A Child-Left-Behind Alerting System Based On Capacitive Sensing Principle

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Abstract: This paper presents a simple and efficient capacitive sensing system suitable for detecting presence of a child in an infant car seat. It also details a warning system that alarms the parents once a child is found to be left alone in a car. Infant seat with child is, usually, kept (safely) in the rear seat. Driver and passengers, in some situations, may leave the car without taking (forgetting) the child. When a car is turned-off (windows closed) temperature inside it will increase rapidly and can be life threatening as the thermoregulatory system of child is weak. Such incidents have been reported worldwide. The proposed capacitive sensor system detects child occupancy. The system also has a warning unit. Once the car is turned-off and a child is found to be left alone in the car (in an infant seat) the unit first generates an audio alarm. After a preset time, if no one takes the child, it will automatically dial (using a GSM module) to parents or driver to help the child. A prototype of the proposed capacitive sensor and warning system have been built and tested. The developed sensor accurately detected presence of a child (in various postures) in an infant seat. It also distinguished a child from other objects such as milk/water bottles, toys, bags, etc. Results showed that the developed system is very efficient and reliable.

Keywords: LPC2148, PIR Sensor, IR Sensor, Temperature Sensor, GSM.

I. INTRODUCTION

Once a car is turned-off and parked, keeping its window glasses closed, the temperature inside the car increases rapidly even on a day with atmospheric temperature of about 210 degrees. As the thermoregulatory system of the child is not well developed, this condition may lead to hyperthermia or heatstroke which can be fatal. As we know, the child entirely depends on elders but, unknowingly, in a busy schedule, the driver or passengers may forget to take the child (who may be sleeping) in the infant seat, usually kept in the back seat of the car. Such incidents can be prevented by sensing the presence of a child soon after a car is turned-off and then generating/sending a suitable warning signal to the driver or parents who can take timely action to save the child. A child presence detection system based on a combination of optical detector, mechanical switch and temperature sensor is taken as reference. Optical or thermal sensors are not well suited for this as it may not detect when a child is wrapped in a blanket or clothes. In this paper, we propose a simple and compact capacitive sensor that can be placed in an infant seat to detect presence of a child. The proposed system also has a vehicle ignition monitor to confirm presence of driver inside a car. It has a temperature sensor to keep track on current temperature inside the car. A GSM modem is used to alert driver or parents/guardians as soon as a child left in the car in an infant seat is detected and the car is found to be turned-off. Principle of operation of the capacitive sensor, measurement scheme employed details of prototype sensor and warning system developed and test results are discussed in the following sections of the paper.

A. The Hardware System
1. Micro controller

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

2. ARM7TDMI

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

3. Liquid-crystal display (LCD)

It is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of

a large number of small pixels, while other displays have larger elements.

4. GSM modem Section

This section consists of a GSM modem. The modem will communicate with microcontroller using serial communication. The modem is interfaced to microcontroller using MAX 232, a serial driver.

II. DESIGN OF PROPOSED HARDWARE SYSTEM
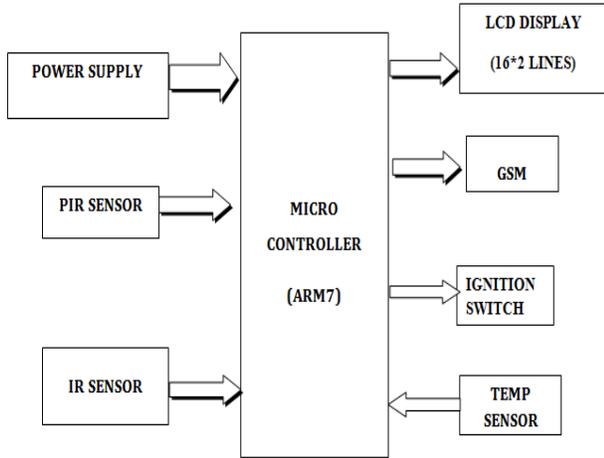
Fig1.Block diagram.

Presence of child in car is recognized her by using temperature sensor output which is in touch with child, PIR sensor output which can detect heat of human body, IR sensor to detect object presence. A GSM modem is used to alert driver/parents/guardians as soon as a child left in the car in front seat is detected and the car is found to be turned-off.

A. Board Hardware Resources Features

1. Thermistor

A thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range, typically −90 °C to 130 °C.

2. IR pair

IR LED: IR LED means Infrared Light Emitting Diode. The IR LED emits Infrared light which is not visible to human eye. we can find these IR LED's in our TV Remotes. IR LED's works like normal LED's but the material used in the core is different, it emits Infrared Light when current passed through it. These IR LED are used to detect obstacles ahead of the robot. The IR LED emits IR light which gets reflected if any obstacle is present in the direction of emitted IR ray,

the reflected IR ray caught by Photodiode which calculates the reflected light strength. The higher the reflected IR ray strength, the closer is the obstacle and vice-verse.


Fig2. IR LED.

IR_Photodiode: Photodiode is a light sensitive semi-conductor diode which converts the light energy into voltage or current based on the mode of operation. In general Photodiodes are operated in reverse bias condition. The clear Photodiode can detect visible and IR rays to limit the Photodiode to detect only IR rays a black cotting is applied to the glass of the Photodiode. The photodiode allows the current to pass through it if the photodiode is exposed to IR rays and it doesn't allow current to pass through it if no IR rays falls on it. The amount of current passed through the photodiode is directly proportional to amount of IR rays falls on it.

Fig3. IR_Photodiode.

PIR Sensor: A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose. The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects.[1] PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.
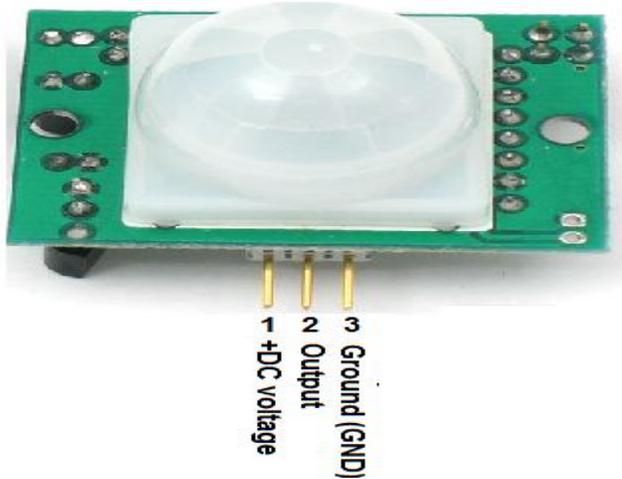
Fig4. PIR Sensor.

3. GSM Module

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates in the 900MHz, 1800MHz, or 1900 MHz frequency bands. GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the era of true broadband services, GSM continues to evolve to meet new demands. One of GSM's great strengths is its international roaming capability, giving consumers a seamless service. This has been a vital driver in growth, with around 300 million. In the Americas, today's 7 million subscribers are set to grow rapidly, with market potential of 500 million in population, due to the introduction of GSM 800, which allows operators using the 800 MHz band to have access to GSM technology too.

GSM together with other technologies is part of an evolution of wireless mobile telecommunication that includes High-Speed Circuit-Switched Data (HCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile Telecommunications Service (UMTS). GSM security issues such as theft of service, privacy, and legal interception continue to raise significant interest in the GSM community. The purpose of this portal is to raise awareness of these issues with GSM security. The mobile communications has become one of the driving forces of the digital revolution. Every day, millions of people are making phone calls by pressing a few buttons. Little is known about how one person's voice reaches the other person's phone that is thousands of miles away. Even less is known about the security measures and protection behind the system. The complexity of the cell phone is increasing as people begin sending text messages and digital pictures to their friends and family. The cell phone is slowly turning into a handheld computer. All the features and advancements in cell phone technology require a backbone to support it. The system has to provide security and the capability for growth to accommodate future enhancements. General System for Mobile Communications, GSM, is one of the many solutions out there. GSM has been dubbed the "Wireless Revolution" and it doesn't take much to realize why GSM provides a secure and confidential method of communication (fig 5).
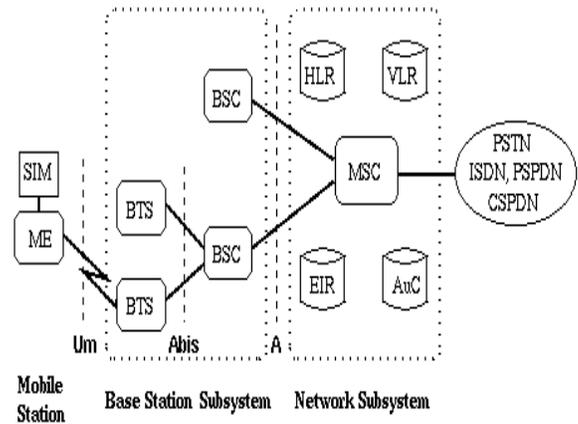
SIM Subscriber Identity Module	BSC Base Station Controller	MSC Mobile services Switching Center
ME Mobile Equipment	HLR Home Location Register	EIR Equipment Identity Register
BTS Base Transceiver Station	VLR Visitor Location Register	AuC Authentication Center

Fig5. General Architecture of a GSM network.

III. CONCLUSION

This paper is an attempt to ensure child's complete safety when it is left unattended by parents in car. The conditions considered above are necessary and sufficient for the same and the system is designed considering different cars structure in general. However there is still scope for improvement as technology is changing every day

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