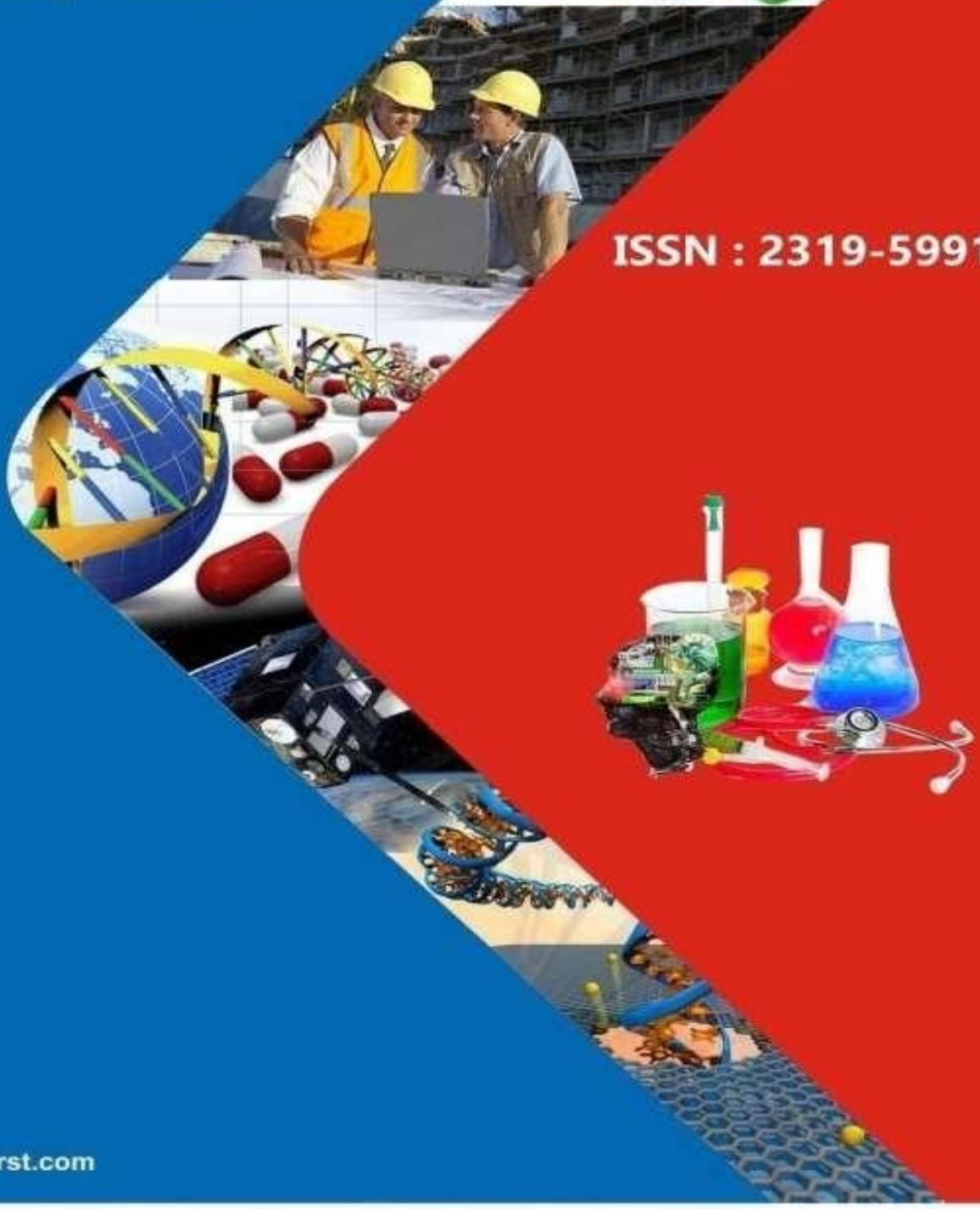
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Fuel Theft Detection Using an Arduino

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ABSTRACT:

We present a Fuel Monitoring System that utilizes the embedded system technology to take care of the prevalent fuel-related issues in parking lots, particularly those without surveillance or security. This proactive approach aims to alleviate concerns about gasoline theft with its real-time fuel level monitoring. The system's integrated Global Communications Technology (GSM) enables smooth communication and timely text message alerting of vehicle owners in the case of fuel theft. We prioritized simplicity, cost-effectiveness, and technical innovation in our design. With the addition of a microcontroller, the system becomes a sophisticated but simple method to increase car safety in different parking scenarios. Topics covered include fuel theft, microcontrollers, and gasoline monitoring.

INTRODUCTION

A well-thought-out, creative answer is needed to the growing issue of fuel theft from parked automobiles. The rise in fuel theft instances is a direct result of the recent spike in gasoline costs, and our initiative is devoted to finding a solution to this problem by using effective strategies specifically geared to tackle this issue. There is an immediate need for practical answers to this widespread issue since it affects even smaller vehicles like motorbikes. Fuel theft harms society, as our recommended strategy deliberately underlines. To optimize fuel economy in vehicles, it deftly integrates Arduino micro-controllers with the rapidly declining cost of GSM technology. Fuel cap and submersible level sensors work in tandem with buzzers and LCDs to provide visible and auditory warnings, allowing for real-time monitoring. Offering a comprehensive and extensible solution, the integration of GSM/GPRS modules enables fast owner alerts. An early reaction to save valuable fuel supplies is provided by our method, which is situated at the intersection of technology innovation and social issues. An important and noteworthy subject for conference discussions, it successfully fights fuel theft by tackling the pressing need for innovative solutions.

LITERATURE REVIEW

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 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

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theft without the need for extra sensors. Built on top of the Convolutional Neural Network (CNN) paradigm, this system may quickly notify security staff of possible intruders by identifying and following questionable characters in surveillance film, thereby creating "a chance for intervention and prevention" [9, 10].

BLOCK DIAGRAM

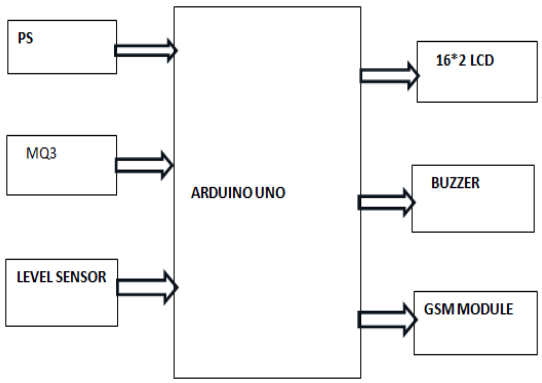


Fig 1 Block Diagram

INTRODUCTION TO EMBEDDED SYSTEMS

An embedded system is a computer that is designed to perform a specific task or set of tasks, typically within the constraints of real-time computing. It is often included into a whole gadget, much like other mechanical and physical components. But general-purpose computers, like personal computers, may have their programs set up to accomplish a broad range of tasks. Embedded systems are now essential to the operation of a great number of commonplace goods. Due to its dedicated nature, design engineers have the opportunity to enhance the embedded system in order to reduce product size and cost while simultaneously increasing reliability and performance. Some embedded systems may take advantage of price reductions thanks to their mass manufacture.

An example of a physically embedded system would be a digital watch or MP3 player; an example of a large, permanently placed system would be the management of a nuclear power plant, traffic signals, or industrial controls. The level of complexity can vary substantially, spanning from extremely simple systems that use a single microcontroller chip to extremely complex systems that house numerous modules, peripherals, and networks in a large chassis or enclosure. Given that most systems provide some kind of programmability, a clear definition of the word "embedded system" is lacking. Because they allow the loading of several applications and the connection of peripherals, portable computers are not strictly embedded systems, even if they share some components with them, such operating systems and microprocessors. Computer components, including both fixed-and programmable-capability software, designed with a specific application device in mind constitute what is known as an embedded system. Numerous items have embedded systems. These include, but are not limited to, cars, cameras, medical equipment, household appliances, planes, toys, vending machines, and, naturally, smartphones and PDAs. Programming for embedded systems is a specialized area, and programmable embedded devices are provided with a programming interface. Windows XP with Embedded Java A few of examples of embedded-specific languages and OSes are embedded and embedded. However, there are several low-priced consumer items that use integrated application and operating system components, small storage capacities, and very inexpensive microprocessors. Here, the software is not loaded into RAM (random access memory) as apps on personal computers are, but rather written into the system's memory permanently.

CHARACTERISTIC OF EMBEDDED SYSTEM

- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

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.

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- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

MICROCONTROLLER VERSUS MICROPROCESSOR

Could you please highlight the main distinctions between microprocessors and microcontrollers? A microprocessor is any general-purpose computer processor, such as an 8086, 80286, 80386, 80486, Pentium, 680X0, etc., from Motorola, or Intel. These microprocessors do not have random-access memory (RAM) and do not have on-chip I/O ports. This is why general-purpose microprocessors are a common name for them.
Adding RAM, ROM, I/O ports, and timers to a system design is necessary when using a general-purpose CPU such as the 68040 or Pentium. These systems are bulkier and more expensive because they use external RAM, ROM, and I/O ports; nevertheless, they are flexible since the designer may pick the amount of RAM, ROM, and I/O ports needed for the task. This guideline does not apply to microcontrollers.
In a microcontroller, a timer, input/output (I/O) ports, a microprocessor, random access memory (RAM), and read/write (ROM) are all housed on a single chip. Therefore, the designer is limited in their ability to include additional memory, I/O ports, or a timer into the device due to the integrated nature of the central processing unit (CPU), random access memory (RAM), read/write memory (ROM), and timer onto a single chip. Microcontrollers are ideal for many applications where space and cost are critical because to their fixed amount of on-chip ROM, RAM, and number of I/O ports.
For many applications, such as a TV remote control, a 486 or even an 8086 CPU is not required. In order to read signals and toggle bits, these applications often need an input/output function.

MICROCONTROLLERS FOR EMBEDDED SYSTEMS

For microprocessors, the term "Embedded System" is used in the literature. Microcontrollers and microprocessors are major components of embedded system products. An embedded system product's microprocessor (or microcontroller) is purpose-built to perform a single task. Since a printer's central processing unit (CPU) is only ever used for printing and data retrieval, it is the ideal device to demonstrate an embedded system. Here we have a Pentium based personal computer. One may find personal computers used for a wide variety of tasks, including word processing, printing, banking, gaming, networking, and accessing the Internet. The software of many different applications may be installed and run. An operating system and random access memory (RAM) are the obvious components that enable a computer to run applications and perform all those other tasks.
Upon detection of fire, the microcontroller is notified by this robot's fire sensor. Typically, an embedded device will have a single application program burned into its read-only memory (ROM). On an x86 personal computer, you may find a wide variety of embedded products, including a keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse, and many more. All of these add-ons include a single-purpose microcontroller.

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.

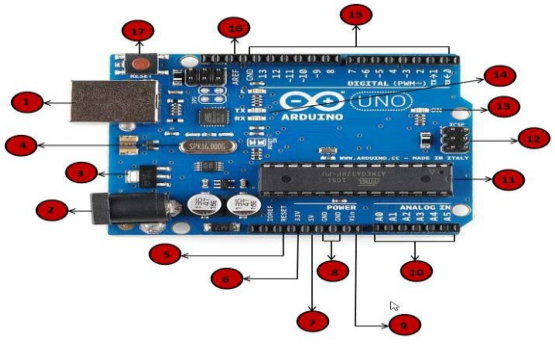


Figure 2 : Arduino uno board

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

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POWER SUPPLY UNIT

The power supply for this system is shown below.

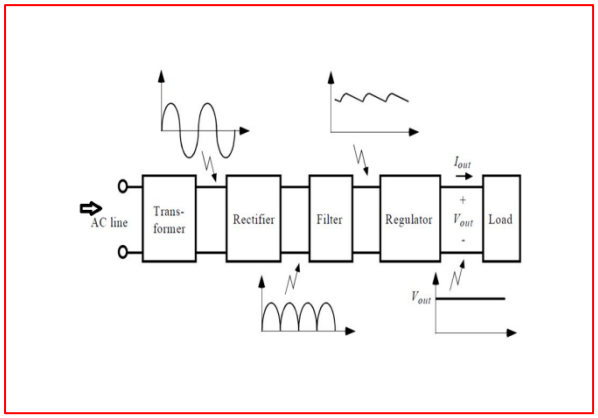


Figure. 3.power supply

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.

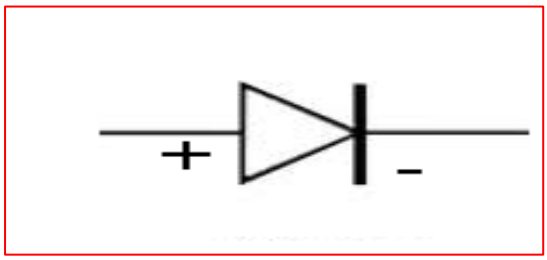


Figure.4. Diode Symbol

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

Transform alternating current (AC) into direct current (DC) is what a rectifier is all about. A rectifier is a device that converts alternating current (AC) into direct current (DC). 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 Rectifier

The half-wave rectifier is the simplest type of rectifier since it only uses one diode, as shown in figure.

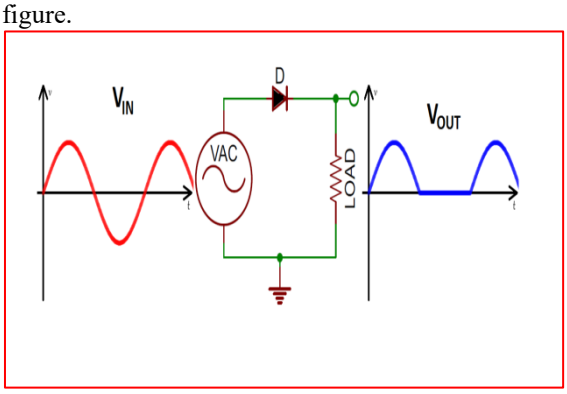


Figure.5 Half Wave Rectifier

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 usage of "smart LCD" screens allows for the visual output of information by several 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.

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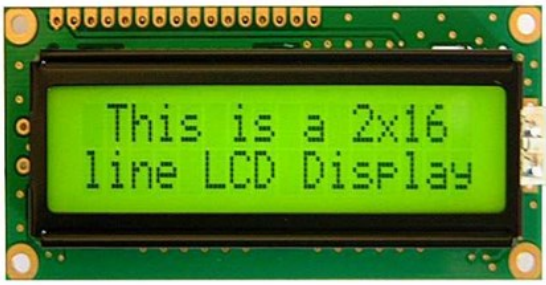


Figure.5. 2x16 LCD Display

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

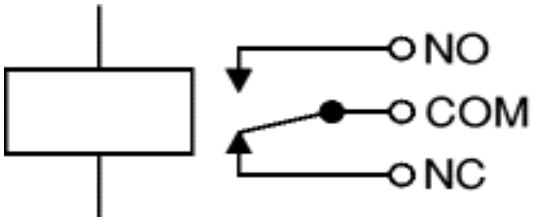
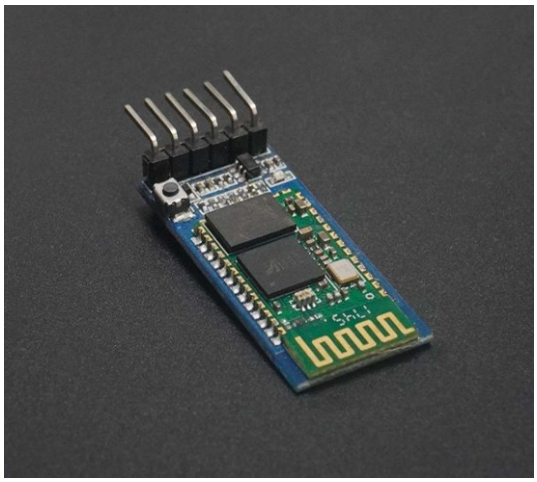


Fig 6: Circuit symbol of a relay

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.

BLUETOOTH MODULE



SOFTWARES

Introduction to Arduino IDE

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 key features 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. A USB cable is all that's needed. • Plus, the Arduino IDE is based on a stripped-down version of C++, which makes learning to program a breeze.
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

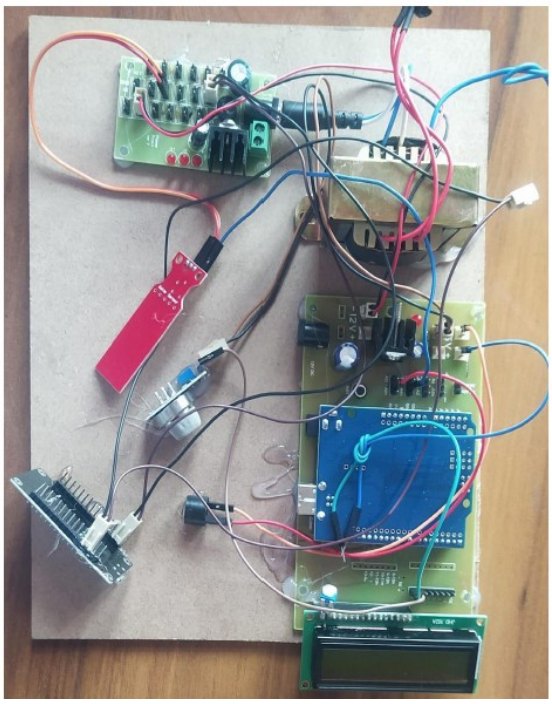
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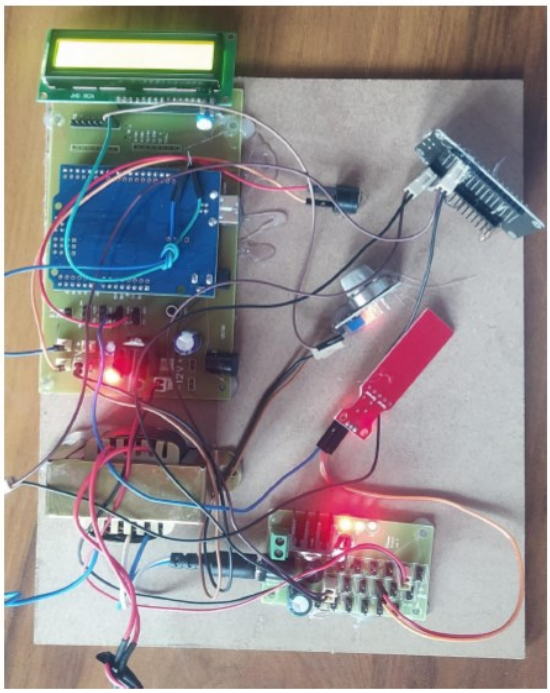
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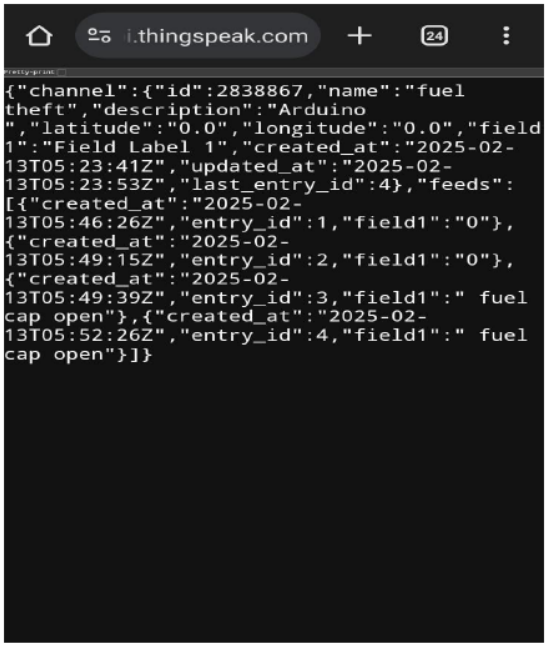
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and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

RESULTS







CONCLUSION

The problem of fuel theft in the present generation is being addressed with this effort. Combating gasoline theft with our technology is easy and effective. Our device's simplicity and low cost contribute to its efficiency. We lose hundreds of rupees per month due to gasoline theft, which may happen anywhere. Our invention is a compact and effective container that safeguards this precious item. If you care about the safety of the things you own, installing a security system is a smart move. Therefore, I'd want to end by stating that our gadget is an affordable, straightforward, feature-rich product. Underwater level sensors, GSM modules, and Arduino microcontrollers are some of the modern technologies introduced in this article, which also highlights the system's efficacy and cost. Our study contributes significantly to solving an issue that is prevalent in the modern period by providing a thorough strategy for preventing fuel theft that considers security, cost-effectiveness, and technology. The system's integrated gasoline cap sensors, optional LCD panels, and aural warning devices provide a full defensive mechanism, further enhancing its adaptability. With the ability to radically alter the strategy for safeguarding fuel resources, our technology is a major step forward in the realms of loT and vehicle security.

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