Intelligent Car Cooling System using Android Application

Anita Shinde
Marathwada Mitra Mandal's College of Engineering

Shashank Chaudhary
Marathwada Mitra Mandal's College of Engineering

Yash Deshpande
Marathwada Mitra Mandal's College of Engineering

Vedang Bhide
Marathwada Mitra Mandal'sCollege of Engineering

Darshan Shah
Marathwada Mitra Mandal's College of Engineering

ABSTRACT
Until now, car owners especially in Asian countries are facing the problems where the temperatures are hot inside the car when they park the car under the scorching sun. Moreover it consumes more fuel to bring down the temperature inside the car as desired. A car with an intelligent car cooling system installed with it would solve this issue completely.

The basic idea is to install a small unit inside the car which would consume minimum battery power and would keep the car cool. This would be controlled by an android application which would extend its benefits. GSM module would be used for communication between the system and the user through the android application. The extended benefits would shortly be: anti-theft, location tracking, security and a better GUI.

General Terms
Wireless communication, ATMEGA-16, eclipse sdk, jvm

Keywords
Micro-processor, GSM, transmitter, receiver, propeller

1. INTRODUCTION
The basic idea of the project is to cool the temperature inside a hot car and to bring it to the surrounding temperature. The system will work on the basis of GSM module. It will send and receive messages through the GSM module which would be controlled through an android application. Using the GSM module will ensure secure communication at all locations from the user to the system and vice versa. To put an end to the discomfort the driver has to confront with soon after getting into the car due to the greenhouse effect formation. To overcome the cooling issues faced by car while their car is parked under scorching sun by installing an intelligent car cooling system. Controlling the system remotely through an android application is also the objective. The project also aims to minimize the fuel consumption than the ordinary cooling circuitry.

The project is divided into two main fragments:

1.1 Hardware

(a)GSM module
The scope of the project would be from using the GSM module, interfacing it with the system and communicating it with the android application. The basic operating environment for the smooth functioning of the system would be to lie in range of communication spectrum so that there is no signal loss and messages cannot be sent and received by the GSM module. GSM module acts an intermediate layer between the micro-controller and any smart device.

Figure 1: GSM module

(b)Atmega16
AVR is an 8-bit microcontroller, which is actually a family of controllers. The controllers have high performance, low power consumption that have the ability to combine 16KB of programmable flash memory, 1KB SRSM, 512B EEPROM, and eight-channel ten-bit analog to digital converter and an interface for on-chip debugging. The device supports throughput of 16MIPS at 16MHz and operates in range between 4.5-5.5volts. By executing instructions in a single clock cycle, the device achieves throughputs approaching high performance with balancing power consumption and processing speed.

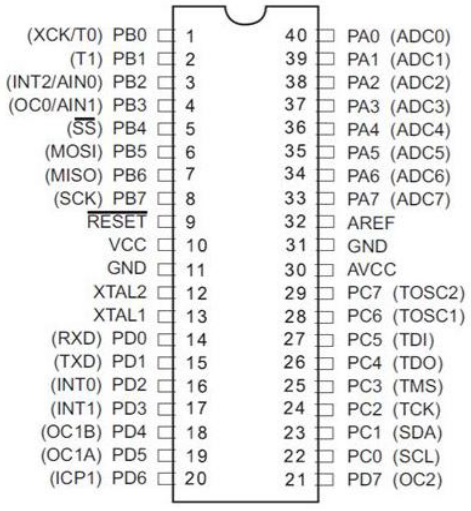

Figure 2: Atmega16 microcontroller

The backbone of Atmega16 lies in its powerful features which are as follows:

- Up to 16 MIPS throughput at 16 MHz
- In-system programming through an on-chip boot program
- Program locking for security of software
- Operating voltages:

  2.7V - 5.5V for ATmega16L

  4.5V - 5.5V for ATmega16
- Power consumption @ 1 MHz, 3V, and 25C for ATmega16L

  Active: 0.0011 A

  Idle Mode: 0.0035 A

  Power-down Mode: ¡ 1 A

(c) Temperature sensor

A temperature sensor is a device that gathers data regarding the temperature from various sources and converts it to a form which can be understood either by an observer or other device.These sensors come in many different forms and are used for a wide variety of purposes. The temperature sensor used in the project is LM35.

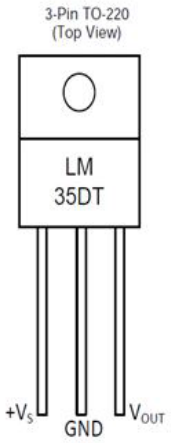

Figure 3: Temperature Sensor LM35

External calibration of the LM35 device is not imperative, that means, any kind of trimming to provide typical accuracy at room temperature and C over a full 55°C to 150°C temperature range is not indispensable. Lower cost is guaranteed by trimming and calibration at the wafer level. The interface to control circuitry is simplified by the low-output impedance, linear output along with the calibration of LM35 device. The device is used with a variation in power supply, that is, increment and decrement the power supply or a linear power supply is also viable. As the LM35 device draws only 60A from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a 55°C to 150°C temperature range, while the LM35C device is rated for a 40°C to 110C range (10° with improved accuracy). The LM35D device is mounted directly on the surface of the circuit board. The 8-lead Thin Small Outline Package, or TSOP is a type of surface mount IC package that are very low-profile and have tight lead spacing. In addition to this, heat dissipation by the Transistor Outline 220 packages is more. The accuracy specifications of the LM35 are given with respect to a simple linear transfer function:

V_{OUT} = 10 mV/F T

Where,

V_{OUT} is the output voltage of LM35

T is the temperature in degrees Celsius.

(d)Motor Driver (L293D)

A motor driver is a little current amplifier, which has the function of motor drivers to take a low current control signal and then turn it into a high current signal that can drive a motor.

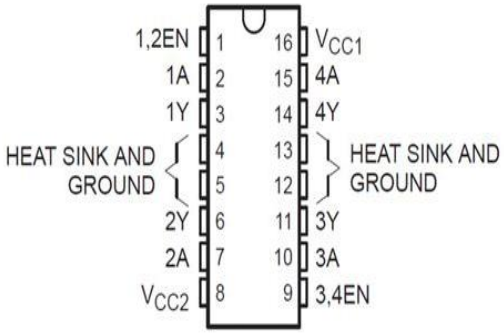

Figure 4: L293D IC

The motor driver that the project requires is L293D that is quadruple half-current half-H driver. The L293D is designed to provide bi-directional drive currents of up to 60-mA at voltages from 4.5V to 36V. The drivers are enabled in pairs, with drivers 1 and 2 enabled by 1, 2EN and drivers 3 and 4 enabled by 3, 4EN. When a high input is enabled, the associated drivers get enabled, their outputs become active and in phase with their inputs. When a low input is enabled, those divers get disabled, and their outputs are off and in the high impedance state. With the proper data inputs, every pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

1.2 SOFTWARE

(a) Operating systems supported by android studio

- *Link for Android Studio:* http://developer.android.com/tools/studio/index.html
- *Android Studio for Windows:*

  Microsoft® Windows® 8/7/Vista/2003 (32 or 64-bit)
- *Android Studio for Mac OS X:*

  Mac® OS X® 10.8.5 or higher, up to 10.9 (Mavericks)
- *Android Studio for Linux:*

  GNOME or KDE desktop.

  GNU C Library (glibc) 2.15 or later.

Software Required:

- Java Development Kit (JDK) 7
- Android Development Toolkit (ADT)

- Java Runtime Environment (JRE) 6
- Android Debug Bridge (ADB)
- Google Play Services Support
- Android Virtual Device (AVD) images
- Android SDK
- Android SDK Manager

(b) JAVA and ANDROID

Java is developed by Sun Microsystems of USA in 1991.The most striking feature of the language is that it is a platform-neutral language. Java is not tied to any particular hardware or operating system. Any system will accept programs developed in Java and will execute them without any flaw. Java can be called as a revolutionary technology because it has redefined the way in which we develop programs. Java has a two-stage system-first, Java compiler translates input program into instructions as byte code which are not machine instructions and therefore, in the second stage, machine code is generated by Java interpreter that can be directly executed by the machine that is running the Java program, hence it is both a compiled and an interpreted language. Java is a portable language that means java programs can be easily moved from one computer to the other in the blink of an eye. Java comes in two variants, the Java Runtime Environment (JRE) and the Java Development Kit (JDK).The Java runtime environment consists of the JVM and the Java class libraries along with essential functionality to start Java programs.

Android is a mobile operating system coming from the technology mammoth - Google. This mobile operating system is based on the Linux Kernel and is basically designed for smart devices. Android apps can be developed by anyone as Linux is open source. The programming language for all Android apps is Java. The code is compiled by Android SDK tools along with resource and data files into an Android package (APK) which is an archive file with an '.apk' suffix. The contents of an Android app are subsumed in one APK file. The beauty of Android phones is that it supports multitasking, that means it can monitor the temperature inside the car while listening to your dearest song. Once the Android app is installed on a device then each Android app has its own security sandbox. Each app is a different user as Android is Linux based system that supports multiple users. By default, a unique Linux user ID is assigned by the system and then it sets permissions for all the files in an app. An app's code run in isolation from other apps as each process has its own Virtual Machine. This process is started by Android when any of the app's components are required for execution. Android also implements the principle of least privilege that means, each app can access only the components that are required to accomplish a specific task. This creates a very stable and safe environment as an app can access parts of the system if it has the required permission. [4] [7]

(c) ECLIPSE

Eclipse is well-known for Integrated Development Environment. The programming language for Eclipse is Java and is mainly used for developing Java applications. Eclipse also supports other programming languages like C, C++, COBOL, FORTRAN, Haskell etc. The Java development tools are subsumed in the Eclipse software development tools (SDK) which is useful for Java developers. Plug-ins can be installed by developers for Eclipse platform and they have the freedom to write their own plug-in modules. Eclipse is strongly recommended to software developers for developing applications as it provides a Rich Client Platform (RCP) that allows integration of independent software components effortlessly. Eclipse has the capability of installing the required server directly from the IDE. To build Android applications Google provides a plug in called as Android Development Tools (ADT) that allows the developers to set up Android projects, create a better graphical user interface, add packages on the Android Framework API, Android SDK tools can be used to debug applications.

Some essential features of Eclipse:

- It is an open source.
- It is most often recommended by Android developers.
- It is directly linked with compiler, thus avoiding the use of a separate compiler for the program.
- It has good UI (user interface)

2. SYSTEM ARCHITECTURE

In this the inter-networking relationship of a GSM module, Microcontroller, Cooling device, Temperature sensor and a cell-phone is discussed and implemented. Here keeping the user's requirement into consideration the system is designed and implemented accordingly with the appropriate conditions given to it for it to work efficiently and effectively. The figure below shows the basic architecture of the intelligent cooling system, showing the interconnectivity between each block.

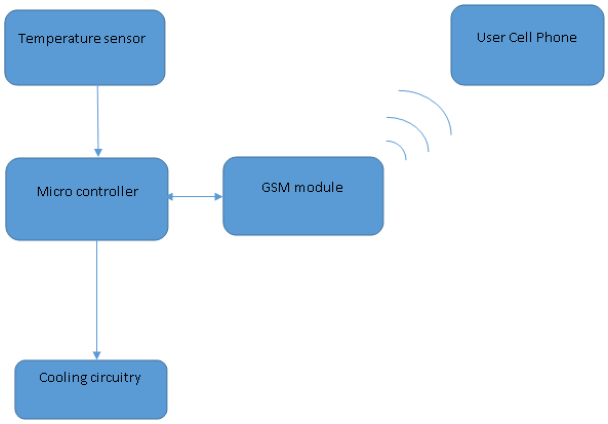

Figure 5: System architecture

(a)Microcontroller

It is the processing module that processes the signal received from the temperature sensor and communicated with the GSM module for sending and transmitting the message to the user. The message send by the user is decoded by the microcontroller and accordingly cooling system is turned ON/OFF.

(b)GSM Module

GSM stands for Global System for Mobile. The module communicated between user and microcontroller. It sends the message to the user indicating the temperature inside the car and accordingly receives the commands from the user. [2]

(C)Temperature Sensor

Temperature sensor senses the surrounding temperature and sends the analog voltage value to the microcontroller. The analog value is then converted to digital by inbuilt ADC in Atmega 16.

(d)Cooling System

The cooling system is connected to the microcontroller which switches ON/OFF based on the signals from microcontroller. As and when it reaches the threshold value, the cooling system is turned OFF. [6]

3. GOALS AND OBJECTIVES

The objectives of the project are as follows:

To send an acknowledgement to the user that the system has received a command for operation, to drop the temperature inside the car to a value determined by the user, to provide the location of the vehicle.

The goals of the project are as follows:

1. To achieve a desired temperature mentioned by the user.
2. To send an objective completion message to the user.

4. RELEVANT MATHEMATICS ASSOCIATED WITH THE PROJECT

System description:

- Input: {I}

  Where, I = {I1, I2}

  I1 = Temperature sensed by sensor (LM35)

  I2 = Location (if required)

- Output: {O}

  Where, O = {O1, O2}

  O1 = Cool the cabin temperature inside the car until threshold is achieved.

  O2 = Determine present co-ordinates.

5. ALGORITHM

1) Initialise the system with a certain threshold temperature (room temperature or any temperature the user wants)
2) Wait for the user's input message and remain idle until then only sensing the current temperature.
3) After user sends a message (messages: T, Y, N) send an acknowledgement back to the user.
4) Perform the necessary action as per the decoded message.
5) Send a completion message to the user and remain in idle state for user's next input.

5.1 Relevant keywords and terms

We would be using messages for the system to perform the necessary actions. [3] The messages are as follows:

T: Tell the temperature => this message tells the current temperature inside the car.

Y: Yes perform cooling => this message activates the cooling system which continues cooling until threshold temperature is reached.

N: No action to be performed => this message overrides the system when the user wants to stop the cooling inside the car.

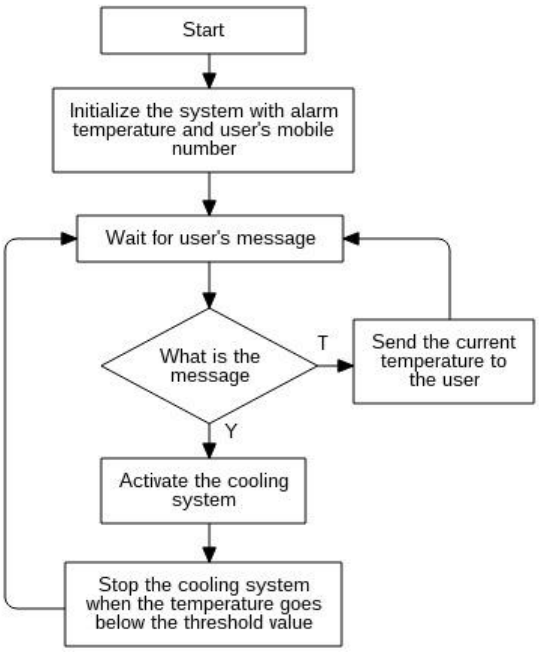

Figure 6: Flowchart of the system working.

6. OPERATING ENVIRONMENT

The basic operating environment for the smooth functioning of the system would be to lie in the range of communication spectrum so that there is no signal loss and messages cannot be sent and received by the GSM module.

7. ADVANTAGES AND DISADVANTAGES

7.1 Advantages

a) Achieve a comfortable temperature inside the car cabin when the user gets inside the car.

b) Save excess fuel consumption in order to bring down the temperature inside the car and prevent excess engine load. [6]

c) Control the system remotely and securely. [7]

d) Location tracking provides high security which makes the vehicle anti-theft.

e) Usage of android application provides better GUI and provides simplicity.

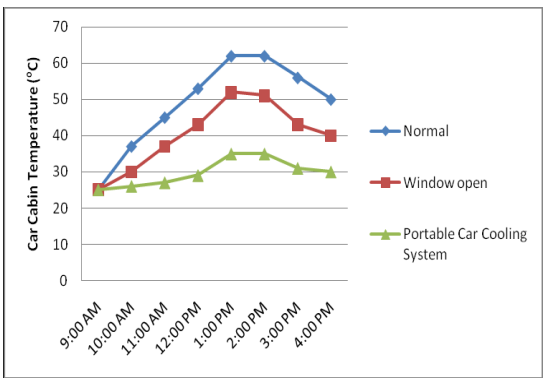

Figure 7: Graphical comparison

7.2 Disadvantages

a) The system cannot work where the GSM module is out of network. [2]

b) User cannot sense the temperature inside the car if his smart device runs out of charge.

8. CONCLUSION

The intelligent car cooling system will finally put an end to the suffering that the driver has to go through after getting into the car which is parked under the scorching sun. By the time the user reaches the car it would be at the desired temperature which would be much more comfortable for the user than the extreme heat experienced when the car gets internally heated. Moreover, this system also aims to consume less fuel than the existing air conditioning mechanism.

The driver does not need to be in proximity of the car as the android application will allow the driver to control, monitor the temperature of the car from a remote location. [1] [2]

9. FUTURE SCOPE

The working of the system can be modified for the purpose of heating in cold countries where there is need to defrost the internal environment in the car.This idea can also be extended and implemented at home under the smart home infrastructure, theaters, seminar halls and conference rooms and in other heavy vehicles.

The application can also be implemented for smartphones other than android such as iPhone, Windows smartphone.

This cooling system can be implemented in GPS tracking can be implemented as an add-on feature to trace car and protect against theft. [5] [9]. Also instead of external power supply or the car battery supply solar energy can be used to power the cooling system. [8]

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