AUTOMATIC SWITCHING CONTROL IN HYBRID VEHICLE SYSTEM

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Abstract—
Only a small percentage of the cars in our country run on batteries instead of gasoline. As a result, there is a fuel shortage and environmental degradation as well. Nearly all emerging nations struggle with a serious issues like air pollution. The automotive industry must discover an alternate fuel source due to the scarcity of fossil fuels and the inadequacy of such fuels. Automobiles produce more CO2 than they should, which makes it necessary to develop new technologies like hybrid electric vehicles (HEV). With the help of this study, we hope to create a system that can power a motor using both batteries and an internal combustion engine that burns gasoline. Regenerative braking is utilized in this system. This system's energy regeneration could result in lower emissions, shorter charging times, and reduced fuel use. The article combines the mechanical and electrical systems industries to demonstrate the improvement in fuel economy. A smart energy management system with solar charging is used in this work.

Key Words: Electric motor, internal combustion engine, hybrid electric vehicle, and fuel efficiency

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DOI: 10.48047/ecb/2023.12.si5a.0391

1. INTRODUCTION

Automakers are discovering that even relatively minor technological enhancements to the internal combustion (IC) engine deliver diminishing returns for their efforts as they strive to create vehicles that are less polluting and more fuel-efficient. As a result, numerous businesses have been looking into more substantial changes to the powertrain as a whole. Although hybrid electric car technology has been around for a long, Ford and other companies are currently giving it a close look. While still keeping the range and usability of an internal combustion engine-powered car, hybrid electric vehicles should be able to achieve some of the gains in pollution and fuel economy obtained by completely electric vehicles. Due to the fact that hybrid electric vehicles combine an electric motor with a heat engine (such as gasoline, diesel, or even a fuel cell), this ought to be doable. Because of their three different modes of operation, using both an electric motor and a heat engine has benefits. Second, by using the electric motor to provide the extra boost the vehicle needs when the conditions are ideal for high performance, the size of the heat engine may be lowered. As a result, the heat engine can operate at its highest efficiency level in circumstances that are significantly closer to its average. Second, the electric motor can be used to move the car forward or reverse. Third, the use of the electric motor as a generator makes it possible to recover some of the vehicle's kinetic energy through the use of regenerative braking. A hybrid electric vehicle (HEV) requires an overall vehicle system control strategy that is significantly more sophisticated than what is found in a typical car because of the HEV's greater complexity. The hybrid electric vehicle (HEV) has additional powertrain parts, giving it access to a number of modes of operation not found in standard cars (e.g., electric drive). In order to identify the proper vehicle operating state, the Vehicle System Controller (VSC) is in charge of continuously monitoring the driver's requirements, the vehicle's current condition, and any potential system defects. Additionally, the controller is responsible for ensuring that the vehicle continues to give the driving feel that customers have grown to appreciate regardless of the road conditions. When the vehicle switches between its various operational modes, this is of the utmost importance (e.g., from In engine drive to motor drive). It is only logical to utilize a hybrid controller that combines a state machine and elements of dynamic control in light of these criteria for the VSC. The focus of this study, which will describe that method, will be on creating a hybrid controller for an HEV. Whether we're talking about measure-ments, status, or control input, any real-time system will have some sort of time delay. In order to smooth out performance stability issues that are unique to the control system, this introduces both theoretical and practical aspects that need to be taken into account. Despite the fact that transportation systems are among the most crucial to modern human society, the advancement of transportation technology has been consistent since the invention of the internal combustion engine (ICE). Internal combustion engines (ICE) and electric motors are combined in hybridization, a relatively recent idea. Hybrids offer a variety of advantages over conventional gasoline-powered vehicles that the latter does not. These flexible systems may distribute power in a variety of configurations, including Plug-in, Series-Parallel, Parallel-Series, and Combination hybrid. A setup that combines plug-in hybrid and hybrid powertrains is the most effective. Plug-in hybrid electric vehicles are uncommon since they need their own unique charging infrastructure. The transmission system and clutch are often used to connect the drive chain of mixed hybrid cars to the power sources. The most popular setup for these cars is front-wheel drive. An electromechanical mechanism is used to do the switching, and a transmission system specifically designed for that purpose is used to transport the power. Only autos and SUVs equipped with four wheels can use this technology. Such automobiles rarely have fully automatic switching systems built into their construction. In this work, a simpler switching method is suggested. The dynamics of the two-wheeled vehicle are utilized to represent the parts, and a chain transmission is proposed as a way to join the power source to the drive chain.

2. LITERATURE REVIEW

Numerous papers are cited in this part of the literature review in order to provide the most up-to-date knowledge on this subject as well as theoretical and methodological contributions. The battery powers the hub motor [1] on the front tire, while the gasoline-powered IC engine powers the back wheel. [2] Battery propulsion is used for low-power applications, whereas gasoline engines are used for high-power applications. [3]. Problems with battery life can be resolved by adopting this technology. This device is more efficient because it uses solar power for charging. [7]. Numerous benefits of this system include low fuel usage, low emissions, a small engine size, and long service life.[16] Relays are used to automatically choose a driving setting. Solar energy is cost-free, constant, and simple to use for battery charging. [17] This system differs from other electric bikes on the market in a number of ways, including handling capability and reliability. It is environmentally beneficial when in electric mode. This system's goal is to identify the self-sustaining hybrid car that will increase human productivity. [21] This device makes use of a microcontroller to provide both an anti-crash warning system and a balanced tire pressure monitoring system.

1. PROPOSED SYSTEM

The paper appears to be outlining a novel strategy for refueling a hybrid electric car. The authors propose using a storage tank that is mostly filled with water as a fuel tank alternative to conventional fuel tanks. The amount of fuel accessible is calculated using a sensor that is constantly submerged in the tank and used to measure the water level. A DC generator that replicates the operation of a gasoline-powered internal combustion engine is used to power the car. The DC motor is attached to the exterior of the vehicle's fuel engine, a freewheeling hub. The sensor alerts the drive system to transition to electric drive when the water level in the tank drops below a set level. As a result, the car uses less gasoline and produces fewer emissions when operating on battery power. Although it might encounter some difficulties in practice, this is generally a fascinating idea. It remains to be seen whether this system will be able to compete with conventional fuel tanks in terms of performance and dependability, as well as how effective it will be at powering a hybrid electric car. To completely explore the potential of this strategy, additional study and development will be required.

2. COMPONENTS

The parts utilized in this suggested method are

4.1RELAY

A relay is an electromagnetic switch that can be turned on and off using a comparatively small amount of electric current. The relay is used in this paper to switch between operating states. Refer the picture 1,

Fig -1: Relay

4.2DC MOTOR

Direct current electrical power is transformed into mechanical power by a DC motor. A current-carrying conductor is placed in a magnetic field, where it experiences a torque and has a tendency to move. This is how a DC or direct current motor operates. Motoring action is the term for this. A mechanical force is created when an electric field and a magnetic field interact. A DC motor can therefore be used at a voltage lower than its rated voltage. However, the speed becomes unstable below 1000 rpm, and the motor will not operate smoothly. However, operating the motor outside of this range will cause significant temperature increases and motor components. Refer the picture 2.

Fig -2: DC Motor

4.3FUEL SENSOR

The mechanical connection between these sensors and a float, which changes height in response to fuel level, is strong. The sensor's resistance varies as the float moves. This sensor is a component of the fuel gauge display circuit's current balancing circuit, which normally comprises coils for the display needle's actuation. As used in vehicles, the Fuel indicator consists of two parts:

- The sending unit - in the tank
- The indicator - on the dashboard

In a modern car, the sending unit normally has a printed ink design and employs a float coupled to a potentiometer. In order to increase the resistance of the resistor, the float slides a movable contact along it as the tank empties. Some vehicles will also turn on a "low fuel" light when the resistance reaches a specified level. The sending unit's electric current is being measured and shown by the indicator unit at the same time. The needle indicates a full tank when it points to "F" when the tank level is high and the maximum current is flowing. The needle points to "E," which denotes an empty tank, when the tank is empty and the least amount of current is flowing; some vehicles use the sign "1." (for full) and "0" or "R" (for empty) instead. The value of the variable resistor, to which a float is linked, is determined by the amount of fuel in the tank by an electric current flowing through it. Such resistors are typically found on the inside of the gasoline tank, or on the inward side, of car fuel gauges. Such a resistor poses a fire hazard and an explosive risk when electricity is sent through it. Refer the picture 3.

Fig-3: Fuel sensor

4.4CONTROLLER

The PIC16F877A has 256 bytes of data memory, self-programming, an ICD, two comparators, eight channels of 10-bit analog-to-digital conversion, capture/compare/PWM functions, and a universal asynchronous receiver transmitter. The synchronous serial port can be configured as either a 3-wire Serial Peripheral Interface (SPI) or a 2-wire Inter-Integrated Circuit (I2C) bus (USART). Refer the picture 4.

Fig-4: PIC Controller

4.1BATTERY

The primary battery is a lead-acid battery. The lead-acid battery is charged using the CC/CV (constant current-constant voltage) method. Up until the upper charge voltage limit is reached, a regulated current increases the terminal voltage; however, at that point, saturation causes the current to decrease. With big stationary batteries, the charge time can be up to 36–48 hours and is typically 12–16 hours.. Other battery technologies can charge lead acid batteries more quickly, but lead acid is slower. Refer the picture 5.

Fig -5: Battery

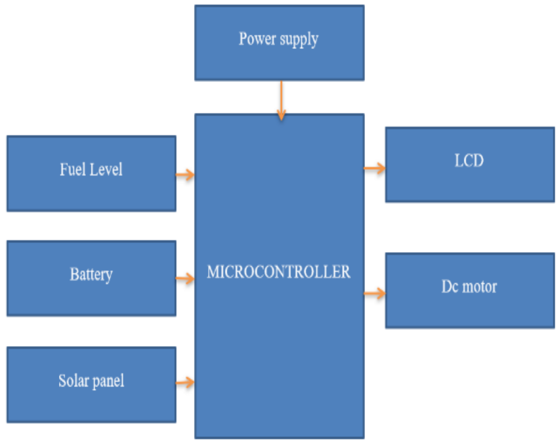
4.2SOLAR PANEL

The solar panel is quickly developing into a highly appealing renewable choice that might be very good for the environment. The efficiency of the process of turning solar energy into electrical energy has increased significantly during the past few decades. Refer the picture 6.

Fig -6: Solar panel

1. BLOCK DIAGRAM

This is a depiction of this paper's notion using a simple block in a visual manner**.**



2. MODES OF OPERATION

This proposed system has three operational modes**.**

6.1MODE 1: BATTERY MODE

If the vehicle runs at any speed solely using the motor, it is referred to as an electric vehicle. This mode only uses battery power. Applications requiring modest speeds and heavy traffic use this battery mode. Moreover, this mode uses less gasoline. In this mode, a high signal sent from the microcontroller to the relay activates the battery circuit.

6.2 MODE 2: ENGINE MODE

The IC engine is what propels the car, just like in battery mode. A 3-way switch's terminal is connected to the self-starter motor. In order to start the engine when in engine mode, the self-starter motor was turned on. In this mode, the microcontroller sends a low signal to the relay at a speed of 750 ms. The starter turns on the engine and turns off the power to the motor.

6.2MODE 3: AUTOMATIC MODE

The most important and efficient mode is this one. This system uses both IC and electricity to function. When the car enters battery mode, the battery is disconnected according to microcontroller programming, and the engine is started when the battery reaches a particular level (low battery level). When the battery is low, the relay automatically changes to fuel mode and turns on the ignition.

3. DESCRIPTION

7.1 CONTROLLING CIRCUIT

The controlling circuit includes a microcontroller, relays, a battery level indicator, and a fuel level indicator, among other things. The governing circuit's brain is described as a microcontroller. A PIC 16F877a microcontroller is used in this system.

The battery level indicator continuously checks the battery's level of charge; if it drops below 25%, the microcontroller signals the relay to turn on. Due to the switching action, the relay then switches from being in the ordinarily closed position to the normally open position. The car will then operate in the fossil fuel mode after the IC engine has started.

7.2 MECHANICAL CIRCUIT

In the electrical mode, a brushless DC motor is used to power an electric motor that is powered by an electric battery that may be charged in a variety of ways (including using solar energy). The vehicle is propelled by an internal combustion engine when in engine mode. There is also an alert system available in addition to that. By adopting this technology, fossil fuels can be preserved and energy will be generated again.

4. RESULTS

8.1SOFTWARE OUTPUT

The simulation for the electrical modes is carried out in PROTEUS 7 Professional, and the program was created in Embedded C. This PROTEUS software is used to design and simulate the modes of operation. To view the battery mode, see figure 8

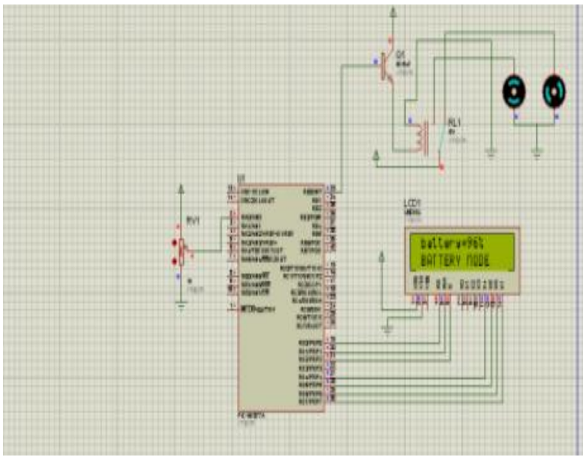


Fig- 8.1(a) Simulation for Battery Mode

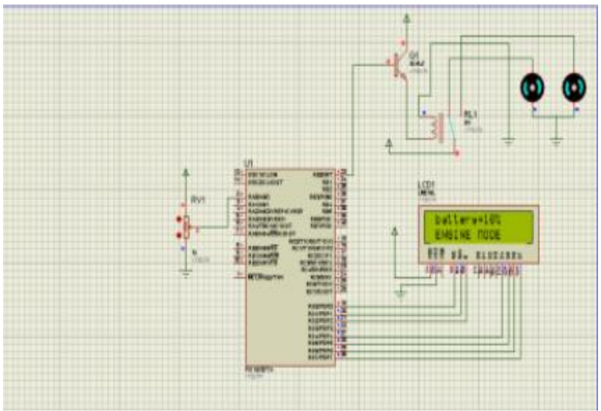


Fig- 8.1(b) Simulation for Engine Mode

8.2HARDWARE OUTPUT

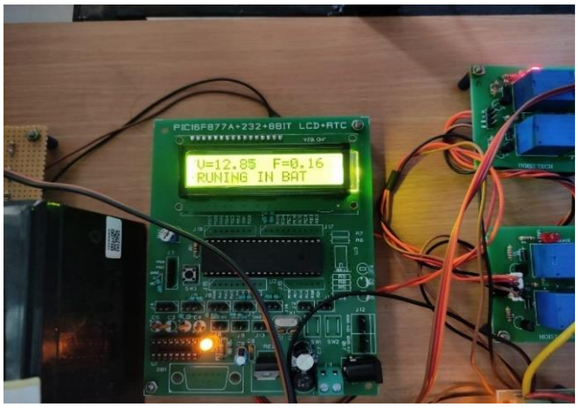


Fig- 8.2(a) Hardware for Battery Mode

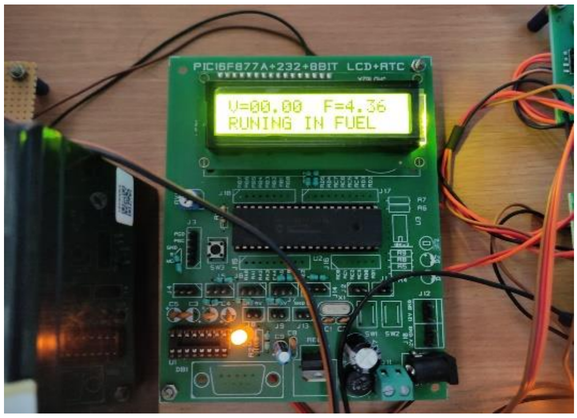


Fig- 8.2(b) Hardware for Engine Mode

5. REFERENCE

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