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Smart Electrical Vehicle System

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ABSTRACT

This research deals with design and manufacturing of the smart electric vehicle, which can automatically shift the power transmission from internal system to the wheels and vice versa by using a gyroscopic sensor and microcontroller in a controlled manner. Nowadays the era of electric vehicles has been just started and it will boost up the automobile industry, in such a way that contemporary fossil fuel vehicles are going to become obsolete in next future. The most important thing is that they are environment friendly in nature which reduces harmful emissions. The objective of the project is to develop a smart car which automatically shifts its power transmission. For this purpose, we have used the gyroscope sensor, to measure angle of slope of the system. We used the Arduino UNO with Bluetooth module controller and some led lights with wire connections. After that the comparative analysis will be carried out between the experimental and analysis results and after that the result & conclusion will be drawn.

INTRODUCTION

An electric vehicle, also called an EV, uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery,solar panels or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels,electric aircraft andelectric spacecraft. An electric car is an automobile that is propelled by one or more electric motors, using energy stored in rechargeable batteries. The first practical electric cars were produced in the 1880s. Electric cars were popular in the late 19th electric spacecraft. An electric car is an automobile that is propelled by one or more electric motors, using energy stored in rechargeable batteries. The first practical electric cars were produced in the 1880s. Electric cars were popular in the late 19th century and early 20th century, until advances in internal combustion engines,electric starters in particular, andmass production of cheaper gasoline vehicles led to a decline in the use of electric drive vehicles.

Gyroscope is a device used for measuring or maintaining orientation and angular velocity. It is a spinning wheel or disc in which the axis of rotation (spin axis) is free to assume any orientation by itself. When rotating, the orientation of this axis is unaffected by tilting or rotation of the mounting, according to the conservation of angular momentum. Gyroscopes based on other operating principles also exist, such as the microchip-packaged MEMS gyroscopes found in electronic devices, solid-state ring lasers,fiber optic gyroscopes, and the extremely sensitive quantum gyroscope. Applications of gyroscopes include inertial navigation systems, such as in the Hubble Telescope, or inside the steel hull of a submerged submarine. Due to their precision, gyroscopes are also used in gyro the odolitesto maintain direction in tunnel mining. Gyroscopes can be used to construct gyrocompasses, which complement or replace magnetic compasses (in ships, aircraft and spacecraft, vehicles in general), to assist in stability (bicycles, motorcycles, and ships) or be used as part of an inertial guidance system. MEMS gyroscopes are popular in some consumer electronics, such as smart phones.

A microcontroller (MCU for microcontroller unit) is a small computer on a single metal-oxide-semiconductor (MOS) integrated circuit chip. In modern terminology, it is similar to, but less sophisticated than, asystem on a chip (SoC); anSoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form offerroelectric RAM,NOR flash orOTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used inpersonal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used inautomatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.

3.PROBLEM STATEMENT, OBJECTIVES, AND SCOPE

3.1 Problem statement

The air conditioner in the car draws more power from the battery and it reduces the capacity of the battery. When a car on a uphill needs more power to drive against gravity and also for an AC. To avoid this problem we have developed this system.

Actual Problem in Vehicle: The air conditioner in a car draws power from the engine, mainly to run the air compressor. An AC system employs a refrigerant flowing through a compressor, condenser, expander and an evaporator. Air blows over the evaporator, where it is cooled and flown into the passenger cabin. So, the AC system does use some of the fuel burnt in the engine. But that usage amount is very small in most modern cars. However in older cars, especially the ones with low engine power, continuously using the air-conditioner could reduce the mileage almost up to 20%.This mileage drop is even more prevalent when such cars go uphill with the AC turned ON. This is simply because, more load is put on the engine to move the vehicle against gravity.

3.2 Objectives

- To reduce battery use on steep/inclination/slope.
- Design a system which transmit the power from secondary usage to primary (i.e. AC or Fan to Wheels).

5. MATHEMATICAL WORK/ CALCULATIONS:

The force required for driving a vehicle is calculated below.

Total force = Frolling + Fgradient+ Faerodynamic drag

i) $F_{rolling} = C_r$*m*a

Where, C_r - Coefficient of rolling resistance

M - mass in kg

a - acceleration due to gravity =9.81m/s^2

$F_{rolling} = C_r$*m*a

= 0.01*5*9.81

= 0.4905 N

i) $F_{gradient}$= m*a*sino Where, m- mass in kg

a - acceleration due to gravity =9.81m/s^2 o -15^0…(flat road o =0^o, slope o = 15^o-22^o)

$F_{gradient}$= m*a*sino

= 5*9.81* sin 15^o = 5*9.81* 0.2588 = 12.69 N iii)

Faerodynamic drag = 0.5(p*V2*Ca*Af)

Where, p – density of air medium (kg/ m^3)

V – Velocity of vehicle (m/s)

C_a– Coefficient of air resistance

A_f– Frontal area of vehicle (m^2)

V= 2*3.14*N/60

= 2*3.14* 30/60

= 3.14 m/s

iv) Faerodynamic drag = 0.5(p*V2*Ca*Af)

$= 0.5(1.23*3.14^2*0.001*0.25*0.01)$

$= 0.0000151444$ N ~ 0

It is very negligible so we cannot consider it.

So, Ftotal = Frolling + Fgradient+ Faerodynamic drag

= 0.4905 + 12.69 + 0

= 13.1805~14 N

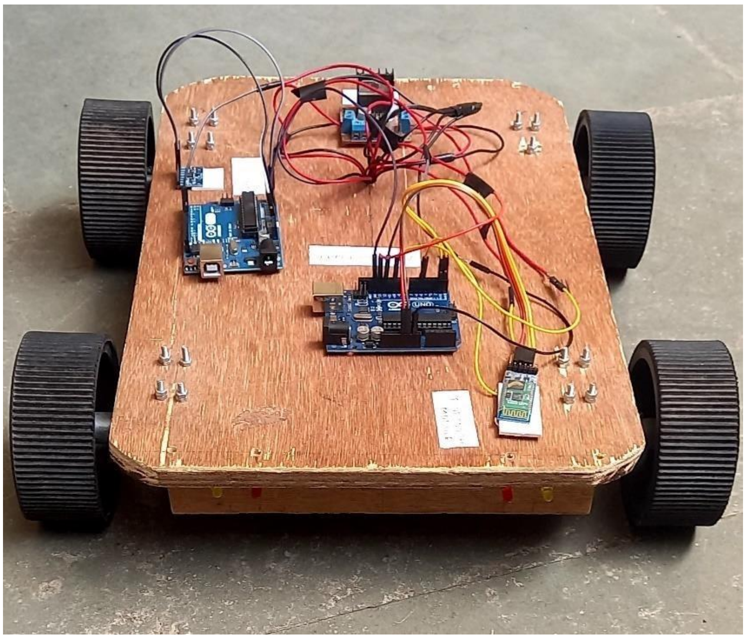
So using the F_{total}we can calculate power

Power = Total resistance force* velocity

= 14*3.14 = 44 Nm/s ~ 44 Watts

Therefore the total power consumed by EV is 4 AH at 12 volts.

7. WORKING MODEL



8. Program:

```
/*
* created by Rui Santos, https://randomnerdtutorials.com
* Control 2 DC motors with Smartphone via bluetooth
*/

int motor1Pin1 = 3; // pin 2 on L293D IC int motor1Pin2 = 4; // pin 7 on L293D IC
int enable1Pin = 6; // pin 1 on L293D IC int motor2Pin1 = 8; // pin 10 on L293D IC
int motor2Pin2 = 9; // pin 15 on L293D IC
int enable2Pin = 11; // pin 9 on L293D IC int state;
int flag=0;       //makes sure that the serial only prints once the state intstateStop=0; void setup() {
```

```
   // sets the pins as outputs:
pinMode(motor1Pin1, OUTPUT);    pinMode(motor1Pin2, OUTPUT);
pinMode(enable1Pin, OUTPUT);    pinMode(motor2Pin1, OUTPUT);
pinMode(motor2Pin2, OUTPUT);    pinMode(enable2Pin, OUTPUT);
pinMode(5, OUTPUT);    pinMode(10, OUTPUT);    pinMode(12,
OUTPUT);    pinMode(13, OUTPUT);    pinMode(7, OUTPUT);
   // sets enable1Pin and enable2Pin high so that motor can turn on:
digitalWrite(enable1Pin, HIGH);    digitalWrite(enable2Pin, HIGH);
digitalWrite(12, LOW);    digitalWrite(13, LOW);    digitalWrite(7, LOW);
   // initialize serial communication at 9600 bits per second:
Serial.begin(9600);
}

void loop() {
   //if some date is sent, reads it and saves in state    if(Serial.available() > 0){
state = Serial.read();        flag=0;
   }
   // if the state is 'O' the DC motor will go forward
if (state == 'F') {        digitalWrite(motor1Pin1, HIGH);
digitalWrite(motor1Pin2, LOW);        digitalWrite(motor2Pin1, HIGH);
digitalWrite(motor2Pin2, LOW);        digitalWrite(12, HIGH);        if(flag
== 0
   }

   // if the state is 'C' the motor will turn left    else if (state == 'B') {
digitalWrite(motor1Pin1, LOW);        digitalWrite(motor1Pin2, HIGH);
digitalWrite(motor2Pin1, LOW);        digitalWrite(motor2Pin2, HIGH);
digitalWrite(13, HIGH);        if(flag == 0){        Serial.println("Closing");
flag=1;
      }

digitalWrite(12, LOW);    digitalWrite(13, LOW);    digitalWrite(7, LOW);}


   else if (state == 'S' ) {        digitalWrite(motor1Pin1, LOW);
digitalWrite(motor1Pin2, LOW);        digitalWrite(motor2Pin1, LOW);
digitalWrite(motor2Pin2, LOW);        digitalWrite(7, HIGH);        if(flag
== 0){        Serial.println("STOP!");        flag=1;
      }
stateStop=0;
   }


else if (state == 'L' ) {
digitalWrite(motor1Pin1, HIGH);        digitalWrite(motor1Pin2, LOW);
digitalWrite(motor2Pin1, LOW);        digitalWrite(motor2Pin2, HIGH);        digitalWrite(5, HIGH);

if(flag == 0){
Serial.println("STOP!");
flag=1;
      }
stateStop=0;
   }


else if (state == 'R' ) {        digitalWrite(motor1Pin1, LOW);
digitalWrite(motor1Pin2, HIGH);        digitalWrite(motor2Pin1, HIGH);
digitalWrite(motor2Pin2, LOW);        digitalWrite(10, HIGH);        if(flag
== 0){
```

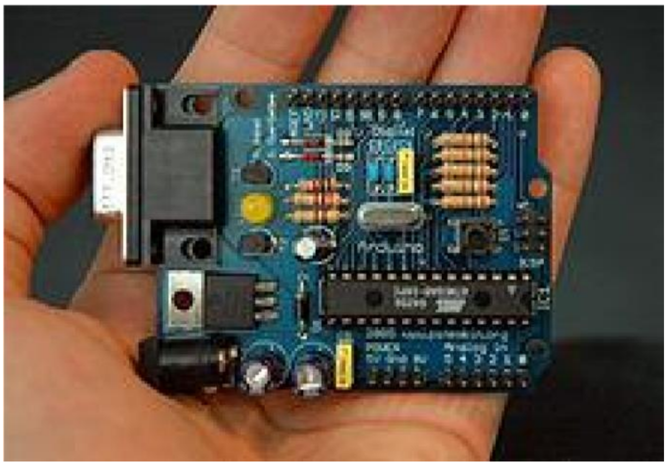
```
Serial.println("STOP!");
flag=1;
      }
stateStop=0;
   }

   //********************************************************//    digitalWrite(12, LOW);    digitalWrite(13, LOW);
digitalWrite(7, LOW);
}
```

8 . COMPONENTS USED:

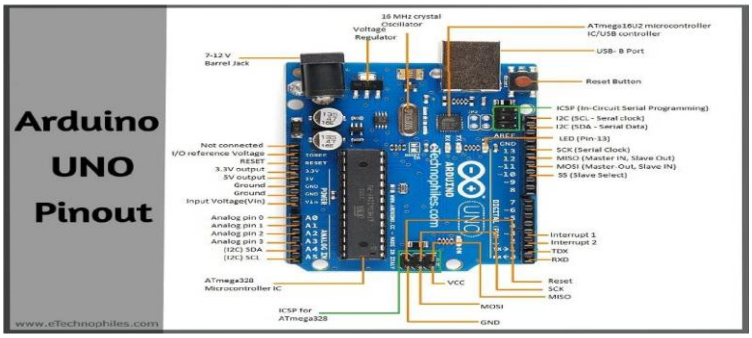
I. Microcontroller:

AURDINO UNO:-

Arduino is open-source hardware. The hardware reference designs are distributed under aCreative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available.



Most Arduino boards consist of an Atmel 8-bitAVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features. The 32-bitArduino Due, based on the Atmel SAM3X8E was introduced in 2012. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarding, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods. When used with traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.



Specifications:

- Microcontroller: ATmega328P
- Operating Voltage: 5V

- Input Voltage (recommended): 7-12V
- Input Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

II. 12V Dc Gear Motor (Geared Motor): 300 Rpm- Set Of 4 :

Specifications:

- 300 Rpm 12V Dc Motors with Gearbox
- 6mm Shaft Diameter with Internal Hole
- 125Gm Weight
- Stall Torque = 1.5Kgcm Torque
- No-Load Current = 60 Ma (Max), Load Current = 300 Ma (Max)

ELECTRIC MOTOR:

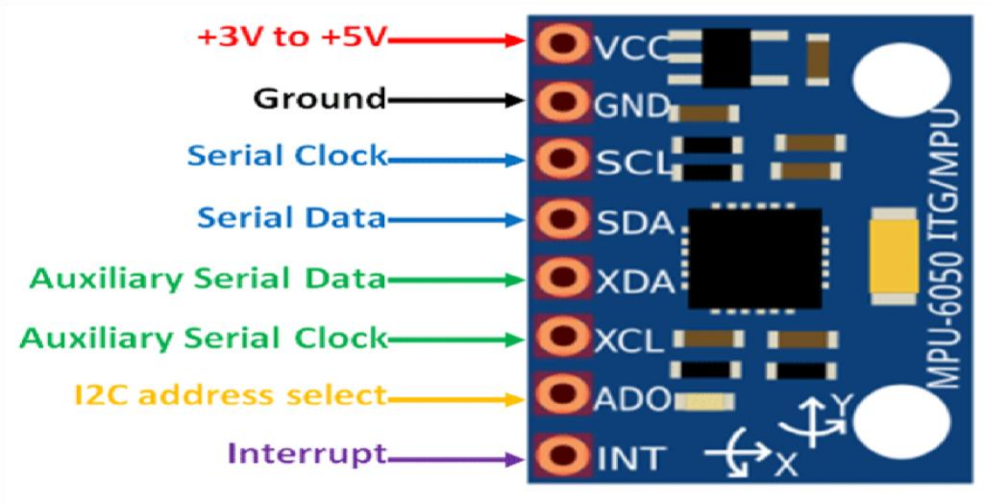
An electric motor s an electrical machine that converts electric energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates in the reverse direction, accepting mechanical energy (such as from flowing water) and converting this mechanical energy into electrical energy. Electric motors may be classified by considerations such as power source type, internal construction, application and type of motion output. In addition to AC versus DC types, motors may be brushed or brushless, may be of various phase (see single-phase, two-phase, or three-phase), and may be either air-cooled or liquid-cooled. General-purpose motors with standard dimensions and characteristics provide convenient mechanical power for industrial use. The largest electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors are found in industrial fans, blowers and pumps, machine tools, household appliances, power tools and disk drives. Small motors may be found in electric watches.

DC motors:

After many other more or less successful attempts with relatively weak rotating and reciprocating apparatus Prussian Moritz von Jacobi created the first real rotating electric motor in May 1834. It developed remarkable mechanical output power. His motor set a world record, which Jacobi improved four years later in September 1838. His second motor was powerful enough to drive a boat with 14 people across a wide river. It was also in 1839/40 that other developers managed to build motors with similar and then higher performance.

III. GYROSCOPE SENSOR :

Gyro sensors, also known as angular rate sensors or angular velocity sensors, are devices that sense angular velocity. In simple terms, angular velocity is the change in rotational angle per unit of time. Angular velocity is generally expressed in deg/s (degrees per second).Angular rate sensors are devices that directly measure angular rate, without integration in conditioning electronics. Gyroscopes also measure angular rate. Generally gyroscopes are able to measure a constant rotation rate, while rate sensors also include devices with a low cut off frequencythat is other than zero.



Specifications:

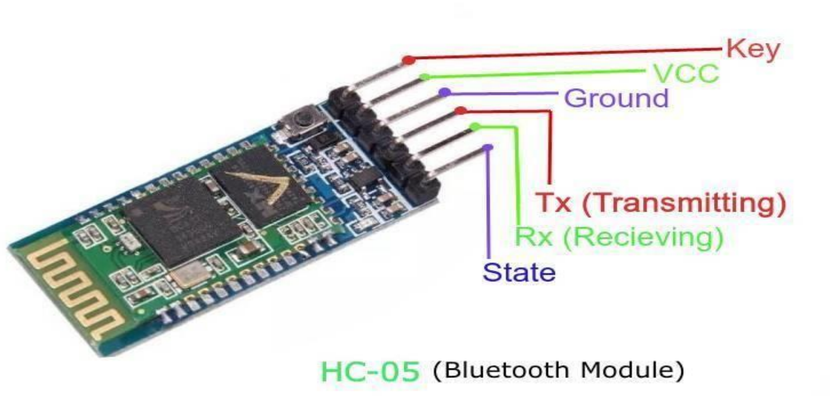
- Supply voltage: 2.3–3.4 V •Consumption: 3.9 mA max.
- Accelerometer:
  oMeasuring ranges: ±2 g ±4 g ±8 g ±16 g oCalibration tolerance: ±3%

•Gyroscope:
  oMeasuring ranges: ±250/500/1000/2000 °/saroCalibration tolerance: ±3%

- I2C interface
- Embedded temperature sensor
- Selectable jumpers on CLK, FSYNC and AD0
- Operating temperature: -40 °C to +85 °C
- Dimensions: 25.5 × 15.2 × 2.48 mm

IV. BLUETOOTH MODULE:

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC.



Specifications:

- HC-05 Technical Specifications
- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible

- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode
- Can be easily interfaced with Laptop or Mobile phones with Bluetooth
- Supported baud rate: 9600,19200,38400,57600,115200,230400,460800

eds a medium through which it
ct as insulator.

7. WORKING METHODOLOGY:

The required objective of our system is that when the vehicle is started to travel on the inclined roads, the complete power supply must be supplied to the tires of the car by automatically turning off the fan (cooling system designed for the traveler). The frequency and amplitude of on and off of the fan depends on the inclination angle of the road. Hence when the slope is very steep controlling is done in such a way that the maximum power is to be supplied to the wheels. Similarly, when slope is very gentle accordingly minimum extra power is supplied to the rear wheels.

We have done our setup in such a way that, the frame of the vehicle has the gyroscopic sensor. When vehicle starts taking inclined path it sends signal to the microcontroller. The microcontroller is programmed in such a way that it will automatically cuts off the power supplied to the fan, and all the power supply is concentrated at the wheels. There is also an arrangement made where the driver can turn off the above designed system so that power can be transferred to both fan and wheels.

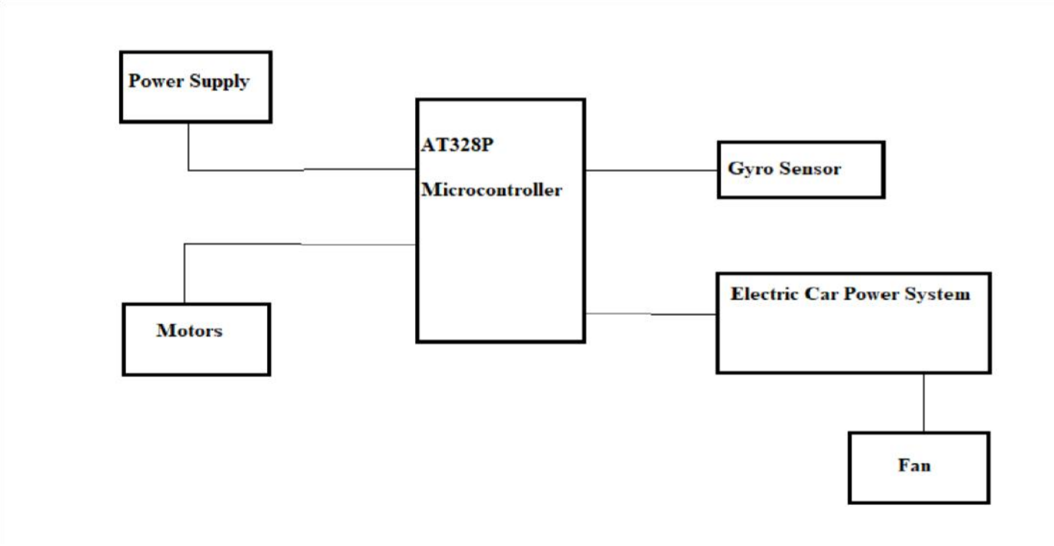


Figure2 : Layout Of Smart EV

CONCLUSION:

- We have build a smart electric vehicle system which senses angle 30 degree while driving on slope by using gyroscope sensor and micro-controlling that signal with the help of Arduino, secendory devices which consumes more power are going to switch off. All together power will be given to primary movers and power will save .
- We have 66 watt power in which we have used 44 watt so we saved power upto 20watt.

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