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Smart Fuel Theft Detection using Microcontroller and IOT

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ABSTRACT -Fuel prices are steadily rising. As a result, there has been a significant increase in the number of incidents of gasoline theft. We created this project named "IOT and Arduino based Vehicle fuel theft detection" to assist individuals in detecting fuel theft in their vehicles. When someone tries to take gasoline from any car, this project will activate a buzzer and communicate data via IoT to a website.

A sensor, microcontroller, and IOT module are the key components of the IOT and Arduino-based car fuel theft detection project.The Internet of Things (IoT) is a network of 'things' that uses sensors, electronics, software, and connection to allow physical objects to share data.There is no need for humans to engage with these systems. IoT technology is used in a variety of industries, including healthcare, energy, and transportation.

Keywords –LCD Display, Atmega 328P, ESP8266, Buzzer

I. INTRODUCTION

The cyber world of things is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people with unique identifiers and the ability to communicate data without requiring human to human or human to computer interaction.A human with a heart monitor implant, a farm animal with a biochip transponder (which doesn't have its own energy or battery and isn't active unless the operator activates it by giving it a tiny electrical charge), and so on are all examples of things in the cyber world of things, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an IP address and is able to transfer data over a network. Organizations across a wide range of sectors are increasingly turning to the Internet of Things to improve efficiency, better understand consumers, provide better customer service, improve decision-making, and increase the value of their businesses. The confluence of wireless technologies, micro-electromechanical systems, and the cyber world has resulted in the Internet of Things..

FIG. 1.1(A): INTERNET OF THINGS (IOT)

II. LITERATURE SURVEY

The work in this area has not been done very much. It is a very recent research area. In one of the articles GSM modem has been used, which send message to the owner of the vehicle when there is fuel theft going on [1]. This system assures the security of vehicle fuel whenever the vehicle is at rest and also monitors the fuel level in the fuel tank. If the fuel level decreases when the bike is at rest the system detects that fuel theft is going on. And it will raise the alarm and send the message to the owner of the vehicle that "Fuel Theft Detected". To send this message GSM module is used. This GSM module has a unique IMEI number which is used to track the vehicle's position. The major

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drawback of this method is that it takes a long time to deliver the message, the position of the vehicle is not accurate most of the times and it is complicated to use.

In another system developed by Mr. P. Senthil Raja and Dr. B.G.Geetha [2] Vehicle Area Network (VAN) and embedded design have been used. In the proposed system, the owner of the vehicle immediately receives a message when the fuel tank is opened by the operator or by a fuel traded and also the height of the fuel tank when opening and closing of the tank. The system uses wireless-based communication for monitoring the vehicle's position. The process involves measuring the fuel level followed by eliciting the information and sends it to the server for further detection. The major drawback observed in this project is that the numeric lock opens after several trials, which is very time consuming, also the proposed system is extremely expensive. There is a scope of improvement for sensors.

Mr. Heda Venkata Sai Ajith1 and Mr. Pinjala Sai Kiran[4] have developed an Antitheft security system that utilizes an embedded system designed with GSM to monitor and safeguard a car. In an attempt of theft, the system sends a text message to the car owner and at the same time starts up an alarm from the buzzer installed within the system. The sensors are not effective in most cases, also, it is complicated to do the setup within the fuel tank.

Ms. Nandini Hiremath, Ms. Mrunali Kumbhar1, and Ms. Aakriti Singh Pathania developed one more system [5]. The system includes a GPS module, Microcontroller, GSM module, LCD, and a keypad. The GPS module transmits coordinates to the microcontroller that converts the data which is sent to the user in text format. This text message contains longitude and latitude of the location. This smart system gives 24x7access to fuel consumption, alerts when fuel drains, and storage tank leaks immediately identified. The only drawback observed here is the size of the model. It is not ideal to fit in small tanks.

III. METHODOLOGY

Fuel prices are skyrocketing by the day. As a result, fuel theft cases have increased significantly. In order to help people perform vehicle fuel theft detection, we have developed this Internet of Things based vehicle fuel theft detection project. In this project, the float sensor is used to monitor the fuel level of the vehicle. If the fuel level drops compared to the threshold, the buzzer sensor will automatically activate. In order to prevent the doorbell from opening while driving, we use the ignition lock as the trigger for this project. When the key is inserted into the ignition lock, the item will be deactivated and activated immediately after the key is removed.

The methodology of this project is based upon the information collected and processed the study and research phase. The technique to be applied for design and implementation of Internet of things for heavy duty vehicle application is as follows

- Sensing of the various parameters of heavy duty vehicle application through the set of the sensors.
- Importing the sensed data from sensors to the microcontroller port configured as input.
- Conversion of the received analog sensed data into digital format using ADC.
- Representation of the digitally converted sensed data on 16x2 LCD screen.
- Initializing the Wi-Fi Module for serial communication with microcontroller.
- Configuring the Wi-Fi Module to use its wireless service.
- Forwarding the sensed data to Internet Cloud through an internet enabled Wi-Fi Module.
- Accessing the sensed data from cloud through remote terminals usually a PC or a Smartphone by entering the cloud address in their web browsers.
- Creating a database to store the monitored session with respect to date and time.
- Selection of a cost effective measure to monitoring a particular heavy duty vehicle application.

IV. PRE-REQUISITES

1 Component Description

In this section we are going to discuss the details of components that we have implemented in our hardware in step by step manner. Here we have used ATmega328P microcontroller, Wi-Fi Module, Float sensor, 16x2 LCD display,Bridge Rectifier, L7805 IC, PCB Relay, Crystal Osillator, Transistor, Zener Diode, Buzzer, ADC Converter.

2 UNO Arduino

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Arduino UNO is an open source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with various digital and analog input / output (I / O) pin sets, which can be connected to various expansion (shield) boards and other circuits. The board has 14 digital pins and 6 analog pins, which can be programmed using the Arduino IDE (Integrated Development Environment) via a USB type B cable. It can be powered by a USB cable or a 9 volt external battery.

General Pin functions

- LED: There is a built-in LED driven by digital pin 13. When the pin is HIGH, the LED is on, and when the pin is LOW, it is off.
- VIN: The input voltage of the Arduino board when you use an external power source (instead of a 5 volt voltage from a USB connection or other regulated power source). You can provide voltage through this pin, or if you provide voltage through the power connector, access it through this pin.
- 5V: This pin generates a stable 5V output from the voltage regulator on the board. The circuit board can be powered by the DC power connector (7-20V), USB connector (5V) or the VIN pin (720V) of the circuit board. Supplying voltage on the 5V or 3.3V pin will bypass the regulator and may damage the circuit board.
- 3V3: 3.3V power supply generated by an integrated voltage regulator. The maximum current consumption is 50 mA.
- GND: Ground pins.
- IOREF: This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
- Reset: usually used to add a reset button to the shielding board to lock it on the board. Arduino Uno has many facilities for communicating with a computer, another Arduino board, or other microcontrollers. ATmega328 provides UART TTL (5V) serial communication, which can be used on digital pins 0 (RX) and 1 (TX). The AT mega 328 on the board guides this serial communication via USB and displays it as a virtual communication port for the software on the computer. The firmware uses the standard USB COM driver, no external driver is required. However, on Windows, an .inf file is required. The Arduino software (IDE) includes a serial monitor that allows simple text data to be sent to and from the circuit board. When data is transferred to the computer via the USB serial chip and USB connection, the RX and TX LEDs on the board will flash (but not for serial communication on pins 0 and 1). The serial software library supports serial communication on any digital pin of Uno.

Automatic (Software) Reset

The Arduino Uno board is designed in a way that allows it to be reset by software running on a connected computer, rather than physically pressing the reset button before charging. One of the ATmega328's hardware flow control (DTR) lines is connected to the ATmega328's reset line through a 100 nanofarad capacitor. When this line asserts (goes low), the reset line drops long enough to reset the chip.

3 Microcontroller ATmega328P

Microcontroller is defined as a system on computer chip which includes number of peripherals like RAM, EEPROM, etc. required to perform some predefined task. There are number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform various task, mostly used of these are 8051, AVR and PIC microcontrollers. In this subject we will introduce you with AVR family of microcontrollers. AVR is an 8-bit microcontroller belonging to the family of Reduced Instruction Set Computer (RISC). In RISC architecture the instruction set of the computer are not only fewer in number but also simpler and faster in operation. The other type is CISC. We will explore more on this when we will learn about the architecture of AVR microcontrollers in following section.

The microcontroller transmits and receives 8-bit data. The input/output registers available are

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also of 8-bits. The AVR families controllers have register based architecture which means that both the operands for an operation are stored in a register and the result of the operation is also stored in a register.

AVR (Advanced Virtual RISC)

The AVR microcontrollers are based on advanced RISC architecture and it consist 32 x 8-bit general purpose working registers. Within one single clock cycle, AVR will take inputs from two general purpose registers and put them to ALU to carry out the operation, and will transfer back the result to any arbitrary register. The ALU performs arithmetic as well as logical operations over the inputs from the register or between the register. We can see that AVR does not have any register like accumulator like in 8051 family of microcontrollers; the operations can be performed between any registers and can be stored in any register.

AVR follows Harvard Architecture format in which the processor which is equipped with the separate memories and buses for Program and the Data information. Here when an instruction is executed, the next instruction will be pre-fetched from the program memory. Since AVR performs a single cycle execution, it means that AVR can execute 1 million instructions per second if the cycle frequency is 1MHz. If the operating frequency of the microcontroller is higher, then processing speed is also higher. We should optimize the power consumption with processing speed and hence should select the operating frequency accordingly.

- **I/O Ports**: Atmega328 has four (PORTA, PORTB, PORTC and PORTD) 8-bitinputoutput ports.
- **ADC Interface**: Atmega328 has an 8 channel ADC (Analog to Digital Converter)and a resolution of 10-bits. ADC reads the analog input for e.g., a sensor input and converting it into digital information which the microcontroller understands.
- **Interrupts**: Atmega328P consists of 21 interrupts sources out of which four are external. The rest are internal interrupts which is supported by the peripherals like USART, ADC, and Timers etc.
- **General Purpose Registers**: Atmega328P has 32 general purpose registers which are coupled directly with the Arithmetic Logical Unit (ALU) of CPU.
- **DAC**: Atmega328P is also equipped with a Digital to Analog Converter (DAC)interface which can be used for reverse action. DAC can be used when there is a need of converting a digital signal to analog signal.
- **SPI**: Serial Peripheral Interface, SPI port is used in serial communication between two devices with a common clock source. The data transmitting rate of SPI is more than USART.
- **Memory**: Atmega328P consist of three different memory sections FlashEEPROM Byte Addressable EEPROM, SRAM.
- **VCC**: Digital supply voltage.

4 Liquid Crystal Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being LCDs are economical, easily programmable, have no limitation of displaying special & even custom characters unlike in seven segments. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

The data register stores the data to be displayed on the LCD.

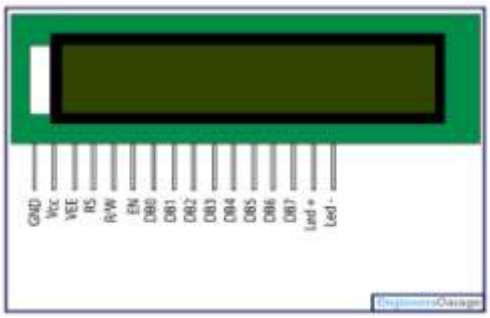

FIG. PIN OUT OF LCD DISPLAY

The display used here is 16x2 LCD (Liquid Crystal Display) which means 16 characters per line, hence total 32 characters can be displayed using this LCD. The standard is referred as HD44780U, which refers to the controller chip which receives data from a microcontroller Atmega328p and communicates directly with the LCD. Here 2-bit mode of LCD is used, thus saving the six lines of microcontroller which can be used for other purpose.

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The three control lines are EN, RS, and RW.

The EN line is called "Enable." This control line is used for telling the LCD that we are sending data. For sending data to the LCD, the program should make sure that the line is low and then set the other two control lines or put data on the data bus. When the other lines are ready completely, bring EN high and should wait for the minimum time required by the LCD datasheet and end by bringing it low again.

The RS line is "Register Select" line. When RS is low, the data is treated as a command or special instruction (such as clear screen, position cursor, etc. When the RS is high, the data sent is text data which is displayed on the screen. For example, to display the letter "A" on the screen you would set RS high.

5 ESP 8266 Wi-Fi Module

The ESP8266 WiFi module is a standalone SOC with an integrated TCP / IP protocol stack so that all microcontrollers can access the WiFi network. The ESP8266 can host applications and offload all WiFi network features from other application processors. Each ESP8266 module is pre-programmed with AT command set firmware. So just plug it into your Arduino device and you'll get the WiFi capabilities that WiFi Shield offers. The ESP8266 module is a very cost effective board with a huge and growing community.

This module has powerful onboard processing and storage that can be integrated with specific devices for sensors and other applications via GPIO while minimizing pre-development and running load. It has a function. Minimal external circuitry, including high-level on-chip integrated front-end modules, is possible and designed to occupy a minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth coexistence interfaces and includes its own calibrated RF to operate under all operating conditions, eliminating the need for external RF components.

6 Floating Sensor

A Floating sensoris a type of level sensor a device use to reveal the level of liquid with in a tank. The switch can be use to control a pump, as an indicator, an alarm or to control other devices.

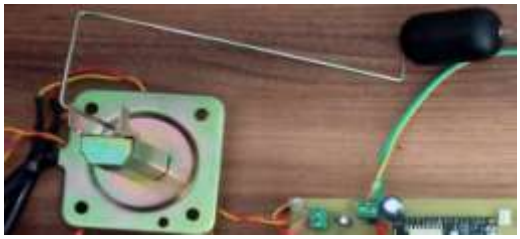

FIG 6.6 (A): FLOAT SENSOR

7 BUZZER

An Arduino buzzer is also called a Piezo buzzer. It is basically a small speaker that we can connect directly to an Arduino. We can make sound a tone at frequency you set.

Features

- Black in color
- With internal drive circuit
- Sealed structure
- Wave solder able and washable
- Housing material: Noryl

Applications

- Computer and peripherals
- Communications equipment
- Portable equipment
- Automobile electronics
- POS system
- Electronic cash register

FIG 6.7 (A): BUZZER

Specifications:

- Rated Voltage **:** 6V DC
- Operating Voltage : 4 to 8V DC
- Rated Current : ≤30mA
- Sound Output at 10cm : ≥85dB
- Resonant Frequency : 2300 ±300Hz
- Tone : Continuous
- Operating Temperature : -25°C to +80°C
- Storage Temperature : -30°C to +85°C
- Weight : 2g
- Value applying at rated voltage (DC)

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EXPERIMENTAL RESULTS AND DISCUSSION

Fig- Reading of Display

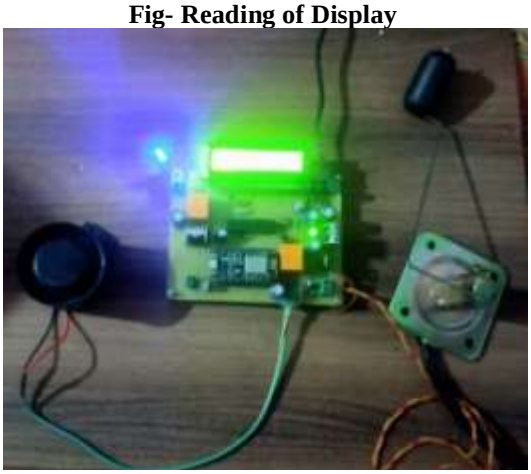

Fig-FULL ASSEMNBLED CIRCUIT OF SMART FUEL THEFT IDENTIFICTION USING IOT

VI. CONCLUSION

The user can access the amount of fuel in the fuel tank through this IoT device. Send a signal for fuel check. If the fuel exceeds the sensor range, the buzzer will "come on" and send to the owner at the same time. The intruder cannot stop the doorbell and will be considered fuel theft.

Fuel theft needs to be tracked due to rising fuel prices. Whenever someone invades or tampered with the fuel and fuel tank, the intelligent system will activate and provide the owner with an accurate indication of the vehicle and its fuel content.

The distinguishing feature of the system is that it continuously sends text messages to the owner until the owner confirms the return.

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