest of the things are not required but are still useful if data needs to be received from the web.

- The ThingSpeak server is initialized and a task is created that will get the data related to the solar panel.
- In the main loop, the solar current and voltage are sensed via an analog pin and the average is done.
- Thetemperatureisgeneratedfromthethermistorusingalogarithmicformation.
- Thedataisreadevery15seconds.
- The data for respective fields is transmitted using the function Thing

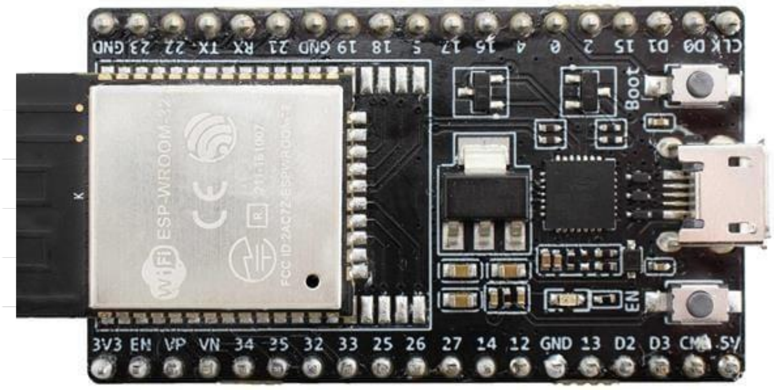
Speak. Set Field (); when the Wi-Fi is connected.

CHAPTER:7

Components Information

Product Reference Manual

KU:A000066



scription:-

For an IOT-enabled application, it is essential to choose the right type kind of development board that will be able to process the data from its analog pins and send the data viaany kind of connection protocol such as Wi-Fi or to the cloud server. We specifically selected ESP32 as it is a low-cost microcontroller with tons of features. Also, it has a built-in Wi-Fi radio through which we can connect to the internet veryeasily.

rget areas:

Maker ,introduction ,industries

Features

- ESP32 **Processors**
  - CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
  - Ultralow power (ULP) co-processor

Memory

- 320 KiB RAM
- 448 KiB ROM

Security

- IEEE 802.11 standard security features all supported, including WPA, WPA2, WPA3 (depending on version)[5] and WLAN Authentication and Privacy Infrastructure (WAPI)
- Secure boot
- Flash encryption
- 1024-bit OTP, up to 768-bit for customers
- Cryptographic hardware acceleration: AES, SHA-2, RSA, elliptic curve cryptography (ECC), random number generator (RNG)

Peripherals

- 34 × programmable GPIOs
- 12-bit SAR ADC up to 18 channels
- 2 × 8-bit DACs
- 10 × touch sensors (capacitive sensing GPIOs)

- 4 × SPI
- 2 × I²S interfaces
- 2 × I²C interfaces
- 3 × UART
- SD/SDIO/CE-ATA/MMC/eMMC host controller
- SDIO/SPI slave controller
- Ethernet MAC interface with dedicated DMA and planned IEEE 1588 Precision Time Protocol support
- CAN bus 2.0
- Infrared remote controller (TX/RX, up to 8 channels)
- Motor PWM
- LED PWM (up to 16 channels)

Memory

- 320 KiB SRAM
- 320 KiB RAM
- 448 KiB ROM

Power

- 3.3 V DC

CONTENTS

Contents

1. OVERVIEW

ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth combo chip designed with the TSMC ultra-low- power 4 0n m technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of applications and power scenarios. The ESP32 series of chips includes ESP32-D0WD-V3, ESP32-D0WDR2-V3, ESP32-U4WDH, ESP32- S0WD,ESP32-D0WDQ6-V3 (NRND), ESP32-D0WD (NRND), and ESP32-D0WDQ6 (NRND), among which, ESP32-D0WD-V3, ESP32-D0WDR2 -V3, ESP32-U4WDH, and ESP32-D0WDQ6-V3 (NRND) are based on ECO V3 wafer. For details on part numbers and ordering information, please refer to Section. For details on ECO V3 instructions, please refer to *ESP32 ECO V3 User Guide*..

FEATURED SOLUTIONS

Ultra Low Power Solution

ESP32 is designed for mobile, wearable electronics, and Internet-of-Things (IOT) applications. It features all the state-of-the-art characteristics of low-power chips, including fine-grained clock gating, multiple power modes, and dynamic power scaling. For instance, in a low-power IOT sensor hub application scenario, ESP32 is woken up periodically only when a specified condition is detected. Low-duty cycle is used to minimize the amount of energy that the chip expends. The output of the

> Note:
> For more information, refer to Section 3.7 *RTC and Low-Power Management*.

power amplifier is also adjustable, thus contributing to an optimal trade-off between communication range, data rate and power consumption.

Complete Integration Solution

ESP32 is a highly-integrated solution for Wi-Fi-and-Bluetooth IOT applications, with around 20 External components. ESP32 integrates an antenna switch, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. As such, the entire solution occupies minimal Printed Circuit Board (PCB) area.

ESP32 uses CMOS for single-chip fully-integrated radio and baseband, while also integrating Advanced calibration circuitries that allow the solution to remove external circuit imperfections or adjust to changes in external conditions. As such, the mass production of ESP32 solutions does not require expensive and specialized Wi-Fi testing equipment.

WiFi

Key Features

- 802.11 n (2.4 GHz), up to 150 Mbps
- WMM
- TX/RX A-MPDU, RX A-MSDU
- Immediate Block ACK
- Defragmentation
- Automatic Beacon monitoring (hardware TSF)
- 4 × virtual Wi-Fi interfaces
- Simultaneous support for Infrastructure Station, SoftAP, and Promiscuous modes Note that in Station mode, performing a scan, the SoftAP channel will be changed.
- Antenna diversity

Bluetooth Key Features

• Compliant with Bluetooth v4.2 BR/EDR and Bluetooth LE specifications

• Class-1, class-2 and class-3 transmitter without external power amplifier
• Enhanced Power Control

• +9 dBm transmitting power

• NZIF receiver with –94 dBm Bluetooth LE sensitivity

• Adaptive Frequency Hopping (AFH)

• Standard HCI based on SDIO/SPI/UART

• High-speed UART HCI, up to 4 Mbps

• Bluetooth 4.2 BR/EDR Bluetooth LE dual mode controller

• Synchronous Connection-Oriented/Extended (SCO/eSCO)

• CVSD and SBC for audio codec

• Bluetooth Piconet and Scatternet

• Multi-connections in Classic Bluetooth and Bluetooth LE

• Simultaneous advertising and scanning

MCU and Advanced Features

CPU and Memory

• Xtensa® single-/dual-core 32-bit LX6 microprocessor(s)

• CoreMark® score:– 1 core at 240 MHz: 504.85 CoreMark; 2.10 CoreMark/MHz – 2 cores MHz: 994.26 CoreMark; 4.14 CoreMark/MHz

• 448 KB ROM

• 520 KB SRAM

• 16 KB SRAM in RTC

• QSPI supports multiple flash/SRAM chips

Clocks and Timers

- Internal 8 MHz oscillator with calibration
- Internal RC oscillator with calibration
- External 2 MHz ~ 60 MHz crystal oscillator (40 MHz only for Wi-Fi/Bluetooth
- External 32 kHz crystal oscillator for RTC with calibration
- Two timer groups, including 2 × 64-bit timers and 1 × main watchdog in each group
- One RTC timer
- RTC watchdog

Advanced Peripheral Interfaces

- 34 × programmable GPIOs
- 12-bit SAR ADC up to 18 channels
- 2 × 8-bit DAC
- 10 × touch sensors
- 4 × SPI
- 2 × I2S
- 2 × I2C
- 3 × UART
- 1 host (SD/eMMC/SDIO)
- 1 slave (SDIO/SPI)
- Ethernet MAC interface with dedicated DMA and IEEE 1588 support
- TWAI®, compatible with ISO 11898-1 (CAN Specification 2.0)
- RMT (TX/RX)
- Motor PWM
- LED PWM up to 16 channels
- Hall sensor

Security

- Secure boot
- Flash encryption
- 1024-bit OTP, up to 768-bit for customers
- Cryptographic hardware acceleration:
  - AESHash (SHA-2)
  - RSA
  - ECC
  - Random Number Generator (RNG)

Applications (A Non exhaustive List)

- Generic Low-power IOT Sensor Hub
- Generic Low-power IOT Data Loggers
- Cameras for Video Streaming
- Over-the-top (OTT) Devices
- Speech Recognition
- Image Recognition
- Mesh Network
- Home Automation
  - Light control
  - Smart plugs
  - Smart door locks
- Smart Building
  - Smart lighting
  - Energy monitoring
- Industrial Automation
  - Industrial wireless control
  - Industrial robotics
- Smart Agriculture

– Smart greenhouses

Block Diagram

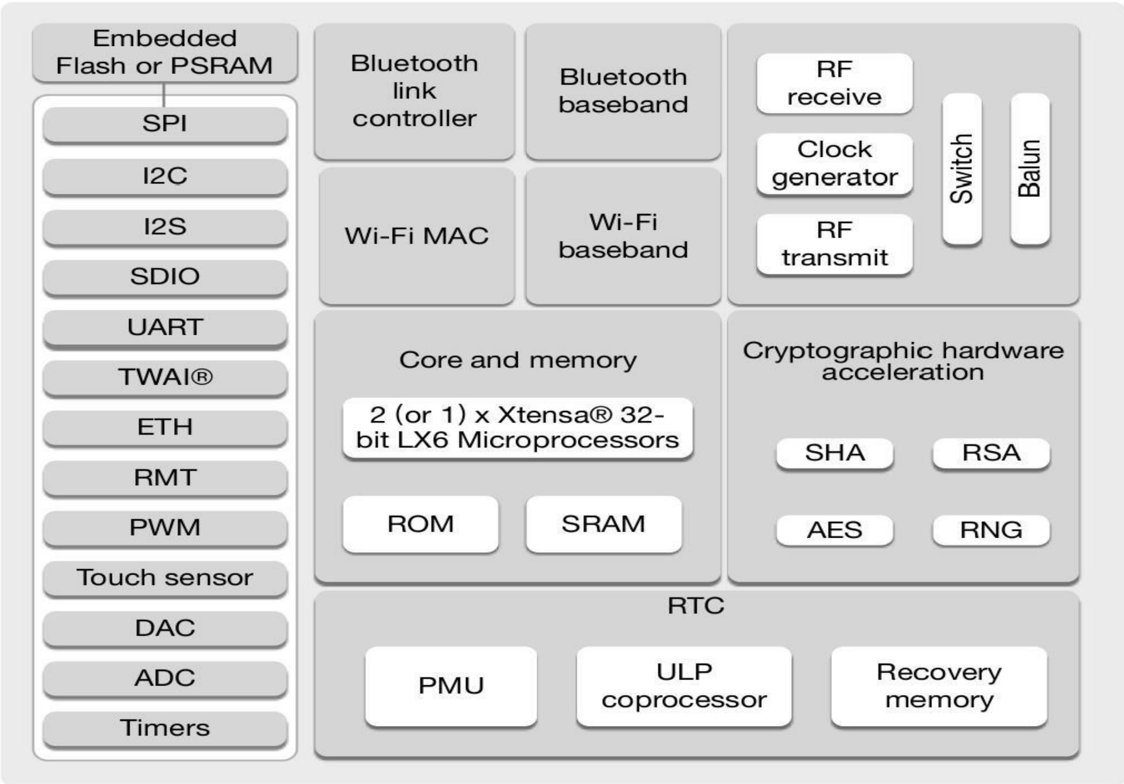


Figure 1: Functional Block Diagram

Note:
Products in the ESP32 series differ from each other in terms of their support for embeddedflash or PSRAM and the number of CPUs they have. For details,

1.2 Pin Description

Table 1: Pin Description

Name	No.	Type	Voltage
VDDA	1	Analog power supply	(2.3 V ~ 3.6 V)
LNA_	2	I/O RF input and output	(2.3 V ~ 3.6 V)
VDD3P3	3	Analog power supply	(2.3 V ~ 3.6 V)
VDD3P3	4	Analog power supply	(2.3 V ~ 3.6 V)

2.3 Power Scheme

ESP32's digital pins are divided into three different power domains:

- VDD3P3_RTC
- VDD3P3_CPU
- VDD_SDIO

VDD3P3_RTC is also the input power supply for RTC and CPU.

VDD3P3_CPU is also the input power supply for CPU.

VDD_SDIO connects to the output of an internal LDO whose input is VDD3P3_RTC. WhenVDD_SDIO is connected to the same PCB net together with VDD3P3_RTC, the internal LDO is disabl automatically. The

power scheme diagram is shown below:

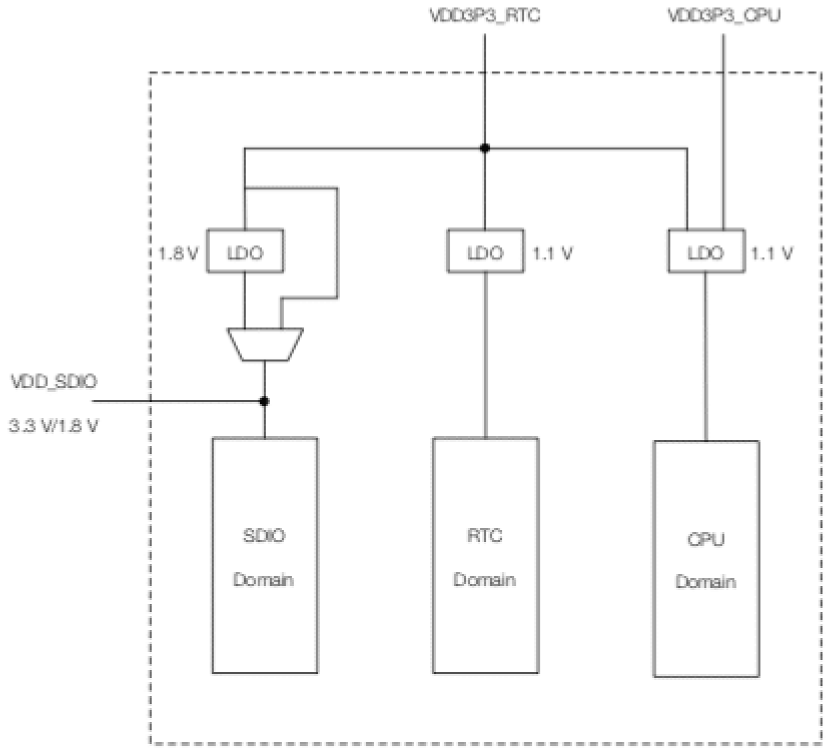


Fig: ESP32 Power Scheme

Timers and Watchdogs

64 bit Timers

There are four general-purpose timers embedded in the chip. They are all 64-bit generic timers whichare based on 16-bit prescalers and 64-bit auto-reload-capable up/down-timers.The timers feature:

- A 16-bit clock prescaler, from 2 to 65536
- A 64-bit timer
- Configurable up/down timer: incrementing or decrementing
- Halt and resume of time-base counter

• Auto-reload at alarming

• Software-controlled instant reload

• Level and edge interrupt generation

For detailed information, please refer to Chapter Timer Group (TIMG) in *ESP32*

Watchdog Timers

The chip has three watchdog timers: one in each of the two timer modules (called the Main Watchdog Timer, or MWDT) and one in the RTC module (called the RTC Watchdog Timer, or RWDT). These watchdog timers are intended to recover from an unforeseen fault causing the application program to abandon its normal sequence. A watchdog timer has four stages. Each stage may trigger one of three or four possible actions upon the expiry of its programmed time period, unless the watchdog is fed or disabled. The actions are: interrupt, CPU reset, core reset, and system reset. Only the RWDT can trigger the system reset, and is able to reset the entire chip, including the RTC itself. A timeout value can be set for each stage individually. During flash boot the RWDT and the first MWDT start automatically in order to detect, and recover from, booting problems.

The watchdogs have the following features:

• Four stages, each of which can be configured or disabled separately

• A programmable time period for each stage

• One of three or four possible actions (interrupt, CPU reset, core reset, and system reset) upon theexpiry of each stage

- 32-bit expiry counter
- Write protection that prevents the RWDT and MWDT configuration from being inadvertently altered
- SPI flash boot protection

If the boot process from an SPI flash does not complete within a predetermined time period, thewatchdog
will reboot the entire system.

For detailed information, please refer to Chapter Watchdog Timers (WDT) in *ESP32 Technical*

System Clocks

CPU Clock

Upon reset, an external crystal clock source is selected as the default CPU clock. The external crystalclock
source also connects to a PLL to generate a high-frequency clock (typically 160 MHz). In addition, ESP32 has an internal 8 MHz oscillator. The application can select the clock source fromthe external

RTC Clock

The RTC clock has five possible sources:

- external low-speed (32 kHz) crystal clock
- external crystal clock divided by 4
- internal RC oscillator (typically about 150 kHz, and adjustable)
- internal 8 MHz oscillator
- internal 31.25 kHz clock (derived from the internal 8 MHz oscillator divided by 256)

Audio PLL Clock

The audio clock is generated by the ultra-low-noise fractional-N PLL. For detailed information, pleaserefer to
Chapter Reset and Clock in *ESP32 Technical Reference Manual*.

3.4.1. 2.4 GHz Receiver

The 2.4 GHz receiver demodulates the 2.4 GHz RF signal to quadrature baseband signals and convertsthem to
the digital domain with two high-resolution, high-speed ADCs. To adapt to varying signal channelconditions, RF
filters, Automatic Gain Control (AGC), DC offset cancelation circuits and baseband filters areintegrated in the
chip.

3.4.2 .2.4 GHz Transmitter

The 2.4 GHz transmitter modulates the quadrature baseband signals to the 2.4 GHz RF signal.

- Carrier leakage
- I/Q phase matching
- Baseband nonlinearities
- RF nonlinearities
- Antenna matching

These built-in calibration routines reduce the amount of time required for product testing, and renderthe testing equipment unnecessary.

Wi-Fi

ESP32 implements a TCP/IP and full 802.11 b/g/n Wi-Fi MAC protocol. It supports the Basic ServiceSet (BSS)
STA and Soft AP operations under the Distributed Control Function (DCF). Powe management ishandled with
minimal host interaction to minimize the active-duty period.

Wi-Fi

Radio and Baseband

The ESP32 Wi-Fi Radio and Baseband support the following features:

- 802.11 b/g/n
- 802.11 n MCS0-7 in both 20 MHz and 40 MHz bandwidth
- 802.11 n MCS32 (RX)
- 802.11 n 0.4 μs guard-interval
- power
- Adjustable transmitting power
- Antenna diversity

ESP32 supports antenna diversity with an external RF switch.

3.6.1 Bluetooth Radio and Baseband

The Bluetooth Radio and Baseband support the following features:

- Class-1, class-2 and class-3 transmit output powers, and a dynamic control range of up to 21 dB
- π/4 DQPSK and 8 DPSK modulation.

LM393 comparator Digital Temperature Sensor Module for ESP32

Specifications:
LM393 Sensor

- Working voltage 3.3V-5V
- Output format : Digital switching output
- (0 and 1)Bolt holes for easy installation
- Using a wide voltage LM393 comparatortion

Description:

The temperature detection threshold is adjustable via a potentiometer. It uses the LM393 based voltage Comparator chip which features a clean and stable digital output signal and a driving ability of 15mA. output can be directly connected to the microcontroller, and it outputs a high or low-level voltage

depending on the temperature changes from the environment.

The DO output can be used directly drive a relay module or as a thermostat switch fo controlling externalequipment, such as a cooling fan.

Features :

1. TC Thermistor sensor
2. LM393 voltage comparator
3. Mounting hole for easy installation
4. Adjustable threshold via potentiomer

EQUIVALENT CIRCUIT

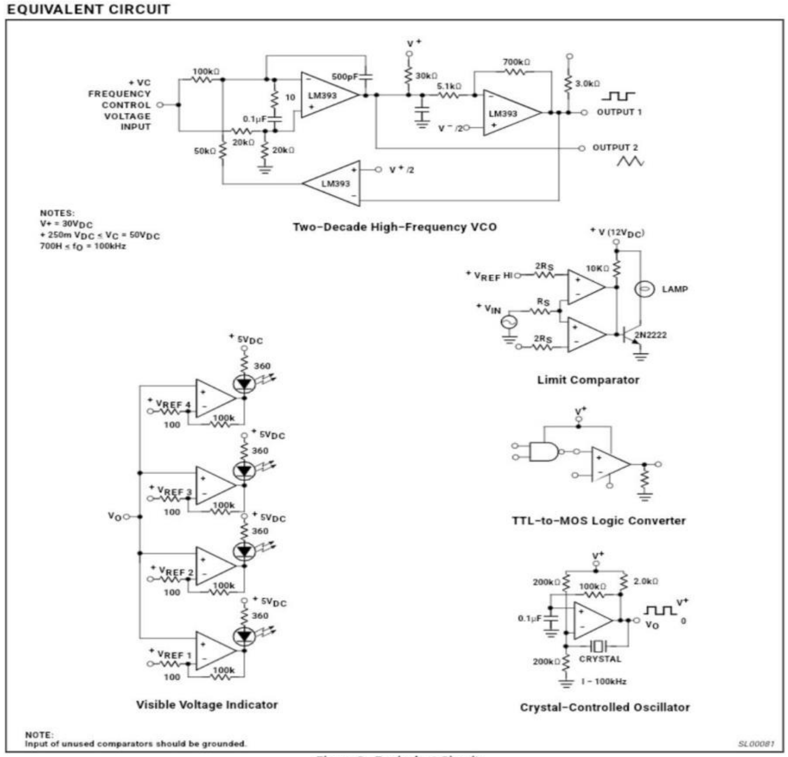


Figure 3. Equivalent Circuit

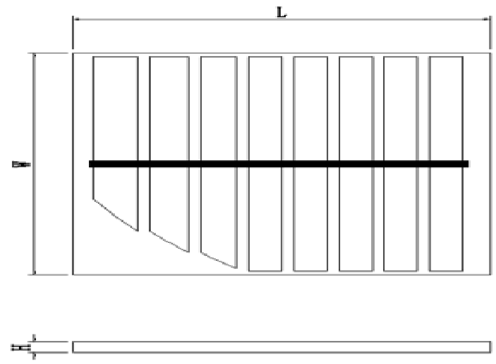
SOLAR PANEL SPECIFICATION

P/N: SW0.4M

Maximum power voltage:4.0V Maximum power current: 100.0mA Dimension: 70*65*3.2mm

1. Outline View:

Outline Dimensions	
L	70±0.2mm
W	65±0.2mm
H	3.2±0.3mm



2. Technical characteristics

(STC Standard Testing Condition: 1000W/M2 AM1.5, 25°C)

Description of Goods	Technical Spec.
Open Circuit Voltage(Voc)	4.6V
Short Circuit Current (Isc)	105Ma
Maximum Power Voltage(Vmp)	4.0V
Maximum Power Current(Imp)	100.0 Ma
Maximum Power(Ppm)	0.4W

3. QUALITY INSURANCES

① 3-year limited, work temperature: -10℃-50℃

5. Notes

① This product couldn’t be contacted directly with strong corrosive substances.

② To be avoid to scratch the surface.

③ This product couldn’t be born bending force during transportation & assembling.

CHAPTER:8

RESULTS AND APPLICATION

RESULTSANDAPPLICATION

- This project can be used in our day-to-day life, which will be able to see the graph of temperature, power ,voltage daily
- This system monitors the status of the temperature, power, voltage is imitates to the cloud setup
- The result of the system is displayed on the web page in the form of the table contains current in amperes, voltage in volts, power in watts and energy in watt-hours with respect to date and time.
- It enables the wireless transmission of data and its data can be accessed any where at anytime.

CHAPTER:9

CONCLUSION AND FUTURESCOPE

CONCLUSION AND FUTURESCOPE

CONCLUSION:-

Solar energy is trustworthy and sustainable hence the utilization of this smart solar system is reliable, adequate and cost-efficient. The proposed smart solar system comprises both Monitoring and Prediction. We have used the Internet of Things(IOT) for monitoring by considering parameters like Temperature, Humidity and Solar Power. Internet of Things is providing practically expert methods that offers required outcome. The designed system monitors panel level PCU and anticipates the error findings. We can analyze the weekly or monthly performance of panels. On the other hand, Prediction uses Hidden Markov Model for forecasting the solar power. We have developed an hourly prediction system. Considering historical records,

- **FUTURESCOPE:-**

The web application can be developed for interaction with the end user; theuser can also predict values of the future events. In the same way we can go for android application also. During the prediction two or more models can be used for same dataset, to find the accuracy of each model. Photovoltaic solar technology has become much more prominent because of huge availability, lower costs, and quick installation. Prediction of the amount of solar energy will be stored in the battery. The data store din cloud canal so be analyzed using the MatLab

As such, many advance improvements can be made up of initial design of solar tracker. It is felt this design represents a functioning scale model which could be replicated

➢ **In our project, the following enhancements can be made:**

-

1) The IOT based solar energy monitoring system is proposed to collect and analyzes the solar energy parameters to predict the performance for ensuring stable power generation.
2) Your solar dashboard is the best way to look at how much electricity your solar panels are making a cross the day.
3) IOT analytics service that allows you to aggregate, visualize, andanalyze live data streams in the cloud.
4) This Flame Sensor Module is used to detect fire/flame source or other lightsourcesofthewavelengthintherangeof760nm–1100nm.

CHAPTER:10

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REFERENCES

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