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Voice Announcement Based Child safety and Temperature Monitoring System for cars

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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.*

***Keywords*—** Embedded C; ARM Processor; GSM; Capacitive Sensor; Audio Alarm

I. INTRODUCTION

About 500 children died in USA, between 1998 and 2010, because they were left alone inside parked cars [1], [2]. This has been reported by a non-profit organization called Kidsn-cars. Similar, unfortunate, incidents also happens in various parts of the world. 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 210X [3]. 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 has been reported in [4]. 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. An electric field sensor to detect infants sitting in rearward position in an infant seat in a car has been reported in [5]. A capacitive seat occupancy detection system (for adult passengers) that provides occupancy information to an airbag control unit has been reported in [6]. In these schemes, sensing electrodes are placed in the car seat as it is to detect adult occupancy. Thickness of infant seat available in the market is not fixed. Thus, distance between child and electrodes in car seat can be between 5 to 12 cm (depending on manufacturer). Thus, it is difficult to sense presence of a child using these sensors reliably. Also, such capacitive/electric field systems are not available in all the cars and usually, if available, it is not installed in back seats of cars where probability of forgetting a child is high. A weighing based child detector has been developed by NASA's Langley Research Center [7]. Such weight based sensors may detect water or milk bottles, filled thermo-flask or bag, toy, etc. (or any combination of such items) as a child and may activate an (unwanted) alarm. 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

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system also has a vehicle ignition monitor to confirm presence of driver inside a car. It also 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.

II. SYSTEM ARCHITECTURE

The system architecture of this proposed system is divided into two different blocks.

ARM7 END: Hardware implementation for this proposed system is shown below with the simple blocks. Power Supply block is designed and developed to generate power source for the ARM processor and its relevant components. Reset Circuit is designed and developed to reset the program whenever necessary and interfaced to the ARM processor for greater stable response. Clock Circuit is designed and developed to generate oscillationsand interfaced to the ARM processor for needy response. LCD Display can also interface to the ARM processor for displaying the status of the system for better understanding. A simple block diagram shown below:

BLOCK DIAGRAM

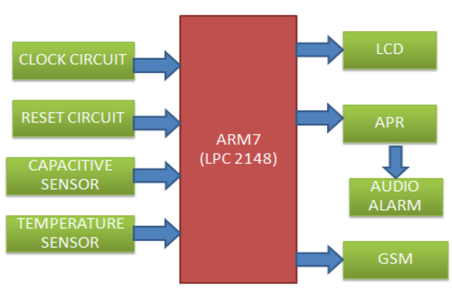

Figure – 1: Block Diagram

III. IMPLEMENTATION

HARDWARE:

In hardware implementation, ARM processor plays a key role in monitoring and controlling the security system. Low-power consumption ARM processor (LPC2148) operating at 3.3V, 50uA is designed and mounted on a PCB along with Reset Circuit and a Clock Circuit. LPC2148, a 32-bit microcontroller with advanced RISC architecture and having 48 GPIO lines with a program memory of 32KB and a data memory of 512Bytes.

And we have 2 UART ports i.e. UART0 and UART1. In this project GSM/GPRS connected to the UART0 port of ARM7 (LPC 2148). And 1 Analog to Digital channels, though I connected one Analog sensor to ADC channels of ARM7, so that it converts Analog Values to Digital Values. Those values i have uploaded into ThingSpeak.

ARM7 (LPC 2148) internal architecture overview has shown below as well ARM7 (LPC 2148) with LCD has shown below.

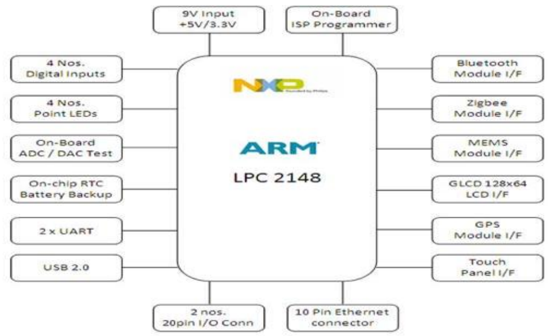

Figure – 2: ARM Overview [LPC2148]

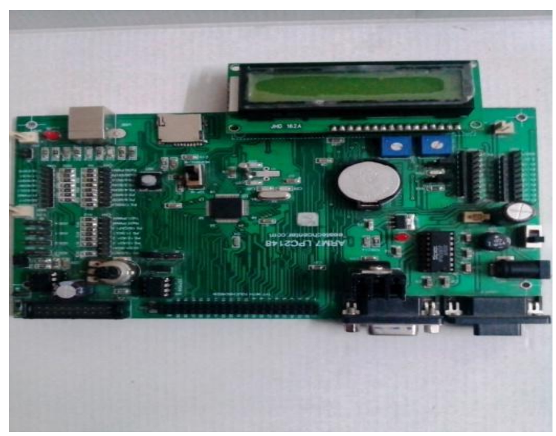

Figure – 3: LPC2148 Development Board

*Capacitive Sensor:*Capacitive sensors are constructed from many different media, such as copper, Indium tin oxide (ITO) and printed ink. Copper capacitive sensors can be implemented on standard FR4 PCBs as well as on flexible material. ITO allows the capacitive sensor to be up to 90% transparent (for one layer solutions, such as touch phone screens). Size and spacing of the capacitive sensor are both very important to the sensor's performance. In addition to the size of the sensor, and its spacing relative to the ground plane, the type of ground plane used is very important. Since

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the parasitic capacitance of the sensor is related to the electric field's (e-field) path to ground, it is important to choose a ground plane that limits the concentration of e-field lines with no conductive object present.

Designing a capacitance sensing system requires first picking the type of sensing material (FR4, Flex, ITO, etc.). One also needs to understand the environment the device will operate in, such as the full operating temperature range, what radio frequencies are present and how the user will interact with the interface.

There are two types of capacitive sensing system: mutual capacitance,[3] where the object (finger, conductive stylus) alters the mutual coupling between row and column electrodes, which are scanned sequentially;[4] and self- or absolute capacitance where the object (such as a finger) loads the sensor or increases the parasitic capacitance to ground. In both cases, the difference of a preceding absolute position from the present absolute position yields the relative motion of the object or finger during that time. The technologies are elaborated in the following section.

Current sensor Device has shown below:

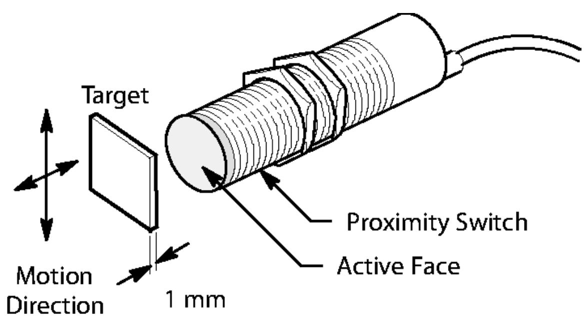

Figure – 4: Capacitive Sensor

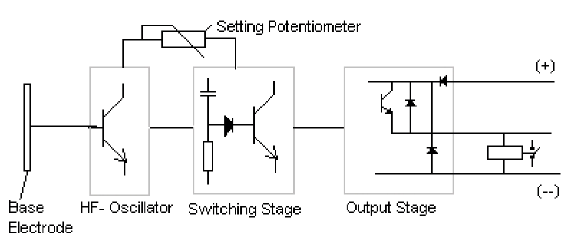

Figure – 5: Capacitive sensor circuit diagram

*Temperature Sensor:*The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device 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. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes 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 device draws only 60 µA 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 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

Pin description of TRIAC BT136 has shown below:

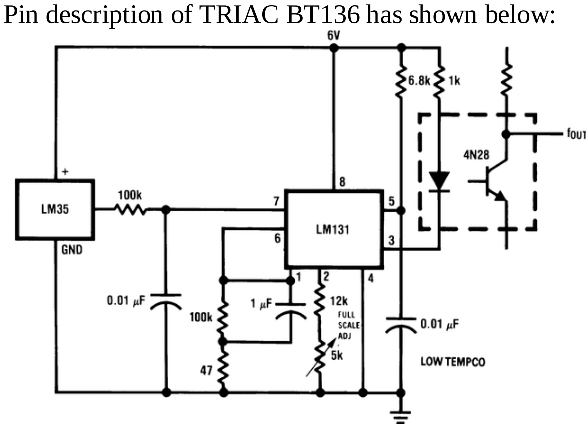

Fig – 6: Circuit Diagram

Temperature Sensor device has shown below:

Figure – 7: LM35 Sensor

GSM/GPRS: GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services.GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in Europe and other 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. It operates at either the 900 MHz or 1,800 MHz frequency band. It supports voice calls and data transfer speeds of up to 9.6 kbit/s, together with the transmission of SMS (Short Message Service). Mobile telephony standards have given below:

Standard	Generation	Frequency band	Throughput	
GSM	2G	Allows transfer of voice or low-volume digital data.	9.6 kbps	9.6 kbps
GPRS	2.5G	Allows transfer of voice or moderate-volume digital data.	21.4-171.2 kbps	48 kbps
EDGE	2.75G	Allows simultaneous transfer of voice and digital data.	43.2-345.6 kbps	171 kbps
UMTS	3G	Allows simultaneous transfer of voice and high-speed digital data.	0.144-2 Mbps	384 kbps

Fig – 8: Mobile Telephony standards

GSM com GPRS device has shown below:

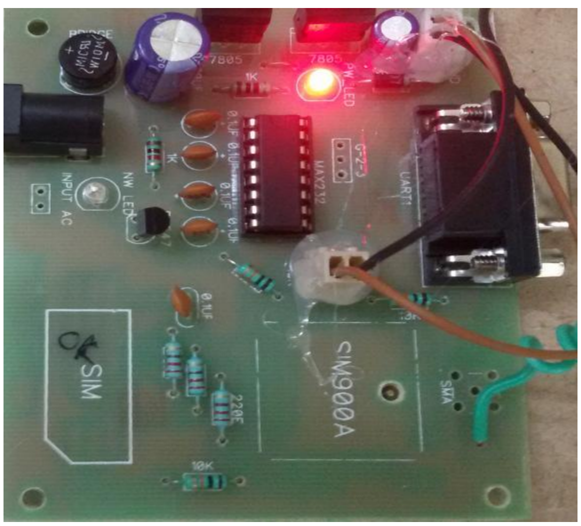

Fig – 9: GSM/GPRS Module

With the help of GSM/GPRS, I have control the LOADS as well I have monitor them.
Connections of GSM have shown in Schematic Section.

Final Schematic Diagram of this Project has shown below:

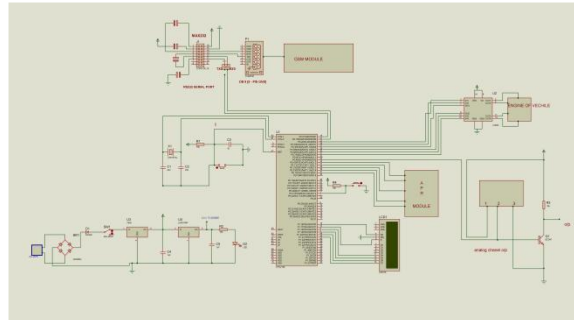

Figure – 10: Schematic Diagram

SOFTWARE:

Here, to program ARM processor Keil uVision 4 was used as a cross-compiler and Flash Magic was used as a programmer. ThingSpeak is an open source Internet of Things application and API to store and retrieve data from things using HTTP over the internet or via a local area network.

IV. ALGORITHM & FLOWCHART

ALGORITHM:

Step – 1: Initialize ARM, LCD, and GSM.

Step – 2: Wait until you see WELCOME on LCD.

Step – 3: Read the ADC values of sensors connected to ARM7 (Temperature Sensor, Capacitive Sensor)

Step – 4: If the temperature value is high, then display HIGH Temperature on LCD, activate voice alert through APR module and send SMS.

Step – 5: If the capacitance value is high, then display BABY IS IN DANGER on LCD, activate voice alert through APR module and send SMS.

FLOWCHART:

The flowchart of this paper is shown below.

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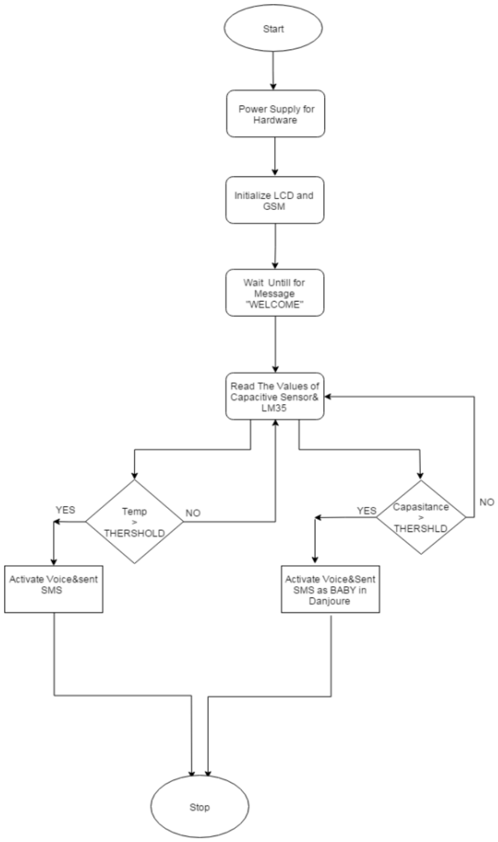


Figure – 11: Flow Chart

V. RESULTS

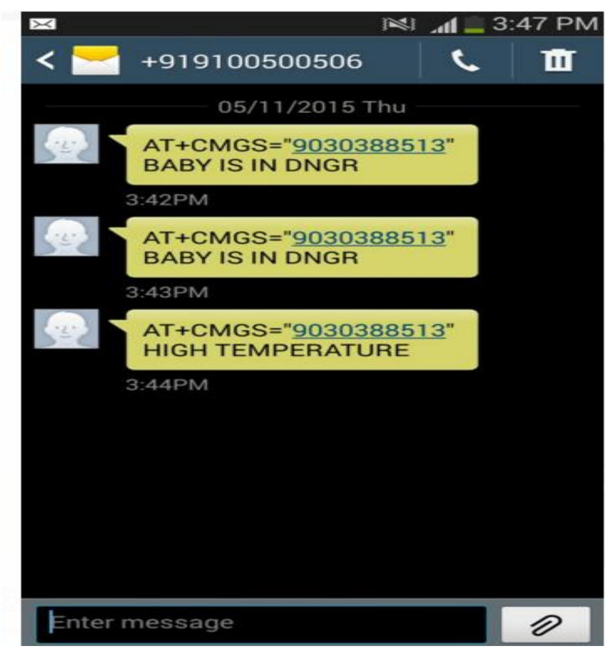
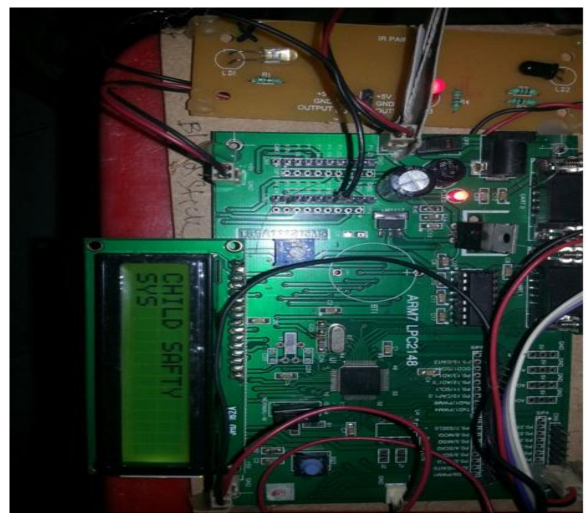


Fig – 12: Final Prototype 1

Fig – 13: Final Prototype 2



Final – 14: Final Prototype 3

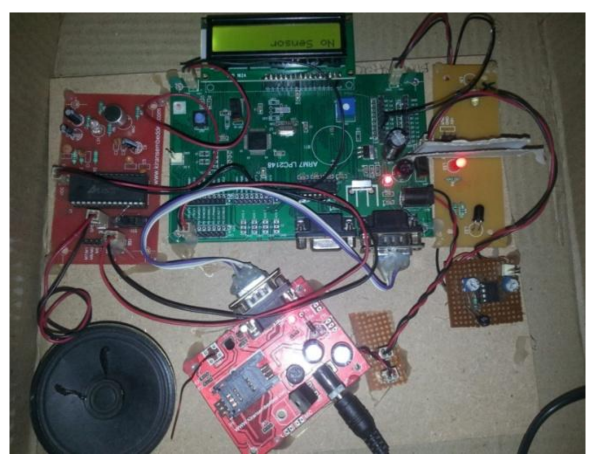


Fig – 15: Final Prototype 4

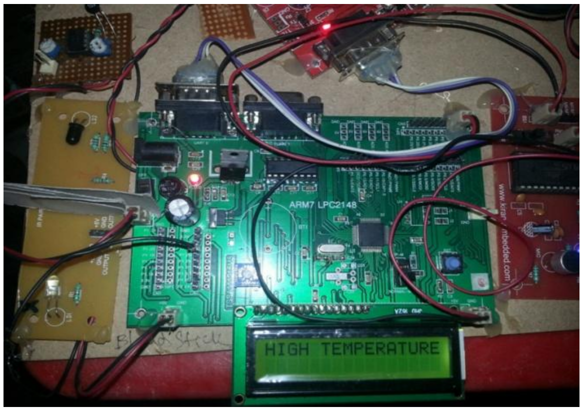


Fig – 16: Final Prototype 5

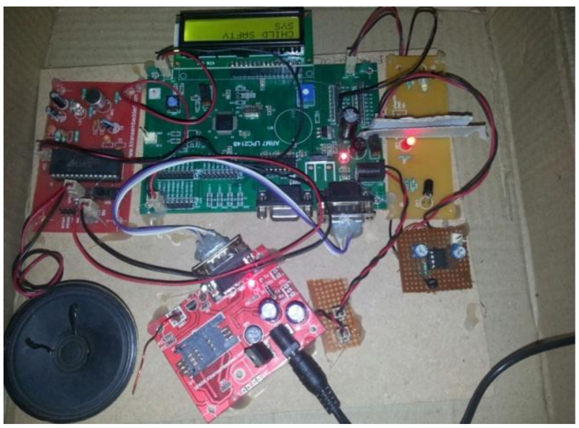


Fig – 17: Final Prototype 6

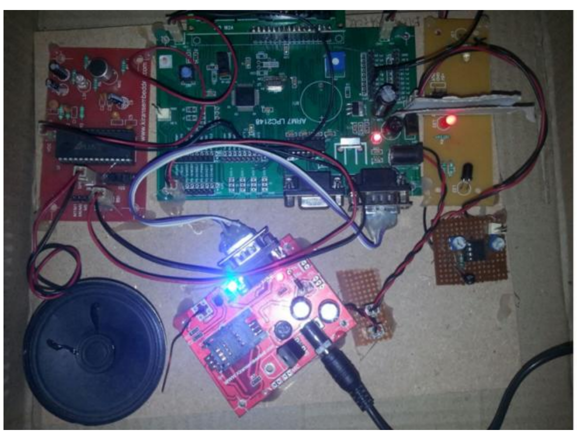


Fig – 18: Final Prototype 7

VI. CONCLUSION

Here, in this paper a baby alert system is designed and developed using sensors and communication is also developed using GSM module. These type of systems were very important for small children. Technology is everywhere and anywhere can be used for solving typical problems like this.

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