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Smart Power Distribution System For Residential And Industrial Applications

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Abstract:- **This project proposes smart power distribution system for optimal dispatch of power in residential and industrial areas. Decentralized methods for computing optimal real and reactive power set points for residential photovoltaic (PV) inverters are developed in this project. It is known that conventional PV inverters which are designed to extract maximum power at unity power factor, cannot address secondary performance objectives such as voltage regulation and network loss minimization. Optimal power flow techniques can be utilized to select which inverters will provide ancillary services and to compute their optimal real and reactive power set points according to well-defined performance criteria and economic objectives. Since the computational burden is shared among multiple devices and the requirement of all-to-all communication can be circumvented, the proposed optimization approach scales favourably to large distribution networks.The proposed decentralized strategy is also used for preparing an energy audit report which provides the real time monitoring of power consumption among various loads.**

***Keywords* --- Solar panel, PIC16F877A, Voltage sensor.**

I. INTRODUCTION

Decentralized methods for computing optimal real and reactive power set points for residential photovoltaic (PV) inverters are developed in this project. It is known that conventional PV inverters which are designed to extract maximum power at unity power factor, cannot address secondary performance objectives such as voltage regulation and network loss minimization. Optimal power flow techniques can be utilized to select which inverters will provide ancillary services and to compute their optimal real and reactive power set points according to well-defined performance criteria and economic objectives. Since the computational burden is shared among multiple devices and the requirement of all-to-all communication can be circumvented, the proposed optimization approach scales favourable to large distribution networks. This project uses Internet of Things (IOT) based monitoring of active and reactive power using PIC16F877A microcontroller. The proposed system measures the amount of power consumed and uploads it to the cloud. The power reading is sent to cloud using a Wi-Fi module and thereby enabling remote access and digitalization suite of decentralized approaches for computing optimal real and reactive power set points in residential PV inverters. The proposed decentralized strategy is also used for preparing an energy audit report which provides the real time monitoring of power consumption among various loads.

II. BATTERY

In electricity, a battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Since the invention of the first battery (or "voltaic pile") in 1800 by Alessandro Volta and especially since the technically improved Daniel cell in 1836, batteries have become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth. There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centres.
A battery is a device that converts chemical energy directly to electrical energy. It consists of a number

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of voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cations (positively charged ions) migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, cations are reduced (electrons are added) at the cathode, while anions are oxidized (electrons are removed) at the anode. The electrodes do not touch each other but are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes. A separator between half-cells allows ions to flow, but prevents mixing of the electrolytes.

III. EMBEDDED C

Embedded C is designed to bridge the performance mismatch between Standard C and the embedded hardware and application architecture. It extends the C language with the primitives that are needed by signal-processing applications and that are commonly provided by DSP processors. The design of the support for fixed-point data types and named address spaces in Embedded C is based on DSP-C. DSP-C [1] is an industry-designed extension of C with s Multiple address spaces

Embedded C supports the multiple address spaces found in most embedded systems. It provides a formal mechanism for C applications to directly access (or map onto) those individual processor instructions that are designed for optimal memory access. Named address spaces use a single, simple approach to grouping memory locations into functional groups to support MAC buffers in DSP applications, physical separate memory spaces, direct access to processor registers, and user-defined address spaces.

Named register

Embedded C allows direct access to processor registers that are not addressable in any of the machine's address spaces. The processor registers are defined by the compiler-specific, named-register, storage class for each supported processor. The processor registers are declared and used like conventional C variables (in many cases volatile variables). Developers using Embedded C can now develop their applications, including direct access to the condition code register and other processor-specific status flags, in a high-level language, instead of inline assembly code.

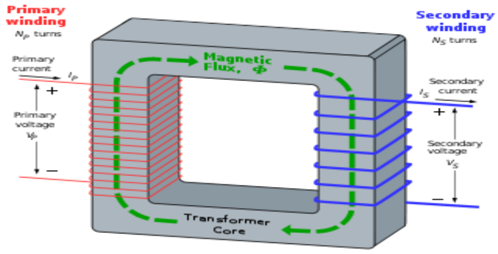
I/O hardware addressing

The motivation to include primitives for I/O hardware addressing in Embedded C is to improve the portability of device-driver code. In principle, a hardware device driver should only be concerned with the device itself. The driver operates on the device through device registers, which are device specific. However, the method to access these registers can be very different on different systems, even though it is the same device that is connected. The I/O hardware access primitives aim to create a layer that abstracts the system-specific access method from the device that is accessed. The ultimate goal is to allow source-code portability of device drivers between different systems.

IV. POWER SUPPLY

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.



Bridge rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Voltage regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to

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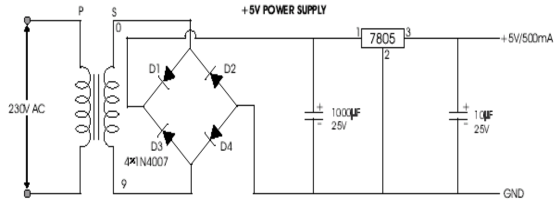
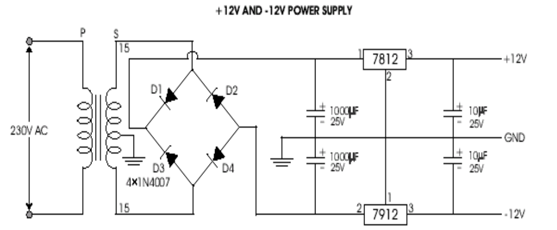
tens of watts.

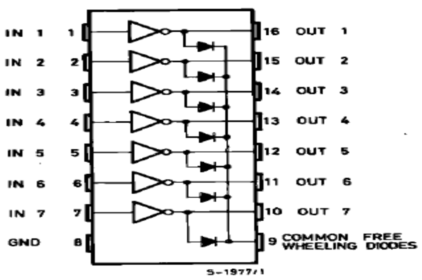




A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

V. DRIVER CIRCUIT:

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.500mA rated collector current (Single output) High-voltage outputs: 50V, Inputs compatible with various types of logic, Relay driver application



Ⅵ. 8051 MICROCONTROLLER

The 8051 family was introduced in the early 1980s by Intel. Since its introduction, the 8051 has been one of the most popular microcontrollers and has been second-sourced by many manufacturers. The 8051 currently has many different versions and some types include on-chip analogue-to-digital converters, a considerably large size of program and data memories, pulse-width modulation on outputs, and flash memories that can be erased and reprogrammed by electrical signals. Microcontrollers have now moved into the 16-bit market. 16-bit micro-controllers are high-performance processors that and applications in real-time and compute intensive fields (e.g. in digital signal processing or real-time control). Some of the 16-bit microcontrollers include large amounts of program and data memories, multi-channel analogue-to-digital converters, a large number of I/O ports, several serial ports, high-speed arithmetic and logic operations, and a powerful instruction set with signal processing capabilities.The simplest microcontroller architecture consists of a microprocessor, memory, and input/output. The microprocessor consists of a central processing unit (CPU) and the control unit (CU).The CPU is the brain of a microprocessor and is where all of the arithmetic and logical operations are performed. The control unit controls the internal operations of the microprocessor and sends control signals to other parts of the microprocessor to carry out the required instructions.Program memory stores all the program code. This memory is usually a read-only memory (ROM). Other types of memories, e.g. EPROM and PEROM flash memories are used for low-volume applications and also during program development. Data memory is a read/write memory (RAM).In complex applications where there may be need for large amounts of memory it is possible to interface external memory chips to most microcontrollers.

Input/ Output (I/O) ports allow external digital signals to be connected to the microcontroller. I/O ports are usually organized into groups of 8 bits and each group is given a name. For example, the 8051 microcontroller contains four8-bit I/O ports named P0, P1, P2, and P3. On some microcontrollers the direction of the I/O port lines are programmable so that different bits of a port can be programmed as inputs or outputs. Some microcontrollers (including the8051 family) provide bi-directional I/O ports. Each I/O port line of such microcontrollers can be used as inputs and outputs. Some microcontrollers provide `open-drain' outputs where the output transistors are left floating (e.g. port P0 of the 8051 family.

Ⅶ PIC16F877A

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single – chip microcontrollers. PIC micros have grown to become the most widely used microcontrollers in the 8- bit microcontroller segment. The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of

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EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

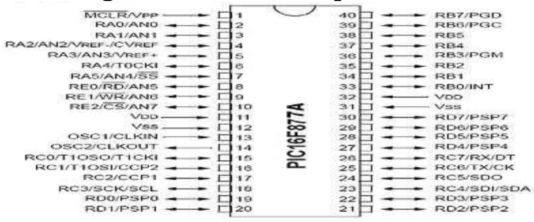
Register File

The term register file in PIC terminology used to denote the locations than an instruction can access via an address. The register file consists of two components, they are

General purpose register file

Special purpose register file

Pin Configuration And Description



The pins RB0-RB7, RC0-RC7, and RD0-RD7 are digital I/O pins. The pins CCP1 and CCP2, which share locations with RC1 and RC2, can be used for a PWM signal (see DC Motor tutorial). The pins AN0-AN7 are for analog I/O (see Photo resistor tutorial). TX and RX are for debugging I/O (see Output Messages to Computer tutorial). The remaining pins deal with power/ground, the clock signal, and programmer I/O.A PIC is made of several "ports." Each port is designated with a letter, RB0-RB7 are a port. RC0-RC7 and RD0-RD7 are a port as well. RA0-RA5 and RE0-RE2 are also ports, but with fewer pins. Some of these pins have special purposes, but most can be used as basic input/output pins.

Memory Organization

There are three memory blocks in each of the PIC16F87XA devices. The Program Memory and Data Memory have separate buses so that concurrent access.

Program Memory Organization

The PIC16F87XA devices have a 13-bit program counter capable of addressing an 8K word x 14 bit program memory space. The PIC16F876A/877A devices have 8K words x 14 bits of FLASH program memory, while PIC16F873A/874A devices have 4K words x 14 bits. Accessing a location above the physically implemented address will cause a wraparound. The RESET vector is at 0000h and the interrupt vector is at 0004h.

Data Memory Organization

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the Special Function Registers. Bits RP1 (STATUS<6>) and RP0 (STATUS<5>) are the bank select bits.

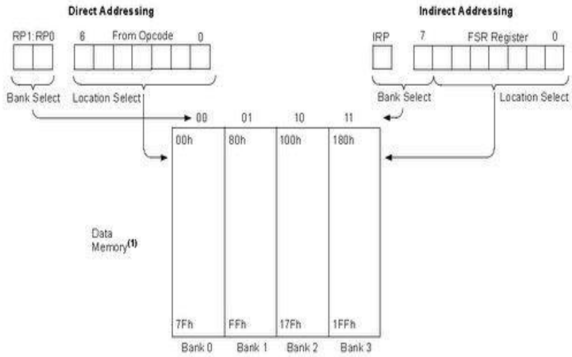
Addressing modes

Direct Addressing

Using this method we are accessing the registers directly by detecting location inside Data Memory from Opcode and by selecting the bank using bits RP1 and RP0 of the STATUS register.

Indirect Addressing

To implement indirect addressing, a File Select Register (FSR) and indirect register (INDF) are used. In addition, when using this method we choose bank using bit IRP of the STATUS register. Indirect addressing treated like a stack pointer, allowing much more efficient work with a number of variables. INDF register is not an actual register (it is a virtual register that is not found in any bank).



PIC16F87XA Data EEPROM

The data EEPROM and Flash program memory is readable and writable during normal operation (over the full VDD range). This memory is not directly mapped in the register file space. Instead, it is indirectly addressed through the Special Function Registers.

PIC Timer

Many times, we plan and build systems that perform various processes that depend on time. Simple example of this process is the digital wristwatch. The role of this electronic system is to display time in a very precise manner and change the display every second (for seconds), every minute (for minutes) and so on.To perform the steps we've listed, the system must use a timer, which needs to be very accurate in order to take necessary actions. The clock is actually a core of any electronic system. In this PIC timer module tutorial we will study the existing PIC timer modules. The microcontroller PIC16F877 has 3 different timers: PIC Timer0, ,PIC Timer1 **,**PIC Timer2.

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Input/output programming in pic16f877a

General purpose I/O pins can be considered the simplest of peripherals. They allow the PIC microcontroller to monitor and control other devices. To add flexibility and functionality to a device, some pins are multiplexed with an alternate function(s). These functions depend on which peripheral features are on the device. In general, when a peripheral is functioning, that pin may not be used as a general purpose I/O pin. The PORT register is the latch for the data to be output. When the PORT is read, the device reads the levels present on the I/O pins (not the latch). This means that care should be taken with read-modify-write commands on the ports and changing the direction of a pin from an input to an output.

Ⅷ SOLAR PANEL

Solar Electricity

If you truly wish your source of energy to be independent, there are only a few choices: solar in the form of solar electric panels, hot water panels, and passive heating; wind generators for electric production and windmills for water pumping; and hydro electric generators. When people think about alternative or renewable energy, the first image that comes to mind is often large blue or black solar panels on rooftops or portable highway signs that have a small panel attached. These panels, also known as photovoltaic modules (or PV modules), convert sunlight into electricity, and they have been the backbone of renewable energy for decades. The Photovoltaic Effect (how sunlight is converted into electrical energy) was discovered over a hundred years ago! Yet widespread implementation of this technology has been very gradual. Only in very recent years has photovoltaics gained wide popularity as an alternative way to produce electricity.

In 1958 the first PV modules were launched into space to power satellites. Even today, solar power is the primary source of energy at the International Space Station. On Earth as well, PV has traditionally been used in areas where there is no practical source of electrical power but there is abundant sunshine. Solar panels are often used for remote applications: like powering cabins, RVs, boats and small electronics when grid service is not available. Recently, "grid-tie" solar electric systems have started gaining momentum as a cost-effective way to incorporate solar electricity into our everyday lives. Now we can take advantage of available solar energy while still enjoying the safety net of the utility grid.

How Solar Panels or PV Modules Work

In very basic terms, a solar panel (PV module) is a device that will produce a flow of electricity under sunlight. This electricity can be used to charge batteries and, with the aid of an inverter, it can power normal household electrical devices, or "loads". PV modules can also be used in systems without batteries in grid-tie systems. Most PV modules are framed in aluminium, topped with tempered glass, and sealed by a waterproof backing. Sandwiched between the glasses and backing layers are the photo-reactive cells themselves, often made of silicon. On the back of the module is a junction box that may or may not have two cables coming out of it. If the junction box has no cables, it can be opened to access the electrical terminals where wires can be attached to conduct the generated electricity away from the module. If there are cables already in place, the junction box is usually sealed and not user-accessible. Sealed junction boxes are more common. There are lots of ways to make use of solar electricity. One of the simplest is to charge small electronic devices, like cell phones and music players, with lightweight, portable PV modules. These small battery-charging solar panels are even being integrated into backpacks and clothing for maximum convenience. These panels can be used individually or wired together to form a solar array. For larger electrical loads, there are two main types of systems for providing electrical power to homes, cabins and offices, etc: stand-alone battery based systems (also called 'off-grid' systems) and grid-tied systems (also known as utility-interactive.

Ⅸ IOT

The **Internet of things** (**IOT**) is the network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data.

The IoT involves extending Internet connectivity to desktops, laptops, smartphones and tablets, to any range of traditionally *dumb* or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

There are many technologies that enable the IoT. Crucial to the field is the network used to communicate between devices of an IoT installation, a role that several wireless or wired technologies may fulfil

Addressability

The original idea of the Auto-ID centre is based on RFID-tags and distinct identification through the Electronic Product Code. This has evolved into objects having an IP address or URI.[128] An alternative view, from the world of the Semantic Web[129] focuses instead on making all things (not just those electronic, smart, or RFID-enabled) addressable by the existing naming protocols, such as URI. The objects themselves do not converse,

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but they may now be referred to by other agents, such as powerful centralized servers acting for their human owners.[130] Integration with the Internet implies that devices will use an IP address as a distinct identifier.

Short-range wireless

Bluetooth mesh networking – Specification providing a mesh networking variant to Bluetooth low energy (BLE) with increased number of nodes and standardized application layer (Models).

Light-Fidelity (Li-Fi) – Wireless communication technology similar to the Wi-Fi standard, but using visible light communication for increased bandwidth.

Near-field communication (NFC) – Communication protocols enabling two electronic devices to communicate within a 4 cm range.

Medium-range wireless

LTE-Advanced – High-speed communication specification for mobile networks. Provides enhancements to the LTE standard with extended coverage, higher throughput, and lower latency.

Long-range wireless

Low-power wide-area networking (LPWAN) – Wireless networks designed to allow long-range communication at a low data rate, reducing power and cost for transmission. Available LPWAN technologies and protocols: LoRaWan, Sigfox, NB-IoT, Weightless.

Wired

Ethernet – General purpose networking standard using twisted pair and fibre links in conjunction with hubs or switches.

X. DC MOTOR

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source—so they are not purely DC machines in a strict sense. We in our project are using brushed DC Motor, which will operate in the ratings of 12v DC 0.6A which will drive the flywheels in order to make the robot move.

XI. LCD

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application.

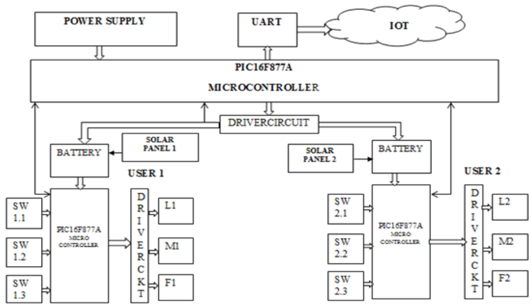
XII. EXISTING SYSTEM:

In existing there is no smart system is currently used for power distribution in residential area, with that distribution system we have to be implemented the smarter dispatch of power in residential areas. That particular distribution should be a simplified and easily handled system in the particular areas.

XIII. PROPOSED SYSTEM:

In our proposed system we are implementing the photovoltaic inverters for power generation and saving. And also the optimized distribution on the residential areas very much reliable. Here, we are introducing optimal load sharing system with the help of controlling power unit section. These power sharing with each user which depends on the usage of the other users. Here we are monitoring the production of the power in solar photovoltaic for each user/home.

BLOCK DIAGRAM



XIV. RESULTS

SI.NO	SECOND BLOCK STATUS	AVAILABILITY	MASTER ACTION
1.	Load 1 - On Load 2 - Off Load 3 - Off	Available	Battery coupling established
2.	Load 1 - On Load 2 - On Load 3 – Off	Available	Battery coupling established
3.	Load 1 - On Load 2 - On Load 3 - On	Not Available	Battery coupling could not be established

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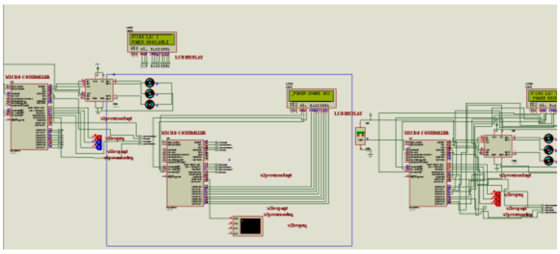
1.



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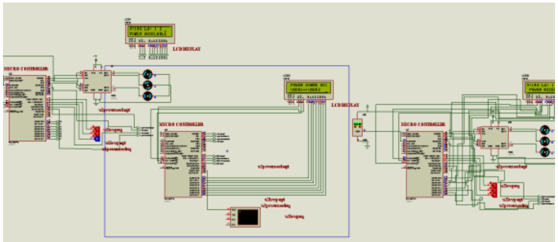

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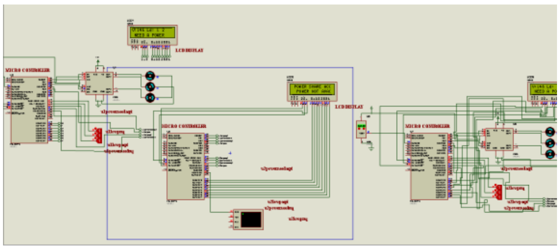

XV. CONCLUSION

Thus a smart power distribution system for optimal dispatch of power in residential and industrial area is introduced. An optimal load sharing system with the help of controlling power unit section.is also introduced.

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