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# DESIGN OF VEHICLE MONITORING SYSTEM USING ARM MICROCONTROLLER

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***Abstract-Present Automobiles are developed by more sensors for efficient operation. Generally a vehicle was built with an analog driver-vehicle interface for indicating various vehicle status like speed, light of spark, Engine temperature etc., It uses an ARM based data acquisition system that uses ADC to bring all control data from analog to digital format and visualize through LCD. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs. In this paper we present the design of vehicle monitoring system using ARM Processor***

## 1.INTRODUCTION

Embedded systems are also known as real time systems since they respond to an input or event and produce the result within a guaranteed time period. This time period can be few microseconds to days or months. The computer system must meet various timing and other constraints that are imposed on it by the real-time behaviour of the external world to which it is interfaced. Hence comes the name real time. Another Name for many of these systems is reactive systems, because their primary purpose is to respond to or react to signals from their environment. A real time computer system may be a component of a larger system in which it is embedded; reasonably such a computer component is called an embedded system.

Vehicles today are much more intelligent than they were years back. The traditional vehicle timed the ignition of the spark using mechanical distributors. This method of co-ordinating the timing of the spark delivery when the fuel and air mixture were compressed in the engine cylinders wasn't ideal. Due to the fixed nature of the mechanical setup, it was very difficult to get optimum fuel combustion resulting in the most efficient power output. Fortunately modern engines are controlled electronically using real time software in a device known as the engine control unit (ECU). This allows the car to adapt to environmental conditions such as air density in order to increase the combustion efficiently subsequently improving fuel economy. The ECU controls many other sub systems of the engine such as, for example, the anti-locking braking system (ABS). All decisions made by the ECU are based on the state of sensors that are placed at various places throughout the vehicle primarily around the engine bay.

As years went on, the ECU became more capable of supplying diagnostic and sensor data to help mechanics identify the source of problems that arise in the engine management system. Eventually a standard was created that all manufacturers were encouraged to follow. The standard became commonly known as On-board Diagnostics (OBD). OBD-II is an enhancement of the OBD standard that was introduced later and made mandatory. Generally data is not obtained from the ECU until a problem arises in the engine management system. The purpose of this project was an attempt to use this data to provide useful features and functionality to the car enthusiast that tunes his engine or a mechanic for easily monitoring engine behaviour.

## 2. VEHICLE CONTROL SYSTEM

With rapidly changing in embedded system and much of the technologyfinding way to monitor and tracking the vehicles. They are undergoing dramatic changes in their capabilities and how they interact with the drivers. Although some vehicles have provisions for deciding to either generate warnings for the human driver or controlling the vehicle autonomously, they usually must make these decisions in real time with only incomplete information. So, it is important that human drivers still have some control over the vehicle. Advanced in-vehicle information systems provide vehicles with different types and levels of intelligence to assist the driver. The introduction into the vehicle design has allowed an almost symbiotic relationship between the driver and vehicle by providing a sophisticated & intelligent driver-vehicle interface through an intelligent information network.

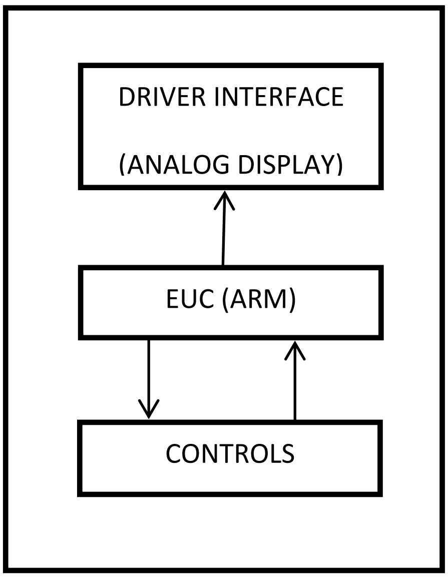



Fig 2.1 Proposed model

A vehicle was generally built with an analog driver- vehicle interface for indicating various parameters of vehicle status like temperature, pressure and speed etc. To improve the driver-vehicle interface, an interactive digital system is designed.Main scope of the project is to monitor the vehicle system parameter such as temperature and spark of light using the ARM processor.

## 3. SYSTEM MODEL

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption.The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles. It is the first RISC microprocessor designed for low-budget market. One of the typical products is ARM 7 family that is the most streamlined RISC. Therefore, it's relatively cheap, and the core of ARM7TDMI-S is a low budget- oriented, emphasizing the control of the system. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions.

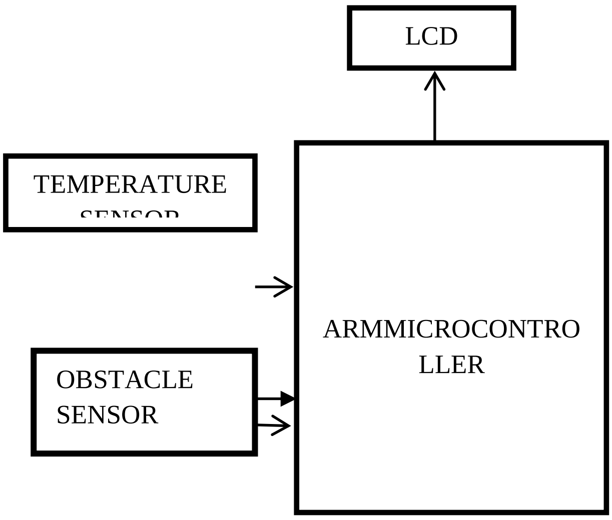



Fig 3.1 System model

It can be used in a variety of areas, such as embedded control, multimedia, DSP and mobile applications. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate. It contains a 16/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package. With their compact 64 pin package, low power consumption, various 32-bit timers,4-channel 10-bit ADC, 2 advanced CAN channels, PWM channels, Real Time Clock and Watchdog and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for automotive and industrial control applications as well as medical systems and fault-tolerant maintenance buses. It does not contain MMU (memory management unit). But because of its low price, reliability and other factors, it is widely used in various industrial controllers.

## 4. HARDWARE SPECIFICATION

### A. *ARM 7 TDMI*

The ARM7TDMI is a member of the Advanced RISC Machines (ARM) family of general purpose 32-bit microprocessors, which offer high performance for very low power consumption and price.The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective chip. Pipelining is employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory.

The major advantage of a 32-bit (ARM) architecture over a 16-bit architecture is its ability to manipulate 32-bit integers with single instructions, and to address a large address space efficiently. When processing 32-bit data, a 16-bit architecture will take at least two instructions to perform the same task as a single ARM instruction.THUMB breaks this constraint by implementing a 16-bit instruction length on a 32-bit architecture, making the processing of 32-bit data efficient with a compact instruction coding. This provides far better performance than a 16-bit architecture, with better code density than a 32-bit architecture.

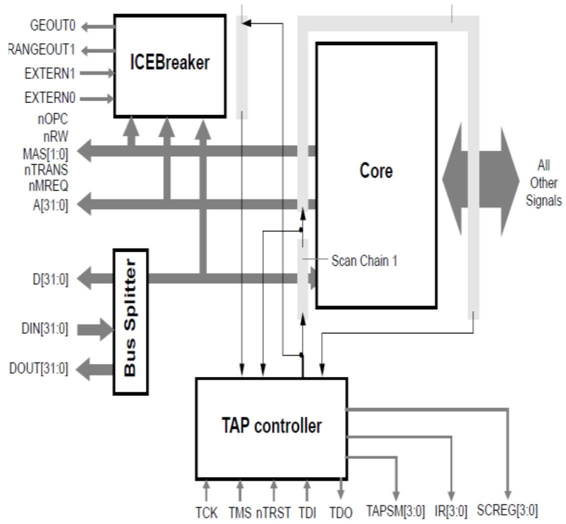



Fig 4.1 ARM 7 TDMI Block Diagram

### B.*LM35*

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air.

The LM35is rated to operate over a −55°C to +150°C temperature range, while the LM35C is rated for a −40°C to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic to transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is alsoavailable in an 8-lead surface-mount small- outline package and a plastic TO-220 package.

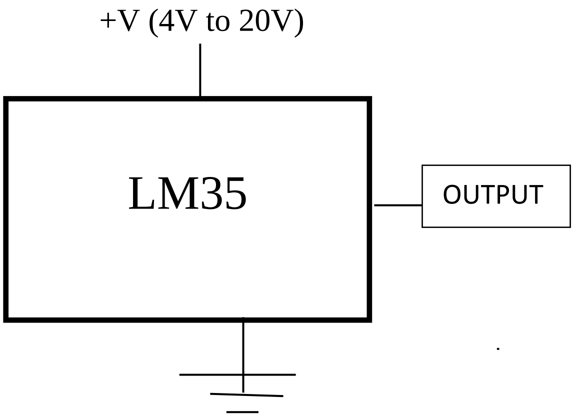
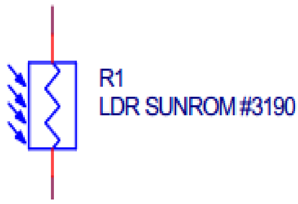



Fig 4.2 Temperature sensor

The LM35is applied easily in the same way as other integrated-circuit temperature sensors. Glue or cement the device to a surface and the temperature should be within about 0.01°C of the surface temperature.This presumes that the ambient air temperature is almost the same as the surface temperature. If the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature, which is especially true for the TO-92 plastic package where the copper leads are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature.

C.*LDR ( Light Dependent Resister)*

An LDR is a component that has a resistance that changes with the light intensity that falls upon it. They have a resistance that falls with an increase in the light intensity falling upon the device. Two cadmium sulphide(cds) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection, automatic lighting control, batch counting and burglar alarm systems.




OUTPUT

Fig 4.3 LDR

0mv + 10.0mv/c

The sensitivity of a photodetector is the relationship between the light falling on the device and the resulting output signal. In the case of a photocell, one is dealing with the relationship between the incident light and the corresponding resistance of the cell.The most obvious application for an LDR is to automatically turn on a light at certain light level. LDRs can be used to control the shutter speed on a camera. The LDR would be used the measure the light intensity and the set the camera shutter speed to the appropriate level.

D.*LCD ( liquid crystal display)*

Dashboard is an information cluster located at the edge ofthe driver's primary field of view. It provides the current state of some important parameters like speed, engine rpm, distancetravelled, engine coolant temperature etc. to the driver. Although most of the cars use mechanical dashboards, electronic implementation of the same will have enough flexibility to cater to varying customers' choice without too much additional cost. Liquid Crystal Displays (LCDs) are agood choice for the electronic dashboards as they operate at low voltages, consume very little power and are also economical.

A simple 8-bit 16x2 LCD is used to interface with PIC 18F458. This means there are 16 characters per line by 2 lines. There are three control signals Register select,Enable and Read/Write. There are two important registers in LCD. Command Code register and Data register. If an 8-bitdata bus is used, the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus). When RS is low (0), the data is to be treated as a command or a specialinstructions (such as clear screen, position cursor, etc). When RS is high (1), the data being sent is text data which should be displayed on the screen. R/W input allows the user to write information to LCD or read information from it.

When RW line is low (0), the information on the data bus is being written to the LCD. When R/W is high (1), the program is registers effectively querying (or reading) the LCD. The enable Pin is used by the LCD to latch information at its data pins. When data is supplied to data pins, a high to low pulse must be applied to this pin in order for the LCD to latch the data present in the data pins. We have to prepare an LCD properly before the character we need, has to be displayed. For this a number of commands have to be provided to the LCD before inputting the required data. LCD doesn't know about thecontent (data or commands) supplied to its data bus. It is the user who has to specify whether the content at its data pins are data or commands.

## 5. SIMULATION RESULTS

A. *Working model*

The system model consists of LPC2138 which is of ARM7TDMI family. The temperature and light due to spark is measured using the temperature sensor LM35 and LDR. The temperature sensor is used to measure temperature inside the vehicle and LDR (Light dependent resistor). The LM016L is the LCD (Liquid Crystal Display) is used to display the current state of temperature and LDR value.

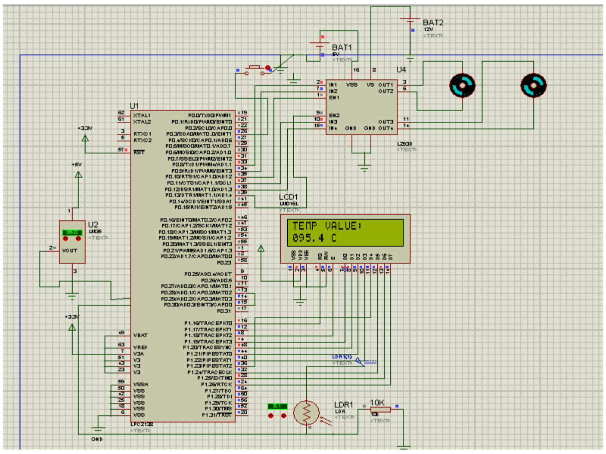



Fig 5.1 Monitoring temperature value of vehicle

The LM35 generate a higher output voltage than the thermocouple and may not require that the output voltage be amplified. The temperature value of the vehicle is calculated by using the LM35 sensor in the system. As the temperature changes in the vehicle the value of the temperature sensor will also change as per the changes in vehicle temperature.

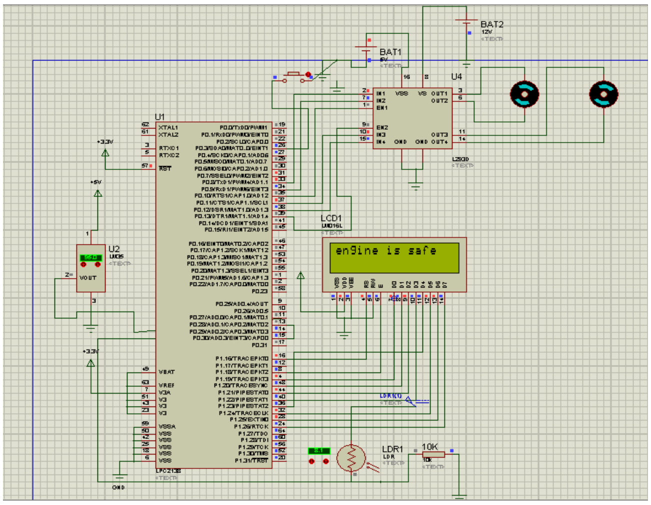



Fig 5.2 Monitoring the spark of light in engine

(ENGINE IS SAFE)

An LDR is made of a high-resistance semiconductor. Iflight falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.The LDR is used to monitor the spark produced by the engine. If the LDR value is less than 10 then it will produce the output as "ENGINE IS SAFE".

When the LDR value exist 10 then it will produce output as "ENGINE NOT SAFE". It means the spark is produced in the engine of the vehicle.

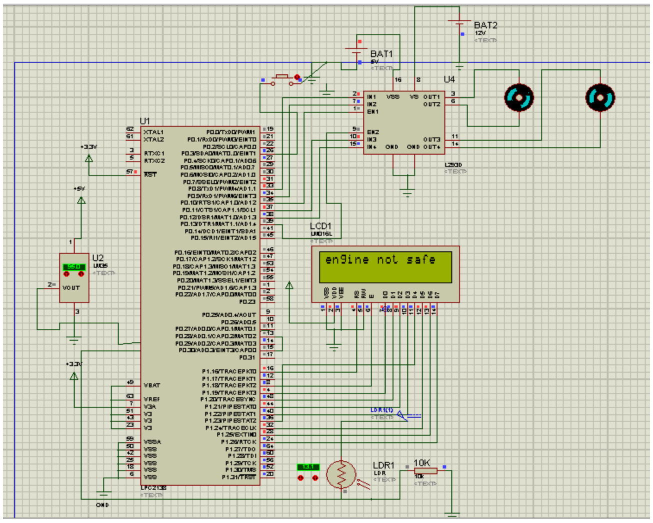



Fig 5.3 Monitoring the spark of light in engine (ENGINE IS SAFE)

## 6. CONCLUSION

An embedded system with a combination of ARM processor and SPI bus systems. Digital control of the vehicle is an important criterion of modern technology. With the rapid development of embedded technology, high-performance embedded processor is penetrated into the auto industry, which is low cost, high reliability and other features to meet the needs of the modern automobile industry.

The monitoring parameters are temperature and light due to spark or fire. For monitoring the above parameters, LM35 sensor and LDR sensors are used. For implementing this, the programming of ADC and LCD interfacing with microcontroller is done using Embedded C. Then the Simulation results are obtained using Proteus professional schematic software. The temperature of the engine and presence of light are transferred from engine to dashboard via SPI Protocol and these readings are displayed through LCD on the dashboard.

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