SERVICE PREDICTOR FOR TWO STROKE FOR IC ENGINES

PROJECT REPORT

Submitted by

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In partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

IN

MECHATRONICS

DEPARTMENT OF MECHATRONICS ENGINEERING

KONGU ENGINEERING COLLEGE

(Autonomous)

PERUNDURAI ERODE – 638 060

AUGUST 2022

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AUGUST 2022

BONAFIDE CERTIFICATE

This is to certify that the Project report entitled **SERVICE PREDICTOR FOR TWO STROKE IC ENGINES** is the bonafide record of project work done by **MURALIDHARAN. N (19MTR056), PRITHIVI RAJAN. N (19MTR062), SUGUNESH. M. K (19MTR094),** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechatronics of Anna university, Chennai during the year 2022 – 2023.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We affirm that the Project Report titled, **SERVICE PREDICTOR FOR TWO STROKE IC ENGINES**, being submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering is the original work carried out by us. It has not formed the part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The usage of two wheelers grows day by day. The rate of production and amount of users of two wheeler are competing together in this modern world. But the usage is more, the maintenance is less. If a two wheeler is left unnoticed for a period of time, it starts to fail in complete combustion of the fuel initially. Then due to incomplete combustion process, it starts to emit toxic gas consist of Carbon monoxide (CO), hydrocarbons, nitrogen oxides (NOx) and particulate matter. This leads to the complete failure of the engine after a certain period. The failure of engine is not only the major the part, the emission of toxic gas due to incomplete combustion also matters. We aim to provide an additional system in the two wheeler for indicating user about state of two wheeler engine, days left to service and loss due to the incomplete combustion in engine. Our proposed model consist of gas sensor used to determine content of CO from exhaust gas, a micro-controller (NodeMCU ESP8266) to control and monitor the inputs and outputs of the system, a LCD display which acts as the interface between user and the system to indicate service date, loss and state of two wheeler and additionally the data collected from controller is stored in IOT cloud platform for future learning using built-in Wi-Fi module of controller which also can be used to alert the user's mobile phone directly. There is no other system prevailing for service indication of incomplete combustion of two wheelers in modern world. If it can be applied to existing and newly produced vehicles as a mandatory function, it can create a global level impact on pollution due to two wheelers.

ACKNOWLEDGEMENT

First and foremost, our sincere thanks to the almighty, who has blessed us to accomplish the project successfully. Then, we thank our correspondent **Thiru. P.Sachithanandan**, and all the members of Kongu Vellalar Institute of Technology Trust for providing us with a plethora of facilities to complete our project in a successful manner.

We wish to express our sincere thanks to our beloved Principal **Dr.V.Balusamy B.E., M.E., Ph.D.,** for allowing us to have the extensive use of college facilities to do this project. We solemnly express our gratitude to our Head of the Department **Dr.B.Meenakshipriya M.E., Ph.D.**, for their guidance, support and encouragement.

We specially thank our guide **Dr.V.G.Pratheep M.Tech., Ph.D.**, for his continuous support for the successful completion of the project. We also thank our project co-ordinators **Dr.S.Shankar M.E., Ph.D. and Dr.R.Nithiya Prakash M.E., Ph.D.** for their suggestions and encouragement.

We express our sincere thanks to all teaching and non-teaching staff members of Mechatronics Engineering department. We also extend our gratitude to our beloved parents and friends.

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LIST OF UNITS AND ABBREVIATION

DC	Direct Current
Kg/m^3	Kilogram per meter cube
Km/Hr	kilometer per hour
kΩ.	Kilo ohm
LCD	Liquid-crystal display
mA	mille-amps
PPM	Parts per million
RPM	Rotations per minutes
SPST	Single pole single throw

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CHAPTER 1

INTRODUCTION

1.1 MOTIVATION OF THE PROJECT

Two-wheelers are the lifeline of urban Asia, where they account for more than half of the vehicles owned in some countries. This trend is amply evident in India, where sales in the sub-category of mopeds alone rose 23% in 2016-17. In fact, one survey estimates that today one in every three Indian households owns a two-wheeler. Two-wheeler ownership is a realistic aspiration in small towns and rural areas, as well as a strategy to deal with congested roads in larger cities, in one of the world's economies that is expanding the fastest. Due to the development of gearless scooters and mopeds, more women are now able to commute independently. According to the Society of Indian Automobile Manufacturers, the combination of these factors has resulted in phenomenal growth in two-wheeler sales overall, which increased by 27.5% over the previous five years (SIAM). According to the ICE 2016 360 survey, two-wheelers are indeed used by 37% of urban commuters to get to work and are owned by 50% of households in larger cities and developed rural areas in India..

A two wheeler must be maintained periodically for prolonged period of lifetime. If a two-wheeler is left unnoticed without any proper maintenance, initially it causes trouble in the engine system, then the combustion process starts to fail and the fuel is not processed completely, furthermore due to incomplete combustion, the process starts to generate toxic gas consist of Carbon monoxide (CO), hydrocarbons, nitrogen oxides (NOx) and particulate matter. Due to improper maintenance, the two wheeler ends up in failure and loss. This is the first and foremost reason to develop an indication for the two wheelers. Then the emission of toxic gas is the major part which needs to concentrated next. Carbon monoxide (CO) is majorly produced in the incomplete combustion of the two-wheeler engine.

CO is a colorless, odorless gas that results from the incomplete reaction of air and fuel. CO pollution is primarily caused by emissions from fossil-fuel-powered engines, such as motor vehicles and non-road engines and vehicles (such as construction equipment and boats). Higher CO levels are typically found in areas with heavy traffic congestion. CO can harm your health by reducing oxygen delivery to your organs and tissues. Lower levels of CO are especially dangerous for people with heart disease because they can cause chest pain, limit their ability to exercise, and, with repeated exposures, and contribute to other cardiovascular effects. High quantities of CO can harm even healthy persons.

People who inhale excessive levels of CO may experience eye issues, decreased capacity to work or learn, decreased physical dexterity, and trouble executing complicated tasks. CO is harmful in very high concentrations and can kill. In addition of an indication system for two wheeler to indicate the state of engine and period for maintenance, a user could properly maintain which may lead to reduction Carbon monoxide emission. Even a 1% change on emission of carbon monoxide could create an impact globally.

This system is not only for carbon monoxide emission, it covers almost the overall pollution caused due to two wheelers. Even though, there are more system to purify the exhaust gas in newly produced vehicles, an improper maintenance will always ends up in loss and failure. Our system can be applied to both existing and newly produced two wheelers. This would help in periodic maintenance of two wheeler and control of pollution. Overall, it is used for **indication of combustion** of two wheeler engine and for **preventive maintenance**.

CHAPTER 2

LITERATURE REVIEW

The main objective of the project is to design, construct and evaluate an effective indication system for combustion process and to indicate the stage of two wheeler. By maintaining two wheelers periodically can reduce the emission of toxic gas and this could to create an impact globally. Mostly people don't service the two wheeler due to their ignorance, it can be changed by adding our system to two wheelers.

2.1 LITERATURES RELATED INDICATORS IN TWO WHEELERS

Two-wheelers manufactured nowadays have an indication system for several functions such as speed, fuel quantity, distance that can be covered with fuel remaining, and even geo-location. There is no system in two-wheelers that indicates engine operation. We are introducing a new system to indicate whether the combustion process is complete or incomplete in two-wheelers.

The indication system of bikes consist of different meters for different functions such that speedometer, tachometer, fuel level indicator, trip-meter, odometer, engine oil level indicator, RPM limit blinker and side stand indicator. These indication system all together form a motorcycle's instrument cluster.

Every vehicle will produce emissions, but the issue arises when they exceed the set limits. The primary cause of this emission level violation is the fuel supply to the engine's inefficient combustion, which is brought on by poor vehicle maintenance. Semiconductor sensors at the vehicle's exhaust outlets, which can both detect the presence of pollutants and display their level in metres, were suggested as a potential solution by Chandrasekaran, S.S., et al. (2013). The vehicle will buzz to indicate that the limit has been exceeded when the pollution or emission level rises above the predetermined threshold level and will eventually come to a stop.

Moos R (2005) provided a summary of electro-ceramic-based automotive exhaust gas sensors. Millions of ceramic exhaust gas sensors are installed in automotive exhaust gas systems. Almost all gasoline-powered vehicles have at least one zirconia exhaust gas oxygen sensor (also known as a "probe") for measuring the air-to-fuel ratio. New exhaust gas after treatment concepts were needed with the introduction of novel combustion concepts like lean-burn operating gasoline direct injection. The NOx sensor, which is made using the same technology, was advanced as a result.

Keawtubtimthong, A., et al. (2010) developed an internal combustion engine control technique that controls fuel injections for various gasoline/ethanol mixtures. The injection timing for E0, E20, E85, and E100 is determined using a Yamaha Spark 135i motorcycle. In order to maintain complete combustion throughout the testing period, a signal from an oxygen sensor installed at the exhaust pipe is sent to the fuel injection system and used as a feedback signal. The results show that the injection timing for E20, E85, and E100 is 8.0%, 34.2%, and 44.8% longer than for E0.

Most of the motorcycle equipment we've seen so far in this literature is used for various purposes. However, we are unable to pinpoint the engine's combustion process using this system. We can at most reach the ideal air-to-fuel ratio with the current system. As a result, we developed a new system to assess engine combustion.

2.2 EXISTING SYSTEM:

Motorcycles currently have a wide range of indication systems for a wide range of tasks. Modern motorcycles have a catalytic converter system with an oxygen sensor. Figure 2.1 show the existing system. It reduces the volume of toxic gases (CO, NOX, HC) emitted by the engine by converting them into less harmful pollutants (CO2, Nitrogen, Oxygen, and water or steam) before they are released into the atmosphere. And the oxygen sensor integrated with the converter monitors the air-fuel mixture and provides real-time feedback to the engine management system. However, this cannot benefit users in terms of indicating the state of an engine's combustion. Furthermore, due to the high cost, these cannot be installed on pre-existing bikes. There is no existing system for indication of combustion. Preventive maintenance is only measure for incomplete combustion problem for both newly produced and pre-existing bikes.

2.2.1 DRAWBACKS

The drawbacks of the existing system are as follows

- No means to indicate the combustion process in engine.
- Converters for concentration reduction of exhaust gas are expensive.
- No measure to condition of engine process.
- Bikes without converters releases toxic gases and user never takes measure for condition of engine.
- Engine may fail anytime if left unnoticed without any maintenance.

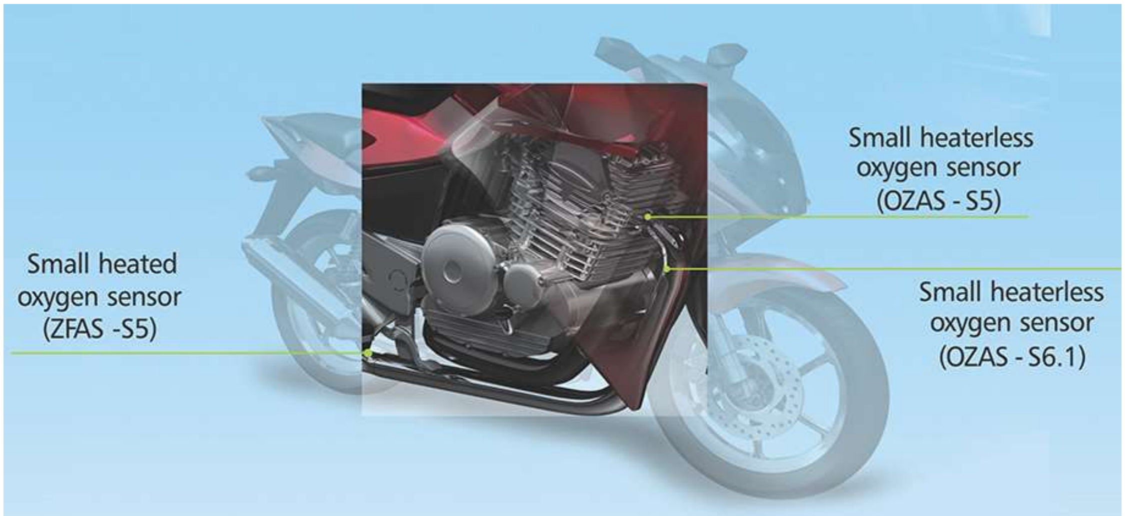

Fig 2.1 Existing modern system in motorcycle

2.3 PROPOSED SOLUTION

Our proposed solution consist of a sensor installed near exhaust system to measure the amount of carbon monoxide produced from the engine. The data from the sensor is controlled, monitored and analyzed using micro-controller. In this data science world, data is gold; the controller with built in Wi-Fi module sends the data to a cloud database whenever the system is connected to user's Wi-Fi. The data can be used for any other activities. There is LCD display which acts as user interface to convey about the condition of engine. In order to obtain high efficiency, and reliability, the system was designed based on the following considerations:

- The system should be user-friendly and should not make inconvenience for the user.
- The system should be easy to understand for any two-wheeler user.
- The system should be affordable to any kind of two-wheeler user ranging from low to high.
- The system should instruct the user to perform routine and preventive maintenance.

2.3.1 ADVANTAGES

The main advantages of using proposed system will be as follows

- It is affordable by anyone and can be installed to any two-wheelers.
- It is user-friendly system and easy to understand by any kind of user.
- Using IOT, now manufactures can monitor condition of vehicle remotely from anywhere and contact user to service.
- This system can benefit both manufacturer and customer in terms of servicing periodically.

- By this system, preventive maintenance is implemented and it is the only way to avoid all sorts of problem.

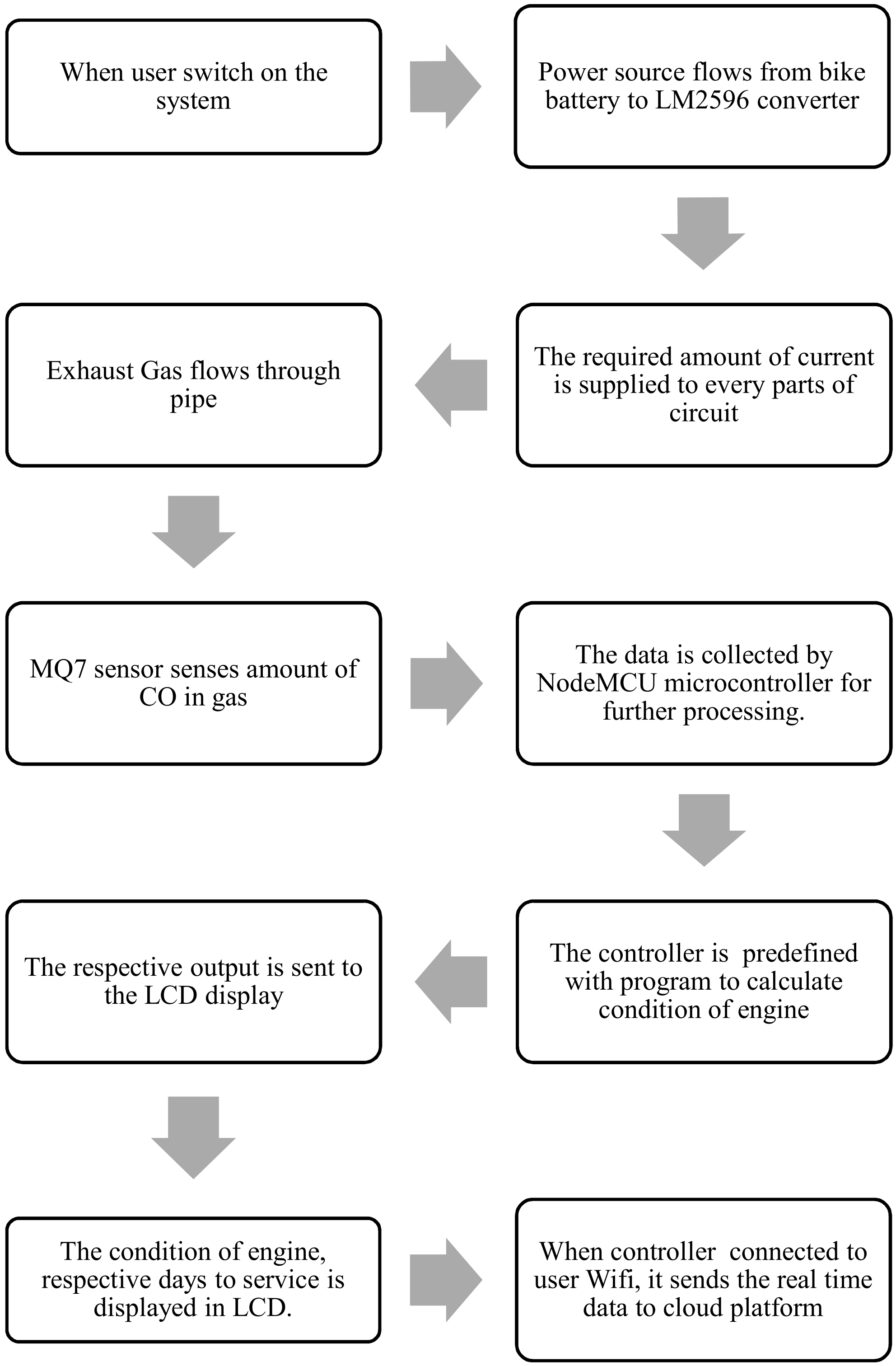

Fig 2.2 Flowchart of Service Indication System

2.4 WORKING PRINCIPLE

Figure 2.2 represents the flowchart of the entire service indication system. The system is powered only when the user switch ON the SPST switch. To power entire system, the two wheeler battery is used, so there is no need for external power source. When the system is switched ON, the current flows to the LM2596 step down DC-DC converter. It is used to regulate the amount of current from battery since the system requires only 5V DC supply, this converter reduces the 12V DC source to the required amount. From the converter, the power supply is distributed to the entire system. After that, when the bike is started, the engine initiates the combustion process, exhaust gas is produced. The main principle of the system is based on the amount of carbon monoxide produced during the combustion process. An improper two wheeler engine releases excess amount of carbon monoxide due to incomplete combustion whereas a complete combustion process does not. By the amount of carbon monoxide produced, the condition of the engine can be determined. The exhaust gas flows through the pipe to the MQ7 sensor. The pipe size and shape depends upon the two wheeler. The gas is sensed by the sensor, after certain process in the sensor, it gives respective output. The output data from the sensor is the collected by the controller NodeMCU and then the data is analyzed by pre-defined program in controller and respective output is generated. After processing, the respective output about the condition of the engine is displayed in LCD display. Finally, whenever the connected to Wi-Fi, the data about condition, amount of CO produced is stored in a cloud platform.

CHAPTER 3

FEASIBILITY STUDY

3.1 ECONOMIC FEASABILITY

The proposed solution is economically feasible, as all the components are already available and it's just an addition of a new system to existing system. Instead of installing expensive catalytic convertors, our system is far better in terms of cost and efficient way of maintaining two-wheelers periodically.

3.2 OPERATIONAL FEASIBILITY

The project consist of simple and less number of components with simple addition of programming for automation of process and simple electrical circuits, there is no big complications involved in operations. Every process is automated and it happens smoothly with a simple click of ON/OFF of a switch. There is no operational difficulty for the user. The condition of the engine is displayed in the LCD display when the system is powered on and there is no need for any human intervention for the system. It is a user-friendly and convenient system for the user. If any part fails, the replacement is simple and easy to install.

3.3 TECHNICAL FEASIBILITY

The system is technically suitable and can be applied for any kind of system. The size of pipe section, the position of the sensor and controller vary depending on the type of vehicle in which the system is to be installed. In case of existing bikes, it can be installed as an additional system and for newly produced bikes this can be connected with bike's electrical unit and the condition can be displayed in built in LED display of the bikes.

CHAPTER 4

DESIGN SPECIFICATIONS

4.1 BRIEF DESCRIPTION OF THE DESIGN:

Table 4.1 shows the components mainly used in the system. The setup consist of electrical components such as microcontroller, LCD display, I2C communication module, a SPST switch, a specific gas sensor, 12V DC to 5V DC stepdown converter, battery source of two wheeler, connecting wires and with a pneumatic part involving solid pipe. All the parts work with synergy to perform the service indication process of incomplete combustion.

Table 4.1 Components Used

S. NO	COMPONENETS	DESCRIPTION
1	Micro controller	NodeMCU ver 0.1
2	16x2 LCD display	85.0 x 29.5 x 13.5 mm, 5V
3	I2C Module	PCF8574 I2C chip, 5v
4	MQ7 gas sensor	5V, 10 to 10,000ppm
5	LM2596 Stepdown converter	Input:3-40V dc output:1.5-35V dc
6	Two Wheeler Battery	12V, 2.5h
7	SPST switch	Single pole single throw switch
8	Solid Cylindrical pipe	Mild steel

4.2 COMPONENTS DESCRIPTION

4.2.1 MICRO CONTROLLER

A microcontroller (abbreviated μC or MCU) is a single-chip computer that contains a processor core, memory, and programmable input/output peripherals. Program memory is typically in the form of NOR flashes or OTP ROM, with a small amount of RAM included on the chip. Microcontrollers, as opposed to microprocessors used in personal computers or other general-purpose applications, are designed for embedded applications. Figure 4.1 shows a NodeMCU ESP8266 version 0.1 microcontroller.

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment based on the ESP8266, a low-cost System-on-a-Chip (SoC). The Espressif Systems ESP8266 contains all critical elements of a modern computer: CPU, RAM, networking (WIFI), and even a modern operating system and SDK.

Here, it is used to control and monitor all the functions of the system. The data from the sensor is collected by the microcontroller and it responds to according to the data and initiates the further process. The main objective of NodeMCU in our system is to collect the data and store in IOT cloud platform for other applications.

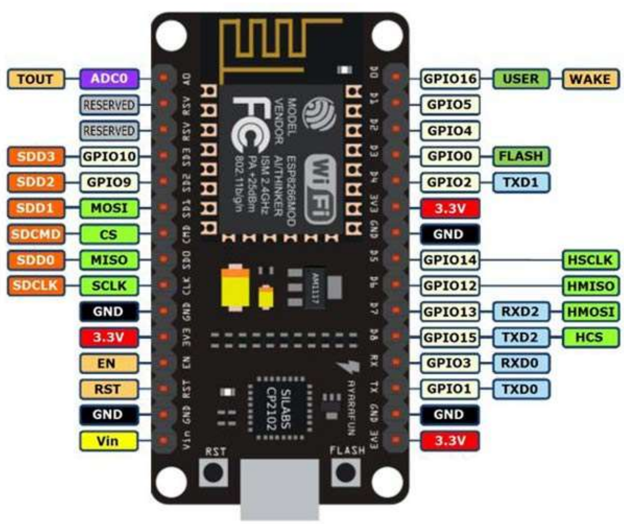

Figure 4.1 NodeMCU ESP8266 version 0.1 microcontroller

4.2.2 LCD DISPLAY 16x2

A 16x2 LCD can display 16 characters per line and has two such lines. Each character is displayed in a 5x7 pixel matrix on this LCD. The intelligent alphanumeric dot matrix display has a resolution of 16 x 2 and can display 224 different characters and symbols. This LCD contains two registers: Command and Data. LCD 162 stands for Liquid Crystal Display, which is a plane panel display technology used in computer monitors and TVs, smartphones, tablets, mobile devices, and so on. Both LCD and CRT displays appear identical, but their operation is distinct.

Instead of electron diffraction as in a glass display, a liquid crystal display has a backlight that illuminates each pixel in a rectangular network. Every pixel has a blue, red, and green sub-pixel that can be toggled ON/OFF. When all of these pixels are deactivated, it appears black; when all of the sub-pixels are activated, it appears white. Different color combinations can be achieved by varying the levels of each light. Figure 4.2 shows a 16x2 LCD display.

In our project, it is used as an interface between the user and system. It indicates the state of the two wheeler engine, days left to service the two wheeler and amount of loss due to incomplete combustion.

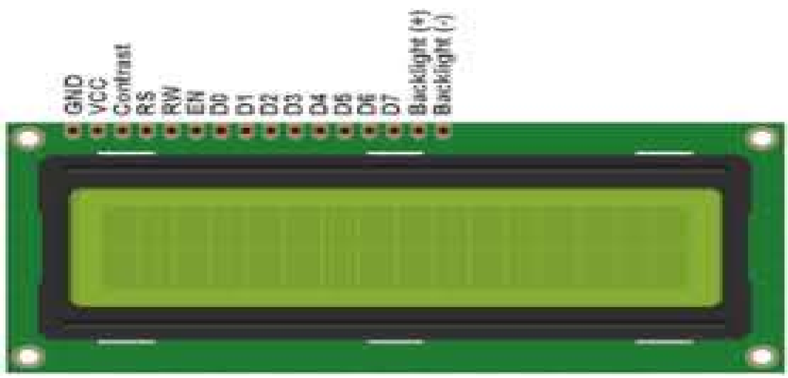

Figure 4.2 LCD DISPLAY 16x2

4.2.3 I2C MODULE

Figure 4.3 shows an I2C Module. It A built-in I2C chip, model PCF8574, transforms I2C serial data into parallel data for the LCD display. The default I2C address for these modules is currently either 0x27 or 0x3F. Check the black I2C adaptor board on the module's underside to see which version you have. If there are three sets of pads with the labels A0, A1, and A2, the default address is 0x3F. The default address is 0x27 if there are no pads. On the underside of the display, the module has a pot for adjusting the contrast. The text on the screen may need to be adjusted in order to display properly.

It uses a 5V power source to function. By using a potentiometer, the backlight and contrast can be changed. LCD display controlled serially over I2C by PCF8574. It has two IIC interfaces that can be connected using a DuPont Line or an IIC-specific cable that is compatible with a 16x2 LCD. Another excellent IIC/I2C/TWI/SPI serial interface is this one. Data display will be possible with this I2C interface module using just two wires. In our system, it plays a major role of interfacing the 16x2 LCD display with microcontroller and reduces the tedious wire connection of direct interfacing of LCD display and the controller. By means of this module, the LCD display can controlled by controller with use of four wires instead of 16 wires.

Figure 4.3 I2C module

4.2.4 MQ7 GAS SENSOR

This carbon monoxide (CO) gas sensor measures the amount of CO in the air and produces an analogue voltage reading. The sensor is able to find concentrations between 10 and 10,000 parts per million (ppm). The sensor requires less than 150 mA and operates at 5V in temperatures between -10 and 50°C. For additional information about the sensor, please see the MQ7 datasheet (185k pdf). The heating (H) pins are designed to operate in a dual voltage cycle, with 5V across the pins for 60 seconds to heat the sensor and 1.5V across the pins for 90 seconds to read the sensor. When either the A or B pins are connected to 5V, the sensor emits an analogue voltage on the other pins. The sensitivity of the detector is controlled by a resistive load placed between the output pins and ground. Although the datasheet's equations should be used to calibrate the resistive load for your specific application, a good starting point for the resistor is 10 kΩ. Fig 4.4 shows a MQ7 gas sensor.

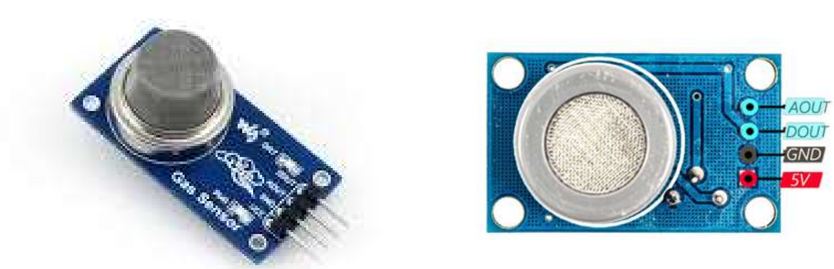

Figure 4.4 MQ7 gas sensor

4.2.5 LM2596 STEPDOWN CONVERTER

The LM2596 regulator series is a monolithic integrated circuit that provides all of the active functions for a step-down (buck) switching regulator capable of driving a 3A load with excellent line and load regulation. These devices come with fixed output voltages of 3.3V, 5V, and 12V, as well as an adjustable output version. These regulators are simple to use and require only a few external components. They include internal frequency compensation and a fixed frequency oscillator.

The LM2596 series operates at a switching frequency of 150 kHz, smaller filter components are possible than would be necessary with switching regulators operating at lower frequencies. Available in both a 5-pin TO-263 surface mount package and a standard 5-pin TO-220 package with a variety of lead bend options. The new LMR33630 product has a lower BOM cost, greater efficiency, and an 85% reduction in solution size, among many other advantages.

A straightforward step-down DC-DC converter with a broad input voltage range of up to 40V is the LM2596 SIMPLE SWITCHER regulator. The regulator maintains excellent line and load regulation while delivering up to 3A DC load current. These devices are available in 3.3V, 5V, 12V, and adjustable output voltage versions. The family requires few external components, and the pin layout was created to be simple and optimal for PCB layout. Figure 4.5 shows a LM2596 stepdown converter.

The converter converts the 12V DC power supply from the two wheelers battery source to 5V DC for the microcontroller. This plays the major role for the conversion of power source in the system. The module reduces tedious conventional circuits for conversion of supply into single small unit.

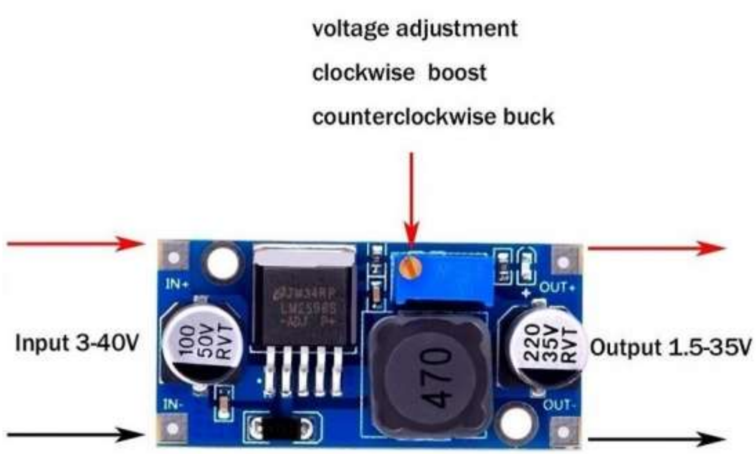

Figure 4.5 LM2596 Dc-Dc converter

4.2.6 TWO WHEELER BATTERY

A motorcycle battery is an electrical storage device used to store electrical energy generated by a reversible chemical reaction between the lead and acid in the battery. Furthermore, a mixture of sulfuric acid and distilled water known as the battery electrolyte or battery acid is added to motorcycle batteries and used as a conductor between the lead in the battery. Thus, battery acid is used to generate an electrical charge.

In our system, the whole circuit is powered by the two wheeler battery. The power supply is connected to the controller through a stepdown converter, then the controller distributes the power supply to the required the devices attached to the system. The amount of power supply required by the system is too minimum, so the system can be powered until the battery dies. Figure 4.6 shows a two wheeler battery.

Figure 4.6 Two wheeler battery

4.2.6 SPST SWITCH

The term "SPST" refers to a "Single Pole Single Throw" switch, which has a single input and a single output. A single input is directly connected to a single output in this case. This switch's primary function is to control the circuit by turning ON/OFF. When the switch in the circuit is closed, the circuit is turned ON; if the switch is not closed or open, the circuit is turned off. It is used in this case to turn on the circuit whenever the user needs to check the status of the two-wheeler and to avoid a continuous flow of power supply in the system. Figure 4.7 shows a SPST switch.

Figure 4.7 SPST switch

4.2.7 SOLID CYLINDRICAL PIPE

In our system, a small constructed pipe section is used for flow of the gas from the two wheeler exhaust to the MQ7 gas sensor. The pipe can be any kind of steel capable of withstanding temperature of two wheeler exhaust. The main usage of a pipe section in our system is avoid the direct contact of the sensor with the exhaust of two wheeler which may reduce the life of sensor due to high temperature. The pipe can be designed in the desired format suitable for the structure of two wheelers. Figure 4.8 shows a CAD model of cylindrical pipe.

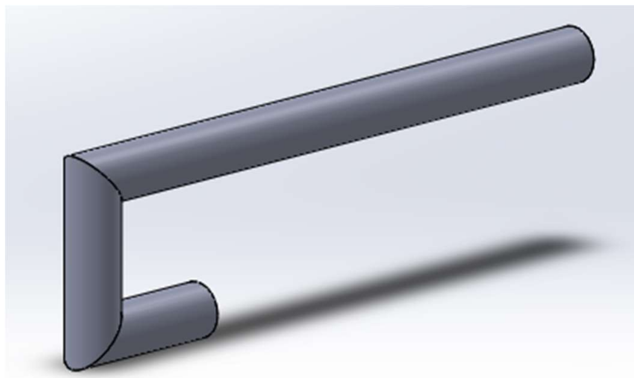

Figure 4.8 cylindrical pipe section

4.3 DESIGN CALCULATIONS

4.3.1 MASS OF THE COMPONENTS

Various masses associated with the fabrication is given below

Material used	=	Mild steel
Density	=	7870 kg/m³
Pipe section	=	0.6 kg
Electric circuit section	=	0.8 kg
Total mass	=	1.4 kg = 1.5 kg (approx.)

4.3.2 MICROCONTROLLER SPECIFICATION

Specifications of the microcontroller considered are

Microcontroller	=	ESP-8266 32-bit
NodeMCU model	=	Clone Lolin

NodeMCU Size	=	58mm x 32mm
Operating Voltage	=	3.3V
Input Voltage	=	4.5V – 10V
Wi-Fi Built-In	=	802.11 b/g/n
Flash Memory/SRAM	=	4 MB / 64 KB

4.3.3 STEPDOWN CONVERTER SPECIFICATION

Input voltage	:	3-40V
Output voltage	:	1.5-35V (Adjustable)
Output current	:	Rated current is 2A, maximum 3A
Switching Frequency	:	150 KHz
Operating temperature	:	Industrial grade (-40℃ to +85℃)

4.3.4 SENSOR SPECIFICATION

Sensor Type	:	Semiconductor
Standard Encapsulation	:	Plastic Detection
Gas	:	Carbon Monoxide
Concentration	:	10-10000ppm CO

CHAPTER 5

FABRICATION PROCESS

5.1 CAD MODELLING

The design of system is common for all kinds of two wheelers but the placement of sensor and the controller may vary. The parts can be placed comfortable to the user. This section shows an assumption of the design and position of components installed in a bike. The model of system is designed using solidworks software. Fig 5.1 shows solid works model of the system.

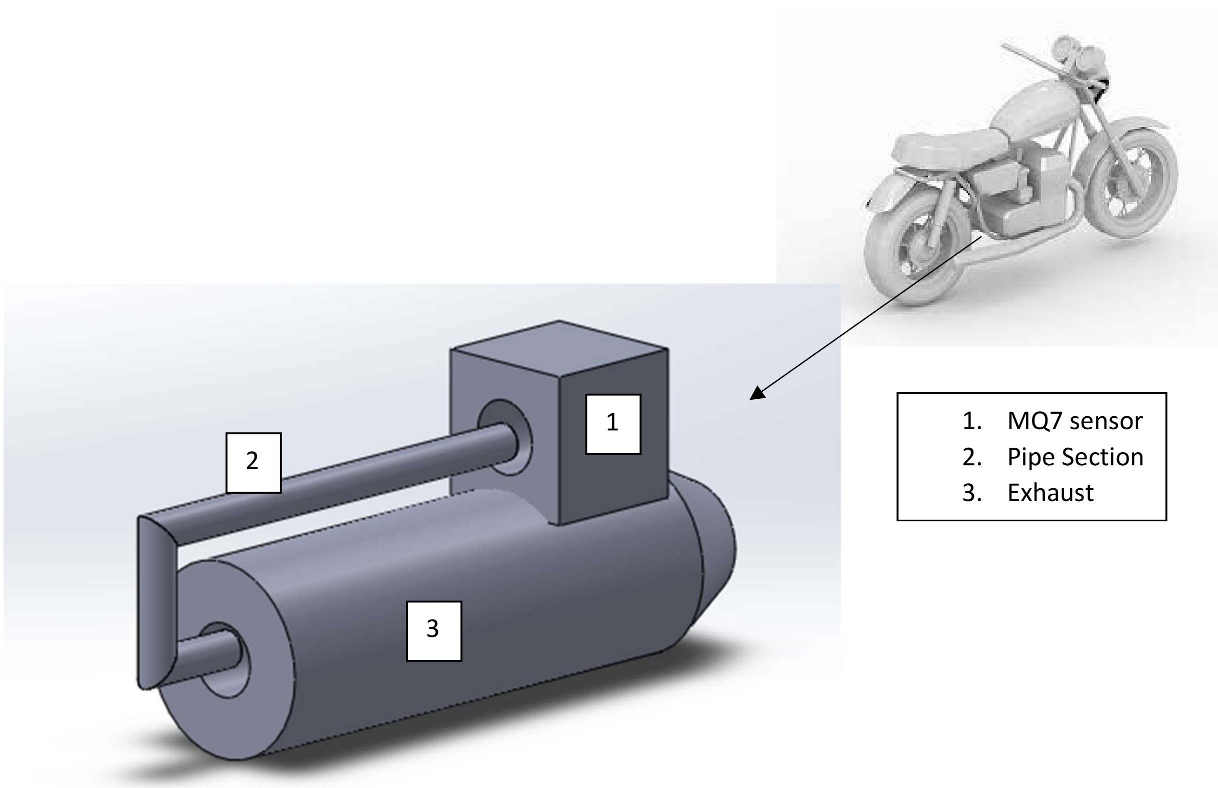

Fig 5.1 Solid Works Model

5.2 ELECTRICAL SECTION

The electrical section of the system consist of sensor, microcontroller, LCD display all connected to LM2596 stepdown DC-DC convertor which is powered by the two-wheeler battery. Components are placed distance apart from one another, so all components are connected using wires to form a single circuit. Figure 5.2 shows electrical connection of the system. The current from two wheeler battery is reduced to required DC voltage by the LM2596 stepdown DC-DC before supplied to the system. The operating range of the system is between 3V to 5V, since the battery is 12V, it is reduced using the converter and then distributed among the system.

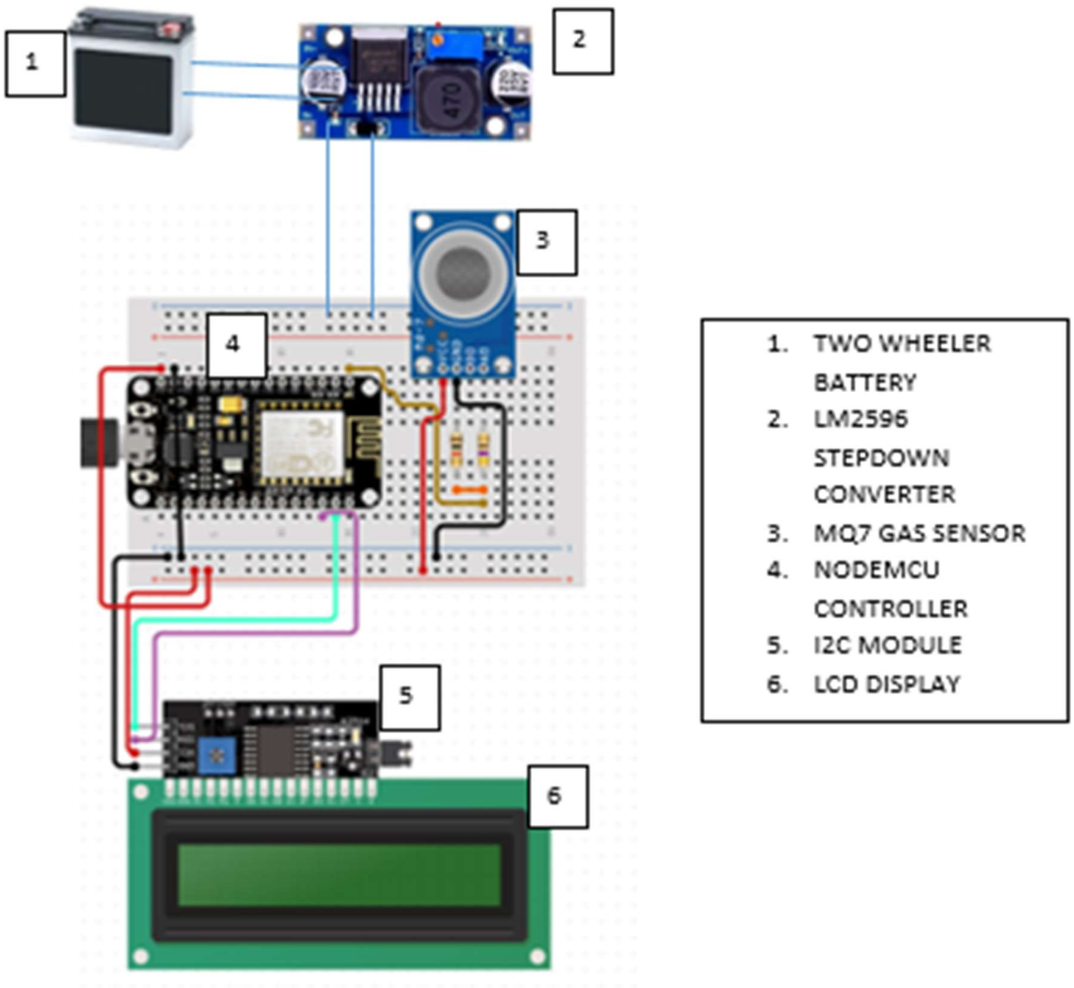

Figure 5.2 Electrical Section

CHAPTER 6

CONCLUSION AND SCOPE FOR FUTURE

6.1 CONCLUSION

A system for service indication of combustion of IC engine has been developed. The equipment used is affordable by any user and can be installed in any kind of two-wheelers. A user who wishes longer life for his/her bike can install our system. The system is reliable, user-friendly, convenient and cost-effective for all two-wheeler user. This system can be installed for both existing and newly produced bikes. A small measure could create a great impact. This could reduce carbon monoxide emission globally. The initial cost of the system is estimated at Rs. 2000/- .

6.2 FUTURE SCOPE

This system can be further improved by integrating it to the bike electrical unit directly and more than that if possible a remedy or preventive service can be done automatically for a few days when the system senses a problem in engine. The sensor part can incorporated within the exhaust cylinder to avoid pipe section. The bike can only start if the periodic maintenance done properly.

CHAPTER 7

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APPENDIX

MICROCONTROLLER PROGRAM

```
#include <ESP8266WiFi.h>;

#include <WiFiClient.h>;

#include <ThingSpeak.h>;

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

const char* ssid = "Prithivi"; //Your Network SSID

const char* password = "prithivi07"; //Your Network Password

float LDRpin = A0; //LDR Pin Connected at A0 Pin

WiFiClient client;

unsigned long myChannelNumber = 1748808; //Your Channel Number (Without Brackets)

const char * myWriteAPIKey = "FQX3OASYBHMUG459"; //Your Write API Key

void setup() {

  Serial.begin(9600);

  delay(10);

  WiFi.begin(ssid, password);

  ThingSpeak.begin(client);

  lcd.begin();

  lcd.backlight();

  lcd.clear();

}

void loop()
```

```
{
  int val = analogRead(LDRpin);
  Serial.println(val); //Print on Serial Monitor
  delay(1000);
  ThingSpeak.writeField(myChannelNumber, 1,val, myWriteAPIKey); //Update in ThingSpeak
  if(value<200)  {
    lcd.setCursor(0,0);
    lcd.print("WORKS FINE");
    lcd.setCursor(0,1);
    lcd.print("HAPPY JOURNEY");
  }
  else if(value>200 && value<800)  {
    lcd.setCursor(0,0);
    lcd.print("INPROPER COMB ST");
    lcd.setCursor(0,1);
    lcd.print("BETTER SERVICE");
  }
  else  {
    lcd.setCursor(0,0);
    lcd.print("IN BAD CONDITION");
    lcd.setCursor(0,1);
    lcd.print("SERVICE SOONER");
  } delay(100);
}
```