International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

NEURAL NETWORK BASED CONTINUOUS MONITORING AUTOMOBILE EXHAUST GAS ANALYSER

Dr. K. Kalyani Radha[1] Dr. B. Omprakash[2] ,

1.Associate Professor, *Dept. of Mech Engg, JNTUACEA, Ananthapuramu, A.P, INDIA*.

2. Associate Professor, *Dept. of Mech Engg, JNTUACEA Ananthapuramu, A.P, INDIA*

Abstract: **With the rising of automobile industry, the number of automobiles released into the market is also increasing. As the count of the automobiles increases, the amount of exhaust gases released from them into the atmosphere also increases. This causes environmental pollution and health hazards. To control the pollution caused because of automobiles, many countries including India had implemented stringent norms. But the implementation of these norms is quite cumbersome because it consumes time and workmen. This problem can be overcome by embedding the exhaust gas analyzers into the automobiles. It works with the help of neural network programming (artificial intelligence) which is most adaptive than any other program. This exhaust gas analyzer is provided with a digital display on the dash board of an automobile for easy monitoring. This improves the safety and sophistication of automobiles.**

I.INTRODUCTION

As a result of their flexibility, adaptability, and low beginning expense, mechanized street vehicles overwhelmingly overwhelm the business sectors for traveler and cargo transport all through the creating scene. In everything except the poorest creating nations, monetary development has set off a blast in the number and utilization of engine vehicles. Albeit significantly more should and ought to be possible to energize an adjusted blend of transport modes—including non-mechanized transport in little scale applications and rail in high-volume passageways—mechanized street vehicles will hold their staggering predominance of the vehicle part for years to come.

Attributable to their quickly expanding numbers and exceptionally constrained utilization of outflow control advancements, engine vehicles are developing presently wellspring of urban air contamination in the creating scene. Other unfriendly effects of engine vehicle utilization incorporate mishaps, clamor, clogging, expanded vitality utilization and nursery gas outflows. Without convenient and powerful measures to relieve the unfavorable effects of engine vehicle utilize, the living environment in the urban

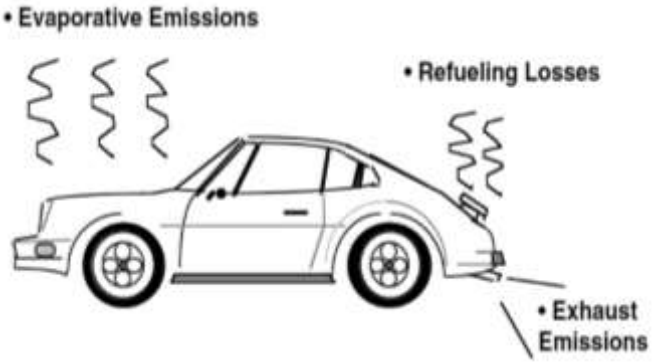

Fig.1. Emissions from an automobile

Communities of the creating scene will keep on crumbling and turn out to be progressively insufferable. Emanations from an individual auto are for the most part low, yet in various urban communities the nation over, the individual car is the single most prominent polluter, presently a huge number of vehicles out and about include. Driving a private auto is most likely a normal resident's most "contaminating" day by day action.

Fuel and diesel powers are blends of hydrocarbons, mixes which contain hydrogen and carbon iotas. In an "immaculate" motor, oxygen noticeable all around would change over all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen noticeable all around would stay unaffected.

The Clean Air Act of 1970 gave EPA expansive power to manage engine vehicle contamination, and the Agency's discharge control strategies have turn out to be logically more stringent since the mid 1970's.

Bharat stage outflow guidelines are discharge models founded by the Government of India to manage the yield of air contaminations from inner burning motor gear, including engine vehicles. The gauges and the course of events for usage are situated by the Central Pollution Control Board under the Ministry of Environment & Forests and environmental change.

II.LITERATURE SURVEY

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Fulton Baylon, John Michael G. Dy, Roveric D. Quidilla, Ralph Andrew D.L. San Pascual, Ann E. Dulay *[4]*.

The portable automobile exhaust emission analyzer is a device that can measure the gas emissions of both gasoline- and diesel fueled cars. For gasoline-fueled cars, the device detects and displays the amount of the following air pollutants, namely, hydrocarbons (HC), carbon monoxide (CO), and nitrous oxides. For the diesel fueled cars, the device displays the opacity measurement. The portable emission analyzer consists of sensors, input devices, a microcontroller, and an LCD display. The sensors used are Iridium 50 gas sensor which detects CO and HC, and the NOXO 100 which detects the nitrous oxide. The temperature sensor together with the stroboscope provides the user the temperature and rpm information needed to start the operation of the emission analyzer. A light source, an LDR and a smoke chamber made of aluminum sheet comprised the opacimeter.

Anita kulkarni, T. Ravi Teja*[1]*.

The Existed project is to monitor and control the pollutants in the vehicle by using the pollution control circuit. This pollution control circuit consists of various sensors like smoke sensor, temperature sensor and GSM, GPS kind of devices, and all of them are integrated and connected to a Controller. It is a real time work where a demo application has been made in which ARM 7 processor is used and a controller board is made where all these devices get integrated and work accordingly. The vehicle is controlled by

this circuit. When a vehicle attains certain threshold pollution level then the engine gets automatically switched off and an SMS is generated and sent to the pre-defined number stored in the memory through the GSM module. The GPS module is used to locate the vehicle position where it is halted.

III.OBJECTIVE OF THE PROJECT

Problems in the existed exhaust emission analyzer are as follows:

1. It works with preset values (not adaptive).
2. It is not an embedded device.
3. It is not a real time device.
4. It is expensive in nature.

These problems are the objective of the present work and they can be rectified by designing an embedded exhaust gas analyzer in the automobiles. It works with the help of neural network programming (artificial intelligence) which is most adaptive than any other program. In this project, semiconductor sensors have been used to detect the pollutant level of the vehicles. This project concentrates mainly on five blocks; smoke detector, microcontroller, LCD display, buttons and piezo buzzer. The smoke detector detects the pollutants continuously. The microcontroller programmed with artificial neural network compares the level of pollutants with the stipulated level allowed by the government. The values will be displayed by the LCD which is provided on the dash board for easy user interface. When the pollutant level exceeds the standardized limit, the microcontroller initializes the buzzer and warns the rider. The microcontroller is programmed such that the preset values can be modified.

IV.NEURAL NETWORKS

A **neuron** is simply a switch with data info and yield.

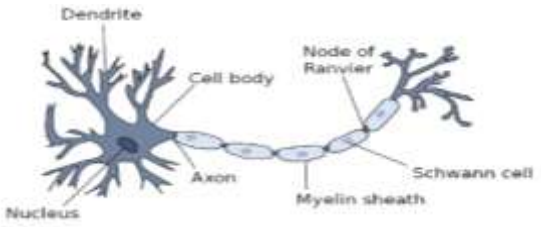

Fig.2. Biological neuron

Artificial neural networks are "naturally" motivated systems. They can gain from experimental information data. They discover use in software engineering and control designing fields.

As of late Artificial Neural Networks (ANNs) have interested researchers and specialists everywhere throughout the world. They can learn and review - the fundamental elements of the (human) cerebrum. A noteworthy purpose behind this interest is that ANNs are "naturally" enlivened. They have the clear capacity to emulate the cerebrum's movement to settle on choices and make determinations when given unpredictable and uproarious data. However there are immense contrasts between Biological Neural Networks (BNNs) of the cerebrum and ANNs.

There are principally two sorts of ANNs: Feed Forward Neural Networks (FFNNs) and Recurrent Neural Networks (RNNs). In FFNN there are no feedback loops. The stream of signs/data is just in the forward heading. The conduct of FFNN does not rely on upon past data. The system reacts just to its available information. In RNN there are feedback loops.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

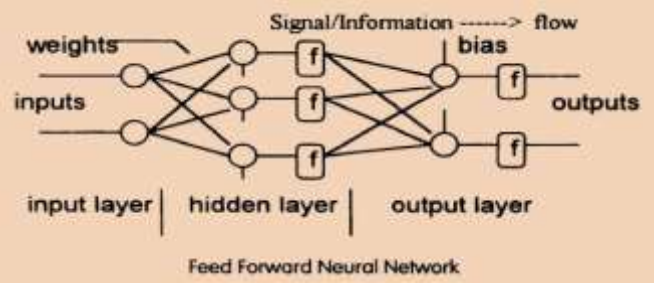

Fig.3. Feed forward neural network

V.EMBEDDED SYSTEMS

An Embedded system is any electronic gadget that fuses a PC in its execution. The client of an inserted gadget is regularly not in any case mindful that a PC is available in the gadget. The PC is utilized principally to give adaptability and to improve the framework plan. Dissimilar to a PC, project code is normally put away in ROM and not a hard plate drive. Commonly, the end client does not grow new programming for the installed gadget.

1. *Real-Time Operating Systems:*

An ongoing framework must react to outside inputs and deliver new yields in a restricted measure of time at this very moment. The reaction time should be limited. Reaction times that are too long can bring about ongoing frameworks to fall flat. An illustrative illustration of a constant framework is the auto airbag controller in your auto. At the point when the airbag's movement sensors (accelerometers) distinguish a crash, the framework needs to react by sending the airbag inside of 10ms or the framework falls flat. At high speeds, with any postponement longer than 10ms the driver will have effectively affected the guiding wheel before the airbag sends.

In a soft Real-Time System, basic errands get need. A soft ongoing framework ordinarily meets the constant reaction imperative. An ordinary soft constant sample is a media player. The player could infrequently avoid a feature edge or sound example and a client may not in any case see right now it ran effectively the dominant part of the time.

Numerous embedded systems are continuous frameworks with a few inputs and yields. Different occasions are happening freely. Writing computer programs is rearranged by isolating the errands, however this requires the CPU to switch forward and backward among the distinctive assignments. A working framework that backings multitasking has elements to time cut the CPU among numerous errands. The OS additionally gives the synchronization primitives expected to arrange exercises among diverse errands running in parallel.

2. *Microprocessor:*

The CPU is a unit that halfway brings and procedures and arrangement of broadly useful guidelines. The CPU guideline set incorporates directions for information exchange operations, ALU operations, stack operations, info and yield (I/O) operations and project control, sequencing and managing operations. The universally useful guideline set is constantly particular to a particular CPU. Any CPU must have the accompanying fundamental useful units [10].

3. *Microcontroller:*

Pretty much at this very moment is the most crucial piece of a registering framework, a microcontroller is the most vital part of a control or correspondence circuit. A microcontroller is a solitary chip VLSI unit (likewise called 'microcomputer') which, however having constrained computational abilities [11], has upgraded info yield capacities and various on-chip utilitarian units. Microcontrollers are especially suited for utilization in installed frameworks for continuous control applications with on-chip program memory and gadgets. A couple of the most recent microcontrollers likewise have high computational and superscalar preparing capacities.

VI.DESIGN AND IMPLEMENTATION

Circuit diagram of the present project involves two input components, two output components. Input components are smoke sensor and learning button. Output components are buzzer and LCD. The block diagram (Fig 4) is given below.

Fig.4. Block diagram

In the above block diagram, the smoke sensor is connected to analog input port and button is connected to digital port. Smoke sensor will read the smoke values and display on the LCD. Depend on the mode, if sensor value exceeds its limits, buzzer will produce high frequency sound to intimate the rider.

1. *Arduino Microcontroller:*

The Arduino UNO is a microcontroller board in view of the ATmega328P. It has 14 computerized input/ output pins (of

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

which 14 can be utilized right now), 6 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB association, a power jack, an ICSP header, and a reset button. It contains everything expected to bolster the microcontroller; just interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin [9].

Fig.5. Arduino UNO AT mega 328P

TABLE I

MICROCONTROLLER OVERVIEW

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	514 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by boot loader
SRAM	1 KB
EEPROM	1 KB
Clock Speed	16 MHz

2. Arduino IDE:

Arduino is an open-source hardware prototyping stage in light of adaptable, simple to-utilize equipment and programming. It's expected for specialists, architects, specialists, and anybody inspired by making intelligent articles or situations [12].

Arduino can sense environment by getting info from an assortment of sensors and can influence its surroundings by controlling lights, engines, and different actuators. The microcontroller on the board is customized utilizing the Arduino programming dialect (in view of Wiring) and the Arduino improvement environment (taking into account Processing). Arduino tasks can beremain solitary or they can speak with programming running on a PC.

Fig. 6. Arduino IDE

3. Flow chart:

Fig. 7. Flow Chart

VII. CASE STUDY

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

The prototype developed has been tested on a two-wheeler whose specifications are given below.

Specifications:

Manufacturer : Hero.

Model : Xtreme.

Type : Four stroke, air cooled petrol engine.

Piston displacement: 150 cc (149.2 cc).

Bore : 57.3 mm.

Stroke : 57.8 mm.

Fig. 9. Prototype

Fig. 8. Testing of prototype.

VIII. RESULT AND EXECUTION

The current prototype is successfully tested at different smoke levels. It is observed that it can sense. It is also observed that it can train for new levels. It executes new threshold levels at the running mode.

IX. CONCLUSION

The present work has been taken up to indicate the real time smoke levels of automobile exhaust levels on the dash board so that the driver knows the condition of the exhaust and avoid futile tests of garages and also whenever the safe levels are exceeded, an alarm to the driver is given.

The proposed neural network based pollution monitoring system provides a real time smoke levels at the exhaust as well as it provides an alert in case of exceeding a threshold limit. By ANN, the monitoring system can also learn a new threshold values as a user defined limits and modify same process. It helps to maintain the IC engine condition as well as its performance also. This system provides long life with good reliability by keeping continuous monitoring and service intimations. A case study has revealed the utility of the programme. This small components embedding into present vehicles will help to raise the performance.

TABLE II

OBSERVATIONS

S.No	Rpm	CO(ppm)
1	0	0
2	1000	100
3	2000	381
4	3000	528
5	4000	650
6	5000	452
7	6000	702
8	7000	405
9	8000	500
10	9000	700

X. FUTURE SCOPE

In this, artificial intelligence is applied only for the exhaust gases. It can also implemented to cooling system, vehicle AC, active suspension system etc. We can also install GPS and GSM in the vehicle for service intimations

.REFERENCES

[1] Anita kulkarni, T. Ravi Teja " Automated System for Air Pollution Detection and Control in Vehicles "*International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 9, September 2014.*

[2] Asif Faiz, Christopher S. Weaver, Michael P. Walsh "*Air Pollution from Motor Vehicles*".

[3] David Kriesel "*A Brief Introduction to Neural Networks*".

[4] Fulton Baylon, John Michael G. Dy, Roveric D. Quidilla, Ralph Andrew D.L. San Pascual, Ann E. Dulay "*Implementation of a Portable Automobile Exhaust Emission Analyzer" DLSU Engineering e-Journal, Vol. 1 No. 1, March 2007, pp.13-27.*

[5] James O. Hamblen's "*Introduction to Embedded Systems using Windows Embedded CE".*

[6] Jitendra R Raol, SunilkumarSMankame "*Artificial Neural Networks*".

[7] U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF MOBILE SOURCES **"***Automobile Emissions: An Overview" EPA 400-F-92-007.*

[8]Wikipedia:http://wikipedia.org/wiki/Bharat_Stage_emission_standards. Arduino.ccm

[9] Kotla, P. (2024). Bridging Legacy Systems with Modern Automation: UiPath RPA in Financial Institutions. Available at SSRN 5346246.

[10] Chawla, N., Kotla, P., Venna, S. R., & Patel, M. B. (2025, August). Comprehensive Analysis of Robotic Process Automation for Software Project Management. In 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS) (pp. 1-4). IEEE.

[11] Hameed, R., Palanivel, R., Kotla, P., Padma, L., & Jeyanthi, S. (2025, August). Blockchain-Integrated Reputation Evaluation Framework for Peer Review. In 2025 Third International Conference on Networks, Multimedia and Information Technology (NMITCON) (pp. 1-5). IEEE.

[12] Kotla, P. (2022). Accelerating Shared Services with UiPath: Lessons from Early Automation Centres of Excellence (CoEs). Available at SSRN 5379367