Underground fuel storage tank monitoring system in a fuel station

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Abstract

Petrol is need of our daily life as we use it continually in our vehicles, machines and industries. Petrol is inflammable, low boiling point liquid (75^{o}C) and has much risk to the human health. Petrol pumps are the source of petrol distribution. We required control measures to monitor the petrol pump tank liquid level and its temperature. Petrol pump employees are responsible to check the petrol level and monitor its temperature by going in the petrol tank. This affects their health because of petrol fumes inhaled by them as well as risk to their life if petrol tanks get introduce to the flame. Human life is precious and important than any other things. As we are living in the 21st century of technology we can go through electronics smart solution to monitor the ambient to have better outcomes without involvement of human. This project is carried out for real time application of the petrol pump to monitor the temperature and petrol level. There are health issues and life risk for the employs of petrol pump to monitor the petrol level and its temperature.

In this work, has provided the smart solution to monitor the petrol level through ultrasonic sensor (HC-SR 04) and temperature sensor (DS18B20) interfaced with Nodmcu. Two modes of notification are used one is through Data Base and LEDs. Things Speak Data base is used to monitor the petrol level and temperature continuously. There are LEDs for the monitoring for the employees and database for higher authorizes. ESP8266 Nodemcu WIFI Microcontroller is programmed through Arduino IDE. Data to the database is being sent through the Wi-Fi connection.

Dedication

I dedicate this work to my beloved Parents and those who help me out throughout my work. Without their support and encourage it was impossible to complete it. I am grateful to them for these unpaid services throughout my life.

Acknowledgement

I am grateful to my supervisor and the academic persons who supported me throughout this work. This work is carried out for the MSC computing course.

Author's Declaration

I declare that the work in this dissertation was carried out in accordance with the regulations of Glyndŵr University. The work is original except where indicated by special reference in the text and no part of the dissertation has been submitted for any other degree. Any views expressed in the dissertation are those of the author and in no way represent those of Glyndŵr University The dissertation has not been presented to any other University for examination either in the United Kingdom or overseas.

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1 Chapter 1: Introduction

In the 21st century, the world is focusing on the technology development as it is the most valuable and enabling commodity. One of the significant aspects of current electronic technologies is that they provide high speed, low cost and reliable operation of the components assembled to a system on chip. The world, therefore, is moving towards the smart solutions because it reduces material usage which consequently reduces cost and develops an effective market scope. World required smart solution for their machine to operate their systems. Electrical field has provided us a great control over the machine by including controls through microcontrollers. These components enable us to do controls over the machine through programming.

This petroleum is widely used in modern life. Oil is used as fuel for vehicles, cooking, home heating and power generation. Petroleum is not only used as fuel, but also in the products we use every day. Cosmetics that comprise oils, perfumes are petroleum derivatives. Petrochemical ethylene is utilized in photographic film. Gasoline is a not unusual place gas used for transportation needs. Oil primarily based totally paints and paint components are produces from petrochemicals. Fuel tanks available at fuel station are the main source of distribution of petrol. All matters being equal, petroleum merchandise approved the usage of extra strength than the prevailing photosynthesis ought to give, considering the fact that they cope with a positioned away kind of solar primarily based totally strength. First coal, then, at that factor oil and flammable fuel line approved short improvement in contemporary-day cycles, agribusiness, and transportation.

- Fossil fuels can generate a massive quantity of power at the remote location.
- They are cost-effective.
- Transportation of oil and fuel line may be carried out without difficulty through pipelines.
- They have grown to be more secure over time.

Fuel stations are the main source of distribution of the fuel. The employees at petrol pump are responsible for the measurement of the tanks ambient. So, it is important to have avoid fuel tanks employees to have some other solution. This system has been proposed for the human safety of the employs at petrol pump. Society is much lacking in the human safety protocols because of the high rates of the products. In this project, have proposed solution real time solution with advancement of database. Because of its huge capacity and minimal floor space required to build, the underground storage tanks in petrol station have long been a favored substance reservation mechanism in most petrol stations. Recently, the attention has been brought to the complex underground system's and surrounding environment's safety issues as a result of contamination caused by unintentional subsurface leaks. Numerous efforts have been concentrated on the damage repair process and fault detection practice. According to studies on relevant defenses; It has also been noted that there are uncertainties in current technical complexities concerning the efficiency of corrective activities and the resilience of condition monitoring approaches at the petrol stations. Figure 1 shows the fuel monitoring system constraints.

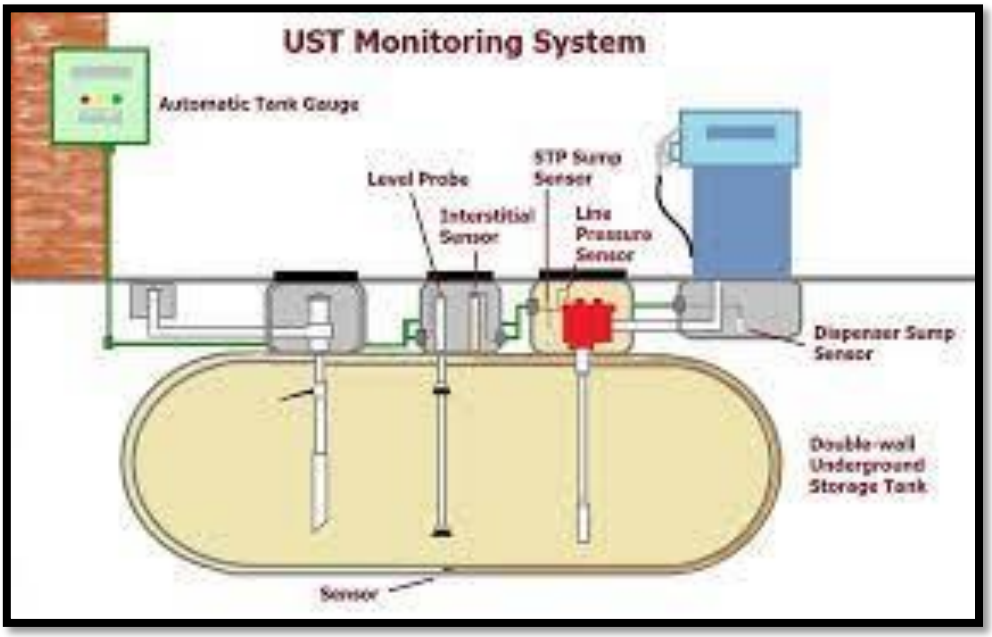

Figure 1:Fuel tank Monitoring System

Underground storage tanks (USTs) have long been used for storing large fuel in fuel stations. The complex containers, which are commonly found beneath gas stations, laundry establishments, and local residences, are inevitably subjected to contaminants, oxidation, and erosion throughout service times. Typically, the deteriorating symptoms concentrate on risky regions such as metal structures, tank bases, sewage pipes, pumps, and safety valves. Harsh operating conditions, metal, and liquid reactions, particular element gravity variations between fluid and tank surfaces, fatigue, mismanagement, and incorrect assembly all contribute to this deterioration. Furthermore, the subsurface aspect of UST operation is a double-edged sword: it provides minimal surface area requirements while also increasing monitoring complexity.

The creation of a model of a fuel station reservoir surveillance system using the Internet of Things is presented in this study (IoT). The present method for measuring the gasoline level in an underground tank in Sri Lanka is to use a dipstick, which is inefficient and dangerous. The suggested monitoring system is fully automated and provides a real-time reading of the fuel level and temperature in the subterranean storage tank, which is obtained using an ultrasonic sensor and a waterproof temperature sensor.

Oil is a significant segment of current progress. In non-industrial nations, admittance to moderate energy can enable residents and lead to better caliber of life. Oil gives transportation fuel, is a piece of numerous synthetic compounds and drugs, and is utilized to make pivotal things like heart valves, contact focal points, and gauzes. Oil holds draw in external speculation and are significant for working on nations' general economy.

Nonetheless, an agricultural nation's admittance to oil can likewise influence the force connection between an administration and its kin. In certain nations, approaching oil can lead government to be less just a circumstance nicknamed a "Petro-autocracy." Russia, Nigeria, and Iran have all been blamed for having petro-dictator systems.

Regular assets, explicitly unrefined petrol, assume a fundamental part in the monetary turn of events and supportable development.

Gas station operators must monitor the subterranean fuel storage tank on a regular basis in order to control fuel stock numbers and discover any leaks. Workers at gas stations currently use the dipstick to gauge the amount of fuel in the subterranean tank. This task usually takes half an hour, which is inconvenient, especially in Sri Lankan hot weather. Not only that, but the workers are at risk of breathing gasoline-derived hydrocarbons, which can create health concerns. Every year, a large number of people are harmed by hydrocarbon poisoning. Furthermore, due to human errors in the measurement process, this traditional method may be imprecise. Automatic fuel level sensor systems are important to most petrol station owners because they help them meet state regulations that require tank and line tightness testing. These systems also provide accurate product levels at a glance. By implementing this type of system, they won't have to manually stick a tank to measure the tank volume. Knowing the tank volume will help provide accurate fuel inventories. Accurate fuel inventories make for easy reconciliation of product use or sales. Most importantly, they eliminate manual measurements and calculation of monthly inventory by providing detailed reports of products delivered and products dispensed. For the prototype: we use two input devices which are an ultrasonic sensor to measure the fuel level and a waterproof temperature sensor to measure the fuel temperature.

1.1 Properties of the Fuel Petroleum

Gasoline additionally called petrol is an effective source that may be impression of a strong GDP of the country. It is used to strength many countries, most significantly it acts as a gasoline for a massive percentage of cars. Most petroleum is used as a supply of energy, being good in gasoline carbon in power technology or strolling a few styles of strong engines. Raw petroleum (additionally called crude oil) is utilized in various major ways: such as:

- Transportation
- Industrial power: Oil is the major source of industrial power.
- Heating and lighting: Heavier oils are used in central heating plants for shops, offices as well as homes.
- Lubricants
- Petro-chemical industry
- Use of by-products
- Boiling point of petrol (gasoline) is 30 to 225 deg C.
- Melting point of petrol(gasoline) is -90.5 to -95.4 deg C

Hydrocarbons:

Gas contains hydrocarbons in the extent of C4-C10, light oil and aviation fills in C4-C19 region and diesel stimulates can be found in the C8-C21 region.

Impurities:

Refined fills contain a few debasements like gum, metals, microbial development, dregs, sulfur, and water however buildup. Gums are framed by oxidization or polymerization of hydrocarbon atoms when presented to air or daylight. Metals are presented during refining and can add to fuel channel obstructing.

Fuel microbes:

As fuel is disinfected when it leaves the processing plant, microbial development happens after the fuel meets air and water. The organisms feed on fuel and when given the change and time they produce musty sludge stopping up fuel channels. Limiting water content and biocide added substance are required. Dregs is simply rust, earth, minerals, sand, and such contaminations. The utilization of channels should address this.

Octane:

Gasoline fuel are appraised with an octane number and this means that their obstruction against explosion (thumping). The higher the rating the safer. A high appraising doesn't infer more force yet that the fuel can be utilized in higher pressure or super really charged motors.

Volatility:

Our notable energizes are consolidated of a few distinctive hydrocarbon compounds detailed to meet explicit properties for an application. Unpredictability is one such property. It influences its capacity to disintegrate and frame an ignitable combination with air in the motor. Lighter fills as gas and Avgas are more unstable than JET or diesel powers as fuel at a similar temperature and pressing factor Identifies with a fluid edge of boiling over and its inclination to vanish at ordinary encompassing temperature and pressing factor. Of all energizes utilized in avionics. Mogas is exceptionally unpredictable followed by Avgas and JET. This property is alluring in carburates as we need a flammable air/fuel combination to run the motor with. Mogas and Avgas fumes are nearly multiple times heavier than air and sink to bring down regions.

Flammability:

Shows how promptly a fuel will begin to consume, exceptionally accommodating in a motor burning chamber after the sparkle plug makes a flash.

Temperature of fuel:

An unconstrained start temperature (or auto start point) is the most minimal temperature at which a flammable substance when warmed takes fire in air and keeps on consuming. The auto start point of petroleum is 280°C.

Combustion Properties:

Combustion, with rare exceptions, is a complex chemical process involving many steps that depend on the properties of the combustible substance. It is initiated by external factors such as heat, light, and sparks. The reaction sets in as the mixture of combustibles attains the ignition temperature. Figure 2 shows the combustion system in vehicle.

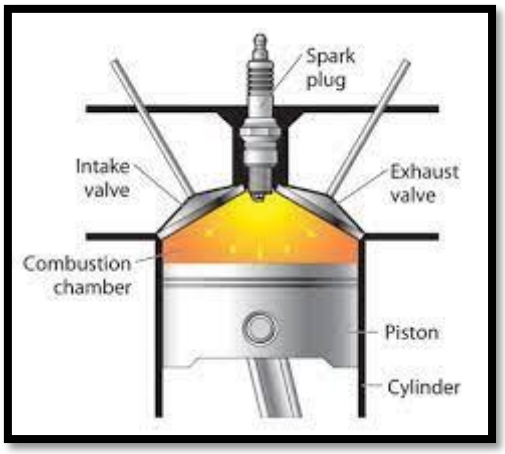

Figure 2: Vehicle Engine Combusting system

1.2 Motivation of the research

Chemicals may be poisonous due to the fact they could damage us after they input or touch the body. Exposure to a poisonous substance which include fuel can have an effect on your health. Since ingesting fuel can motive burns, vomiting, diarrhea and, in very massive amounts, drowsiness or death, it's far poisonous. The artificial materials which might be discarded into our streams make streams, waterways, lakes and is derived risky to apply for ingesting or farming purposes. Creatures and flowers nauseate and kick the bucket after they drink from those waters, and human well-being in areas downstream is probably influenced. There are many sides effects of the toxic material on the health of the people. The synthetic substances that are discarded into our streams make streams, waterways, lakes and springs dangerous to use for drinking or farming purposes. Creatures and plants nauseate and kick the bucket when

they drink from these waters, and human wellbeing in regions downstream might be influenced. Getting a modest quantity of gasoline on the skin for a brief timeframe is typically innocuous. The skin doesn't promptly ingest the synthetic substances in gas. Nonetheless, if gas stays on the skin or attire for a couple of hours, it can enter the skin.

A few side effects of skin and eye openness to gas include:

- Gentle skin bothering
- Skin irritation
- Breaking, rankling, or stripping skin
- Discharge like release.

Risks detailed included inward breath of petroleum exhaust 145 (67.4%), conflict from clients 112 (52.1%) and clamor 98 (45.6%). Medical conditions detailed included migraine (53.6%), low back torment (33.3%), eye bothering (29.5%), tipsiness (24.6%), hack (18.6%) and sickness (18.6%).

- Living almost a gas station could be unsafe to wellbeing, another examination has found. As indicated by the investigation, air at gas stations is defiled with emanations from vanished vehicle energizes. Airborne mixtures, for example, benzene was at a lot more elevated levels close to carports than in spaces of high traffic thickness

- Gas station chaperons experience a few risks and medical issues while working. This examination was led to decide the word related risks, medical conditions also, security practices of gas station chaperons.

Petroleum health risk:

- Oil wellbeing hazards

- Causing migraine, discombobulation, sickness, retching, obscured vision, disarray, and loss of equilibrium and coordination.

- More elevated levels may cause unconsciousness and demise. Constant Wellbeing Impacts.

- The accompanying constant (long haul) wellbeing impacts can happen at. sometime after openness to Oil Distillates.

- Oil is basically a combination of different hydrocarbons. These hydrocarbons must be refined first to be utilized differently. During this cycle, different harmful gases like carbon monoxide and solids, for example, plastic are transmitted.

- Different synthetic compounds in oil-based goods in processing plants can cause malignant growth, birth deserts or other conceptive mischief. ... Singular treatment facilities don't really make openings this load of synthetic compounds: Acetaldehyde may build the danger of malignant growth. Benzene can cause leukemia.

1.3 Problem Statement

The Problem Statement of this work is "**Provide a technologically smart solution for the underground fuel storage tank measurements to avoid human interactions**".

1.4 Project Aims and Objectives:

Following aims and objectives will be covered by the research.

So, our aim is measuring the fuel station by different means and informed the concern person by different sources. The objective of this project is to create a hardware circuit using microcontroller to build a fuel measurement system. Safety is valuable for all people and whether is its intent to protect from small or a huge risk. The proposed fuel storage tank monitoring system will be designed in a two-tab interface: Fuel level tab and fuel temperature tab. The first tab will show the amount of fuel level in the underground storage tank (in liter

unit) and in a display gauge. The distance between the ultrasonic sensor and the fuel surface is also displayed (in cm unit) for troubleshooting purposes. If there is no fuel, it will show the distance between the ultrasonic sensor and the bottom surface of the container. Two LED indicators each represent normal fuel level and low fuel level. The virtual LCD will also display in the text the state of the fuel level. Similar to the first tab, the fuel temperature interface is designed with two LED indicators for normal and high temperature, a virtual LCD displaying the temperature condition, and a graph of temperature trends. To verify the system, we will first use water with different temperatures and different volumes. The system responds correctly concerning the fuel temperature (alerts when high temperature) and with respect to the water volume (alerts when the water is low quantity).

1.5 Scope of the Work

The system starts with the microcontroller (on the NodeMCU board) being initialized. Then, both of the sensors will simultaneously measure the fuel and temperature level. The microcontroller will calculate the fuel volume and process the temperature value of the fuel. These measured data are stored in the cloud and can be monitored through the IoT platform that we use. The system will alert the user when the fuel is on low stock (lower than 0.5 Liters) and when the fuel temperature is high (greater than 35℃).

1.6 Thesis Outline

The plan of this thesis addresses the hardware development, solution to the problem of the fuel tank measurements and results it's all constraints.

Chapter 2 presents the literature review, the work done earlier to deal with same kind of problem, the issues which they have faced during their working. The side-effects which can be

faced by the human body to introducing with the petroleum and the components which they have used for the completion of their work.

Chapter 3 mentions the methodology which is followed to meet the solution. The components, sensors and modules which are used in this work are explained with details. Hardware and software which are responsible for fulfilling this work needs are enlightened.

Chapter 4 Investigation and Analysis mentioned the testing of the sensors which are mainly dealing and extracting the data of this work. Results of the sensor are interpreted in this section.

Chapter 5 3D shape of the product is presented in this section, dimensions, shapes, reasons to choose this shape and placement of the components are mentioned.

Chapter 6 communication protocols, flow chart of the code, block diagram and codes are placed in this section. The implementation is displayed in proper format to declared each thing which should be helpful for the people coming in future.

Chapter 7 presents the evaluation of the product in terms of objectives, relationship with the engineering and sources of error which may be altering the results.

Chapter 8 offerings the insight view of the project, like the things which may affect the system, components limitations and issues which are affecting the environment. Battery possible issues which may affect the working of the system.

Chapter 9 is the concluding section which includes the project conclusion and future works.

2 Chapter 2: Literature Review

Literature has co-operated much to relate our research observations and figure out the short-comes to avoid them. Literature is basically the work which is done earlier, it helps and guide the work which we are taking. We get the ideas by increasing our knowledge from the literature. Many people who have done the work before share it in best way. By extraction of data from their domains we come to know that which technique will be the best to be executed. The drawbacks, weaknesses, strength and implementing methods are provided in the literature to have the best outcomes. Those who avoid to focus on the literature basically remain unaware about the work which is done previously. In this work, literature review is performed to study the techniques, equipment and mode of system to make it efficient in terms of performing, cost and affectivity. The literature review part is distributed in techniques adopted, equipment used and health issue.

2.1 Equipment Used

The cheap and affective components are required along with good quality product. Quality is always a great deal as being the product. The quality depends on the equipment of the products, boxing and system performance. Different Alternative equipment are available to perform the same task. Many domains and companies provide different product price it is only because of the product quality. In this work, literature has helped us a lot to deal with the equipment. And have come to know about the best equipment which can be used for our system with the best efficiency.

A. Waske et.al has controlled the room temperature by using thermomagnetic generator. They are detecting the room temperature by DS18B20 sensor and using this they have controlled the

room temperature. But the method they purposed has much expensive and can't be afforded by the normal person. Figure shows the DS18B20 temperature sensor with two different shapes, the first one is used for the long distance, which is also named as water proof DS18B20 sensor as it contains high tip, which make it easy to deal with the longer distance measurement. Second is small like the half nail of the last finger, it has less ability like small wires. So, if need to extent have to increase the wires by soldering [1]. Figure 3 shows the temperature sensor.

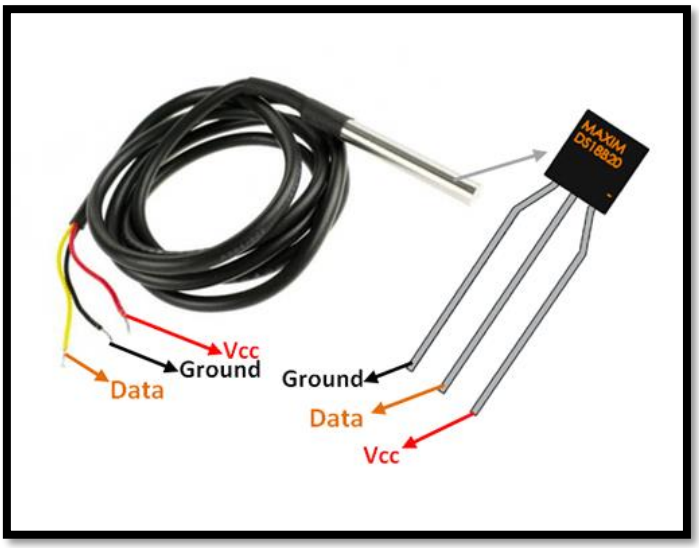

Figure 3: DS18B20 temperature sensor with two different shapes.

M. Kenner has proposed the wireless-based system for controlling the temperature of the room. They have used thermostat and measured its resistance. Their results are not affordable because the thermostat itself has so much resistance and have no considerable response rate [2].

W. Legrand has proposed as system which used Nitrogen gas to control the temperature of the container. Nitrogen is a cooling gas, which is released when container temperature exceeds to certain limitation. The technique they have adopted has major applications in an industrial temperature control. Figure 4 shows the nitrogen gas, as nitrogen is a cooling gas it helps out to keep the container temperature an adopted value. If temperature of the container is increased then we release the nitrogen gas to keep the temperature at constant [3].

Figure 4: Nitrogen gas container to keep temperature constant

Notwithstanding the former methodologies' shown achievement, they are badly designed to apply to UST because of the underground climate's compelled and hard to-arrive at characteristics. Moreover, on the grounds that a UST is a framework impacted by various components, straightforward customary techniques are probably going to disparage the discovery model. Moreover, the low connection between's time-shifting segments, just as the similarly long filling-release cycle spans, add to the extensive calculation and postponed response. In light of the static idea of the segments and the various powerful properties of the outcome, for example, the fluid volumetric stream rate, USTs are generally unaffected by movement type checking. Because of the lethargy of underground constructions, an aggregate investigation into condition checking approaches has been completed to adjust ecological antagonism and unravel a couple of accessible signs. The achievements and discoveries from assorted examinations will be introduced in the request recorded underneath [4].

D. Pogare et al. have suggested microcontroller-based room temperature control system. They have used PIC-16F877 microcontroller for programming purposes. Our report is focusing on this particular domain but used Arduino microcontroller for programming purpose. Figure 5 shows the PIC-16F877 microcontroller which is interfaced with the temperature sensor to keep the temperature measurements [5].

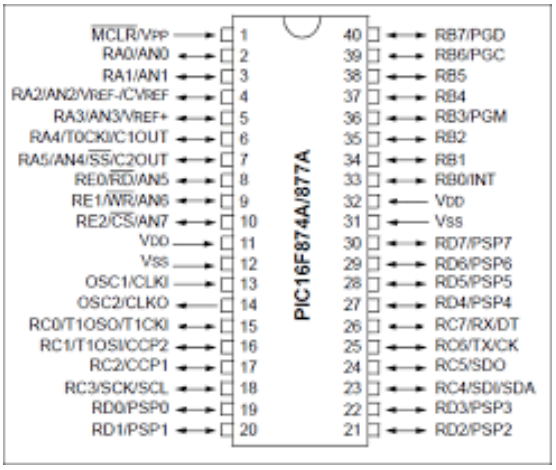

Figure 5: PIC-16F877 Microcontroller

Adebisi 2018 revealed that this study has a simple, resilient, and cost-effective fuel level measurement device for liquid tanks underground. The main system components include Atmega 328P, HC-SR04, and the liquid crystal display of Hitachi HD44780. A prototype elliptical tank with its diameters and cm lengths was developed and built using a modified gas cylinder. The petrol levels from the tank's base were monitored by an ultrasonic sensor and transformed, using a tank volume equation encoded into the microcontroller, into volume equivalent of one liter. On the developed system, a performance test was conducted. The tank capacity has been estimated at 10 liters, correspondingly with the distance to the sensor, minor diameter, big diameter, and length of 22, 23.39, 23.39, and 26.67 cm. The performance test demonstrated a working system that provided an average absolute percentage inaccuracy of 4.74%. For uses within gas stations, depots, or other enterprises, the designed fuel level measurement system can be used for information on the quantity of petrol or other fuels stored in tanks underground [6].

Baqir 2021 said that IoT currently assembles and embeds those with programming that use our equipment to mix all equipment (sensors, gadgets, hardware, and so forth). The oil pump is

now physically operating. It's an activity that essentially takes time out and requires additional staff. Furthermore, petrol stations are costly to install in remote areas. To tackle these challenges, a web-based automated fuel filling system has been developed. Various proposed solutions are designed to improve fuel operation to make it less complicated, reliable, and safe, guaranteed to help end fraud at different gas stations. The purchaser receives the same gasoline quantity in exchange for what they paid for. Those systems use the web-enabled technique to take human-software contact, thereby eliminating any human errors. The essential purpose of this review article is to examine recent projects in the design of the intelligent petrol pump based on RFID as the payment instrument and remote operation of this pump with the highest level of security [7].

Kalidoss 2017 deals with the procedure involved in constructing a fossil-fuel pump automation system for container filling. In general, the operator should be careful not to overflow the fluid container. No operator is required to manage the system under this model. Although automatic water level controllers are currently available on the market, these controllers cannot be used for this purpose since the electrodes contact the fluid directly. But for the predominantly petrochemical fluid, direct contact with electrodes should be avoided. A novel system has been developed with magnetic sensors for this application. The sensors are attached to the container nominally. A fluid glides on the liquid and triggers one by one magnetic sensor relying on the fluid level. This research is currently designed solely for industrial use. This project has meticulously avoided direct contact of the level probes with the content/liquid. It is a type of "Fit and Forget" system and is free of fluoride and Buzzer Indication oxidation [8].

Zahra'a (2021) claimed that IoT is currently assembling and integrating programming to create our gadgets to combine all devices, such as sensors, gadgets, hardware, etc. The oil pump is now physically operating. It is essentially an activity that demands more employees and draw-out time. Furthermore, it's costly to establish fuel stations in remote areas. To tackle these challenges, researchers achieved a web-based automated fuel filling system. Dense proposed methods are available to improve the fuel system. It becomes less complicated and more reliable, safer, and the same amount of fuel the buyer receives in exchange for what they pay to eliminate fraud at various fuel stations. The web-labeled procedures connect with human software systems and thereby prevent all human mistakes. The fundamental purpose of this review article is to examine recent projects in the design of the intelligent petrol pump based on RFID as the payment instrument and remote operation of this pump with the highest level of security [9].

Since inert time is not, at this point required, the web-based checking of issues like erosion and spilling has been heartily valued. Innovation move from the mining region to subsurface dangerous gas restricted checking was done in France. A unique aggregation chamber arranged among soil and environment for inflow gas checking, just as a coordinated gas sensor framework estimating CO2 focus at pit subsurface, has both been demonstrated to be compelling CO2 following arrangements. A few gas properties, for example, isotopic and piece, affect the recognizable proof interaction, as per the creator. In the UST limited component model online condition checking, a type of optic fiber tactile cluster called Fiber Bragg Grating (FBG) was utilized. Tank-base thickness misfortune because of consumption and divider vibration reaction is reflected in the proportionate connection among strain and FBG frequency variance. To diminish the recurrence of UST underlying reviews, the Environmental Results Program (ERP) assistant instruments have been introduced. While the

arrangement is fundamentally centered around lessening the peril of water supply tainting, it has additionally been resolved to be administrative agreeable and financially savvy. To limit erosion, different kinds of tank divider materials have been thought of, like the high pliable fiber/polymeric composite; be that as it may, because of dampness assimilation, this substance isn't appropriate for improvement as a tank divider material substitution. Improved warm protection execution for urgent parts of water tanks has been shown utilizing a natural palm-made protector, and it very well may be utilized as a warm pressure reliever notwithstanding environmental change. To screen gas accessibility, soil temperature, and building structure strain boundary, a multifunctional layer sensor strategy was made [10].

Sensor estimations were approved by field application to empower CO2 stockpiling observation. Material pressure and fluid sloshing tallness were discovered to be conversely relative to the fluid level and stature to-sweep proportion when utilizing 3-D Coupled Euler-Lagrange (CEL) reproduction. A definite item life cycle study was attempted to streamline the water tank stockpiling plan Tank and control material, remarkably tank situating, shape, and volume setting, were resolved to be the main natural components. The Electrical Impedance Tomography (EIT) approach was utilized to project underground partitioning territories by using the conductive character of petroleum debasements. Utilizing a neighborhood projective conductivity picture approach, the reactions from covered terminals are imagined [11].

Gizzatov (2021) reported that CO_2 foam helps boost the viscosity of CO_2 liquid, hence improving the process efficiency in anthropogenic greenhouse gas consumption and underground sequestration. To create high-performance chemical products near the reservoir, successful CO_2 foam formation requires extensive laboratory testing and evaluations. The proposed approach uses a microfluid-like pool to quickly evaluate and detect commercial Surfactants efficiently producing supercritical CO_2 foam at high salinity, temperature, and efficiency. The microfluidic counterpart was designed for geological storage rock pores at

100°C/13.8MPa. The value of the pressure-lowering over the micro-Fluidic analog during CO_2 flow through its pore network was utilized to measure the strength of the foam generated. The transparent microfluid pore network allows for quantitative imaging of CO_2 foam half-life and pore grid damage from precipitation and obstruction in static situations. Compared to the results of the spray loop rheometer measurements, the microfluidic technique provided more precise information on the stability of the foaming agent than batch testing. The results can be used to test microfluidic systems for carbon sequestration and enhanced petroleum recovery [12].

Moorthy (2021) claimed that it is known that India is the third most significant fossil fuel country, and Indian economies depend heavily on the conveyance of fuel-saving goods and services. Tank stations should ensure the correct stock of fuel and restore fuel to its exhaustion on schedule. Therefore, the needs of the customer are met. The level monitoring in fuel tanks is usually conducted using dipsticks or some level sensors, float switches, and load cells. In level measurement, dipsticks are used more commonly. The use of dipsticks involves the removal and reading of the dipstick scale by a human operator. The measured data are transmitted via phone calls to the refill manager, and the tank station is refilled. Tanker replenishment may be delayed because of incorrect communication and late movement of fuel when traffic is closed. This work seeks to solve a material problem by incorporating automation in measurement and communication and to increase efficiency and accuracy in fuel level measuring. A level sensor with a WiFi module to produce automation calculates the depth of the gasoline tank. The user can directly access the measured data via a telegram application. The gasoline tank level is indicated automatically. You can also obtain dynamically changing information from the gasoline tank using the telegram app. The refill manager is aware of the fuel level and can restore the fuel in due course. In distant places, this device is quite handy.

The device has enormous potential and will play an essential role for key oil firms in measuring gasoline [13].

Karthick research claimed it is necessary to monitor the gasoline level of the vehicle, locate the nearest gas station and provide the route. An ultrasonic sensor, Xilinx PYNQ board, and LCD screen are used. Create a model and describe the need for an automated system for anybody who drives or navigates an automobile. Everyone needs some navigation in this world to execute their job successfully. It is our nature to seek advice. So, know where your agreed timetable is. Autos do not have navigation systems to help drivers find petrol stations in new places. The research, therefore, checks the level of petrol, alerts the driver, finds the nearest tank station, and shows the route [14].

2.2 Techniques Adopted:

There can be different way to perform the same work. In this part, has taken different modes of work which are adopted to deal with the level and temperature measurements. Most of the time we are aware of the method but to recall we go for literature help to provide accurate and affective way.

Makhwathana (2020) claimed that accurate measurement of fuel quantities has increasingly risen due to their impact on the range forecast. The vehicle fuel measuring devices available are only capable of providing inconclusive estimates of fuel level. Anxiety about the car fuel range of drivers is likely to motivate academics to introduce alternative measurement techniques to increase the status quo. The paper of Makhwathana contains an integrated measuring method for the quantity of fuel based on the segmented reed trigger points of a specified tank capacity to monitor continuous fuel density and the available fuel weight

measurement. The technology provides precise energy, compensating for fluctuations of fuel density and eliminating the effects of fuel sloshing. Figure 6 shows the fuel level and display unit [15].

Figure 6: Petrol Level module and display Unit

Gijre (2017) said that we have heard about frauds with gasoline bunk regularly recently. The pumps have been used by most petrol bunkers today to display the amount as entered, but the amount of fuel filled in the customer's tank is significantly lower than the stated value. To benefit the petrol bunker owner, the pumps are being manipulated. This leads to tremendous earnings for the petrol stations but also the cheating of customers. Therefore, it is not feasible to know precisely the amount of fuel currently in the vehicle, and the amount of energy placed in the petrol bunk cannot also be checked cross-checked in all automobiles. This research area focuses on producing a digital display of the exact amount of fuel in the tank and helping to control the amount of energy in the petrol bunk. The project also tends to find the kilometer of the bike, which is a long and challenging task to accomplish manually by noting the readings all the time. When fuel tanks fall into reserve mode, the nearest petroleum pump will also be displayed using GPS [16].

Goswami (2019) stated publications often have the news that tempered petrol pumps are being used and that pump mafias trick chips are used by ordinary people. Familiar motorcyclists frequently do not know these chips. Users receive less fuel than the amount of pay. All bikes feature the fuel indicator on the dashboard, but the precise value of the present energy does not appear within the tank in a numerical format. The display does not show minimum fuel level changes within the tank. Ordinary bikers typically fail to spot these modest modifications on a fuel indicator with a fuel value below 100 ml. This research shows that most riders have little confidence in the hands of petrol pumps' gasoline dispensers—a gasoline sensor system to indicate the actual fuel value inside the motorcycle's fuel tank. The proposed True-Fill prototype (the proposed name for a microcontroller system for the true worth of filled petrol) will assist ordinary people in defending themselves against tempered petroleum pumps [17].

According to Patil (2019), the use of vehicles is rapidly expanding, causing a big problem with gasoline availability, giving rise to petrol pump scams. The fuel pump devices will be thus modified that the amount input, however, will be less than the amount of petrol in the customer's tank. It says clearly that the tankers are tempered to make maximum profits for their owners. This approach gives the proprietor enormous income, but clients are simultaneously misled. Our vehicles' meters are analogous and do not reflect the actual value of petrol in the tank. The amount of gasoline to be added is virtually not available to the consumer. This project aims to construct a digital display to show the precise petrol in the car so that the client can verify both the readings on petrol pumps and their fuel tanks. In addition, the average distance the vehicle can cover in the available fuel can also be calculated [18].

Bhongade 2021 said we heard about the fraud of petrol bunk. In countries like India with numerous cars, fuel from fuel stations is utilized in increasing amounts. Most of the time, because individuals are deceptive, people are unhappy with the amount of energy available at gas stations. In many of today's pumps, the amount input by the supplier is changed to indicate. Still, the amount filled into the customer's tank is significantly less than the value stated. The owners of gasoline lines make a great deal of money, but clients are being fooled. Due to the usage of analog fuel meters on every Indian car, the exact quantity of petrol in the tank can't be determined. So, a digital fuel gauge in the car in today's society will help us know how much fuel the tank has left. This research focus is to develop a mechanism to show the availability of gasoline online. An ultrasonic sensor is used to calibrate the fuel tank's exact amount of fuel in an intelligent gasoline meter. The primary objective of this project is to provide a computerized display of the actual power in the car. Other features, such as km/l distance to a comparable fuel, vehicle speed, and km/l miles, are included in this arrangement. This study concentrates on the indication of gasoline level in two-wheeler tanks [19].

2.3 Health Issue for Workers

The boiling point of petrol is 75ºC which is less than boiling point of drinking water, it can easily convert to fumes. When petrol station employees enter into the fuel tank for some activity these fumes are inhaled by them in breathing. These fumes are health affecting and causes much negative effects on their health. The literature in this heading shows the composition which are available in the petrol. Mostly there is carbon composites which affects the breathing of the human, later on affects are skins and lungs cancers.

Thomas (2020) reported the complicated hydrocarbon mixture of petroleum (gasoline). Gasoline ingredients (benzene, toluene, ethylbenzene, and xylene (BTEX)) are the most hazardous chemicals for humans among several elements of petroleum products. These chemicals are inherently volatile and lipophilic, and the inhalation, ingestion, or skin exposure of employees can be used. This may be accidental or deliberate and is insidious. A tank station is a facility where employees are exposed to both gasoline and diesel exhaust vapors. Operators use petroleum pumps in India, whereas auto-completing stations are rare; hence, exposure to harmful exhaust is increased. Tankers do not wear personal protective equipment, and personal hygiene also varies during work. There are mainly unknown impacts on workers' exposure to oil vapor and air pollution from vehicles. Health studies in petrol pump workers concentrated on clinical symptoms with little lung function reports or breathing morbidity of petrol pump workers exposed to vapors [20].

Mbengue, 2020 stated that oil pump workers are exposed in combustibles to poisonous chemicals. Petroleum vapors are repeatedly released for fuel refueling and are often toxic to pump workers. This study aimed to examine fuel exposure-related ventilation issues among the pump workers. The investigation comprised a medical survey conducted on anthropometrics, seniority, smoking, and working circumstances. The trial included a medical evaluation of anthropometric properties, elderliness, smoking habits, and working situations. Petroleum/diesel fumes exposure has a detrimental effect on the ventilation function of the gasoline pump agents [21].

Jaiswal, 2020 claimed that occupational health research in the petrochemical sector is investigated to improve worker health and safety in India. Contrary to other industries, the petrochemical industry poses significant threats and risks to workers' health. It is not a legal formality. People are unaware of health and safety issues since workers are not trained, and

management is not valued in the petrochemical business. The average ventilation function parameters of smokers were lower than nonsmokers. The mean ventilation parameters were lower in nonsmoking workers than in nonsmoking controls. Employees who smoked compared to nonsmokers had similar ventilatory functioning parameters. The study found a significant influence on ventilatory performance but not anthropometric exposure in pump employees (who worked for over one year). The study also found that gas station personnel had an uneven ventilation pattern that hampered airflow [22].

3 Chapter 3: Methodology Techniques

Experiments are carried out through different techniques and characterized to test that it will work properly or not. As we make this project, we go through different modes of working to figure out the perfect solution. There can be different methods to solve the same problem, these components which are mentioned below are taken after long research and study on the same kind of works. The task is distributed in two parts, research for the hardware and software. Here is the method mentioned which will be used for this project.

3.1 Hardware

The components which are used to make the circuit and deal with the measurements from physical atmosphere. The module which converts data from the environment and transfer in electrical form from sound, wave, temperature and other sources are known as transducer. The common name used for the transducer is sensor as these modules senses the environment. Similarly, the microcontroller is the device which is used to do interference with the other components. To make the microcontroller enable for the defined sensor, programming is used. In this work ESP8266 microcontroller is used which is programmed with the Arduino IDE in Arduino language.

3.1.1 Temperature Sensor

The temperature sensor which we are using is DS18B20, this is 1-Wire bus communication sensor, which means that different sensor can be added with same bus and data can be extracted individually. It provides 9-bit to 12-bit Celsius temperature measurements, from -55 °C to 125 °C with accuracy from -10 °C to 85 °C with a tolerance of +/-0.5 °C. This sensor contains 3 wires, ground, VCC, and DQ, the data is extracted from DQ, as this pin is used with the microcontroller. Temperature sensor is available in different shapes and sizes, the sensor which is being use contains long probes, this probe helps to measure the temperature at longer range. Figure shows the long probe type DS18B20 temperature sensor. It communicates over the 1-

Wire bus, this means that it most effective wishes one records line (and ground) with a pull-up resistor of 4.7k Ohm to talk with a microcontroller. Waterproof Temperature Sensor DS18B20 is a sealed temperature sensor that lets in customers to exactly degree temperature in moist environments. Figure 7 present the long probe temperature sensor.

Figure 7: Long probe type DS18B20 temperature sensor

3.1.2 Character LCD 16X2

LCD display is an important part of an alarm system and it help to display the time, date, and temperature. In the market there are many types of LCD display and it can be easily identified by the interface most of the LCD display are 16 pin interfaces. 16x2 have a parallel interface which means the microcontroller has to operate many crossings point pins at once to control the display. Figure 8 shows the I2C based character LCD.

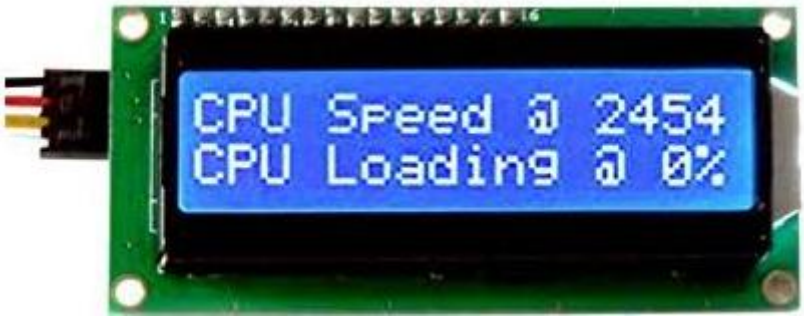

Figure 8: Character LCD 16X2

3.1.3 Light Emitting Diode (LED)

LED is two terminal lightening components. The two terminals are anode (+) and cathode (-). It required resistor for the current limitation. When high logic is applied to the + terminal while connecting the (-) terminal with the ground it gets turns ONN. There are different colors of LEDs like red, green, blue etc. A small value resistor must be used for the protection of the LED to limit the high voltage to the LED. When voltage is applied to the LED it glows. Figure 9 shows the LED used for lightening purposes in this project.

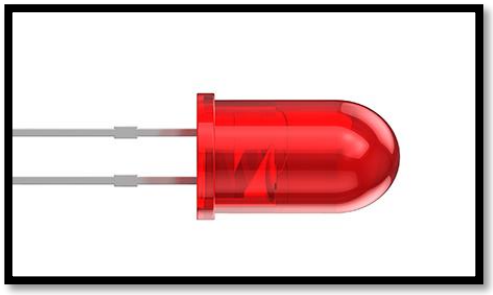

Figure 9: Light Emitting Diode (LED)

3.1.4 Ultrasonic Sensor

Ultrasonic Sensor is used to measure the distance of the obstacle in front of it. There are four pins of the Ultrasonic sensor 1. VCC; 2. Trig; 3. Echo; 4. GND. VCC is connected to the +5V; Trig is the input pin; Echo is output pin, GND is connected ground. This is sensor is very

popular in distance sensing applications. In generally, module is resembled to two eyes as transmitter and receiver. Ultrasonic sensor send wave of 40Hz through trigger pin after we write high logic. Wave reflected back after strike with the obstacle placed in front of it. We receive the wave at pin echo, the time required to transmit and receive is measured and stored. We further used this time to measure the distance of the object through distance formula. Figure 10 shows the ultrasonic sensor which is added with this project.

Figure 10: Ultrasonic Sensor

3.1.5 Arduino Uno Board

Arduino Uno is a microcontroller board which we are using in our system and is integrated with AT mega 328P IC. Arduino board comprises on fourteen digital inputs and output pins also known as general purpose input outputs (GPIOs), out of fourteen digital pins 6 pins can be used as pulse width modulation (PWM) outputs. This board has different components such as six analog inputs, 16 MHz crystal, a USB port and power jack along reset button. The schematic view of the Arduino Uno board is shown in figure. Arduino Uno is a microcontroller board, which we are using in our alarm system, which composed of ATmega 328P IC. This board is layout in a way, and has all important matters to assist the hardware. Arduino Uno board may be very smooth to hook up with pc easy it could be linked with USB cable or strength it with AC to DC adopter or it could additionally be useful with battery connection.

This board is simple to buy simply in case when you have finished something incorrect simply purchase a brand-new board for few bucks and begin all of it again. Before the use of this board, it ought to be programmed. Arduino Uno board is the primary in a chain of ISB Arduino forums and reference version for the Arduino platform. Figure 11 represents the Arduino Uno Board.

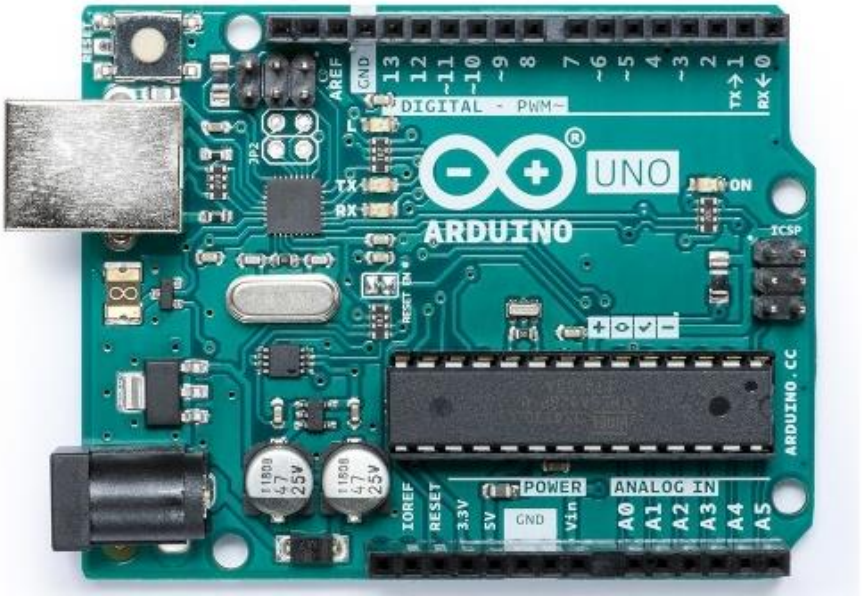

Figure 11: Arduino Uno

3.1.6 Nodmcu ESP8266 WIFI Microcontroller

This is CP2012 chip board which have unique features like Wi-Fi communication, I/O ports, ADC inputs. As well has all feature of microcontroller. It is easy to use as can be program through Arduino IDE. Its working frequency is 80Mhz. And has flash memory of 80KiB. In this case, we will only consider the function of its inputs and outputs because we want a certain output according to certain input. All of programming and controlling is done in Arduino software. NodeMCU is a low-cost open-source development board that runs on the ESP8266 Wi-Fi microchip. This board integrates 16 General Purpose Input/Output (GPIO) pins, Pulse Width Modulator (PWM), serial 2-wire bus interface (Inter-Integrated Circuit, IIC), 1-Wire interface, and Analog to Digital Converter (ADC). It features 4MB of flash memory, 80MHz

of the system clock, around 50k of usable RAM, and an on-chip Wi-Fi Transceiver. NodeMCU operates on an external DC voltage supply of 6 to 24 volts. This board contains Wi-Fi, so it can be connected with the internet connection and can communication through internet protocols. Same like Arduino it contains input and output ports which are added with the devices to control, transmit and communicate data. Figure 12 shows the ESP8266 WIFI module.

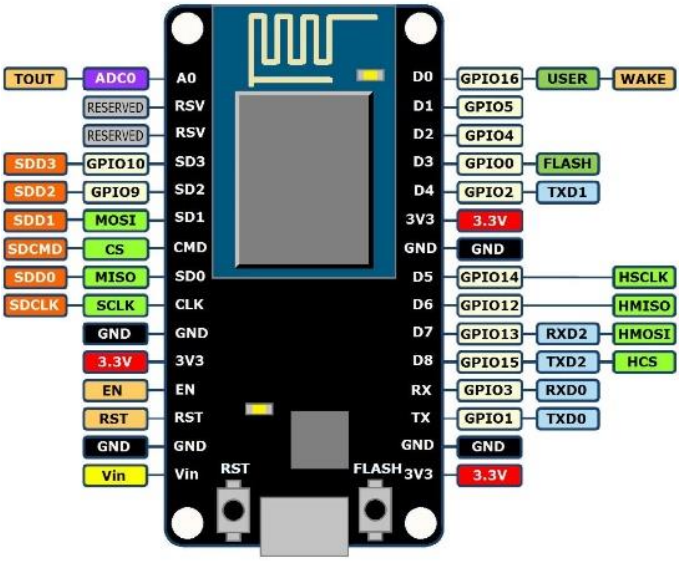

Figure 12: NodeMCU ESP8266

3.2 Software

In software programming is involved, in the programming scenario, logics are used in the codes, which required mind storming and indicated a well management in it to avoid unwanted lines for the optimization of the code. Programming is the field of self-decision, which is added in the machine to takes by its own. Suppose that there are multiple scenarios added in the system through which it has to go through to execute its many decisions. Code directly affecting the system performance in terms of control, movement, working, and speed. Although in it, the controller was a NodMCU, which were coded by C compiler. Many times, logics were

implemented in different way to have better results of the system. Therefore, it has made a great improvement in me for the purpose of software usage and hardware interfacing.

3.2.1 Arduino IDE

Integrated development Environment (IDE) is software for application that chain developer tools on one GUI. The IDE, which is used to program the Arduino, is known as Arduino IDE. It contains the feature of program compilation, uploading and serial interface. Serial monitor interface is available for debugging purposes, which follows UART communication. Arduino IDE is used for the coding purpose of Arduino and other Microcontroller boards. The boards are connected with the PC through USB port and program is uploaded into it and compiled by pressing the 'Upload' button. The front-end of the Arduino IDE software has shown in Figure 13.

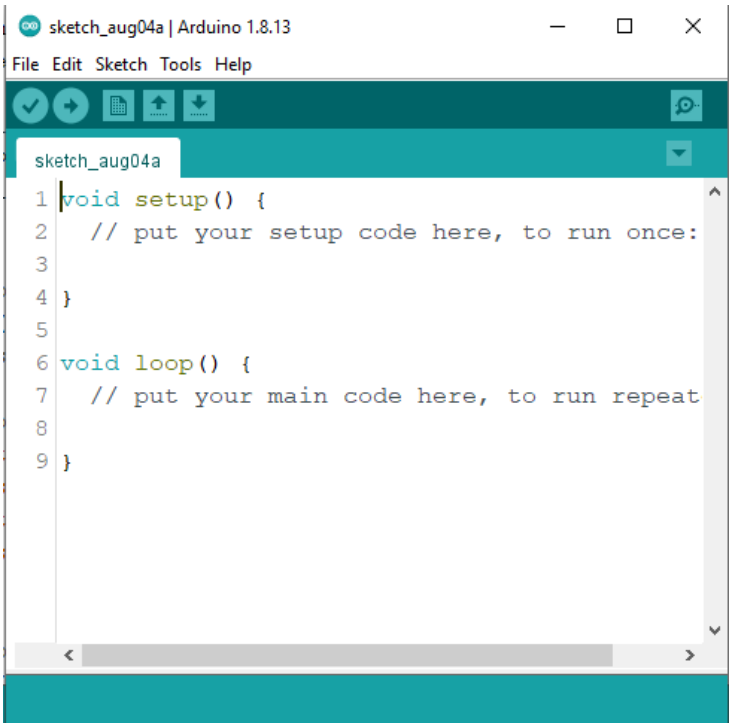

Figure 13: Arduino IDE

3.2.2 Thing Speak Database

Thing speak is a free cloud database which is provided by MATrix LABoratory which commonly known as MATLAB. This is an open IOT platform which is used to collect and visualize the data in different formats. This database can be connected with the hardware through internet. That's the reason, ESP8266 Wifi Module is being used for the communication purpose to send the level and temperature data to the things speak database. The data can be stored and can be displayed in the form of graph, pi-chart and many other visual arrangements. The response time of this database is fifteen seconds, which means that data from the devices transmitted to the database will take 15 seconds. The reasons of adding database to this project is to visualize the data at different location. Firstly, as we have developed the project data was available on the local site, which means that the employees and the person who is available on the fuel station can monitor the data. The person who was sitting on the distance was unaware about the data and was not able to deal with the fuel station without his involvement independently. By adding this feature, he was able to visualize and can take instant action in case of emergency and business works. Figure 14 shows the random temperature data at the things speak database.

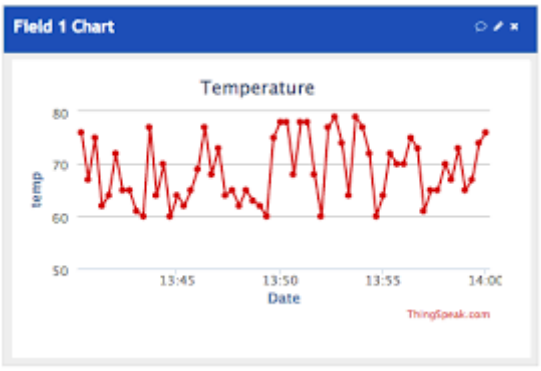

Figure 14: Database thing Speak

4 Chapter 4: Investigation and Analysis

This chapter presents the results of testing of the sensors and their results to the problem under research.

4.1 Ultrasonic sensor Testing

is placed at 10 and 11 while these pins are defined as input and output respectively. A pulse is sent to the 10 by making it high for a moment then setting it back to zero level. Wave is transmitted which is absorbed by the receiver at pin 10. The time of transmission and receiving is measured and used for calculating the distance. Ultrasonic Sensor calculate the distance by transmitting and receiving the echo wave, same like the Doppler effects used by the dolphin fishes. Those fishes used this feature to measure the distance of their neighbor fishes. Human normally used to study the nature to make improvements in their life. In ultrasonic sensor that natural phenomena are used to measure the distance. Figure 15 shows the results measured by the ultrasonic sensor.

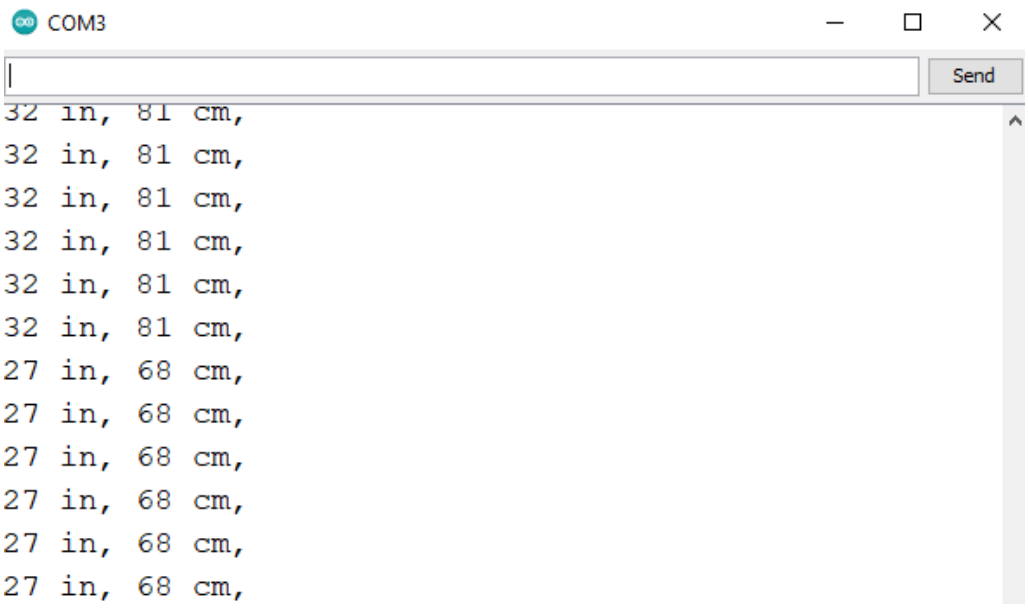

Figure 15: Ultrasonic Sensor Measurements

4.2 Temperature sensor DS18B20 Testing

Temperature sensor DS18B20 is connected to pin 2 of the Arduino. This is three terminal module, one pin is connected to VCC, we can connect it 5V as well as to 3.3V. While in the code we will do calculation according to that applied voltage. Other pin of the sensor is connected to ground. The working principle of the temperature is that, as we increase the temperature, the resistance of the temperature sensor material increase, which increase in resistance the voltage drop across the sensor also increases. We develop a voltage divider by applying the external resistor, so that there should be comparison of the values. Temperature sensor uses Dallas temperature library, which work on the bases of one-wire communication. One-wire communication is described in communication protocol section. The data from this sensor can be taken in degrees as well as in Celsius. The data can be changed from one form to another with alterations and calculations. In figure 16, we can see that temperature sensor is working fine and temperature is available in degrees ^{o}C and Fahrenheit (F).

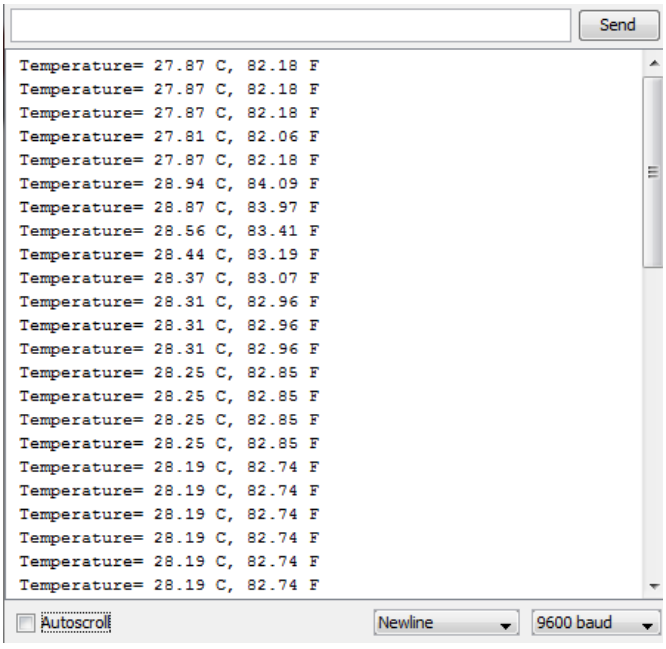

Figure 16: Temperature Sensor Results

5 Chapter 5: Design

Design of this product is based on the all covering from all side. It is because it will be located inside the fuel tank. So, it is necessary that it should be covered from all sides so that it should get exposed to vapors. The shape which is chosen for this product is rectangular. This is the best shape in my view because among the components which are being used are rectangular so, they will good to adjust the them. Most of the time we consider it as the sharp because this shape will be stable and easy to hang on the wall or floor of the fuel tank.

5.1 Design Shape of the project

The shape is basically box which has the dimensions of 200 X 185 mm. In this area, all the components are adjusted easily while the height of the box is 50 mm. There are many holes such as: there are 4 holes for the LEDs, the LCD, temperature sensor and ultrasonic wires to be brought out. The holes should be precise so that there should less exposure to liquid drops to enter into the box. Figure 17 shows the components placed on side, while base is showing the dimensions at which components will be properly adjusted and tighten so that they should not be able to leave their place when rotated in any direction.

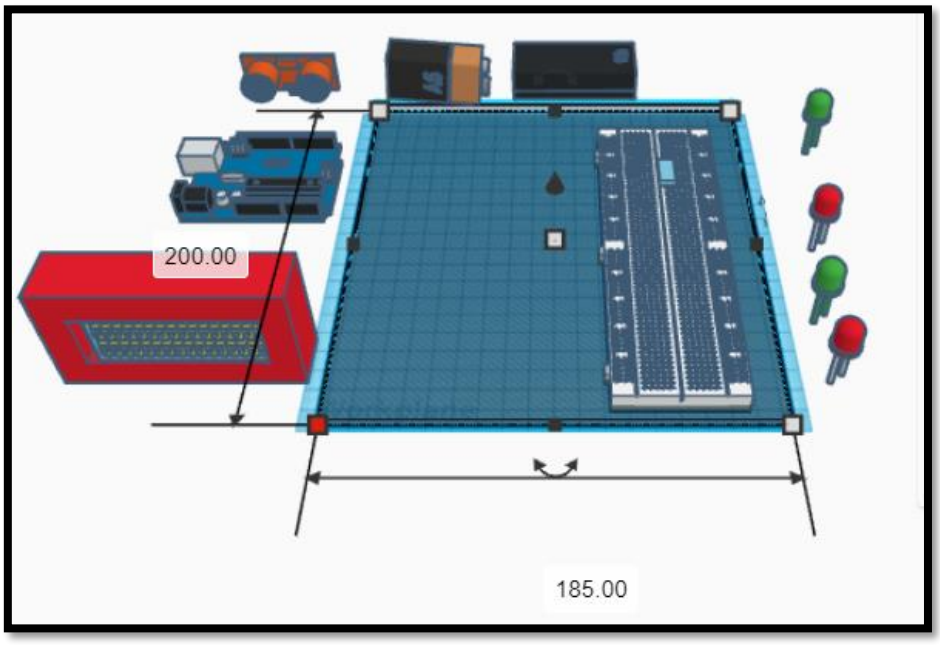

Figure 17:Components and the base for the Box

This is the side view of the components and while center contains the base of the box, the base non-flexible with height of 5mm, the height of the base is kept little more than usual because all the components will be kept for longer time also will be the base will be exposed to the vapor. There are two reasons behind keeping the height a bit longer, 1. Base is responsible for stopping the vapors, so it should be big because there might be the pours in the box. 2. Vapors from the fuel tank will be affecting the wall like swelling it due to continuous interaction. Figure 18 shows the side view of the component, modules and base.

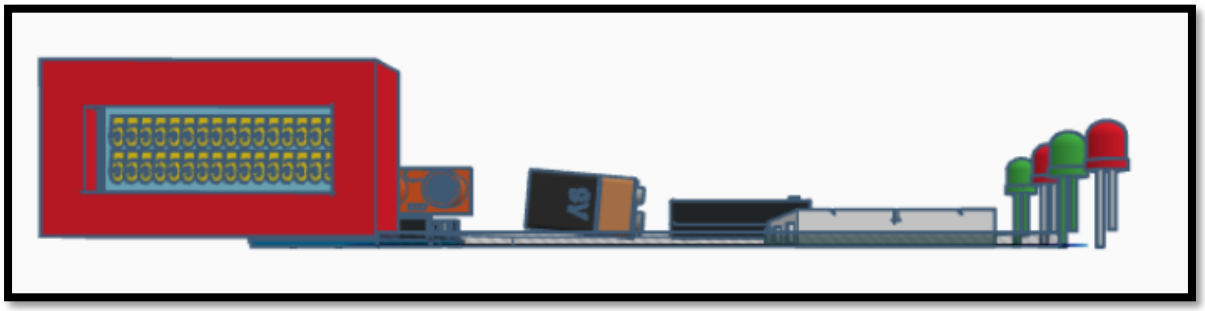

Figure 18: Base and components side view

This is the top front view of the product which show the adjusted components in the base. Display is set at one side although it will be outside the box, while same with the temperature and ultrasonic sensor. These three components will be connected through wire and there will be hole in the top body of the box. LEDs will be placed on the box through hole and they will be soldered by the resistor and the wires to I/O pin of the Arduino. Battery is chosen on one side of the box, through the connector it will be supplied to the Arduino Uno. The third thing which is in black is the power bank it will provide long extention to the supply. Power bank will be providing the long life to the system. Figure 19 shows the components adjusted inside the box.

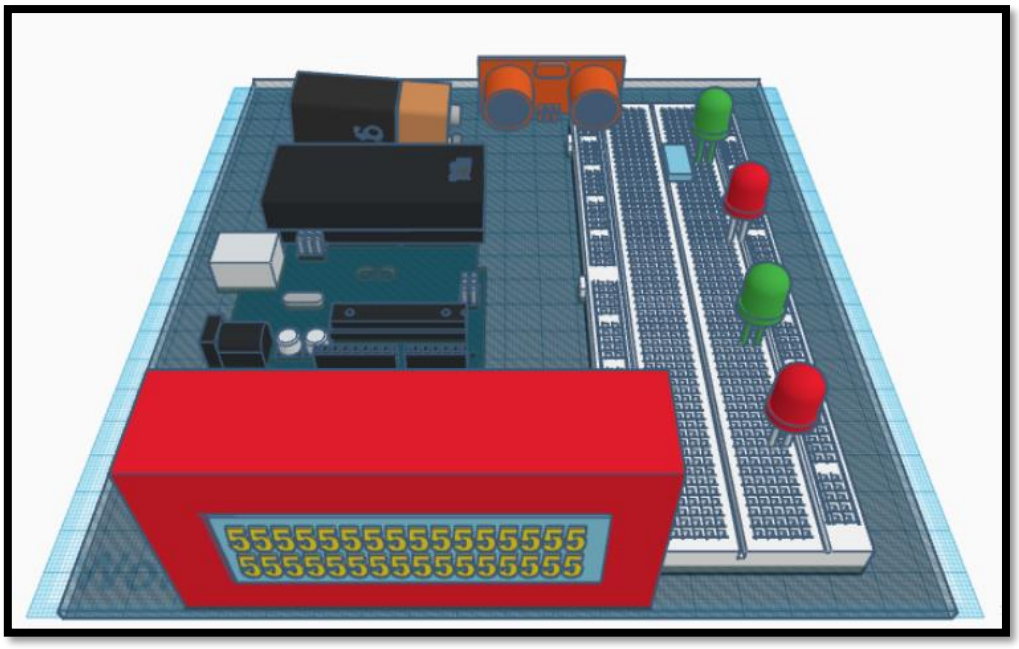

Figure 19: Components and sensors adjusted inside the box

This is the final product of this project, all sides walls are covered, while there will small hole for the LEDs and other components. The total dimensions of the product 200 X 185 X 50 mm. All the way through the adjustment we found this as acceptable dimensions. Dimensions are kept a bit more than the product it is because things need to adjusted and modified with time in the box. Figure 20 display the final product of this work.

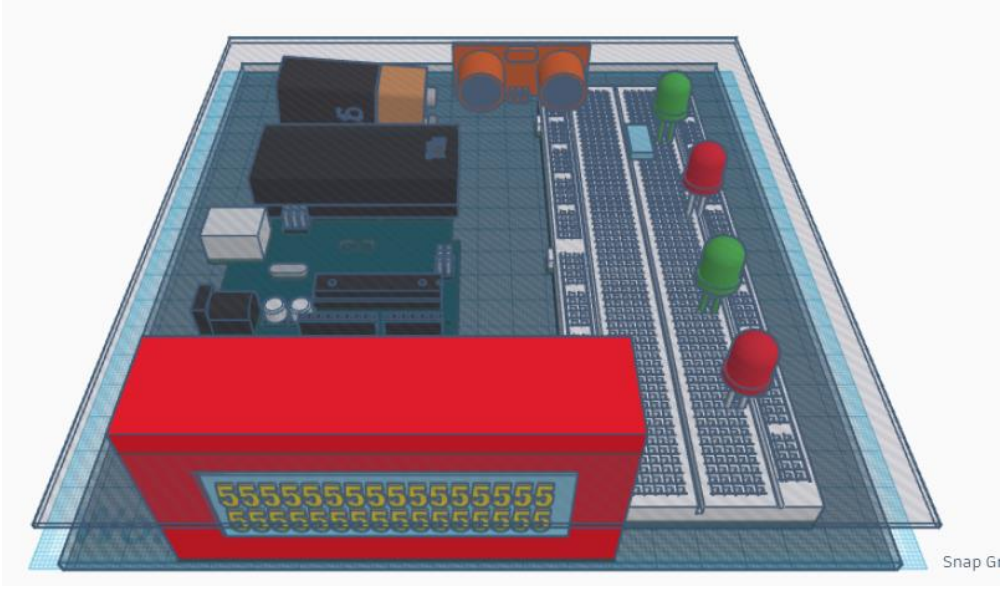

Figure 20: Final Product of this Project Top

6 Chapter 6: Implementation

This work is planned according to the features. Each of the feature is done completely then moved towards the next. Each feature is distributed further to for coding and hardware simulation. The list under in table 1 is given to describe the whole work.

Table 1: Project Work Distribution

Sr#	Task
1.	Components Selection
2.	Algorithm and logics for implementations.
3.	Coding is done for Temperature sensor and Ultrasonic sensor
4.	Coding for LCD
5.	Implementation is done and tested out in simulation.
6.	Data sending to the Data Base
7.	Merging of the Code and Final testing
8.	Report Writing

6.1 Communication Protocols

There are different modules which are added to this project, each module has its own mode of communication and adopt unique protocols. The components for which communication protocol are necessary to be explained are LCD, temperature sensor and data to the database. Table 2 shows the communication protocol for selected components.

Table 2: Communication protocol for selected components

Sr.	Module/Component	Communication Protocol
1.	16X2 Character LCD	I2C
2.	Temperature sensor	One Wire
3.	Data to Database	Wi-Fi
4.	Data to ESP from Arduino	USART

6.1.1.1 LCD Communication protocol I2C

Inter-Integrated Circuit is a brief distance, intra-board conversation protocol. It can speak among a community of gadgets with simply 2 pins. There are pins 1. SCL and 2. SDA. SCL is a clock producing pin, even as SDA stocks records. There are matters that are protected integrating a couple of gadgets. Figure 21 provides the waveform of I2C conversation, I2C cope with, I2C clock and I2C records are accountable to conversation. The cope with of the tool that's chargeable for speak with described tool of that cope with. Data is located on SDA cord and then SCL is is going right all the way down to percentage the records to the tool that's enabled via way of means of cope with.

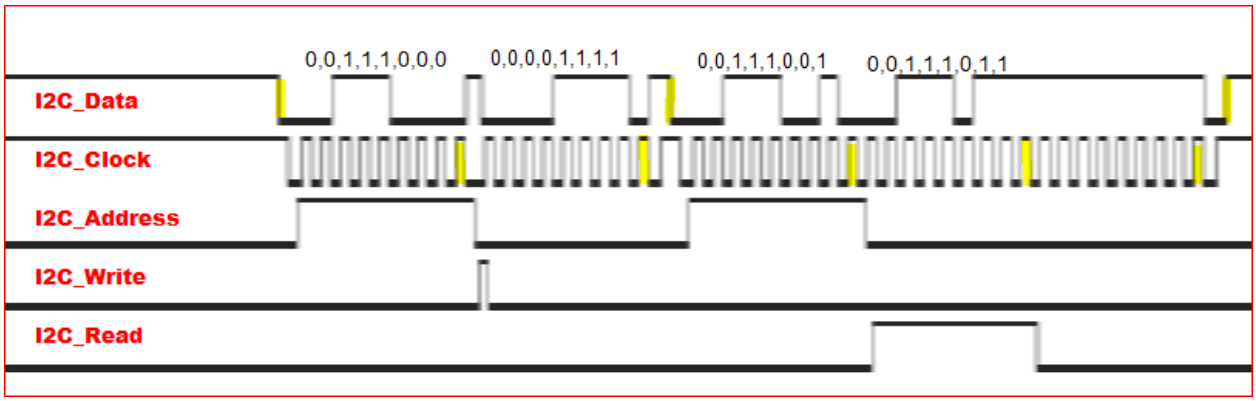

Figure 21: I2C waveform

I2C is bi-directional serial conversation, which has voltage stage from ground and +5V. Controller that is asking for the statistics is called grasp whilst tool that is responding to that request is called slave. Speed of I2C conversation varies from 100Kb to 400Kb. Two gadgets which received the identical cope with on the time of execution, the only who has decrease impedance get the statistics.

6.1.1.2 Temperature Sensor Communication Protocol One Wire

1-Wire communication protocol is half duplex bidirectional serial communication which use single data line. Different modules can be added with the 1-Wire as the data is transmitted by unique address and data size. There is unique for each component which enable it deal with different devices. Normally 1-bus device not contain any power pin, it takes power from 1-wire bus through parasitic power supply. There are four voltages at which 1-wire do communication. Table shows the voltages at which communication protocol is occur in the data bus. Table 3 present the voltage at which 1-Wire works.

Table 3: Voltages at which 1-Wire communication is performed

Sr.	Minimum Voltage	Maximum Voltage
1.	1.71	1.89
2.	1.71	3.63
3.	2.97	3.63
4.	2.8	5.25

6.1.1.3 ESP8266 to Database protocol Wi-Fi Communication

The communication which is used in our project is point to multiple topologies, as data is carried out from the ESP8266 to the Wi-Fi and then shared through different domains to the things speak database. Wi-Fi is wi-fi generation which make use of radio wave for imparting Internet services. The statistics is modified to radio sign that's transmitted via antenna. We commonly call the Wi-Fi as wi-fi place network (WLAN). Router is used to transmit and acquire the sign. Received statistics is decoded and converted into stressed out statistics to percentage with the non-public computer. Table 4 suggests the specifications of the Wi-Fi sign for use concerning working frequency, pace e.tc.

Table 4 : Wi-Fi featured listing

Sr.	Feature	Specs
i)	Operating frequency	2.4Ghz *(802.11b)
ii)	IEEE standard	802.11
iii)	Founded	1997
iv)	Wavelength	Radio operating
v)	Speed	54Mbps for 5Ghz (.11a) 11 Mbps for 2.4; (.11b) 54 for 2.4Ghz (.11g) 600Mbps for 2.4 and 5Ghz (.11n)

The operating frequency depends varies with respect to the versions while it lies in the rand of 2.4-2.5Ghz (free band), while 5.8 (required licensing).

Here are the topologies which Wi-Fi follows

- Point to point topology:

  Static routing, one transmitter to one receiver system is known as pp topology.

- Point to multipoint:

  One master, do communicate with the many slave devices. While all slave devices communicate only with the master.

- Multipoint to multipoint:

  Many devices do communicate with each other, also share the data between each other.

"**Frequency-Hopping Spread Spectrum (FHSS)":**

In communication, radio sign is sub-divided into minor spectrums and circulate from one frequency to different to transmitting the sign. By this manner it may speak with a couple of

channels even as pace is sent amongst many devices. While get hold of is likewise speaking with the grasp to get hold of the facts, if a few facts are overlooked then transmission is completed once more simply so get hold of ought to get hold of first-rate facts.

“Direct-sequence spread spectrum (DSSS)”:

In this system, collection is unfolding via way of means of radio sign via way of means of 22 MHz channel, even as frequency isn't extrude as FHSS. DSSS do talk via way of means of hyperlink to at least one channel. Power of the sign in DSSS is 22 MHz that's glaringly extra than 1 MHz in FHSS.

6.1.1.4 USART Serial Communication

Normally USART is known as serial communication in literature. Universal Synchronous/Asynchronous receiver/Transmitter (USART) contains synchronous and asynchronous mode of communication. The different between synchronous and asynchronous is that synchronous required clock and data while asynchronous required only data. The data transmitted in a synchronous is in one byte at a time, while synchronous transmitted data in the form of blocks. Data in synchronous is transmitted at fixed rate, while in asynchronous data is not transmitted at fixed rate.

The communication which is being performed is UART which is asynchronous feature of the USART communication. There is no requirement of clock in UART communication. The data from the Arduino is transmitted to the ESP8266 through UART/Serial communication. The ground of ESP and Arduino needs to common so that the threshold should be omitted out. Normally voltage level difference makes the false data, that the reason that ground is connected to make them at common level. The data rate of the UART are noted in bit per seconds (bps) e.g., 9600 bps. Here is the waveform of the figure 22.

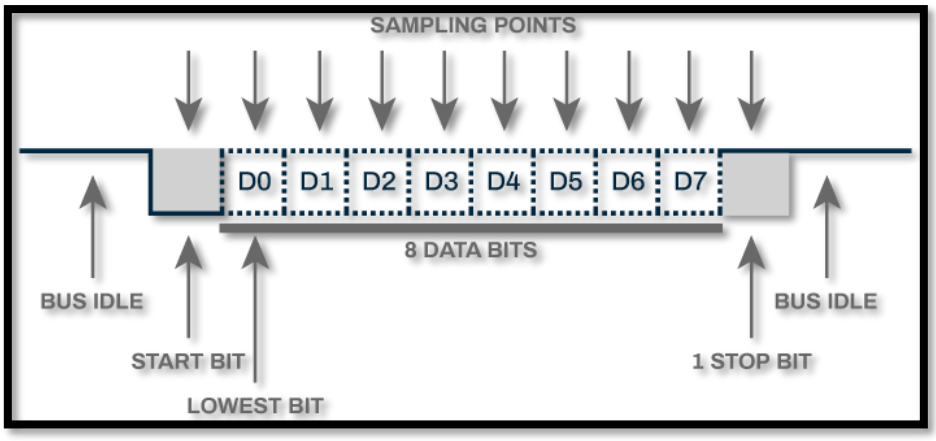

Figure 22: UART Communication Data

6.2 Flow Chart

In this flow chart the detailed arrowed shaped diagram is followed to display the direction and easy understanding. Each arrow displays the phase from one step to another. The flow chart is following the coding line which is performed in Arduino IDE. In the start, after initialization of input and output pins for the specified devices the flow chart is presented. Firstly, take measurement of the distance of the fuel and subtract the tank distance from measured distance to get the fuel level. If fuel level is fine and greater than the threshold, display green led, while if level is less than threshold than red led is turn on. Secondly, measured the temperature of the fuel tank, which is almost equal to the fuel temperature. Check on the threshold is set, if fuel is equal or less than threshold than green led is turn on while if fuel temperature is greater than threshold than red led is turn On. Thirdly, temperature and fuel level are displayed on the I2C based LCD, as LCD has two rows, so one row display the temperature and other display the fuel level. This data is transmitted by the Arduino to the Nodmcu through serial communication the baud rate for communication is set at 9600 and similarly received at same baud rate. The data is transmitted between Arduino and Nodmcu by UART communication by TX of Arduino is connected to RX of nodmcu. The ground of both the module is set common to avoid the level

of voltage, the ground is common to ensure that the both components have same threshold for the data. ESP 8266 further transmit this data to the database which is known as things peak. Thing speak is database which is freely provided by the MATLAB, we required internet connection for this case. API of the things speak data base and channel is provided by the database on which bases, data is sent by ESP8266 same as we do browsing. Graph is made by settings few options. The respond rate of thing speak base is fifteen seconds, which means that fuel tank and temperature data updated in this database will be after fifteen seconds. Figure 23 shows the flow chart of the code.

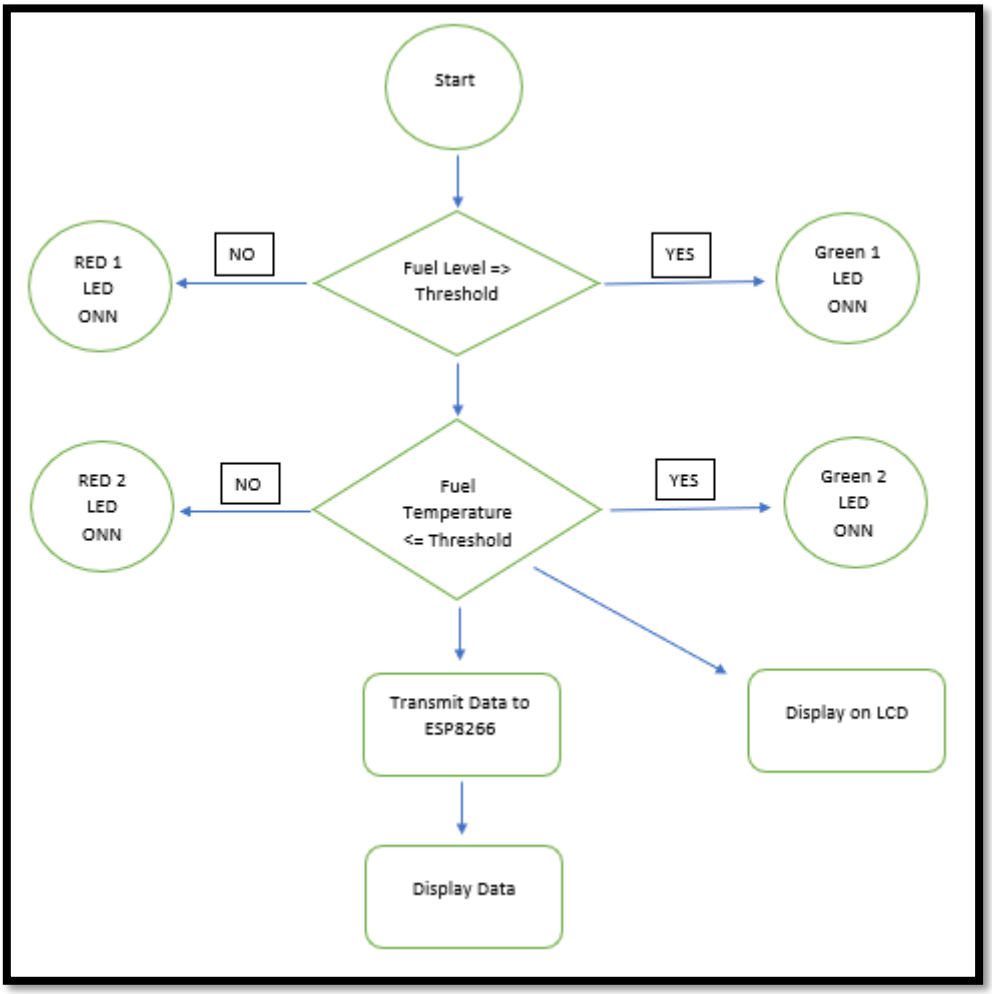

Figure 23: Flow chart of Project

6.3 Connection Diagram

The components are connected with the Arduino by wires while connections are made on the breadboard to make them easy and simplified. Breadboard contains holes which can hold wires tightly. There are different designs of breadboard, which can be used for easiness in wiring. There are four LEDs which are connected with the different GPIO of the Arduino. These LEDs will be displaying depending on the threshold set for the temperature and level. There are two pins of the LED, one is anode and other is cathode, anode is connected with the GPIO through the resistor while cathode is connected to the ground (0V). Ultrasonic sensor contains 4 wires, which are VCC, GND, Trig and Echo. VCC is connected to the 5V, GND is connected with the 0V, Trig and Echo are connected with the GPIO pins. Temperature sensor contains 3 pins. VCC, GND and vout, VCC is connected to 5V, GND is connected to 0V while vout is connected with the GPIO pin through the resistor by making voltage divider. Character LCD 16X2 is I2C based it will be connected with the I2C pins of the Arduino. ESP8266 is connected with Arduino by RX and TX respectively. Figure 24 shows the components connected together with the microcontroller.

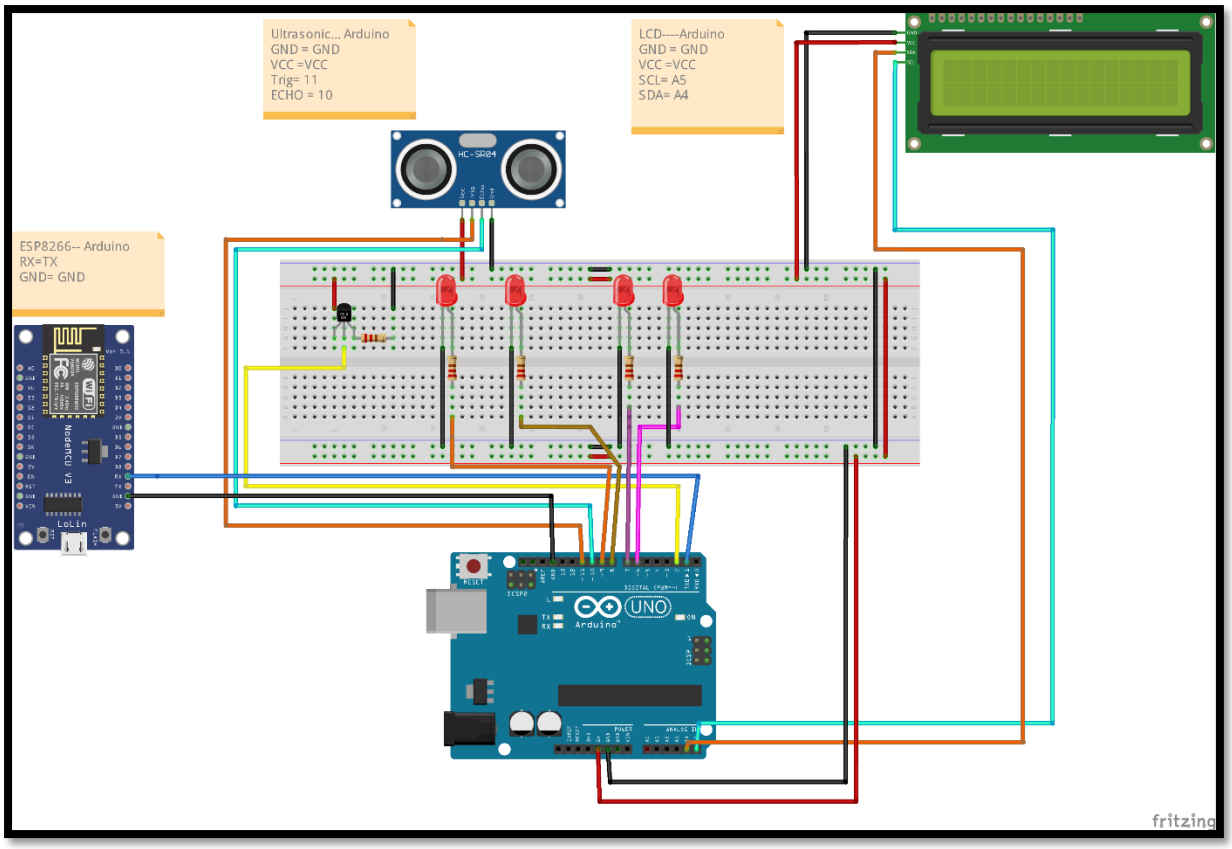

Figure 24: Connection diagram of the Components

6.3.1.1 Connections Tables

Here is the connection of each module with the Arduino uno. In the table microcontroller is Arduino, while module is mentioned with its name. Table 5 is for LCD, Table 6 is for Ultrasonic Sensor, Table 7 is for temperature sensor, table 8 is for LEDs and table 9 display the connection of ESP8266 with Arduino.

Table 5: LCD Connection with Arduino

Sr.	Character LCD	Microcontroller
1.	VCC	+5V
2.	SCL	A5
3.	SDA	A4

4.	GND	GND

Table 6: Ultrasonic Sensor with Arduino

Sr.	Ultrasonic Sensor	Microcontroller
1.	VCC	+5V
2.	Trig	D4
3.	Echo	D3
4.	GND	GND

Table 7: Temperature Sensor with Arduino

Sr.	Temperature Sensor (DS18B20)	Microcontroller
1.	VCC	+5V
2.	Vout	Pin 2
3.	GND	GND

Table 8: LEDs with Arduino

Sr.	LED	Microcontroller
1.	LED 1 (Level)	9
2.	LED 2 (Level)	8
3.	LED 3 (Level)	7
4.	LED 4 (Level)	6

Table 9: ESP8266 Connection with Arduino

Sr.	ESP8266	Microcontroller
1.	RX	TX
2.	GND	GND

6.3.2 Uploading of the Code:

After making the connections, we need coding support to deal with the hardware, code is already given in the pseudo code which needs to be implemented by uploading it.

The procedure for uploading:

1. Connect the microcontroller with the USB port as shown in figure 25 a.
2. Upload the code by pressing the upload button as shown in figure 25 b.

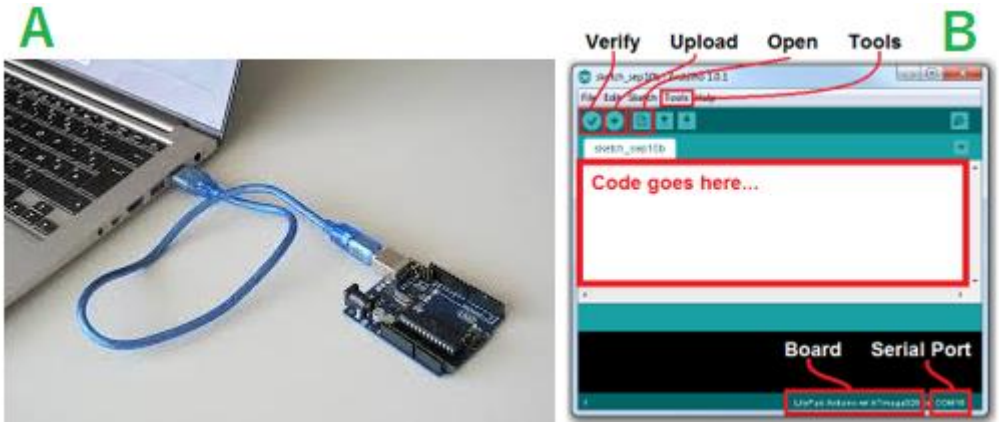

Figure 25: Arduino Code uploading

6.4 Block Diagram

There are sensors, modules and microcontroller which are linked together to make this project. The components and modules which are sending the data information to the microcontroller are input devices while those which are receiving data from the microcontroller are output devices. In the figure arrow displays the input and output devices on left and right side respectively. Temperature and ultrasonic sensor are the input devices which are written on left side. LCD, four LEDs and ESP8266 are the output device for the microcontroller as these components are receiving data from u-controller. The data from the microcontroller to the ESP8266 is further transmitted to another output device. So, the esp8266 is acting as the intermediate and medium to transmit the data. The figure 26 shows the separation in between both receiver and transmitter of data.

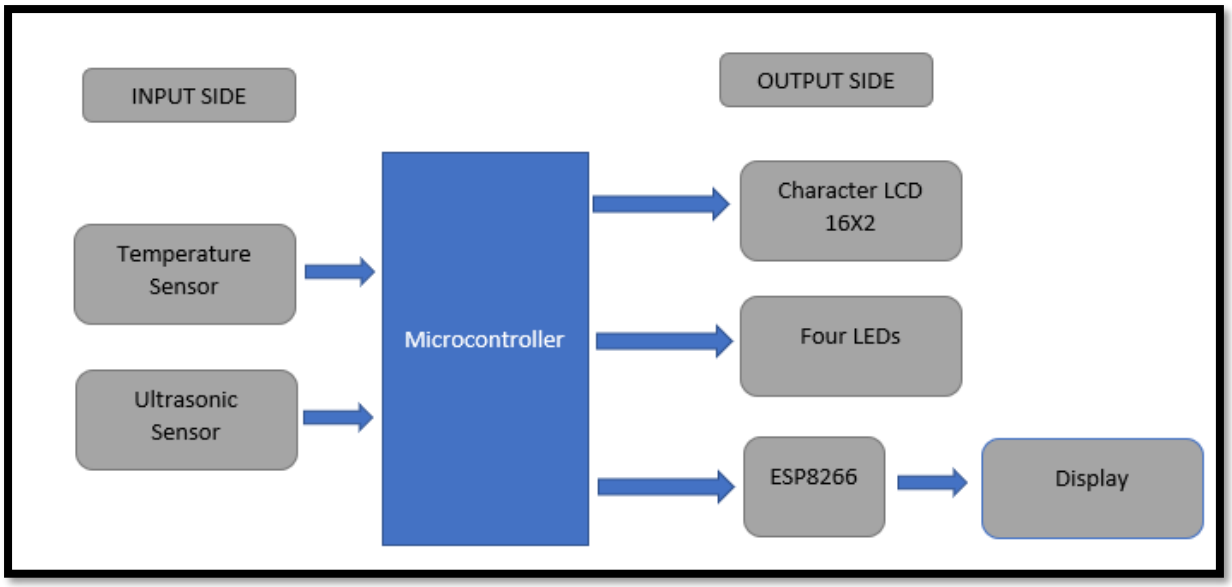

Figure 26: Block Diagram of Input and Output

6.5 Codes

6.5.1 Code for Arduino

```
#include <Wire.h>// I2c initialization

#include <LiquidCrystal_I2C.h> // LCD library for I2c

LiquidCrystal_I2C lcd(0x27, 16, 2); // LCD address and its low and column defining

#include <OneWire.h> // one wire for temperature sensor

#include <DallasTemperature.h> // temperature sensor library declaration

#define ONE_WIRE_BUS 2 // Temperature sensor pin defining

OneWire oneWire(ONE_WIRE_BUS); // child for the temperature sensor

DallasTemperature sensors(&oneWire); // pass by reference for temperature sensor

//Ultrasonic sensor pins

const int trigger = 4; // ultrasonic pin trigger defining

const int echo = 5; // ultrasonic pin echo defining
```

```
// defines variables for distance measurement
long duration; // variable use for time duration measurement of wave
int distance; // distance calculated by the ultrasonic sensor
float tankdistance = 200.0f; // total tank distance
float fuellevel = 0.0f; // fuel level used for calculation

// temperature variable
float temperature = 0.0f;

// Start of Setup
void setup() {
  Serial.begin(9600); // Starts the serial communication
  pinMode(trigger, OUTPUT); // Sets the trigger as an Output
  pinMode(echo, INPUT); // Sets the echo as an Input
  lcd.begin();   // initializing the LCD
  lcd.backlight(); // Enable or Turn On the backlight
  lcd.print(" Fuel Project "); // Print message on LCD
  sensors.begin(); // Start the temperature sensor
  delay (2000);
}
// END of setup

void loop()
```

```
{
  distancing (); // call distance function
  temperature1 (); // call temperature1 function
  calculation (); // call calculation function
  dataprint (); // call dataprint function
  datatrasmission (); // call datatrasmission function
}

// Function to measure the distance
void distancing ()
{
  digitalWrite(trigger, LOW); // make trigger pin low
  delayMicroseconds(2); // wait for 2 microseconds
  digitalWrite(trigger, HIGH); // make trigger pin HIGH
  delayMicroseconds(10); // wait for 10 microseconds
  digitalWrite(trigger, LOW); // make trigger pin low

  duration = pulseIn(echo, HIGH); // make ECHO pin HIGH
  distance = duration * 0.034 / 2; // duration of the receiving the wave divided by 2
  // as tranmission and receiving two distances are covered.
  Serial.print("Distance: "); // print on the serial monitor
  Serial.println(distance); // print distance on the serial monitor
}
```

```
// Function for measuring the temperature
void temperature1 ()
{
  sensors.requestTemperatures(); // request for temperature measurement
  temperature = sensors.getTempCByIndex(0); // take the temperature data
  delay(1000);  // wait for one seconds
}
// Function for print the data on LCD
void dataprint ()
{
  lcd.clear(); // clear the data
  lcd.setCursor(0, 0); // set cursor at 0,0
  lcd.print("Level = "); // print level on LCD
  lcd.print(fuellevel); // print fuel level value on lcd
  lcd.print("cm  "); // print cm on lcd
  lcd.setCursor(0, 1); // set cursor at 0,1
  lcd.print("Temperature = "); // print temperature on LCD
  lcd.print(temperature); // print lcd value on lcd
  lcd.print("C  "); // Print C on the LCD
  delay(1000);
}
// Fuel level calculation function
void calculation ()
```

```
{
  fuellevel = tankdistance - distance; // Fuellevel = tanklevel - distance measure
}
// Data trasnmission function by Serial
void datatrasmission ()
{ Serial.print("S"); // print S for start data on the serial monitor
  Serial.print("F"); // print F on the serial monitor
  Serial.print(fuellevel); // print fuel levl on monitor
  Serial.print(":"); // print : on the serial monitor
  Serial.print("T"); //print T on the serial monitor
  Serial.println(temperature); // print temperature value on the serial monitor
  Serial.print("_"); //print _ on the serial monitor
  Serial.println("E"); // print E for end data on the serial monitor
}
```

6.5.2 Code for ESP8266

```
#include <ESP8266WiFi.h> // ESP8266 wifi library which enable wifi constraints of the ESP8266 module
#include "ThingSpeak.h" // MATLAB thingspeak library addition
char SSID[] = "my wifi name"; // WIFI name, router connection name
char PASS[] = "my wifi password"; // Password of the wifi
unsigned long ID = 868969; //id channel of thingspeak
const char * keyapi = "Ahyk78432p121"; // API of the channel
const int location1 = 1; // location of data 1
const int location2 = 2; // location of data 2
```

```
String value = ""; // string data receiving variable from the Arduino

int fuellevel = 0; // fuel level value storing variable

int temperaturevalue = 0; // temperature value storing variable

WiFiClient  client; // child initilization of the wifi



// start of the setup

void setup()

{

  Serial.begin(9600); // serial monitor baud rate

  WiFi.mode(WIFI_STA); // wifi set as browsing mode

  ThingSpeak.begin(client); // inilization of things speak on wifi

  Connectioninternet(); // connection establish for internet

}

// start of loop

void loop()

{

  Connectioninternet(); // connection establish function call

  if (Serial.available() > 0) // check if data is avaialable from the arduino

  {

    while (Serial.available() > 0) // if data is avaialble

    {

      value = Serial.readString(); // read data from USART

      bool start = value.startsWith("S"); // string contain S variable
```

```
    bool end = value.endsWith("E");// string contain E variable
    if (start) // value of Start is 1 if string contain S variable
    { if (end) // value of end is 1 if string contain E variable
      {
        int colon = value.indexOf(":"); // check index of : in the string
        int Edigit = value.indexOf("E"); // check index of E in the string
        String level =  value.substring(start, colon); // copy string from start to colon
        String temperature =  value.substring(colon, Edigit); // copy string from colon to Edigit
      fuellevel = level.toInt(); // convert string to integer for fuel level
      temperaturevalue = temperature.toInt(); // convert string to integer for temperature
      }
    }
  }
 }
 upload(); // upload data to thingspeak
}
//function to uplad data to thingspeak
void upload()
{
  ThingSpeak.writeField(ID, location1, fuellevel, keyapi); // channel, location, value upload , api key to upload the data
  delay(15000); // wait for 15 seconds as thingspeak upload time is 15 seconds.
```

```
  ThingSpeak.writeField(ID, location2, temperaturevalue, keyapi); // channel, location , value upload , api key to upload the data
  delay(15000); // wait for 15 seconds as thingspeak upload time is 15 seconds.
  value = ""; // set string recevive to empty
}
// function to connect the internet
void Connectioninternet()
{
  if (WiFi.status() != WL_CONNECTED) // check if internet is connected or not.
  {
    while (WiFi.status() != WL_CONNECTED) // if internet is not connnected
    {
      WiFi.begin(SSID, PASS);// connected the internet
      delay(5000);// wait for 5 seconds to establish stable connection
    }
  }
}
```

6.5.3 Pseudo code:

Define echo pin at A4

Define trigger pin at A5

Start setup;

Set baud rate of 9600 for serial monitor;

End of setup

Start loop

Define variables for distance measurements;

Set trigger pin as OUTPUT

Write LOW level to pin Trig

Wait for two microseconds

Write HIGH level to pin Trig

Wait for 20 microseconds

Write LOW level to pin Trig

Set echo pin as INPUT

Measure the duration of pin echo to get logic change

Call function to convert duration to inches

Call function to convert duration to cm

Display distance in inches

Display distance in cm

Wait for 100 milliseconds

End of loop

Function for converting duration to inches

{Duration /74/2}

Function to convert duration to cm

{Duration/29/2}

7 Chapter 7: Evaluation of Product

There are lot of systems which follows health protection protocols like some circuits are detecting temperature, Carbon Monoxide Gas detection and flash sensor. Each of these hardware has its importance and drawbacks which leads to an effective with respect the customer requirements. Currently, we have done it in general works to give the understanding of the system processes by using ultrasonic and temperature sensor.

7.1 Performance vs. Design Goals

This project has achieved all the goals which we have proposed in our work. Each of the goal is described as feature under the heading of results and Discussion.

Goal of the Project:

- **"The goal of the system is to set "Measure the petrol level and temperature through smart technology"**

The system purposed was done by using ultrasonic sensor and temperature sensor along with other notifying components such as LEDs. The project had achieved all the goals with satisfaction.

The results of my work are telling about the temperature and the petrol level. Also, the LED showing the status of the level. Temperature is continuously monitored which enable us to know about the temperature information to let us know that our results are fine or not. As we see on the LEDs temperature reached to 40 C the red LED gets ONN. So basically, it's the check for our system that its working is perfect. Similarly, at the 30 C the green LED gets ONN.

7.1.1 Objective and Goal:

In this project have achieved all the goals, 1. Reduce the human interaction. 2. Keep the monitoring at every time to save time. In introduction section has given statement to monitor

the temperature and level with the temperature sensor and ultrasonic sensor which is achieved in final testing.

7.1.2 Engineering Relation:

Our system is checking the petrol level and temperature, as it based on electrical components so it's totally relating with the electrical engineering field. Connections are using wiring; LEDs interfacing, ultrasonic sensor for level and temperature sensor communication is done in this project.

7.1.3 Sources of Error:

The things which were source of error as under:

1. Loss connection of the Wiring
2. Temperature gets abrupt change if sensor is added with residue layer of petrol fumes.
3. LEDs brightness is quite small which may affect to not see the results clearly.

Our results confidence is because of its tested out and the results as same as per our objectives.

8 Chapter 8: Critical Evaluation of Project

This project is built for the petrol tank installed in underground of the petrol station. The components which are used in this work contains. This project contains components which are used for experiments and the contains limited ranges. Here are the explained data for the critical evaluation of the project:

8.1 Limitation of the Level Sensor:

Ultrasonic sensor can discover up-to the described distance, this sensor hc-04 can degree most of 254 inches, in addition different fashions have variety withinside the described measures. The variety is likewise laid low with outside atmosphere, it's miles because of the purpose that we generally try and keep away from such sensor with can clean to alternate the accuracy with recognize to the ambient. Ultrasonic sensor is used for the detection of level but when there are petrol fumes, the wave which is transmitted while be reflected back by the fumes and level information maybe false. Ultrasonic sensor is a transducer which means that it converts energy from one form to another as it is converting electric energy into sound energy. This sound maybe distracted through different domains of the waves. The other reason behind its limitation is that its receiver and transmitter maybe introduced to the residue like the fume can deposit and contains a layer. This layer will affect the results of the ultrasonic sensor. Limitation 3 is that the angle of wave interaction with the petrol, if angle is much then results will not be same as the real. Figure 27 shows the ultrasonic wave angle of interaction with the object, petrol in our case.

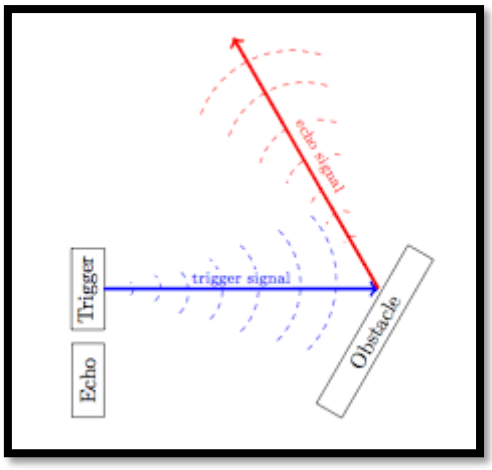

Figure 27: Ultrasonic wave direction and reflection

8.2 Limitation of the Temperature Sensor:

Temperature sensor has -55 to 125 ^{o}C, but it can only measure the area where it has contact. The other area which is out of its contact will not be measured, so we required more temperature sensor to measure the exact value. Temperature sensor which we are using is metal node, which means there is metal plating on the nipples. This will be affecting the temperature sensor to get late to cool down. The long distance of the wire, affects the results as voltage drop in between the path. Temperature sensor will be in the fuel it will be deposited with the layer of carbon, we have to check it with the time, like we have to do cleaning of the sensor. Figure 28 shows the temperature sensor when installed and after sometimes oxide layer added on its top.

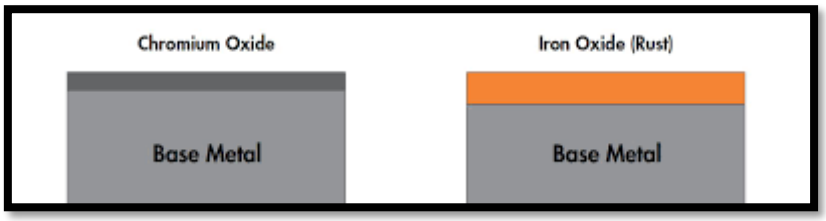

Figure 28: Temperature Sensor node without and with oxide layer on its top

8.3 Battery Issues

The sensors, microcontroller and LCD is powered by the battery. And except all LCD everything will be almost in the tank. In the tank there are fumes which are coming out of the petrol because of it low boiling point. These fumes affect the health of the battery because of the electrostatic voltage passage. As well as there is risk of shortage because of the fumes, which may cause fire. This fire maybe introduced to the fuel available in the tank. Similarly, the sensors are also supplied with the voltage from the battery, in case they get short circuit may cause much damage. Figure 29 shows the swollen batter which might be the cause of short circuit or internal self-modifications.

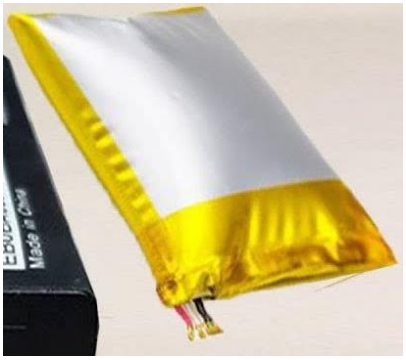

Figure 29: Battery Swollen

8.4 Health & Safety/Environmental/Contemporary Issues

For safety purposes temperature sensor should be available at some moderate speed air flowing area. The results of such areas are much better. It is human friendly as there is not any hazard module or sensor is used. In case of launching, it as product, plastic covering of the module should be grill type so that air get flow and it will be best if it is insulator and it will avoid any burning scenes. There are distinct tool and sensors that may assist to address the hearthplace detection. Sensors, controller and cellular utility machine are few of the instance to address monitoring. While different aggregate of this paintings may be laptop tool which has the

characteristic to address web sites and database from distance. The manage which we will hold from distance may be manage the machine through measuring the extent and get to recognize the temperature manage from office. This characteristic saves our time in addition to offer an additional safety for life. Like we will recognize the hearthplace brought in gas station through inclusive of hearthplace sensor with a purpose to be telling us every moment. There are many sensors which may be brought with the gas station machine to offer us persuade of life.

9 Chapter 9: Conclusion

In the project summery I would like to include some important points and aspects which are useful for a petrol level and play key role. This system has been proposed for the human safety of the employs at petrol pump. Society is much lacking in the human safety protocols because of the high rates of the products. In this project, have proposed solution real time solution with advancement of database.

Liquid level and temperature of the fuel in the fuel tank is measured after few intervals of time, especially at refilling and placing order. Station employs are responsible to monitor the temperature and fuel level by going inside the tank. As we know fuel boiling temperature (petrol) is 75^{o}C, depends on the composition of the petrol, fumes are normally available in the tank, these fumes get interact with the employs. There are various diseases such as skin issues, breathing and lungs cancer which may case because of working continuously in such fumes area without proper treatments. As being the researcher, it is the responsibility to provide solution for this issue. So, the solution which is provided and performed successfully in this project is to measure the level and temperature through technology. For that purpose, have used ultrasonic and temperature sensor alone with LEDs, LCDs and database. LCD is continually displaying the fuel level and temperature, while four LEDs are displayed accordingly to show the level and temperature.

Things Speak database is used to show the temperature and level in graph. Nodmcu ESP8266 is used as the microcontroller, this board contains Wi-Fi. Data to the thing speak online free database is sent through Wi-fi communication. There are three modes on monitoring the whole system as at each time, data can be seen through the database, LEDs and LCD. Data on the database can be seen from the laptop and personal computer (PC) from the any distance. This thing enables to have remote communication with the authorities in case the fire is started or there is risk of the fire. Along with this employee which were continuously responsible to enter

the fuel tank to monitor the fuel level and temperature were safe to get introduced with the fuel. They are now avoided by the risk of the health which were caused by the interaction with the fuel in the tank.

10 Future works

In order to make our system more attractive and reliable, other further works can be done to improve the performance and efficiency of the system.

These improvements include:

- Involvement of fire brigade with the system to have instant response to reduce damage.
- Website response to the authorities should use to get data on it which should be monitor at instant level for better human safety.
- Currently the LED are used for demo, in productive work buzzer amplification circuitry should be added to have louder sounding.
- A combo of flame sensor, temperature sensor and gas sensor should be used to have much effective result. Addition of flame sensor.

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12 Appendix.

12.1 Proposal

Project Proposal Form

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Student Forename: Prageeth Kumara.

Student ID: 20003951

Course: MSc Computing

Proposed Project Title:	**Underground fuel storage tank monitoring system in a fuel station**
Requested Supervisor(s):	

Overview:

This proposal seeks to provide a thorough examination of underground fuel storage tank (UST) condition monitoring methodologies in a fuel tank station. Because of its huge capacity and minimal floor space required to build, the underground storage tanks in petrol station has long been a favored substance reservation mechanism in most petrol stations. Recently, the attention has been brought to the complex underground system's and surrounding environment's safety issues as a result of contamination caused by unintentional subsurface leaks. Numerous efforts have been concentrated on the damage repair process and fault detection practice. According to studies on relevant defenses; It has also been noted that there are uncertainties in current technical complexities concerning the efficiency of corrective activities and the resilience of condition monitoring approaches at the petrol stations.

Contents

The Rationale for choice of project:

Underground storage tanks (USTs) have long been used for storing large fuel in fuel stations. The complex containers, which are commonly found beneath gas stations, laundry establishments, and local residences, are inevitably subjected to contaminants, oxidation, and erosion throughout service times. Typically, the deteriorating symptoms concentrate on risky regions such as metal structures, tank bases, sewage pipes, pumps, and safety valves. Harsh operating conditions, metal, and liquid reactions, particular element gravity variations between fluid and tank surfaces, fatigue, mismanagement, and incorrect assembly all contribute to this deterioration. Furthermore, the subsurface aspect of UST operation is a double-edged sword: it provides minimal surface area requirements while also increasing monitoring complexity.

The creation of a model of a fuel station reservoir surveillance system using the Internet of Things is presented in this study (IoT). The present method for measuring the gasoline level in an underground tank in Sri Lanka is to use a dipstick, which is inefficient and dangerous. The suggested monitoring system is fully automated and provides a real-time reading of the fuel level and temperature in the subterranean storage tank, which is obtained using an ultrasonic sensor and a waterproof temperature sensor. Through the use of an open-source microcontroller board called NodeMCU, all of the input data from these sensors are communicated to an IoT platform. The gasoline storage tank monitoring system notifies users when there is a shortage of gasoline or when the temperature rises above 35°C. The suggested internet-of-things-based solution might assist gas station owners in monitoring fuel parameters from were ever using devices with an internet connection. It is possible to achieve effective monitoring without physically being present at the local location.

Problems

Gas station operators must monitor the subterranean fuel storage tank on a regular basis in order to control fuel stock numbers and discover any leaks. Workers at gas stations currently use the dipstick to gauge the amount of fuel in the subterranean tank. This task usually takes half an hour, which is inconvenient, especially in Sri Lankan hot weather. Not only that, but the workers are at risk of breathing gasoline-derived hydrocarbons, which can create health concerns. Every year, a large number of people are harmed by hydrocarbon poisoning. Furthermore, due to human errors in the measurement process, this traditional method may be imprecise.

Automatic fuel level sensor systems are important to most petrol station owners because they help them meet state regulations that require tank and line tightness testing. These systems also provide accurate product levels at a glance. By implementing this type of system they won't have to manually stick a tank to measure the tank volume. Knowing the tank volume will help provide accurate fuel inventories. Accurate fuel inventories make for easy reconciliation of product use or sales. Most importantly, they eliminate manual measurements and calculation of monthly inventory by providing detailed reports of products delivered and products dispensed.

Solution of the research

For the prototype: we use two input devices which are an ultrasonic sensor to measure the fuel level and a waterproof temperature sensor to measure the fuel temperature. The system starts with the microcontroller (on the NodeMCU board) being initialized. Then, both of the sensors will simultaneously measure the fuel and temperature level. The microcontroller will calculate the fuel volume and process the temperature value of the fuel. These measured data are stored in the cloud and can be monitored through the IoT platform that we use. The system will alert the user when the fuel is on low stock (lower than 0.5 Litres) and when the fuel temperature is high (greater than 35°C)

Literature Review

A few significant conventional checking methods have been created to cover a wide scope of uses for different conditions. Visual examination by experienced laborers, for instance, is fitting for fundamental investigation. Oil and trash investigation is significant for ferrous and non-ferrous sections to identify any chips, holes, or spots where the covering may have isolates. The thermography technique screens underlying temperature change concerning material qualities and conductivity by using the principal heat move hypothesis. Administrative Control and Data Acquisition (SCADA) is an online boundary following organization that spends significant time in tribological observing with wide inclusion. SCADA's concentrated control framework, when joined with adequate information stockpiling, may give an extensive evaluation of a few bits of gear or huge offices over the long run. Due to its grounded rapid segment finger impression design recognition and finding, the vibration-based examination is another remarkable choice. [1]

Notwithstanding the former methodologies' shown achievement, they are badly designed to apply to UST because of the underground climate's compelled and hard to-arrive at characteristics. Moreover, on the grounds that a UST is a framework impacted by various components, straightforward customary techniques are probably going to disparage the discovery model. Moreover, the low connection between's time-shifting segments, just as the similarly long filling-release cycle spans, add to the extensive calculation and postponed response. In light of the static idea of the segments and the various powerful properties of the outcome, for example, the fluid volumetric stream rate, USTs are generally unaffected by movement type checking. Because of the lethargy of underground constructions, an aggregate investigation into condition checking approaches has been completed to adjust ecological

antagonism and unravel a couple of accessible signs. The achievements and discoveries from assorted examinations will be introduced in the request recorded underneath. [2]

Utilizing the Complex Finite Fourier Transform (CFFT), an association of temperature changes between a tank divider, its environmental factors, and the fluid inside was seen during a UST temperature-control reenactment. The UST nuclear power controlling model likewise accepts that operational conditions affect framework responsiveness. To address petroleum spills, specialists explored an online soil-venting gadget. The expense adequacy of progressing toward zero-outflow soil was analyzed after definite data on spillage events was gathered, especially during refueling exercises. In the case of pollution, a reusable substance called HDTMA (hexadecyl-trimethylammonium)- kaolin was presented as a confinement material. HDTMA-kaolin compound has a water-driven network and the capacity to retain oil synthetics practically identical to a customary bentonite blend. Fluid sloshing because of delayed high seismic plentifulness impacts was utilized to demonstrate an occasion of UST skimming rooftop harm. The harm expectation is improved by considering close-by dregs, profound bowl construction, and ground movement source distance, to look like the fallout of seismic tremor. CO2 underground dislodging and spillage observing were explored utilizing an optic fiber mid-infrared separating approach. Examinations have shown that utilizing legitimate infrared attributes, for example, the frequency range limit, optical way similarity, and optical fiber sorts, it is feasible to assess gas passage and outflow. As the result of an imploded rooftop event, a UST plan evaluation dependent on outrageous pressure investigation was directed. To genuinely analyze the impacts of design math on erosion circulation, a strain check exploratory dataset was assembled under different pressure classification conditions. To diminish neighborhood focuses, a similar tank pressure test proposed weld toe calculation support. Then, it has been found that an upward UST floor plate examining application is utilizing non-damaging Acoustic Emission (AE) signal investigation. [3]

Since inert time is not, at this point required, the web-based checking of issues like erosion and spilling has been heartily valued. Innovation move from the mining region to subsurface dangerous gas restricted checking was done in France. A unique aggregation chamber arranged among soil and environment for inflow gas checking, just as a coordinated gas sensor framework estimating CO2 focus at pit subsurface, has both been demonstrated to be compelling CO2 following arrangements. A few gas properties, for example, isotopic and piece, affect the recognizable proof interaction, as per the creator. In the UST limited component model online condition checking, a type of optic fiber tactile cluster called Fiber Bragg Grating (FBG) was utilized. Tank-base thickness misfortune because of consumption and divider vibration reaction is reflected in the proportionate connection among strain and FBG frequency variance. To diminish the recurrence of UST underlying reviews, the Environmental Results Program (ERP) assistant instruments have been introduced [43]. While the arrangement is fundamentally centered around lessening the peril of water supply tainting, it has additionally been resolved to be administrative agreeable and financially savvy. To limit erosion, different kinds of tank divider materials have been thought of, like the high pliable fiber/polymeric composite; be that as it may, because of dampness assimilation, this substance isn't appropriate for improvement as a tank divider material substitution. Improved warm protection execution for urgent parts of water tanks has been shown utilizing a natural palm-made protector, and it very well may be utilized as a warm pressure reliever notwithstanding environmental change. To screen gas accessibility, soil temperature, and building structure strain boundary, a multifunctional layer sensor strategy was made [4]

Sensor estimations were approved by field application to empower CO2 stockpiling observation. Material pressure and fluid sloshing tallness were discovered to be conversely

relative to the fluid level and stature to-sweep proportion when utilizing 3-D Coupled Euler-Lagrange (CEL) reproduction. A definite item life cycle study was attempted to streamline the water tank stockpiling plan [48]. Tank and control material, remarkably tank situating, shape, and volume setting, were resolved to be the main natural components. The Electrical Impedance Tomography (EIT) approach was utilized to project underground partitioning territories by using the conductive character of petroleum debasements. Utilizing a neighborhood projective conductivity picture approach, the reactions from covered terminals are imagined.[5]

Project Aims and Objectives:

Following aims and objectives will be covered by the research.

The proposed fuel storage tank monitoring system will be designed in a two-tab interface: Fuel level tab and fuel temperature tab. The first tab will show the amount of fuel level in the underground storage tank (in liter unit) and in a display gauge. The distance between the ultrasonic sensor and the fuel surface is also displayed (in cm unit) for troubleshooting purposes. If there is no fuel, it will show the distance between the ultrasonic sensor and the bottom surface of the container. Two LED indicators each represent normal fuel level and low fuel level. The virtual LCD will also display in the text the state of the fuel level. Similar to the first tab, the fuel temperature interface is designed with two LED indicators for normal and high temperature, a virtual LCD displaying the temperature condition, and a graph of temperature trends. To verify the system, we will first use water with different temperatures and different volumes. The system responds correctly concerning the water temperature (alerts when high temperature) and with respect to the water volume (alerts when the water is low quantity).

Technologies and resources.

Ultrasonic sensor

Ultrasonic sensor HC-SR04 Ultrasonic sensor measures the distance of an object by using ultrasonic sound waves. It uses a transducer to emit ultrasonic waves, and the waves will be reflected back to the sensor; transmitting all the information about an object's proximity distance

Waterproof temperature sensor

Waterproof Temperature Sensor DS18B20 is a sealed temperature sensor that allows users to precisely measure temperature in wet environments. It provides 9-bit to 12-bit Celsius temperature measurements, from -55 °C to 125 °C with accuracy from -10 °C to 85 °C with a tolerance of +/-0.5 °C. Not only that, as depicted in Fig. 4, it also communicates over the 1-Wire bus, which means it only needs one data line (and ground) with a pull-up resistor of 4.7k Ohm to communicate with a microcontroller.

NodeMCU

NodeMCU is a low-cost open-source development board that runs on the ESP8266 Wi-Fi microchip. This board (cf. Figure 5) integrates 16 General Purpose Input/Output (GPIO) pins, Pulse Width Modulator (PWM), serial 2-wire bus interface (Inter-Integrated Circuit, IIC), 1-

Wire interface, and Analog to Digital Converter (ADC). It features 4MB of flash memory, 80MHz of the system clock, around 50k of usable RAM, and an on-chip Wi-Fi Transceiver. NodeMCU operates on an external DC voltage supply of 6 to 24 volts

Arduino IDE

Arduino IDE Arduino IDE (Integrated Development Environment) is an open-source software based on the C/C++ language. The algorithm for the monitoring system is first coded using this software and then programmed to the compatible microchip. All the measured data collected from the sensors will be processed by NodeMCU and transmitted to cloud servers.

Methods and work plan

The main objective of this work will be to develop a cost-effective and efficient tool to monitor the fuel level of underground storage tanks via IoT technology. Results show that the proposed prototype can be very useful for fuel station operators. The end-user can monitor their fuel level conveniently using any devices with an internet connection.

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Student Signature: **Date:**