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E-Mail :
editor.ijasem@gmail.com
editor@ijasem.org

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Fuel Theft Detection Using an Arduino

[1]K. BhaskarMutyalu,[2]T. Gangadhara Rao
[3]Sripathi Jagadeesh Phani Sri Charan, [4]Narava Manoj Sai Kumar, [5]Eeli Sriram,
[1]Professor, Department of Mechanical Engineering, Rajamahendri Institute of Engineering & Technology.
[2]Associate Professor, Department of ECE, Rajamahendri Institute of Engineering & Technology.
[3,4,5]Student, Department of ECE, Rajamahendri Institute of Engineering & Technology.

ABSTRACT:

Particularly in less-protected sites, such as parking lots, transportation companies, and rural regions, fuel theft has grown into a major problem. Unauthorized fuel draining is often prevented by conventional fuel monitoring procedures. A gasoline theft detection system is shown in this project. It incorporates a level sensor, button, and buzzer to provide alarm mechanisms for real-time fuel monitoring.

The fuel level is constantly being monitored by the Level Sensor. The device can identify potential theft if the gasoline level drops suddenly while the car is at a stop. Users may manually customize the system by using the Button, which allows them to activate or disable notifications as needed. In the event that fuel theft is discovered, a buzzer will immediately sound an auditory warning.

Using sensor data, an Arduino-based microcontroller processes the system's operations and triggers alarms in the event of an unlawful decrease of fuel. Further remote notifications and better security may be achieved with the optional integration of a GSM module, which allows for the transmission of SMS alerts to car owners.

This scalable and reasonably priced system improves fuel management and vehicle security by taking a proactive stance in detecting gasoline theft. An Internet of Things (IoT) connection might allow for remote monitoring in the future, GPS tracking could provide position updates in real time, and anomaly detection could be based on artificial intelligence to avoid false alarms.

EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld gadgets like digital watches and MP3 players to massive, permanently installed systems like those managing nuclear power plants, traffic lights, and industrial controls are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

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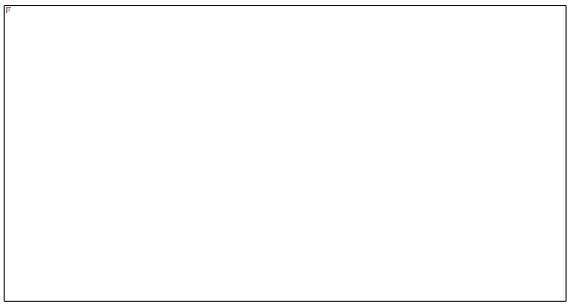
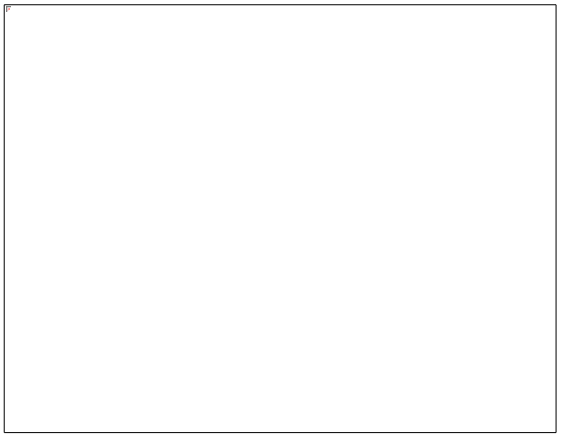
CHARACTERISTIC OF EMBEDDED SYSTEM



APPLICATIONS OF EMBEDDED SYSTEMS

Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.



MICROCONTROLLER VERSUS MICROPROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM, ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. Because of its set quantity of on-chip ROM, RAM, and number of I/O ports, microcontrollers are perfect for many applications where space and cost are important considerations. It is not necessary to have a 486 or even an 8086 CPU for many applications; for instance, a TV remote control. Typically, these programs will need some kind of input/output function in order to read signals and toggle bits.

INTRODUCTION

The increasing problem of gasoline theft from parked autos requires a solution that is both innovative and well-planned. The recent increase in gasoline prices has led to an uptick in fuel theft incidents; our program is committed to resolving this problem by implementing effective solutions that address this issue particularly. Since this pervasive problem impacts even smaller vehicles like motorcycles, there is an urgent need for workable solutions. As our proposed approach points out on purpose, fuel theft is bad for society. It skillfully combines the ever-decreasing cost of GSM technology with Arduino micro-controllers to maximize vehicle fuel efficiency. A combination of fuel cap and submersible level sensors, together with buzzers and LCDs, provide real-time monitoring by providing visual and audio alerts. The use of GSM/GPRS modules allows for quick owner notifications, providing a complete and expandable system. Situated at the crossroads of technological progress and societal challenges, our strategy offers an early response to preserve precious fuel sources. It combats fuel theft by addressing the urgent need for new solutions, making it a significant and interesting topic for conference talks.

LITERATURE SURVEY

Integrating GSM alert and GPS tracking capabilities driven by an ARM7 microprocessor, this article presents an intelligent fuel theft detection technique. The technology ensures 2417

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surveillance and security by allowing real-time tracking of a vehicle's position and fuel levels, as well as delivering fast alerts to the owner's mobile device in the event of any unwanted entry [1-3]. In this work, we discuss the results of a study that targeted the global problem of gasoline theft and describe a system that can detect when a bicycle has been stolen and immediately notify the owner by text message and a loud alarm (979-8-3503-2820-2/$31.00). copyright 2024 Presented by IEEE3n1 Sri Sairam Engineering College in Chennai, India, a yyarra ja when it comes to computer science and engineering Address: ayyarraja03@gmail.com Currently enrolled as a fourth-year computer science and engineering student at Sri Sairam Engineering College in Chennai, India fuel theft [4-6] to sheela.cse@sairam.edu.in. An essential step in strengthening the security posture of any loT-based system is the integration of standard intrusion detection systems (IDS) with convolutional neural networks (DCNNs), which are built in this study to provide a robust intrusion detection system (IDS). The security architecture of loT systems may be strengthened and the performance issues caused by traditional IDS methods can be addressed with this new development, which has promising implications [7].

Due to issues including false alarms and limited datasets, anomaly-based network intrusion detection systems (NIDS) have limited real-world applicability, which are highlighted in this research review. The paper concludes that explainable artificial intelligence (XAI) techniques may enhance NIDS performance by using the NSL-KDD dataset to test a random forest model. Results demonstrate enhanced classification performance, highlighting the potential of XAI approaches to correct data and model biases, thereby improving the trustworthiness of anomaly-based NIDS [8]. Using image processing to detect theft and track the movement of criminals inside CCTV video, this study proposes a system that can detect and track theft without the need for extra sensors. Built on top of the Convolutional Neural Network (CNN) paradigm, this system may quickly notify security guards of possible intruders by identifying and following questionable actors in surveillance video, thereby creating "a chance for intervention and prevention" [9, 10].

EXISTING SYSTEM

When it comes to detecting gasoline theft, the old ways of doing things like manually checking the tank level or using mechanical locks just don't cut it anymore. Unauthorized gasoline drain causes operational inefficiencies and financial losses for many fleet managers and vehicle owners. Basic gasoline gauges are used by certain automobiles, but they do not provide real-time theft alarms. Relying on manual inspection techniques is problematic since it necessitates periodically checking the fuel level. When it comes to preventing theft, most car alarm systems fall short since they aren't designed to detect gasoline tampering.

Delays in detecting gasoline theft are further caused by the fact that most fuel monitoring systems do not have real-time alarm devices like buzzers or remote alerts. Smart, sensor-based fuel theft detection systems are necessary since there are currently no automated detection and warning procedures.

PROPOSED MODEL

A Level Sensor, Button, and Buzzer are all part of the suggested gasoline theft detection system, which may automatically identify fuel theft and notify the owner. To keep track of the gasoline level in real-time, the Level Sensor is put into the fuel tank. An alarm will sound to alert the owner of a possible fuel theft if the vehicle's fuel level drops suddenly while it is not in use. Giving the user control over when alerts should be activated, a button is included to enable or deactivate the security alert system manually. To discourage gasoline theft, the Buzzer emits an immediate audible alert. Adding GSM connectivity to the system also allows for the sending of SMS alerts to the owner's mobile device, so they can still get real-time messages even if they aren't physically near the car. Included in the proposed system are key features such as: • A level sensor that monitors the fuel level in real-time. • A button that can be used to activate or deactivate the system. • A buzzer that can be used to warn of unlawful fuel drainage. • An optional GSM module that can be used for remote warnings. • Simple, effective, and inexpensive to install in cars and gas tanks. Better fuel management and less financial losses for vehicle owners and fleet operators are benefits of this system's proactive protection against fuel theft.

BLOCK DIAGRAM

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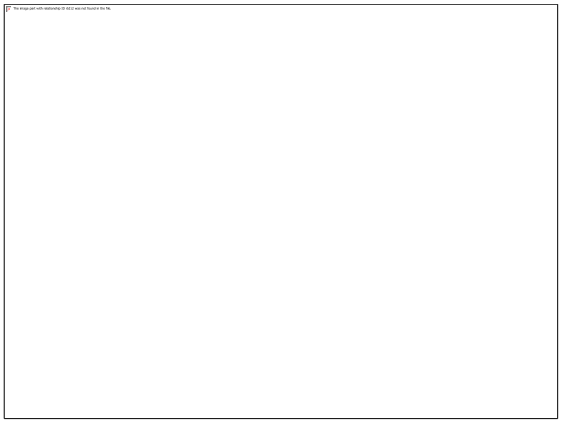

Figure 1: Block Diagram

Microcontroller:

A tiny controller, or microcontroller, as the name implies. Often used as a processing or controlling unit, they are similar to single-chip computers. For instance, microcontrollers that do decoding and other regulating operations are likely integrated into the control you are using. They find further use in vehicles, home appliances, microwaves, toys, and any other area requiring automation.

Arduino Uno Microcontroller:

One such microcontroller board is the Arduino Uno, which uses the Atmega328 (datasheet). It has a 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins (6 of which may be used as PWM outputs), a power connector, an ICSP header, a reset button, and a USB connection. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

A key difference between the Uno and all previous boards is the absence of the FTDI USB-to-serial driver chip. Rather of that, it has an Atmega8U2 that has been configured to convert USB to serial. To celebrate the impending release of Arduino 1.0, the name "Uno"—which means "One" in Italian—has been chosen. The Uno and Arduino version 1.0 will serve as the foundational versions for future Arduino releases. For a comparison with prior generations, see the index of Arduino boards. The Uno is the newest in a series of USB Arduino boards and the standard model for the Arduino platform.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

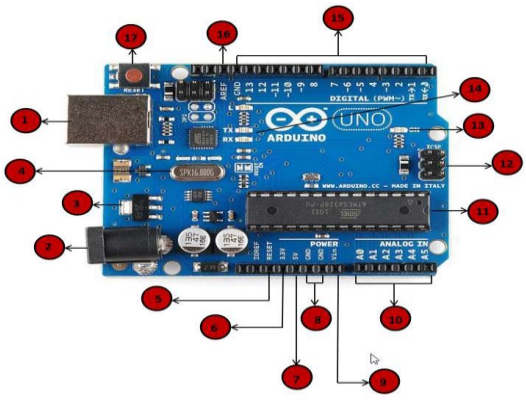

Figure 2: Arduino uno board

In contrast to all of its predecessors, the Uno does not have the FTDI USB-to-serial driver chip. As an alternative, it makes use of USB-to-serial converters coded into the Atmega16U2 (Atmega8U2 up to version R2).

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

Figure 3: power supply

Diodes:

Only one path of electrical current may pass through a diode. Current may flow in either direction, as shown by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

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Figure 4: Diode Symbol

One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

A rectifier's job is to change the phase of an alternating current (AC) waveform so that it appears as a direct current (DC) waveform. Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current. The Half-Wave Resettable The graphic shows that the half-wave rectifier is the simplest rectifier type since it only employs one diode.

Figure 5: Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of liquid crystal molecules hanging between two transparent electrodes make up each pixel. Light would not be able to travel through them if the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter. A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. 16X1, 16x2, and 20x2 LCDs are among the most popular types of displays that are often linked to the controllers. Which works out to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line. The use of "smart LCD" displays allows for the visual output of information by many microcontroller devices. Affordable, user-friendly, and capable of producing a readout utilizing the display's 5X7 dots plus cursor, LCD displays built on the LCD NT-C1611 module are a great choice. They use mathematical symbols and the usual ASCII set of characters. The display needs a +5V power and 10 I/O lines (RS, RW, D7, D6, D5, D4, D3, D2, D1, D0) for an 8-bit data bus. The only additional lines needed for a 4-bit data bus are the supply lines and six more (RS, RW, D7, D6, D5, D4). The data lines are tri-state and do not affect the microcontroller's function when the LCD display is disabled.

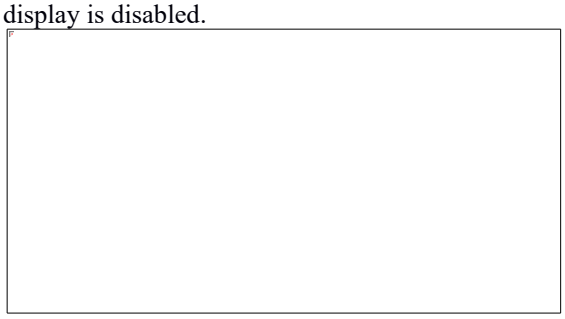

Figure 6: 2x16 LCD Display

BUZZER

In a magnetic transducer, the circuitry includes an iron core, a yoke plate, a wound coil, a permanent magnet, and a vibrating diaphragm that can be moved. The magnet's field gently draws the diaphragm up nearer the core's surface. A positive alternating current (AC) signal causes the diaphragm to move up and down, which in turn vibrates the air. This is achieved by the current passing through the excitation coil, which forms a fluctuating magnetic field. A resonator, which is composed of a cavity and one or more sound holes, may amplify vibrations in order to generate a loud sound.

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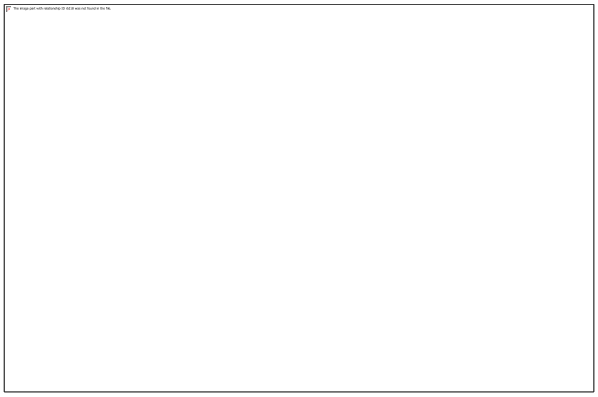

ESP8266 Wi-Fi Module

This project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it.
One remarkable feature of this tiny board is the integrated MCU (Micro Controller Unit), which allows for the control of I/O digital pins via a simple programming language that is almost pseudo-code like. Another benefit is that the ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget.
In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. He was His tiny size and cheap pricing (1.7–3.5$) enticed a lot of hackers and geeks to look into it and utilize it for all sorts of projects. Because of its enormous success, Espressif now offers a wide variety of models with varying size and technological specs. Its replacement includes ESP32.

RELAYS:

Industrial controls, automotive systems, and home appliances all make extensive use of electrically controlled switches called relays.
By using a relay, two independent voltage sources may be isolated from one another; in other words, a little quantity of voltage or current on one side can manage a big amount of current or voltage on the other side, and vice versa.

Inductor

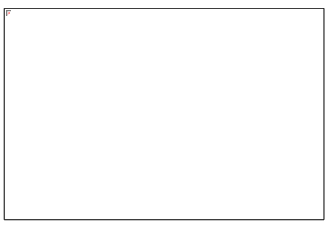

Fig7 : Circuit symbol of a relay

DRIVING A RELAY:

Two of the SPDT relay's five pins are used by the magnetic coil, one serves as the common terminal, and the other two are typically closed and normally connected. The coil is activated when a current passes across it. At the beginning, when the coil is deenergized, the usually closed pin and common terminal will be connected. A new connection will be formed between the common terminal and usually open pin when the coil is activated, breaking this connection. Therefore, the relay will be activated whenever the microcontroller sends an input signal to it. You may drive the loads connected between the common terminal and typically open pin while the relay is on. Consequently, the high-current loads are driven by the relay, which receives 5V from the microcontroller. This means the relay may be used as a means of isolation. The microcontroller and digital systems do not have enough current to operate the relay. In contrast to the 10 milliamps required to activate the relay's coil, the microcontroller's pin can only provide 1 or 2 milliamps. This is why the microcontroller and the relay are separated by a driver, like ULN2003, or a power transistor. By connecting ULN2003 to the relay and microcontroller, it is possible to activate many relays simultaneously.

SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board. The main characteristics are: • Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more. • The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board. • A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks. Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the

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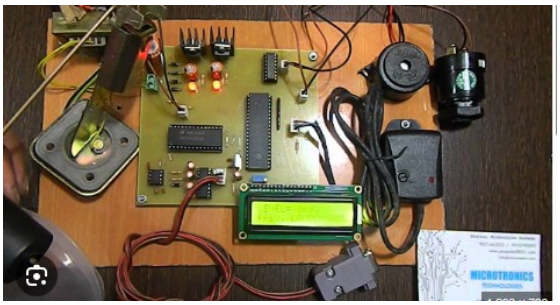
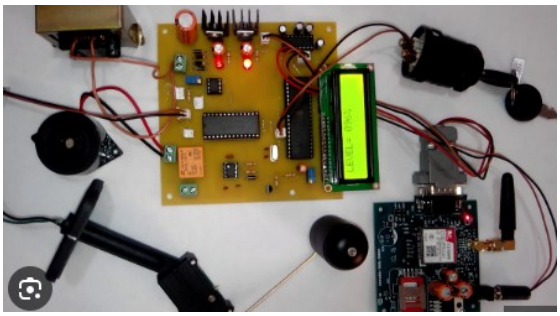
Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

RESULTS





Model

CONCLUSION

The gasoline theft detection system that uses level sensors, buttons, and buzzers is an efficient, clever, and inexpensive way to prevent fuel theft. The technology identifies and warns the owner in real time, unlike previous security systems, allowing for fast action.

The suggested technique drastically cuts down on gasoline theft by combining automatic fuel level monitoring with user control via a button and an auditory warning system. Internet of Things (IoT)-based remote monitoring, GPS tracking to identify stolen gasoline, and artificial intelligence (AI)-based predictive analytics to increase detection accuracy are all potential future upgrades.

Better safety and cost savings for car owners are guaranteed by this system's scalable, easy-to-deploy, and successful approach to improving vehicle security and fuel management.

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