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Solar Powered Vehicle Using IoT Controller

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ABSTRACT: Auto rickshaws/cars that are extensively used in many Asian countries as taxis of people and good. Due to poor vehicle maintenance and the use of inefficient two or four stroke engines with very little pollution control, these vehicles present a grave pollution problem in major Indian cities. This project presents a solar powered motor vehicle with the efficient charging system. The energy for the vehicle will be supplied by Solar panel (10W). An Arduino is utilized alongside an Android Application for the ideal task. The Android Application is associated with the Bluetooth module (HC-05). The directions are given to the robot utilizing voice directions present on the android application.

I. INTRODUCTION

1.1 OVERVIEW:

An electric vehicle (EV) is a vehicle that 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, solarpanels, fuel cells 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 and electric spacecraft.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines have been the dominant propulsion method for motor vehicles for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types. Commonly, the term EV is used to refer to an electric car. In the 21st century, EVs have seen a resurgence due to technological developments, and an increased focus on renewable energy and the potential reduction of transportation's impact on climate change and other environmental issues. Project Drawdown describes electric vehicles as one of the 100 best contemporary solutions for addressing climate change.

1.2 DESCRIPTION OF AN ELECTRIC VEHICLE

The electric vehicle (EV) is propelled by an electric motor, powered by rechargeable battery packs, rather than a gasoline engine. From the outside, the vehicle does not appear to be electric. In most cases, electric cars are created by converting a gasoline-powered car. Often, the only thing that clues the vehicle is electric is the fact that it is nearly silent. Under the hood, the electric car has:An electric motor, A controller,A rechargeable battery.
The electric motor gets its power from a controller and the controller gets its power from a rechargeable battery. The electric vehicle operates on an electric/current principle. It uses a battery pack (batteries) to provide power for the electric motor. The motor then uses the power (voltage) received from the batteries to rotate a transmission and the transmission turns the wheels. Four main parts make up the electric vehicle: the potentiometer, batteries, direct current (DC) controller, and motor. See Figure 1.1

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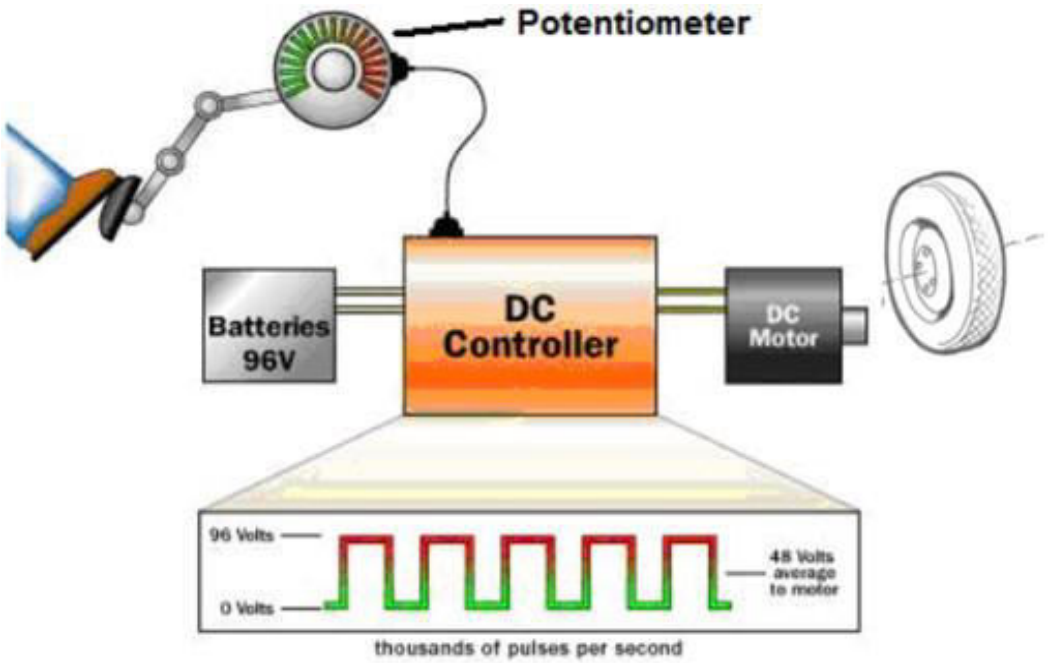

Figure 1.1 Parts of an electric vehicle

Potentiometer: The potentiometer, also called the variable resistor, provides the signal that tells the controller how much power is it supposed to deliver.
Batteries: Three types of batteries: lead acid, lithium ion, and nickel-metal hydride batteries. Batteries range in voltage (power).
DC Controller: The controller takes power from the batteries and delivers it to the motor. The controller can deliver zero power (when the car is stopped), full power (when the driver floors the accelerator pedal), or any power level in between. If the battery pack contains twelve 12-volt batteries, wired in series to create 144 volts, the controller takes in 144 volts direct current, and delivers it to the motor in a controlled way.
Motor: The motor receives power from the controller and turns a transmission. The transmission then turns the wheels, causing the vehicle to run.

1.3 SOLAR POWERED ELECTRIC VEHICLE

Figure 1.2 Solar powered car

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A solar car is a solar vehicle used for land transport. Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car.

Most solar cars have been built for the purpose of solar car races. Cars without gauges almost always feature wireless telemetry, which allows the driver's team to monitor the car's energy consumption, solar energy capture and other parameters and free the driver to concentrate on driving. Solar cars depend on PV cells to convert sunlight into electricity.

1.4 ELECTRIC-VEHICLE BATTERY

An **electric-vehicle battery** (EVB) (also known as a **traction battery**) is a battery used to power the electric motors of a battery electric vehicle (BEV) or hybrid electric vehicle (HEV). These batteries are usually rechargeable (secondary) batteries, and are typically lithium-ion batteries. These batteries are specifically designed for a high ampere-hour (or kilowatt-hour) capacity. Electric-vehicle batteries differ from starting, lighting, and ignition (SLI) batteries as they are designed to give power over sustained periods of time and are deep-cycle batteries

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Electric-vehicle batteries differ from starting, lighting, and ignition (SLI) batteries as they are designed to give power over sustained periods of time and are deep-cycle batteries.

Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, specific energy and energy density; smaller, lighter batteries are desirable because they reduce the weight of the vehicle and therefore improve its performance. Compared to liquid fuels, most current battery technologies have much lower specific energy, and this often impacts the maximum all-electric range of the vehicles.
The most common battery type in modern electric vehicles are lithium-ion and lithium polymer, because of their high energy density compared to their weight. Other types of rechargeable batteries used in electric vehicles include lead–acid ("flooded", deep-cycle, and valve regulated lead acid), nickel-cadmium, nickel–metal hydride, and, less commonly, zinc–air, and sodium nickel chloride ("zebra") batteries. The amount of electricity (i.e. electric charge) stored in batteries is measured in ampere hours or
in coulombs, with the total energy often measured in kilowatt-hour.

MOTOR CONTROL:

This implies three things:

- Speed of the motor is directly proportional to supply voltage.
- The Speed of the motor is inversely proportional to armature voltage drop.
- The motor speed is inversely proportional to the flux due to the field finding

Thus, the speed of a DC motor can control in three ways:

- By varying the flux, and by varying the current through field winding
- By varying the armature voltage, and the armature resistance.

1.5 MOTOR DRIVE

DC drive is basically a DC motor speed control system that supplies the voltage to the motor to operate at desired speed. Earlier, the variable DC voltage for the speed control of an industrial DC motor was generated by a DC generator.
By using an induction motor, the DC generator was driven at a fixed speed and by varying the field of the generator, variable voltage was generated. Soon after this Ward Leonard set was replaced by a mercury arc

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rectifier and later by thyristor converters. Nowadays, the thyristor family of devices is used widely to control the speed of the DC motor.

1.5.1 COMPONENTS OF A DC DRIVE

DC Drive Input:

Rectifier Bridge:

Field Supply Unit:

Speed Regulation unit:

Firing Circuit:

II. METHODOLOGY FLOW

2.1 SYSTEM DISCRIPTION

This project discusses about the development of a solar power vehicle. To make a sufficient solar vehicle we have used energy efficient components like Arduino, Motor driver IC (L293D), Solar Charge Controller, Bluetooth module (HC-05), Lithium-Ion Battery. We have tried to make a lightweight mini vehicle having a chassis and other mechanical components bolted on it.

The architecture design of the proposed vehicle is sown in figure 3.1

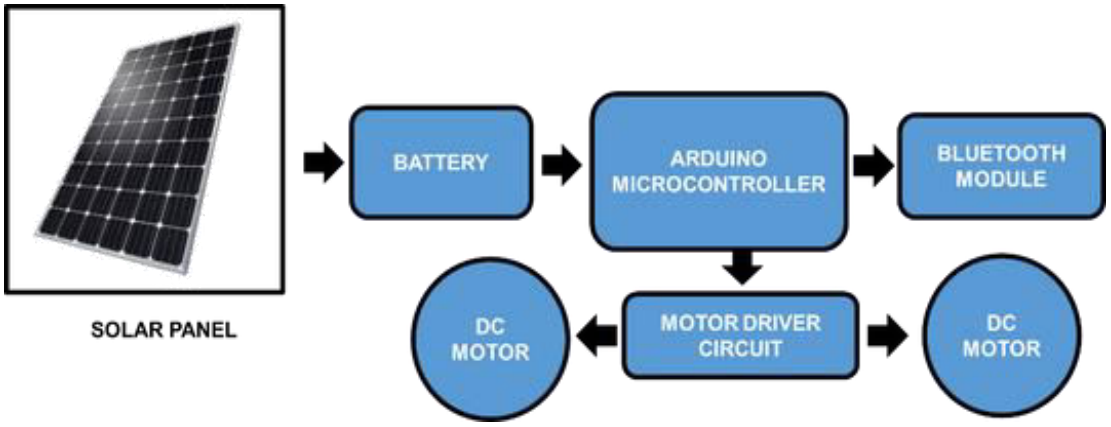

Figure 3.1 System Architecture

We have used 200 rpm DC Geared motors for the faster movement and heavier loads. Two motors on the left and the two motors on the right are connected in series with each other so that they can be simultaneously moved forward or backwards. The Code is flashed into the Arduino before bolting it to the chassis.

2.2 METHEDOLOGY

Whenever the vehicle is in presence of sunlight, the battery starts getting charged, else it provides power to the load from the stored energy. We have set a threshold in charge controller at 10.3 V so that whenever the voltage comes down under this value, the battery low led will glow and power to load gets terminated to prevent the battery from over- discharging. Figure 3.2 shows the circuit diagram of the syst

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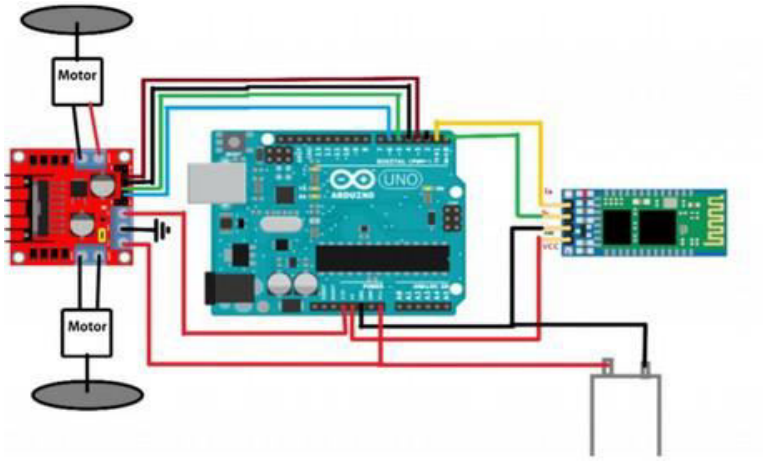

Figure 3.2 Circuit diagram

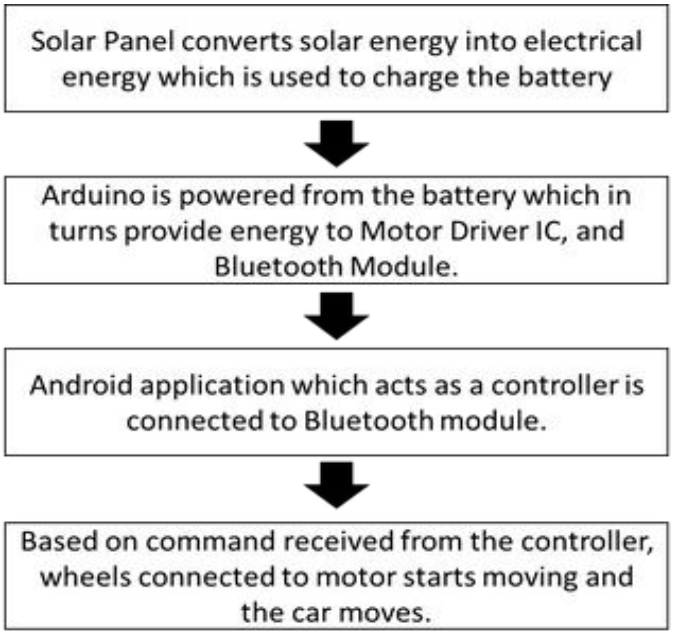

Figure 3.2 operation Flowchart

III. HARDWARE DISCRIPTION

3.1 POWER SUPPLY

There are different kinds of rechargeable batteries. The most common type is the lead-acid battery. It is the first type of rechargeable battery ever created. Compared to later types of rechargeable batteries, Lead-Acid batteries have the lowest energy density. Despite this, its ability to supply high surge currents means that the cells have a relatively large power-to- weight ratio.

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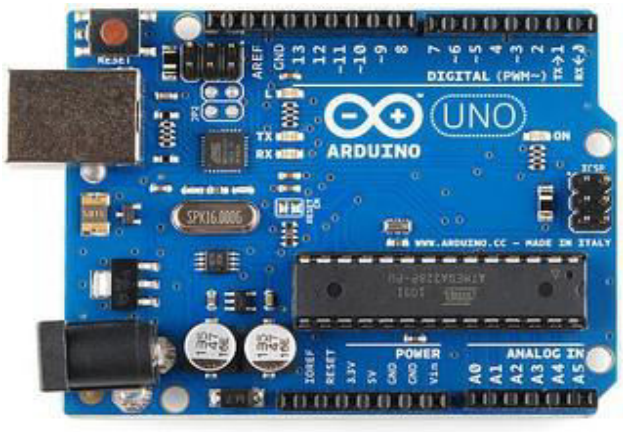
Figure 4.1 Lead acid Battery

3.1.1 PRINCIPLE OF THE LEAD-ACID BATTERY

A battery is a device that stores electric power in the form of chemical energy. When necessary, the energy is again released as electric power for DC consumers such as lighting and starter motors. A battery consists of several galvanic cells with a voltage of 2 volt each. For a 12-volt battery, six cells are linked in series and fitted inside a single casing. To achieve 24 volt, two 12-volt batteries are linked in series. Each cell has positive oxidised lead plates and negative lead metal plates, and has an electrolyte consisting of water and sulphuric acid.
There are limits set for the charge voltage to prevent the release of an excessive amount of hydrogen. A charge voltage of more than 2.4 V per cell, for instance, releases a lot of hydrogen gas, which can form a highly explosive mixture with the oxygen in the air.The upper limit on charge voltage for a 12 V battery is 14.4 V, and the corresponding value for a 24 V battery is 28.8 V at 20 °C.

3.2 ARDUINO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package



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3.3 DC MOTOR DRIVER IC

For the up and down motion of the arm and open close motion of the arm fingers we have used a mechanical arrangement that converts the rotation direction of motor in to equivalent motion.

3.3.1 CONCEPT

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to otate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.
In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

3.3.2 VOLTAGE SPECIFICATION

VCC is the voltage that it needs for its own internal operation 5v; L293D will not use this voltage for driving the motor. For driving the motors, it has a separate provision to provide motor supply VSS (V supply). L293d will use this to drive the motor. It means if you want to operate a motor at 9V then you need to provide a Supply of 9V across VSS Motor supply.
The maximum voltage for VSS motor supply is 36V. It can supply a max current of 600mA per channel. Since it can drive motors Up to 36v hence you can drive pretty big motors with this l293d

3.4 HC-05 BLUETOOTH MODULE

HC-05 is a Bluetooth device used for wireless communication with Bluetooth enabled devices (like smartphone). It communicates with microcontrollers using serial communication (USART). It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART). HC-05 is a Bluetooth module which is designed for wireless communication.
This module can be used in a master or slave configuration.

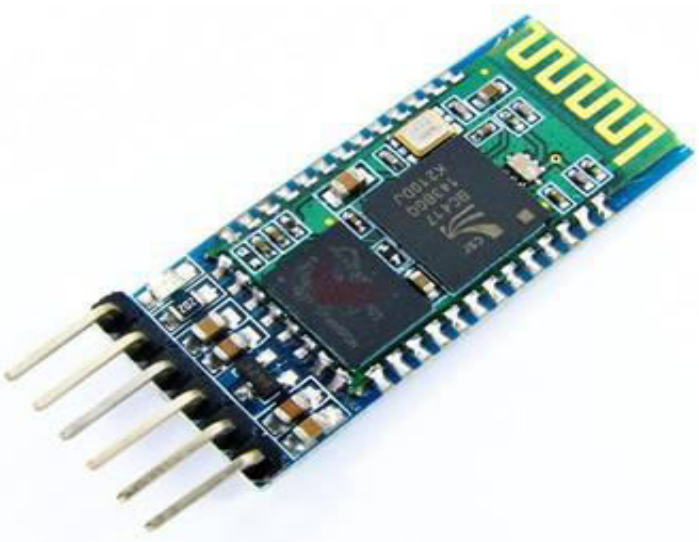

Figure 4.7 HC-05 Bluetooth Module

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3.4.1 HC-05 BLUETOOTH MODULE INTERFACING

As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, there is no need to shift TX voltage level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.

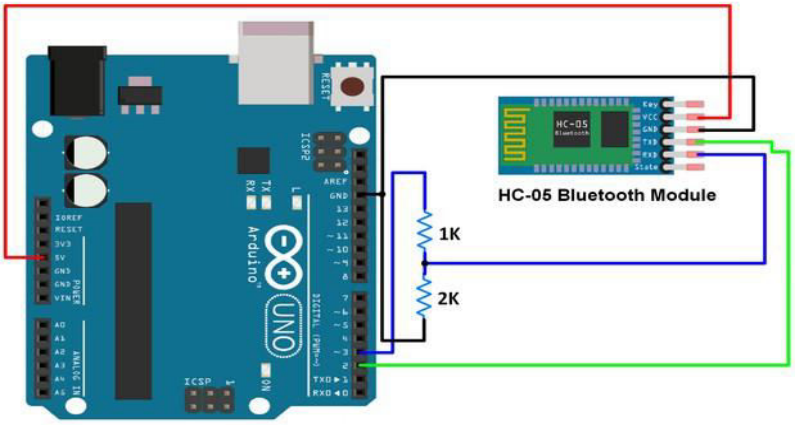

Figure. Interfacing HC-05 Bluetooth Module with Arduino UNO

IV. VALIDATION METRICS

4.1 ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

4.2 PROGRAMMING

When you open the Arduino program, you are opening the IDE. It is intentionally streamlined to keep things as simple and straightforward as possible. When you save a file in Arduino, the file is called a sketch – a sketch is where you save the computer code you have written.The coding language that Arduino uses is very much like C++ ("see plus plus"), which is a common language in the world of computing. The code you learn to write for Arduino will be very similar to the code you write in any other computer language.learning a new dialect should you pursue other programming languages.

V. RESULT AND DISCUSSION

5.1 INTEGRATION OF ALL PARTS

All the hardware components are integrated and finally the robotic vehicle is developed. Power is supplied to the Arduino which further supplies power to other components. The solar panel is mounted just above the chassis with light-weight metal sheet gripped firmly. View of the developed prototype of solar power electric vehicle is shown in figure 6.1.

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Figure 6.1 Image of Developed Solar vehicle

5.2 RESULT DISCUSSION

The "Connected" status on the application screen shows that our application is connected to the Bluetooth module successfully. Now, we can move our vehicle in any direction according to our requirement. The four-direction icon helps in the smooth movement of the vehicle. The stop icon in the middle is for emergency brake. The approximate calculation of charging time and running time is mentioned below: On connecting two terminals of solar panel, battery and load to the charge controller, the charge controller provides constant 12V supply to the load, which is same as that of battery. So, for charging and discharging time, the parameters of voltage can be ignored

The designing of the whole system depends on the application of the vehicle and accordingly the components has been chosen right from the motor to the solar modules. The motor of the required rating is chosen first. From the rating of the motor, the battery which can satisfy its starting current and full load current is selected, and then according to the rating of the battery, the solar panels are select.

VI. CONCLUSION

This model vehicle runs efficiently utilizing the solar energy. In a developing country like India, solar energy can become boon to meet its energy requirement. The dependency on the fossil fuels and compressed natural gas can be drastically reduced if this type of energy seeking mechanism is taken in to operation. Also, unlike fossil fuels, this renewable energy is abundant in quantity and does not emit any kind of harmful emission. So, the proposed methodology is very much efficient and effective and can be developed further for its usage in the domain of public transportation.

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