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Title of the project: WIRELESS ELECTRONIC NOSE FOR MONITORING EMISSION LEVELS USING ANDROID APPLICATION

Name of the College & Department: B.G.S. Institute of Technology, Adichunchanagiri University. Department of Information Science and Engineering, B.G. Nagara, Nagamangala Taluk, Mandya – 571448.

Name of the Students & Guide(s):

Name of Students	Name of Guide
Mr. DARSHAN D S Mr. NANDAN S Ms. NISARGA M Mr. SANDEEP B	Mrs. AFSHA FIRDOSE

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Introduction: Air pollution caused by the emission of hazardous gases from vehicles, such as carbon monoxide (CO), carbon dioxide (CO2), hydrocarbons, and sulfur dioxide (SO2), on public health and the environment. The increasing population and the need for automobiles have led to a rise in the number of vehicles on the road, resulting in a significant increase in the emission of air pollutants. The project aims to address the issue of pollution, which is caused mainly by human activities on the biophysical environment.

The model designed in this project can monitor the emission levels of vehicles wirelessly and record the real-time values. This constant monitoring is essential to reduce the pollution caused by hazardous gases emitted by vehicles, which can have grievous effects on the environment and living creatures. The increase in carbon emissions may cause the greenhouse effect and lead to global warming, while the increase in air pollution can cause respiratory diseases like bronchitis, asthma, emphysema, and carcinoma. The current emission monitoring system in India is outdated and involves multiple malpractices, like manipulating recorded emission levels for bribes. The Electronic Nose system, which is inexpensive, portable, wireless, and instant, can be used anywhere and anytime by anyone who intends to monitor the emission levels. It can revolutionize the present system of monitoring the emission data and can be calibrated according to industry standards. The android application developed for this model displays statistic and graphic data of

the respective vehicles and has permission to enter the vehicle registration number. The emission levels of vehicles can be monitored by any android device with the application installed in it, and the accurate values of respective vehicles can be stored in the SD card along with the peak values of individual gases. If the model is handed over to traffic police for fast and constant monitoring of emission levels of vehicles, appropriate action can be taken against defaulters.

Objectives:

1. To propose a system that is useful in detecting hazardous gases with the help of different sensors.
2. To maintain the accuracy and reliability of the sensors over time.
3. To enable real-time monitoring of emission levels by continuously collecting and analyzing data from the electronic nose.
4. To detect the percentage of pollutants released by the vehicle.
5. To develop an Android Smartphone Application.
6. To plot graph and obtain values on smart phone and save in SD card.
7. Ensure the wireless electronic nose and the Android application are portable and easy to use in various environments.

Methodology: To design the embedded system for our project, we have followed the iterative waterfall model of embedded system design. Basically, our requirements are MQ-135, MQ-4 and MQ-7 which are CO2, HC and CO gas sensors respectively placed in an array called "sensor array".

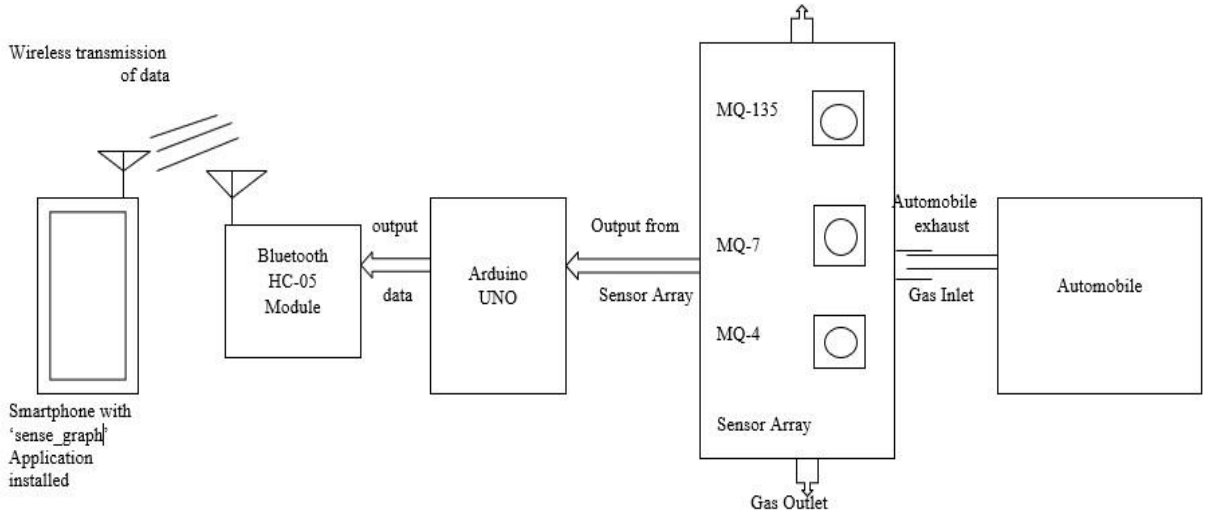

Fig.1: Design of Electronic Nose

We have used Arduino Mega 2560 as the microcontroller to process the data output from the sensor breakout board. The analog output from the MQ sensor array is amplified using LM-393 and there is also provision for sensitivity adjustment. The analog output from the respective MQ sensors with breakout is given to analog ports A0, A1 and A2 of the Arduino. A Bluetooth module HC-05 is used to wirelessly transfer serial data to the smart phone with android application installed in it. The range of the HC-05 Bluetooth is approximately 10 metres (30 feet). By placing the device near the exhaust of the automobile, one can monitor the emission readings on the Smartphone using our android application. The graph plot functionality in the proposed system is used to display the emission levels of individual gases in a graphical format. The graph plot functionality can be accessed through the android application, which has been developed as a part of the system. The graph is plotted using the emission levels of each gas on the Y-axis and time on the X-axis.

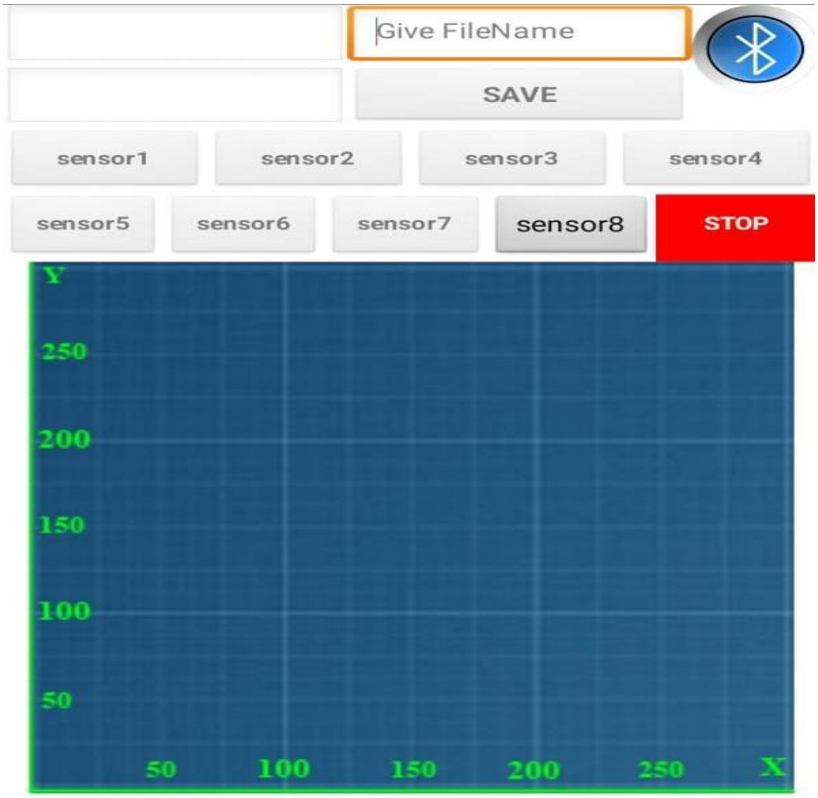

Fig.2 : Sense graph android application

Android Application is a software designed to run on an Android device or emulator. The term also refers to an **APK** file which stands for Android package. This file is a Zip archive containing application code, resources, and meta information. Android applications are organized as a collection of components. There are four types of components, and applications can be composed

of one or more of each type. A dynamic instance of a component corresponds to an application subset that can be executed independently of the others. So, in many ways, an Android application can be thought of as a collection of interacting components. Android application components come in four flavors:

- Activities : User-facing components that implement display and input capture.
- Services : Background components that operate independent of any user-visible activity.
- Broadcast Receivers : A component that listens for and responds system-wide broadcast announcements.
- Content providers : components that make application data accessible to external apps.

A provision is given in the smart phone application to enter the registration number of the vehicle whose emission is being monitored. A graph of time v/s amplitude of the emissions (CO, CO2 and HC) is plotted. CO and CO2 are represented in %vol and HC is represented in ppm according to the present standards in India. Also a provision is made to display the peak values of these gases.

Results and Conclusions:

Below Table shows the emission report of a vehicle using the device at an emission testing Centre. The report should include information on the testing process, the model used, the data collected, and the analysis of the data. This involves connecting the device to the vehicle and conducting a series of tests to measure different types of emissions, such as carbon monoxide, hydrocarbons and carbon dioxide.

Table 1: Emission report in testing centre

Vehicle Number		KA 05 JD 2918	KA 01 HK 4326	KA 05 B 9185	KA 01 MG 158
Type of Vehicle (wheeler)		2	2	3	4
Model		TVS Apache	TVS XL	Bajaj Auto	Maruthi Alto
Type of Engine		4-Stroke	2- Stroke	2- Stroke	4- Stroke
Threshold Value	CO (in %vol)	3.5	3.5	3.5	3.0
	CO_2 (in %vol)	-	-	-	-
	HC (in ppm)	4500	6000	3000	1500
Measured Value	CO (in %vol)	1.03	2.89	0.48	2.15
	CO_2 (in %vol)	4.35	5.07	5.53	2.20
	HC (in ppm)	104	1754	2857	302

The figure below shows the emissions report for the same vehicle tested with the electronic nose. As we can see, a compact and accurate report is generated by the electronic nose and displayed wirelessly using the Sense Graph Android application. This report is saved on the SD card with the vehicle number. Table 1 shows emissions results from some vehicles with electronic noses.

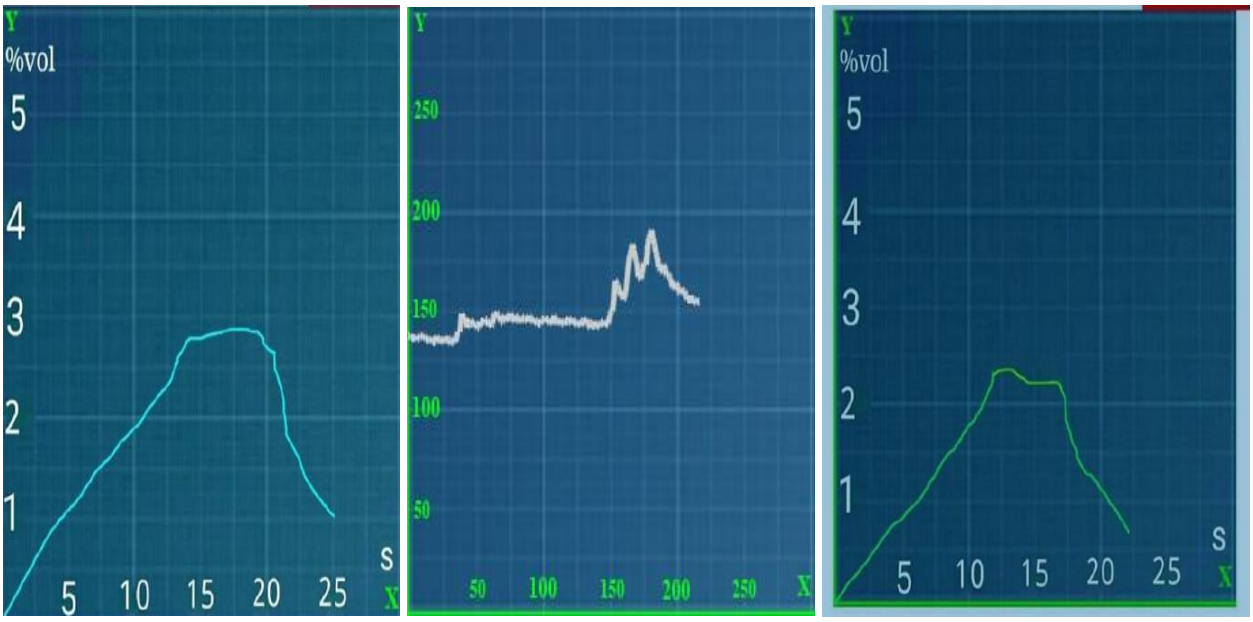

Fig. 3: CO2,HC,CO Emission Graphs

There is an increase in the level of air pollution over last couple of decades, leading to several environmental problems, which are resulted in Ozone layer depletion leading to green house effect. Air pollution also affects the human health causing the lungs and respiratory system problems. So, the developed system will be highly beneficial in curbing this problem in the society by detecting the level of pollution and indicating it to the RTO by sending a message. Also this system will be one of the greatest improvements in technology to keep the Environment free from vehicular emission and bring it to halt if the pollution level is more than the Standards mentioned by the government.

Scope for future work:

Further miniaturize the electronic nose device to improve portability and ease of use. By Research and develop more sensitive and selective gas sensors to improve the detection capabilities of the electronic nose. This could involve exploring new materials, optimizing sensor configurations, and enhancing sensor response. Also By Conducting extensive field testing and validation of the wireless electronic nose system in various real-world environments. This would help evaluate its

performance, reliability, and accuracy under different conditions and against established standards or reference methods. And also Enhance the Android application's user interface and visualization capabilities to provide a more intuitive and informative experience for users. This could involve designing interactive charts, maps, and Gather feedback from users, such as researchers, environmental agencies, or industries, to understand their requirements and refine the system accordingly. collaborations with industry stakeholders, research institutions, and environmental agencies to gather expertise, insights, and resources for further advancements in wireless electronic nose technology. This can include joint research projects, knowledge sharing, and pilot deployments in real-world settings. Continuous iteration and improvement based on user feedback would help enhance the overall usability, functionality, and value of the wireless electronic nose for emission monitoring. real-time monitoring features to display emission levels and trends effectively.