

# Connected Cars using MSP430 Real-time car datalogger

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*Abstract* : Transportation has been the extension of the human's fugitive system, attentive and recipient to the driver's commands. Present improvements in communications, controls and embedded systems have changed this model, surfacing the way to the Intelligent network of vehicles. The car is now a fearsome sensor platform, receiving information from the environment (and from other cars) and feeding it to drivers and infrastructure to assist in safe navigation, pollution control and traffic management. The next step in this evolution is just around the corner: the Internet of Autonomous Vehicles. Pioneered by the Google car, the Internet of Vehicles will be a distributed transport fabric capable to make its own decisions about driving customers to their destinations. Like other important instantiations of the Internet of Things (e.g., the smart building), the Internet of Vehicles will have communications, storage, intelligence, and learning capabilities to anticipate the customers' intentions. The concept that will help transition to the Internet of Vehicles is the Vehicular IoT, the equivalent of Internet IoT for vehicles, providing all the services required by the autonomous vehicles. In this article, we discuss the evolution from Intelligent Vehicle Grid to Autonomous, Internet-connected Vehicles, and Vehicular IoT.

*Keywords* – Real-time data loggers, Internet of Things, Vehicle Monitoring.

## I. INTRODUCTION

In recent years, the rapid development of cars across the world has increased the public availability of cars. Because cars are effective means of transport both for safety and comfort, and are internationally popular, it has emerged as a racing sport. Modern cars have various styles and functions, and ease of use has become crucial for car design. Cars can primarily be divided into the following categories: sub urban cars, race cars, and electric cars. Although cars have a myriad of functions, they fail to provide drivers with sufficient driver information while they drive. For example, contrary to professional drivers, who train with coaches, average drivers cannot ascertain whether they have achieved their desired or the optimum utilization of the car's ability. This has contributed to a loss of motivation and interest of drivers in racing.

At the same time, the concept of the Internet of Things (IoT) is putting forward a vision where the Internet is extending into the real world, connecting physical items to the virtual world and making computing truly ubiquitous. Smart objects with embedded information and communication technology are considered an essential building block of this vision. IoT idea, in general, is expected to be opening up huge opportunities for individuals as well as the entire economy. Building upon the unique availability of electrical power on e-cars, numerous initiatives have started exploring the implementation of sensing devices also on race cars moreover; we have found evidence that the data collected by such devices may in the form of social normative feedback ultimately be useful in influencing driver's performance and safety. Thus, identifying an efficient method to obtain driving-related information is the key to design new-generation cars. The use of embedded systems with sensors has, therefore, become increasingly common.

Currently, drivers' experiences are typically converted into numerical data, which are collected for speed, engine temperature, and air quality measurements. The sensor systems used for cars typically display basic data such as wheel speed; total driving distance and fuel burned or the mileage are also calculated through simple deduction. As technology advances, these systems also increase in function and decrease in volume. Embedded systems in cars can be employed in a variety of fields such as parking lot management, position trajectory management. Therefore, when designing embedded systems for cars, designers may use smartphones as replacements for conventional computers to monitor information. This reduces the volume and capacity of embedded systems as well as power consumption. Therefore, this study presented a car data recorder system of ground conditions based on IoT. This recorder was constructed by combining a smartphone with an embedded system. The event data recorder, which comprised a "on-board real-time information feedback system," displayed and recorded drivers' driving-related information while they drive. Regarding hardware planning and design, this study assumed that all drivers installed this on-board system at all times because of the popularity and convenience of this device. This substantially reduced the development cost of the event data recorder. In this study, the sensors used were categorized as "on-board sensors or inbuilt sensors" and "additional sensors". Which are divided into two modules according to their functions? The two modules are the Temperature sensor and the gas sensor.

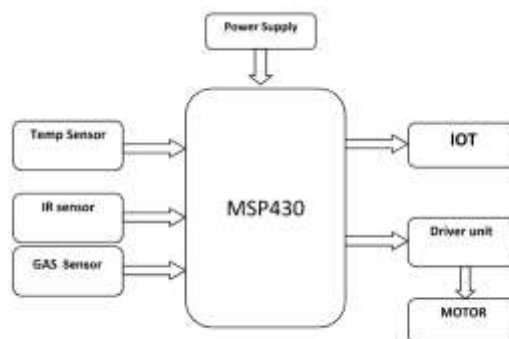
To obtain drivers' real-time information when driving, an on-board real-time information feedback system was built and divided into three modules based on function. The three modules were the Collecting the required data through the sensors both inbuilt and additional sensors, transmitting the required data over Wi-Fi, and processing the data to take autonomous decisions. Through the real-time data recorder, this study aimed to integrate various types of real-time information and provide them to drivers and their crew when they participate in a race or to fine tune their vehicle to obtain a maximum of the available resources and to help them achieve their desired results. In addition, the technology developed in this study enables drivers to view race-related information through software analysis after they completed driving. This information includes the routes taken, total distance, average speed, and engine performance. Such information is useful for drivers who are about to make their career in racing and those who are already existing to brighten it. By analysing the recorded information, drivers not only gain insight into their results but can also share driving-related information through the Internet.

## II. PROBLEM TO BE ADDRESSED

The motivation behind this project is the fact that all the existing data loggers[1] are reading the data while the event is happening and then later displaying it after the event is completed. We have proposed systems for to transmit the data over the internet in real-time and help driver with the exact details and description without the fear of overkilling the engine. If any such event is detected the safety systems warns the driver about the potential danger to be occurred and help to save the driver. The major goal of our project is to propose a way to transmit and receive the car data during the execution and helping the drivers to achieve big. In order to implement it we have proposed a solution for the complete fulfillment of the existing system adding this additional feature of real-time monitoring using the Internet of Things (IoT)[2][3].

## III. PROPOSED SYSTEM

The proposed system collects the data from various sensors like temperature sensor, gas sensor and an IR sensor and are interfaced with MSP430[] and an IoT module. As shown in the block diagram below.



The diagram above shows how all the sensors are interfaced and are linked with each other. These components are chosen wisely to match the requirements. Which is connected to the internet through **ESP-8266EX**[4] arduino[5] compatible IoT module.

### 3.1 ESP-8266EX

ESP8266EX has 17 GPIO pins which can be assigned to various functions by programming the appropriate registers. Each GPIO can be configured with internal pull-up or pull-down, or set to high impedance, and when configured as an input, the data are stored in software registers; the input can also be set to edge-trigger or level trigger CPU interrupts. In short, the IO pads are bidirectional, non-inverting and tristate, which includes input and output buffer with tristate control inputs. These pins can be multiplexed with other functions such as I2C, I2S, UART, PWM, IR Remote Control, etc. For low power operations, the GPIOs can also be set to hold their state. For instance, when the chip is powered down, all output enable signals can be set to hold low. Optional hold functionality can be built into the IO if requested. When the IO is not driven by the internal or external circuitry, the hold functionality can be used to hold the state to the last used state. The hold functionality introduces some positive feedback into the pad. Hence, the external driver that drives the pad must be stronger than the positive feedback. The required drive strength is small — in the range of 5µA to pull apart the latch.



### 3.1.2 FUNCTIONS

- Apply NMI (Non Maskable Interrupt) to interrupt, more precise.
- Can be extended to 8 channels of PWM signal.
- Resolution ratio higher than 14 bit, the minimum resolution can reach 45 ns.
- Configuration can be completed by call interface functions, without set the register.
- Could differentiate the light spectrum easily.

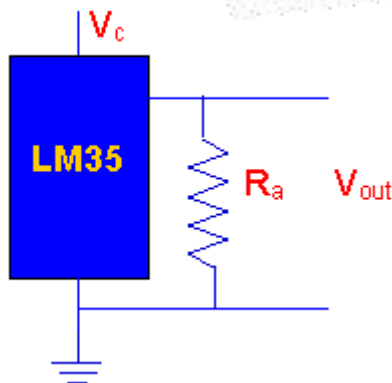
### 3.1.3 Implementation

An optimized software algorithm provided by ESP8266 system enable the transmission of multi-channel PWM signals via GPIO (General Purpose Input Output) interface by way of mounting NMI on FRC1 timer. The clock of PWM is provided by high-speed system clock, the frequency speed of which can reach as high as 80MHz. Through pre-frequency divider, the clock source can be divided into 16 separated frequencies, the input clock frequency of which is 5MHz. PWM can issue coarse tuning timing via FRC1, which combined with fine tuning issued by the high-speed system clock, can improve the resolution to as much as 45 ns.

### 3.2 LM35 - Precision Centigrade Temperature Sensor

The LM35[6] [7] series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of  $\pm 1/4^{\circ}\text{C}$  at room temperature and  $\pm 3/4^{\circ}\text{C}$ , over a full  $-55$  to  $+150^{\circ}\text{C}$  temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only  $60\ \mu\text{A}$  from its supply, it has very low self-heating, less than  $0.1^{\circ}\text{C}$  in still air. The LM35 is rated to operate over a  $-55^{\circ}$  to  $+150^{\circ}\text{C}$  temperature range, while the LM35C is rated for a  $-40^{\circ}$  to  $+110^{\circ}\text{C}$  range ( $-10^{\circ}$  with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package.

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C)



### 3.3: MQ2 Gas Sensor

MQ2[8] is the ideal sensor to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense Iso-butane, propane, LNG and cigarette smoke.



#### Applications

- Gas leak detection system
- Fire/Safety detection system
- Gas leak alarm
- Gas detector

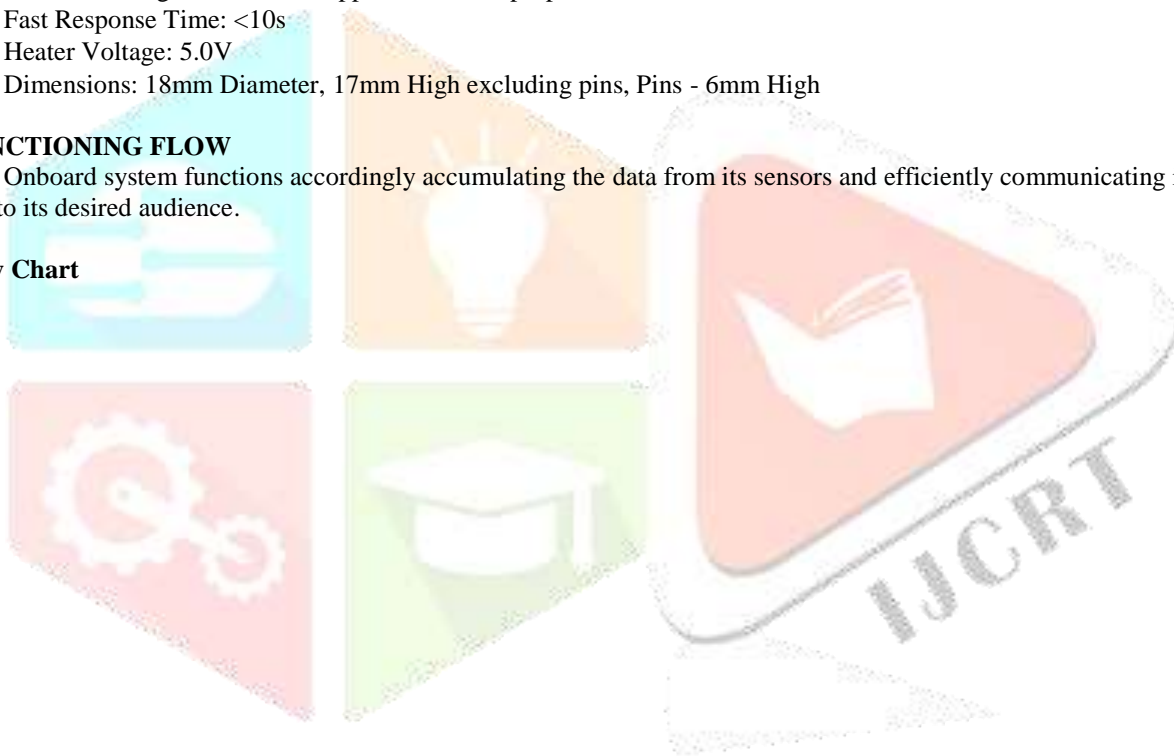
#### Features

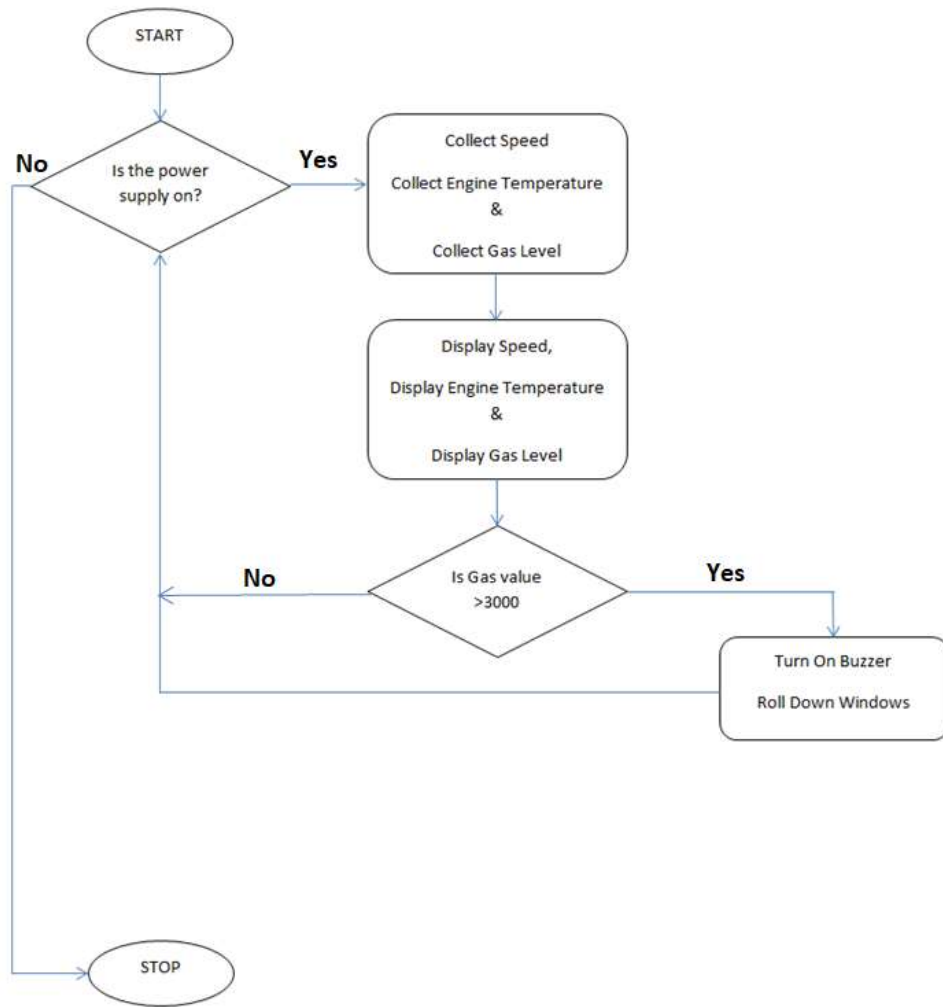
- High Sensitivity
- Detection Range: 100 - 10,000 ppm iso-butane propane
- Fast Response Time: <10s
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High

#### IV. FUNCTIONING FLOW

Onboard system functions accordingly accumulating the data from its sensors and efficiently communicating it over the internet to its desired audience.

##### 4.1 Flow Chart





#### 4.2 Algorithm

**Step1:** Checks the system if the power supply is on.

**Step1.1:** If it's on the system continues to Step 2.

**Step1.2:** If not continue to Step5.

**Step2:** Collect the speed, engine temperature and gas level.

**Step3:** Display the speed, engine temperature and gas level.

**Step4:** Check if the gas level is greater than 3000.

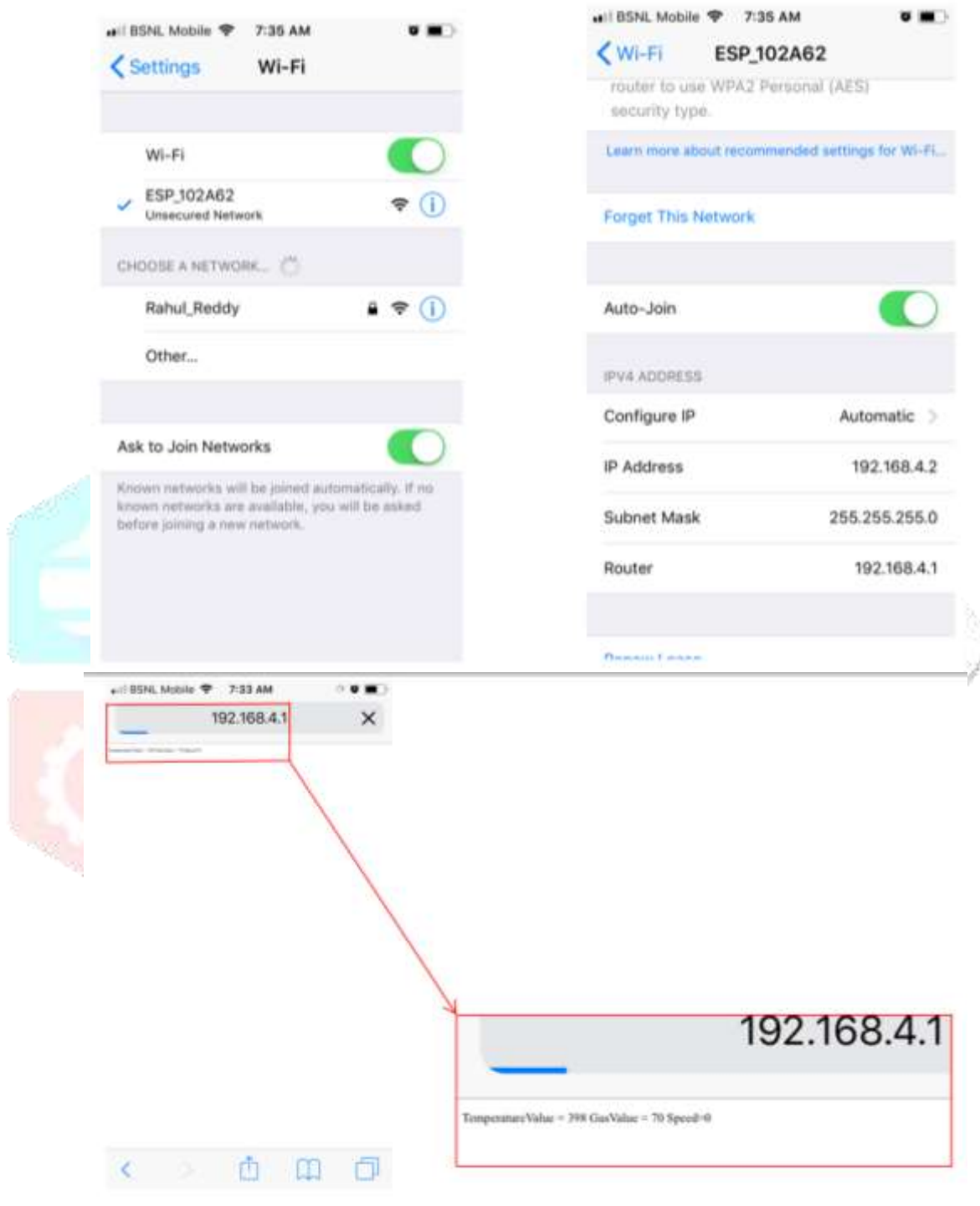
**Step4.1:** If yes, turn on the buzzer and roll down the windows

**Step4.2:** If no, go to Step 1.

**Step5:** System remains turned off.

## V. RESULTS AND DISCUSSION

### 5.1 Results



### 5.2 Conclusion

This project developed a real-time information feedback system for cars, providing drivers with information while they are driving. Smartphones/Laptop computers were used for information display. To use the system introduced in this study, drivers are only required to install the aforementioned modules and connect to the Wi-Fi network through their smartphones or Laptop Computers. This system is expected to provide drivers with complete driving-related information. Just as how a coach instructs professional drivers, this system provides drivers with information about the effectiveness of their lap when driving, helping drivers to achieve their goals. Also, the proposed system allows drivers to share driving information online. This information is useful for other

drivers to train over a particular course. Overall, this study attempted to develop a car record system of ground conditions based on IoT that can provide drivers with accurate real-time information, thus enabling drivers to enjoy a well-equipped driving environment.

### 5.3 Future Scope

- This system can be further enhanced with the integration of a GPS module and Video camera for detailed inspection.
- Further this can also be equipped with a GSM module for it to be operated from any part of the world.

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