Development of Smart Petrol Station Prototype Using IoT Technology

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ABSTRACT

This research entitled Development of Smart Petrol Station Prototype using IoT Technology used Prototyping Methodology in developing the project. Internet of Things (IoT) technologies were utilized in order to develop the project. The main goal of this research is to build and develop faster and easier SMART Petrol station that can cope in the technological change in the world especially in the retail of oil and gas business using IoT Technology. The proposed project will deliver or serve fuel to the clients safely and efficiently and will give additional comfort to the employees in the petrol station using the prototype refueling pump for SMART Petrol Station the client can refuel the car and fill by himself without the intervention of the employees. The project composed of three major functionalities such as: Auto Braking System, Auto Light and Wi-Fi On/OFF. In order to check if all the required or expected functionalities attained by the project the research proponents conducted Functional Testing. The proponent conducted the functional testing of the prototype resulted to full performance of all the functionalities set by the proponents at the start of the development of SMART Petrol Station Prototype.

Introduction

IoT or Internet of things enables the people to work, live smarter and to have complete control on their activities in life. Aside from the benefits of having SMART devices at home IoT also become important to businesses. It gives businesses a real time look on how their respective systems are working, giving insights from different aspects like in logistics, supply chain, sales, etc. IoT allows the businesses to lessen the cost for the labor and automate processes. It helps to lessen the waste and enhance the delivery of services, makes it cheaper in terms of manufacturing and delivering good and makes the transactions more transparent. That is why IoT is considered as one of the vital technologies nowadays and continuing to pick up since businesses realized its potential in making their enterprises more competitive to others (Gillis, 2021).

Nowadays, petroleum is the global economy and the most common source of electricity generation. Petrol pump station is built all over the world to save fuel where an underground petrol tank and pumping stations are made in the front line and a convenience store next to the station. The application of IoT technology in petrol stations is vital since this kind of business deals with different customers and the monitoring of their gasoline stock is very important for their inventory which happens morning and night to ensure that there is enough reserved fuel in the tanks.

In this study the proponents designed an automatic system that can be used to petrol pump to facilitate and address some problems in monitoring the level of the stocks gasoline and to enhance and improve the refueling process.

Problem Statement

This research shows and make sense of the improvement of customary fuel retail at petrol stations with the pattern of bringing down costs through self-administration and self-installment of the fuel, as well likewise with the separation of administrations. Petrol industry ends up in the ready period of its life cycle and retail on gas stations is inclined to many changes. Other than the essential deal, the nature of the fuel and the area which was vital for the endurance of a petrol station have been extraordinary changes in the approach to directing business and the battle for endurance, so the organizations have zeroed in more on the customer. Presently, petrol stations other than oil subordinates and vehicle gear offer purchaser merchandise in the shops at the gas stations also. The quantity of gas stations has not been essentially developing throughout the past years and huge organizations take over more modest ones which vanish from the business sectors (Kawli, 2022).

In this context, the research proponents would like to impose some technological changes in the gasoline station using IoT Technology that will give more benefits to the management, consumers and workers in the petrol station.

Research Questions

This project seeks to address the accompanying queries:
1. How to develop a SMART Petrol pump station?
2. What are the needed software and hardware to develop the project?
3. What are the future recommendations about the project?

Research Objectives

The SMART Petrol Station would like to attain the following:
➢ Establishment of a remote-control system in manual lighting
➢ Utilization of a sensor in terms of automatic refueling the by customer.
➢ To monitor the amount of fuel remaining in storage through a sensor.

Significance of the Study

This project is significant to the following:

Management. This is useful for monitoring the level of the gasoline in the tanks and can lessen the number of employees in the Petrol Station.

Consumers/ Clients. The consumers can perform their own refueling and can save time especially if they are in a hurry because no need to be served by the workers.

Employees. The tasks of the employees will be lessened, and they can perform other tasks in the Petrol Station.

Students/Researchers. If there are researchers conducting similar topic wherein, they can use this documentation as reference.

Scope of the Study

The project consists of four main components:
1. Auto breaking system: In this part of the project the proponents made a parking sensor system, it measures the distance based on the data received from the ultrasonic sensor between the vehicle and the object behind it and alerts the driver to the exact safe distance in case the Arduino microcontroller senses the nearby

objects, using the ultrasonic sensor To calculate the distance between the sensor and the object, and whenever the sensor gets close to an object, the Arduino emits an audible alert or a light flash of approach and the probability of collision.

2. Auto light: It will automatically turn on when it gets dark and turn off when there is no light.
3. Wi-Fi ON OFF: In this process, the control of the lighting is via Wi-Fi, using the phone and there is installed the application named BlynkIoT to turn off and on the overhead lighting of the station.
4. Gasoline stocks: The system will detect the level of gasoline at the station through the water sensor. It can tell if the gasoline level is good or not. There is one water sensor used to determine the type of gasoline in the tank.
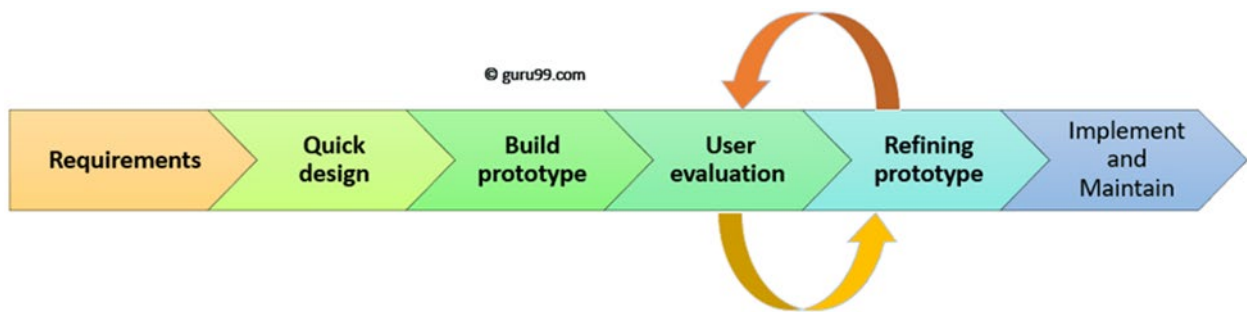
Methodology

Figure 1. Prototyping Methodology

Prototyping model is a methodology used in software development for building or creating a prototype. The prototype will be built and tested and if necessary, need to rework until the final acceptable prototype developed. In this kind of methodology, the requirements of the project are not detailed and after the testing the developers will come to know what the lacking requirements are. This methodology is iterative, or they called it trial and errors procedures between the development team and the end users (Martin, 2023).

In prototyping model, the first stage if the system requirements by knowing the functional and nonfunctional requirements needed in the project. Then the second stage is to create the design wherein the first prototype will be constructed. There will be testing of the prototype to get the feedback and the process will repeat until all the functional and nonfunctional requirements meet by the project. The last step is the implementation and the project maintenance (Lewis, 2022).

Functional Testing

The IoT applications can be test using the functional testing. In this kind of testing the application of the project and different scenarios can be   tested (Doppelio, 2023)

Figure 2. Testing Results

The research proponents have achieved several results during testing such as:

Creation of a Smart Gas station that includes an automated lighting system that works automatically at night time, a control system for lighting the station using Wi-Fi, using an application on the phone (BlynkcIot), and a car with an ultrasonic sensor so that if the car touches any object, it stops, and we Also control and check the level of oil inside the tank through an infrared sensor as well, and we also allowed the customer to fill the car via Bluetooth using an application on the phone (Arduino Bluetooth) by voice when saying open, the pump automatically pumps and when it is finished it stops.

In general, the objectives of this research were achieved because all the functionalities set to the SMART Petrol Pump achieved at the end of the testing phase.

Table 1. Functional and Non-Functional Requirements

Functional Requirements	Non-Functional Requirements
• The prototype turns on and off the lights automatically. • The customers can refuel in the gas station without the help of the gas station attendant. • The system can monitor the gas level automatically. • The car will have automatic break using the sensor.	• Accuracy – in terms of monitoring the level of the gas. • Usefulness – the project is useful for the customers and management of the petrol station. • User-Friendly – the customer and the management can use the automation easily. • Security – the system is secure from the hackers and cannot be used without the authority of the management.

Table 2. Hardware Functionality Testing

Hardware	Expected Output	Actual Output	Remarks/Comments:
Arduino Microcontroller	The SMART Petrol Station will perform all the set functionalities using the different sensors.	All the sensors and functionalities of the system	The research objective was met.
Light Sensor	There will be automatic light in the SMART Petrol Station without	The light turned on once there is movement in the prototype	The research objective was met.

	human intervention.	of SMART Petrol Station	
Ultrasonic Sensor	The car will stop automatically once there is	The system water the plants when the moisture of the soil became less.	The research objective was met.
Infrared Sensor	The pump will connect through the WIFI in refueling.	The Wi-Fi connected and the customers refueled automatically.	The research objective was met.

Discussion

1. How to develop a SMART Petrol pump station?

The proponents conducted research online in order to come up with the ideas on the needed in developing IoT Projects. The proponents followed the Prototyping methodology in software development to produce the SMART Petrol Prototype.

2. What are the needed software and hardware to develop the project?

In developing the SMART Petrol Pump Station the proponents used the following hardware and software for the development such as:

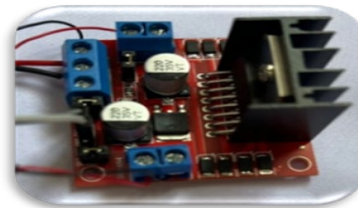**Figure 3.** Arduino Microcontroller   **Figure 4.** Motor driver.

Arduino Uno is the microcontroller of the SMART Pump station and will control all the hardware and sensors connected to the system.

Motor driver is a module for motors that allows you to control the working speed and direction of two motors simultaneously.

Figure 5. IR Sensor   **Figure 6**. Ultrasonic sensor   **Figure 7.** Sketch IDE

IR Sensor**:** The infrared sensor can measure the level

Ultrasonic sensor: measures the distance to an object using ultrasonic sound waves.

SKECTCH IDE: It is the text editor for Arduino for creating codes or program to run the hardware, console bar for the text, message is and a toolbar with common functions and menus. It is used to upload the programs to the hardware in order to make the two components communicate. The program for making program in Arduino is called Sketch. The codes are written in the IDE and saved using .ino file. The IDE is displayed in the console (Arduino, 2022).

3. What are the future recommendations about the project?

The management must inform the employees who control the management of the station about using the Internet of Things, which provides a solution in informing them by sensing the amount of fuel present and also in the event of any collision between vehicles, which makes the system more secure.

In the future, the system will certainly become more efficient, safer, and more popular by offering many improvements. Consumers can also prepare the amount of oil required through the sound sensor, and also provide an alternative to broken devices and reduce costs by integrating all devices into one system.

Conclusion

In conclusion, the proponents developed the SMART Petrol Station using Prototyping Methodology. Internet of Things (IoT) technology was used in the creation of SMART Petrol Station. The project used Arduino microprocessor as the project microcontroller along with other sensors such as: motor driver, ultrasonic and infrared. Sketch IDE was used in creating the program for the project. The SMART Petrol station features automatic lightning, automatic break, blue tooth-controlled fuel re-filler and automatic gasoline monitoring. The prototype was tested using functional testing and the output of the testing resulted to 100% performance of the SMART Petrol Station Prototype.

Limitations

This project is limited only to refueling of gasoline, monitoring the oil level in the tank, automatic lighting in the Petrol Station and automatic breaking system. Other features for automating Petrol station is not covered and can be done for future studies.

Acknowledgments

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