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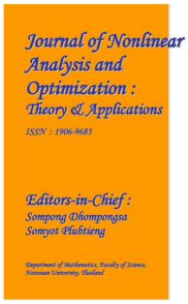

SOLAR POWERED GRASS CUTTER ROBOT USING IOT

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ABSTRACT

A grass cutter driven by solar energy is intended to trim healthy grass in public areas, hotels, parks, etc. The Internet of Things (IoT) is used to construct the grass cutter, which allows for remote control via the Blynk smartphone application. Hardware elements of the suggested model include the ESP 8266, solar panel, motor driver, DC motor, ultrasonic sensor, and rechargeable batteries. The ESP 8266 is used to programmed the developed model, which in turn controls how the grass cutter operates. The http server software is used to operate the control mechanism and movements of the grass cutter prototype, including forward, backward, right, and left movements. An ultrasonic sensor attached to the model's head prevents the system from running into objects when it is moving. If cutting grass was done traditionally and it still is in many places like an institution, organization, sports field, industry, hotel, public center, etc. with a cutlass, this manual process takes a lot of time, and cutting accuracy is not perfect. Since the invention of technology, grass has been trimmed to a consistent height using one or more blades. Usually, a lever or nut that is adjusted to the machine wheels will be used by the operator to fix or alter the height of the grass cutting. When creating the ideal equipment for the user, even the grass cutter's power source is important. Modern energy sources have been adopted in the implementation of technology-oriented cutting down the grass.
Keywords: Grass Cutter, IoT, Blynk application, Advent technology, adaptation

1. INTRODUCTION

Historically, grass cutting in various settings was done manually using a cutlass, which was time-consuming and inaccurate. The following reviews technological advancements in creating efficient and cost-effective grass cutters. It examines various types of grass cutters, including solar, electric, and internal combustion engines, and their performance. Currently, these cutters have limitations in cutting grass at specific heights. The paper aims to create a new innovative concept for agricultural fields, focusing on creating grass cutting machines that can cut crops and grass simultaneously. The goal is to create machines that are both efficient and cost-effective. An energy-efficient, labor-saving, and environmentally friendly lawnmower powered by solar electricity has been developed by Jabbar et al. In order to cut grass quickly, the new model has one DC blade motor and two DC gear motors that are controlled by a microprocessor. The Arduino UNO is used to remotely control the prototype, and a smartphone can also control it using Bluetooth the Smart Solar Grass Cutter has a two-hour operating battery life., and the Smart Solar Tracker can be operated via Bluetooth. The fig1 shows the solar grass cutter. The costliest engine in the past has been replaced with a more ecologically friendly one: the cutting iron [1].

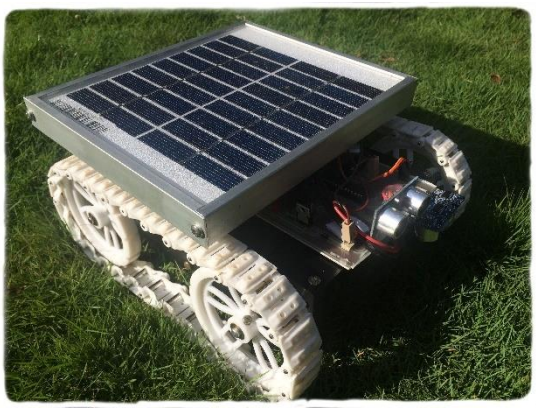

Figure 1. Solkar Grass cutter

According to a study by Kartik et al. on the construction of lawn cutters, current machines are more efficient because of their engines and superior blade materials, which requires less labor. These devices are well-liked for their ability to cut lawns, tidy gardens, and produce soft grass. Because they are versatile and simple to use, they are often utilized for landscape upkeep [2]. Vanishree et al.'s study is to design and assess a small field grass cutter machine for tiny height grass in India. The project uses ANSYS software to analyses the cutting roller and horizontal cutting blade. The machine's horizontal cutting blade and cutting roller can assist cut grass more swiftly and economically. This machine is beneficial for small farms and gardens. The project included conceptual design, input from books and literature surveys, real design, material selection for project components, and design of the grass cutter's actual appearance. After that, the model's dimensions were determined using the appropriate resources. The mission's is to give small farms and gardens a more effective and affordable option [3]. Lawnmowers and other single-rider open vehicles are susceptible to tipping on steep slopes, which is why steep slopes should be avoided and separation advised. A maximum slope of 15 degrees is advised. Slope gauges are offered by manufacturers so that consumers can evaluate slopes in unaltered environments. Karnes et al., however, discovered that neither of these strategies was effective in preventing injuries and recommended trying a different technique. According to the study's conclusion, preventing accidents requires assessing slopes and putting separation protocols in place [4].

Sravani et al. want to build a solar-powered lawnmower, since solar energy is an essential resource for contemporary life and work. An infrared sensor, DC motors, a relay switch, and a battery for charging will make up the device. The motor is driven by an electric switch and runs at a high speed. The motor shaft is connected to the tempered blades in a plane perpendicular to the ground. For manufacturing, the project also needs welding and grinding equipment [5]. Balakrishna et al. used solar power and Internet of Things technologies to create a robot that cuts grass. Using a Bluetooth module, the robot may be remotely controlled to shear grass with seven different signals. The movements and control mechanism are supported by the Blynk app. The design's economical nature stems from its efficient use of components and solar panel power source. Global system monitoring is possible if COAP-SMS or COAP-MQ cellular connectivity is used in place of the Bluetooth module [6].

Sagar et al. propose to create an automated lawn cutter that runs on a 12-volt battery and solar panel, eliminating the need for human labor in grass cutting fields. With spiral roller blades, AC charging capabilities, and a small, lightweight design, the machine tries to minimize the need for human labor and fossil fuels. The lightweight, portable solar-powered grass-cutting device generates electricity using photovoltaic cells. Grass height is adjusted according to ground clearance [7]. The intention of Rohini et al.'s solar-powered autonomous lawn cutter is to use renewable energy sources to cut down on pollution and fuel expenses. Users are able to designate the area and grass height using its solar panel and battery operation. Infrared sensors guard against harm to people, pets, and other items by seeing obstructions. The little, lightweight robot has a green grass sensor that allows it to cut the remaining grass on its own without needing human direction. It is operated by a TV IR remote. The lawn moving robot is powered by four 45 rpm, 6-volt DC geared motors on its four wheels, which are driven by the solar panel [8]. In order to lessen the amount of work needed for lawn care, DILIP et al. introduce an autonomous solar grass cutter that will also save energy and prevent pollution. The cutter operates on solar power and makes use of a number of sensors to identify and steer clear of unwanted

things. For improved user comprehension, the design incorporates an LCD display, IR sensors, and an Arduino ATmega328p microprocessor. The autonomous lawn mower is powered by nickel-metal hydride batteries that can be charged by sunlight and distinguishes between grass and pavement using an accelerometer and ultrasonic sensor. The fig 2 represents the manually operated grass cutter. The best location for the sensors determines how successful the design is [9].

Figure 2. Manually operated Grass cutter

In order to combat pollution and power shortages, Yadavrutuja et al. are working on developing a portable solar-powered grass-cutting tool. The gadget runs an AC motor attached to a belt drive blade shaft using a solar panel and batteries to convert DC electricity to AC current. This green technology minimises power issues and enables the robot to be used on a regular basis. In Stroud, a robotic mower driven solely by solar energy was created and intended for use in gardens and sports fields. Rain sensors and self-docking were characteristics that the Moonboot, the first robotic lawnmower on the market, introduced. The solar-powered lawn cutter project was finished successfully and has several advantages, including reduced wear and tear, pollution, and fuel costs. It may be charged during the day and used in the dark [10]. In order to lessen noise and environmental pollution, Patil et al. have invented a solar-powered lawn cutting equipment that employs radio frequency to power an electric motor. This model uses non-renewable energy instead of petroleum to power lawn mowers, providing a more environmentally responsible and sustainable option than conventional lawn mowers. The project intends to be carried out and released onto the market [11].

In the modern world, automation is essential, yet human lawn cutters cause pollution and waste energy. Sweta wants to create a transportable, solar-powered grass-cutting tool to address these problems. The gadget converts DC electricity to AC current by means of a solar panel that is linked to a battery. High-speed grass cutting is achieved via the motor's belt drive rotation of the blade shaft. The robot uses less electricity since the solar panel is fixed to the top of it. The project's goal is to build an environmentally friendly system that reduces pollution and does not require human interaction. The design layout was shown in Fig 3 [12].

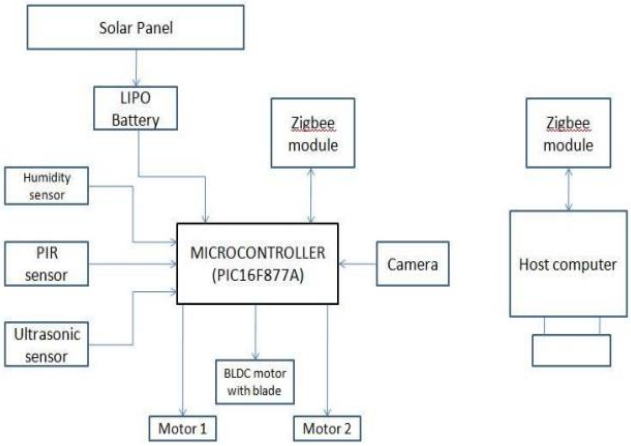

Figure 3. Design layout of Solar grass cutter [12]

A robotic lawnmower driven by solar energy and vision, as proposed by Srishti et al., can cut grass with little effort and without the need for perimeter wires or human labour. The robot is efficient and

safe since it utilises sensors to identify things and people. The prototype works well for people of all ages and abilities and is affordable, easy to use, and eco-friendly. The objective is to develop a user-friendly, safe, and economical robotic lawnmower that is dependable. The proposal also takes resource conservation using solar energy into account [13]. This autonomous robotic lawnmower runs on solar power and uses vision technology to cut grass. It doesn't need perimeter cables and requires less work from the user while operating in manual mode. It prioritises safety by avoiding and identifying objects and people, and it has predefined patterns. Businesses and the government alike embrace the Nehai et al. initiative, which benefits the environment and customers alike. The solar-powered lawn mower charges its battery either manually or with sunshine. It utilises ultrasonic sensors for obstacle avoidance, humidity sensors for humidity checks, and PIR sensors for human involvement. Using a safety-sensor equipped micro-controller (PIC16F877A), an Android smartphone takes pictures of lawns. A 200-rpm stepper motor is used for stability and a lithium polymer battery provides power to the device [14]. Victor et al.'s autonomous robotic lawnmower, which runs on solar power and relies on vision to cut grass, requires no maintenance in the form of perimeter wires and requires less labour while operating in manual mode. It employs perimeter wires and GPS to determine the limits of the grass and has preset patterns for cutting various lawn designs. In addition, the gadget makes use of PIR sensors to detect human involvement, humidity sensors to assess humidity, and ultrasonic sensors to avoid obstacles. The grass is randomly sequenced and captured using an Android smartphone [15].

2. PROPOSED METHODOLOGY

Creating a portable, solar-powered grass-cutting tool is the goal of this project, which aims to address the current power shortage. Thus, we have made the decision to create a solar-powered gadget. The battery and solar panel are linked. After that, the battery is linked to the inverter, which changes DC current into AC current. The AC motor will be powered by this. Belt drive is used to link this motor to the blade shaft. As a result, the blade will spin more quickly, cutting the grass. This gadget will contribute to the development of an eco-friendly system. The standard tool used today to cut grass is a manually operated one. But it might take a lot of time and work to do this. We can lessen our carbon footprint and save time and work by switching to a solar-powered grass cutting tool. Thanks to developments in solar technology, we can effectively cut grass by using the sun's energy instead of conventional power sources. This invention will not only save the environment but also greatly simplify and improve the efficiency of the grass-cutting process. The Figure 4 illustrates the proposed system for the current work.

3. MATERIAL SELECTION

The prototype model of a solar grass cutter will consist of several key components, such as the following:

- Solar panel
- Battery
- Motor driver
- Wi-Fi module
- Relay module
- DC gear motor
- Arduino IDE

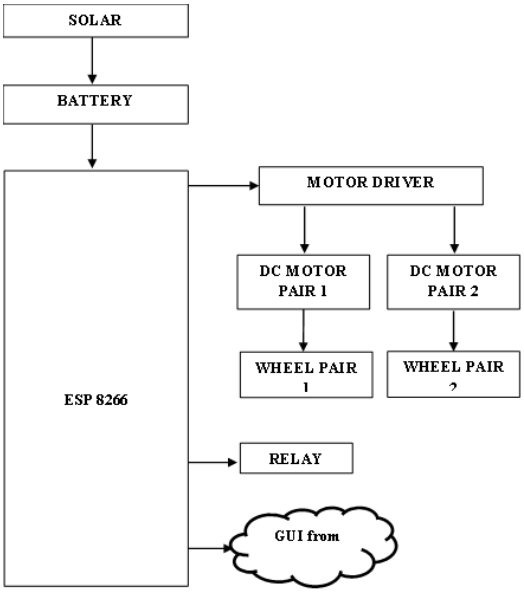

Figure 4. Proposed System

3.1 Solar Panel

Through the photovoltaic effect, which absorbs photons and releases electrons into the electric field, solar panels transform solar energy into electrical power. Applications for these panels include solar electric systems for homes and businesses, telecom equipment, remote sensing, and remote power systems. Solar arrays are connected to a balanced grid and provide electricity together during the day and at night. A battery bank, charge controller, and inverter are components of off-grid solar systems. Power from solar panel arrays, which can be used for both residential and commercial purposes, is sent directly to the battery bank and then picked up by the inverter.

Figure 5. Solar Panel

3.2 Lead Acid Battery

Lead acid batteries are used in this project since they are often found in solar power systems. These batteries cost more and last longer, but they also need more upkeep, have a lower energy density, and are only moderately efficient. They are appropriate for automobile engines because of their well-established technological foundation. Lead oxide makes up the positive electrode while permeable lead makes up the negative electrode. Both electrodes are submerged in an electrolytic solution made of sulfuric acid and water. When they come into touch, an electrically insulating barrier stops short circuits.

Figure 6. Lead acid battery

3.3 Motor Driver

The L293D is a 16-pin integrated circuit that can run two DC motors in any direction using the H-bridge concept. This allows voltage to flow in either direction, making it ideal for driving DC motors in either clockwise or anticlockwise directions.

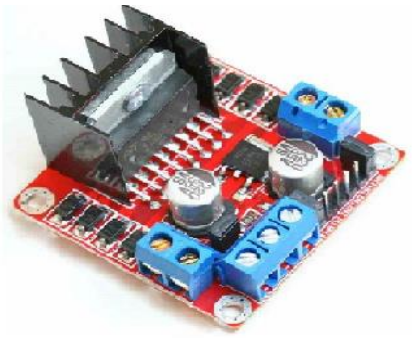

Figure 7. Motor Driver

Figure 8 displays the L293D pin description. A single L293D chip has two separate h-bridge circuits that can each operate two DC motors. Owing to its compact design, the L293D is a popular tiny DC motor controller in robotic applications. Its four input pins are, in order, 2, 7, 15, and 10. The left input pins cause the motor to revolve, whereas the right input pins cause the motor to rotate. The inputs sent across the pins as either LOGIC 0 or LOGIC 1, which necessitates the provision of logic 0 or 1, govern the rotation of the motor.

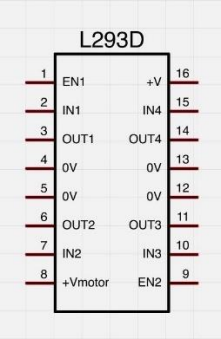

Figure 8. Pin description of L293D module

3.4 Wi-Fi Module

A highly integrated chip made for a connected world is the ESP8266 NodeMCU CP2102 board. With its self-contained Wi-Fi networking solution, it can host apps or delegate all Wi-Fi networking tasks to a different CPU. Because of its strong on-board processing and storage capabilities, the ESP8266 requires less development and runtime load when integrating with sensors and other application-specific devices. The board comes pre-flashed with NodeMCU firmware and is made to take up as little space on the PCB as possible.

Figure 9. Nodemcu ESP8266 Wi Fi Module

For low-cost Wi-Fi projects, the it provides a plug-and-play option. Pre-flashed with NodeMCU firmware a Lua-based firmware for the ESP8266 it enables simple control through the use of the elegant scripting language Lua. Thirty pins on the board connect it to the external environment. The MCU pin setup for the ESP8266 Node, as depicted in Figure 10 below.

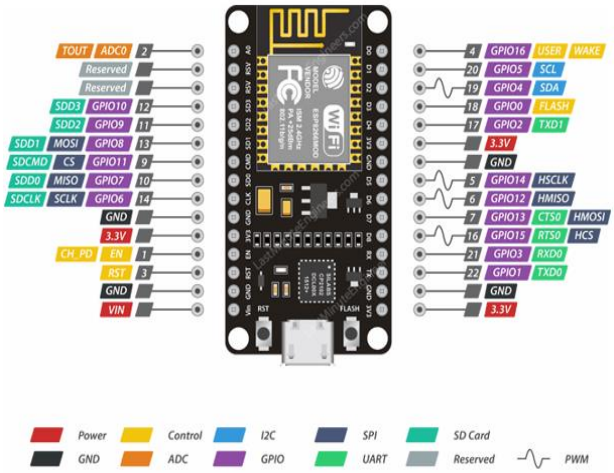

Figure 10. ESP8266 NODEMCU Pin configuration

3.5 Relay Module

In Fig. 11, a relay module was displayed. This automated switch is widely used in automatic control circuits and can adjust a big current using a low current signal. The input voltage range for the relay signal is 0 to 5V.

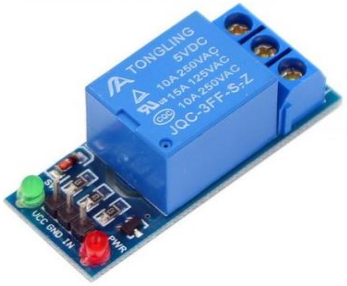

Figure 11. Relay module

The current supply is used by the relay to open or close switch contacts. For this, a coil is usually used to magnetise the switch contacts, which bring them together when they are engaged. As soon as the coil is not reinforced, a spring push them independently. There are two key advantages to employing this approach. The first is that it requires less current to activate the relay than it does to switch the relay contacts. The coil and contacts are galvanically isolated, meaning there is no electrical connection between them, which is an additional advantage.

3.6 DC motor:

When an electric and magnetic field interact, a it is an electrical device that transforms electricity into mechanical energy, producing torque and mechanical force. The motor is made up of an armature and a stator, and the stator's magnetic field causes the armature to rotate. Static magnets in the stator and a wire coil powered by electricity are used to align the electromagnetic field with the coil's center. To focus the magnetic field in a spinning motor, insulated wire windings are wrapped around the core. Every armature coil is energised by a commutator, also known as a rotary electrical switch, which produces a constant spinning force or torque.

Figure 12. DC Gear motor

3.7 Arduino IDE

Arduino's software is called the Arduino IDE (Integrated Development Environment). It's a multifunctional text editor that resembles a notepad. It is utilised for writing code, uploading it to the

Arduino, and compiling the code to see if there are any issues. The software interface is shown in fig. 13.

The C/C++ language is supported. Since it's open-source software, the user is free to utilise it whatever they like. Additionally, they are able to create and add their own modules and functionalities to the programme. All Arduino boards, such as the Arduino Mega, Arduino Leonardo, Arduino Ethernet, and others, are supported.

The IDE will produce a Hex file for the code when the user writes and compiles it. Hex files, or Hexadecimal files that Arduino can understand, are then transferred to the board via a USB cord. Each Arduino board has an inbuilt microprocessor, which interprets the hex file and executes the programmed instructions.

- Window Bar
- Menu Bar
- Shortcut Buttons
- Text Editor
- Output Panel

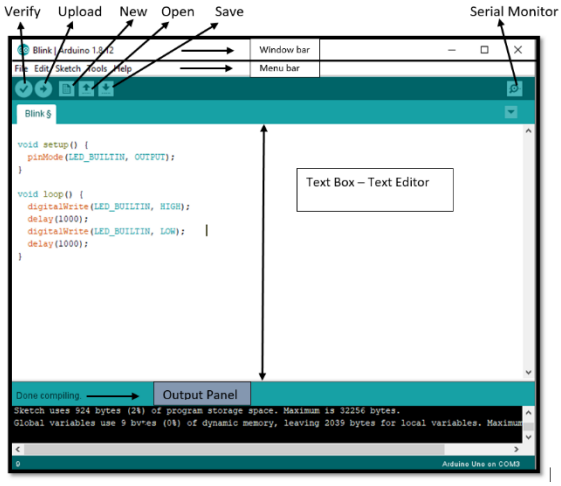

Figure 13. Software Interface

4. METHODOLOGY

The Smart Solar Grass Cutter is a Bluetooth-enabled machine designed to achieve efficiency and utility while considering the chosen positions and materials. The machine uses building materials and a solar panel with varying sizes, spinning rubber wheels, and varying roof battery lengths. The Arduino controller manages the cutting mechanism, while the Node MCU controller connects the grass cutter to the internet, allowing users to remotely control and monitor it through a smartphone or computer. and the Node MCU controller are used to operate the grass cutter with the help of IoT. The Arduino controller is responsible for managing the cutting mechanism of the grass cutter, while the Node MCU controller is used for connecting the grass cutter to the internet. This allows the user to remotely control and monitor the grass cutter through a smartphone or computer. The IoT technology enables the grass cutter to be more efficient and convenient to use, making lawn maintenance easier for homeowners.

The DC motor has a grass-cutting blade and is run by a battery and solar panel. The structure is supported by a metal roll framework, and the solar panel charges the system if the system doesn't run. The grass cutter uses both day and night, with a backup battery for 2 hours at night. The chassis is powered by the blade engine, DC engines, solar panels, and batteries. The goal is to make lawn maintenance easier for homeowners. The cutting and gathering of grass will be done efficiently and quietly, without the need for gasoline or harmful emissions. The use of renewable energy sources ensures that the project is environmentally friendly and sustainable. With the ability to operate day and night, homeowners can enjoy a beautifully maintained lawn without any hassle. The project ultimately aims to revolutionize lawn care practices and promote the use of clean energy solutions in everyday tasks.

6. RESULT:

Figure 14. Grass cutter user interface

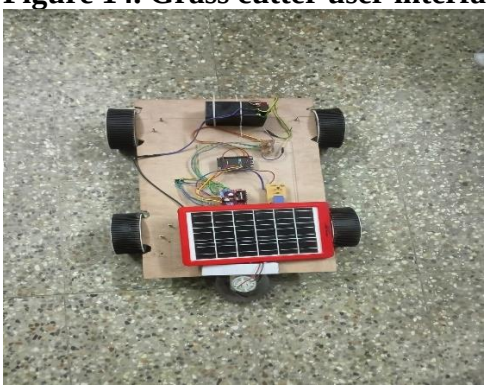

Figure 15. overall assembling of grass cutter

The protype model was successfully made and it was Shown in the above figure 15. It represents the overall assembling of a prototype grass cutter in which all the components are assembled and the Arduino controller, The Internet of Things is being used by the Bluetooth-enabled solar grass cutter to lessen reliance on renewable energy sources. Its 175-meter coverage in an hour and its remote-control functionality via a smartphone app let users to conveniently handle their lawn care from any location. Green space maintenance made sustainable with the Bluetooth-based solar grass cutter's cutting-edge technology and eco-friendly design. and it can be used with a smartphone app by people with or without experience. The user interface of the mobile application as shown in Fig 14. This gadget allows flexible user control and is a cost-effective substitute for current machinery. It is an affordable option for big-scale production since it can be produced in enormous quantities. For convenience of use, the gadget also has a straightforward touch interface. Overall, it offers a greener alternative to current machines.

5. CONCLUSION

The primary goals of this project were to create a grass cutter that is smaller but still effective than the ones that are already on the market, which are heavy and bulky but yet insufficiently effective. The suggested prefabricated grass cutter is much easier to use and transport. Two DC gear motors that can operate noiselessly are used to move the cutter. Since we exclusively used solar power, the system produces no carbon emissions and runs entirely on renewable energy, creating a noise-free and environmentally beneficial atmosphere. The grass cutter's primary steel structure is coated in sheets of wood. It is therefore hundreds of times less expensive than what is currently available. Since the grass cutter runs on solar power, fuel is not needed for its operation. As a result, the price is immediately effective. The grass cutter machine is simple to use because it is operated over Bluetooth through a smartphone app. The labour cost is quite efficient. No one needs to be hired to trim the lawn because it is simple to use and can be operated by the average individual.

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