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Bi-direction design of robot using GSM technology

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Abstract: The design and construction of a "GSM Technology Demonstrator" robot to be used as an educational and advertising tool by one local GSM network provider namely MTN, is discussed. The robot will be used to introduce the public to new services that are not often used, with the purpose of boosting the demand and popularity of such services. The "GSM Technology Demonstrator" robot is remotely controlled by a mobile phone using GPRS and is able to receive and reply to SMS and MMS messages. The design and construction of this telecommunication robot required a lot of expertise in many different fields ultimate such as an the Mechanics, Electronics, Telecommunication, and Software development.

Keywords: Ultrasonic sensor, Buzzer, DC motor, Gas sensor, GSM, ARM.

I. INTRODUCTION

The object of this research is to develop a wheeled robot to be used in the science center of a mobile network service provider as an educational and advertising tool. In the science center, the robot will play the role of a "GSM Technology Demonstrator", showing the public the importance and how to use the wireless technologies and services implemented therein. The "GSM technology demonstrator" project has mainly been initiated to address the challenge of making known certain technologies and services offered by MTN, one of the three GSM network service providers in this country.

The project entails the design and construction of a remotely controlled mobile robot, in which most of the latest telecommunication technologies such as ultrasonic sensor for object detecting and buzzer makes beep sound for detecting any gas by using gas sensor. This project, initiated by MTN (Mobile Telephone Networks), was inspired by the Wars spunky and adventurous astromech droid R2-D2.

The aim is to use the GSM technology demonstrator in the MTN science center in Cape Town to educate children and adults about telecommunication technologies.

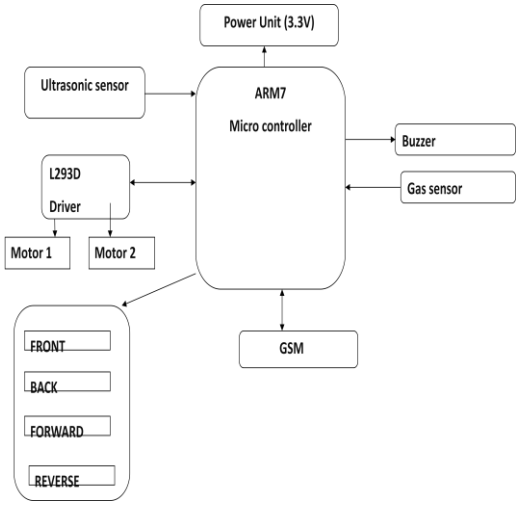

Fig: 1.Overview of Gsm Using

II.MICROCONTROLLER (ARM7) FAMILY

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.
The ARM7TDMI-S core is the synthesizable version of the ARM7TDMI core, available in both VERILOG and

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VHDL, ready for compilation into processes supported by in-house or commercially available synthesis libraries. Optimized for flexibility and featuring an identical feature set to the hard macro cell, it improves the time-to-market by reducing the development time while allowing for increased design flexibility, and enabling >>98% fault coverage. The ARM720T hard macro cell contains the ARM7TDMI core, 8kb unified cache, and a Memory Management Unit (MMU) that allows the use of protected execution spaces and virtual memory. This macro cell is compatible with leading operating systems including Windows CE, Linux, palm OS, and SYMBIAN OS.

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI – low power consumption, small size, and the thumb instruction set – while also incorporating ARM's latest DSP extensions and Jazelle technology, enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM and x scale architectures. This gives designers a choice of software-compatible processors with strong price-performance points. Support for the ARM architecture today includes:

- Operating systems such as Windows CE, Linux, palm OS and SYMBIAN OS

- More than 40 real-time operating systems, including wind river's VXworks

A.LPC2148 Microcontroller:

LPC2148 Microcontroller Architecture. 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, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

Pipeline techniques are 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 ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue.

The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

• The standard 32-bit ARM set.

• A 16-bit Thumb set.The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system

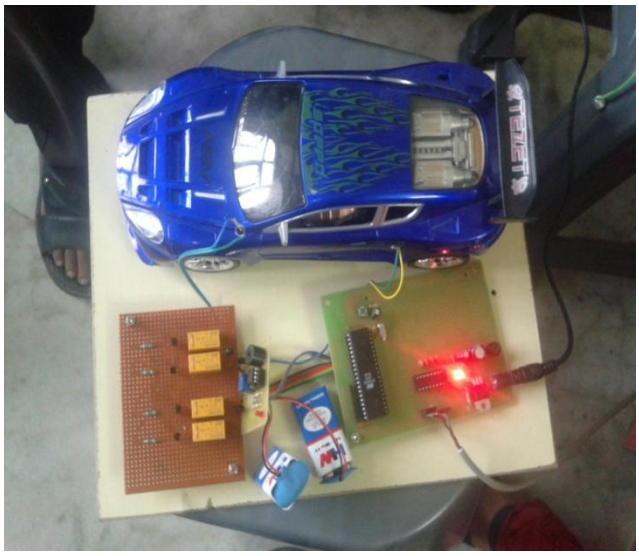

Fig: 2 smart car kit demonstraction

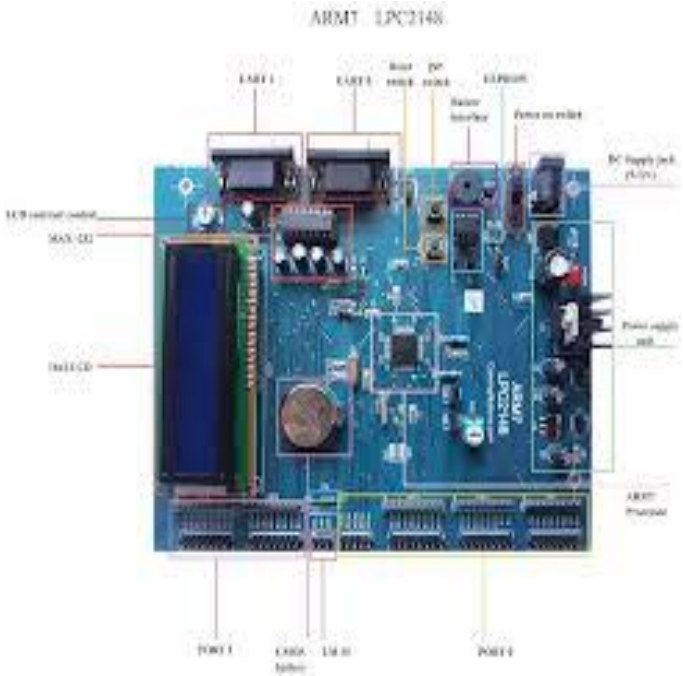

Fig: 3 ARM7TDMI PCB board

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III. GSM OVERVIEW:

Global System for Mobile Communications or GSM (originally from Groupe Special Mobile) is the world's most popular standard for mobile telephone systems. The GSM Association estimate that 80% of the global mobile market uses the standard.GSM is used by over 1.5 billion people across more than 212 countries and territories. This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. The GSM standard has been an advantage to both consumers, who may benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors.

Fig: 4 GPRS Module

A.SMS Commands:

¬AT+CIMI
Note: scan IMSI
¬AT+CMGS=”+919704040791”
¬AT+CMGR=1
¬AT+CMGD=1,4
Note: Delete it Note: Message
Global system for mobile communication (GSM) .A globally accepted standard for digital cellular Communication.GSM is the name of standardization Group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands always start with AT means Attention) and finish with a <CR> character. For example, the dialing command is ATD<number>; ATD3314629080; here the dialing command ends with semicolon. The AT commands are given to the GSM modem with the help of PC or controller. The GSM modem is serially interfaced with the controller with the help of MAX 232.

B.New approaches:

Neither of these approaches proved to be the long-term solution as cellular technology needed to be more efficient. With the experience gained from the NMT system, showing that it was possible to develop a system across national boundaries, and with the political situation in Europe lending itself to international cooperation it was decided to develop a new Pan-European System. Furthermore it was GSM system. To achieve the basic definition of a new system a meeting was held in 1982 under the auspices of the Conference of European Posts and Telegraphs (CEPT). They formed a study group called The Groupie Special Mobile (GSM) to study and develop a pan-European public land mobile system. Several basic criteria that the new cellular technology would have to meet were set down for the new GSM system to meet. These included: good subjective speech quality, low terminal and service cost, support for international roaming, ability to support handheld terminals, support for range of new services and facilities, spectral efficiency, and finally ISDN compatibility. realized that economies of scale would bring significant benefits. This was the beginnings of the with the levels of under-capacity being projected for the analogue systems, this gave a real sense of urgency to the GSM development. Although decisions about the exact nature of the cellular technology were not taken at an early stage, all parties involved had been working toward a digital system. This decision was finally made in February 1987. This gave a variety of advantages. Greater levels of spectral efficiency could be gained, and in addition to this the use of digital circuitry would allow for higher levels of integration in the circuitry. This in turn would result in cheaper handsets with more features. Nevertheless significant hurdles still needed to be overcome. For example, many of the methods for encoding the speech within a sufficiently narrow bandwidth needed to be developed, and this posed a significant risk to the project. Nevertheless the GSM system had been started.

C.Global usage:

Originally GSM had been planned as a European system. However the first indication that the success of GSM was spreading further afield occurred when the Australian network provider, Telstra signed the GSM Memorandum of Understanding.

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D.Frequencies:

Originally it had been intended that GSM would operate on frequencies in the 900 MHz cellular band. In September 1993, the British operator Mercury One-to-One launched a network. Termed DCS 1800 it operated at frequencies in a new 1800 MHz band. By adopting new frequencies new operators and further competition was introduced into the market apart from allowing additional spectrum to be used and further increasing the overall capacity.

This trend was followed in many countries, and soon the term DCS 1800 was dropped in favor of calling it GSM as it was purely the same cellular technology but operating on a different frequency band. In view of the higher frequency used the distances the signals travelled was slightly shorter but this was compensated for by additional base stations.In the USA as well a portion of spectrum at 1900 MHz was allocated for cellular usage in 1994. The licensing body, the FCC, did not legislate which technology should be used, and accordingly this enabled GSM to gain a foothold in the US market. This system was known as PCS 1900 (Personal Communication System)

IV. THE GSM NETWORK:

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).

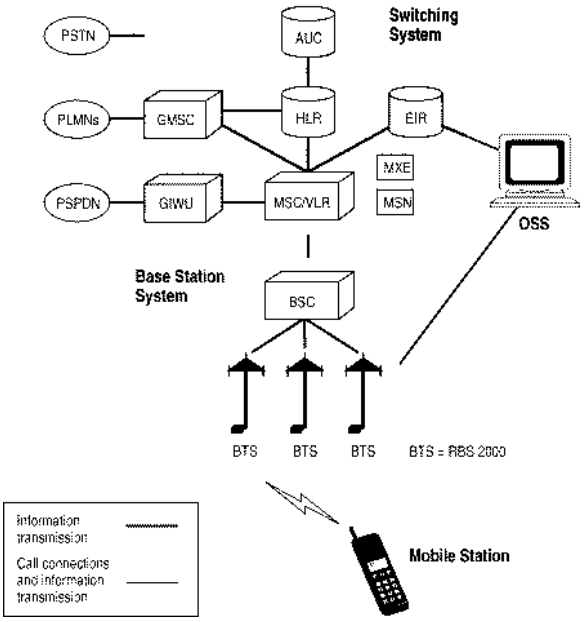

Fig: 5 GSM Network Elements

The operations and maintenance center (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of OMC is called the operation and support system (OSS). The OSS is the functional entity from which the network operator monitors and controls the system. The purpose of OSS is to offer the customer cost-effective support for centralized, regional and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

A. Specification and Characteristics for GSM:

The specifications and characteristics for GSM

- Frequency band—the frequency range specified for GSM is 1,850 to 1,990 MHz (mobile station to base station).
- Duplex distance—the duplex distance is 80 MHz Duplex distance is the distance between the uplink and downlink frequencies. A channel has two frequencies, 80 MHz apart.
- Channel separation—the separation between adjacent carrier frequencies. In GSM, this is 200 kHz.
- Modulation—Modulation is the process of sending a signal by changing the characteristics of a carrier frequency. This is done in GSM via Gaussian minimum shift keying (GMSK).
- Transmission rate—GSM is a digital system with an over-the-air bit rate of 270 kbps.

V. PWM TECHNIQUE:

Pulse-width modulation (PWM), or pulse-duration modulation (PDM), may be a modulation technique that conforms the dimension of the heartbeat, formally the heartbeat length, supported modulator signal info. Though this modulation technique is accustomed encipher info for transmission, its main use is to permit the management of the facility provided to electrical devices, particularly to mechanical phenomenon masses like motors. additionally, PWM is one in all the 2 principal algorithms utilized in electrical phenomenon solar array chargers, the opposite being MPPT.The average price of voltage (and current) fed to the load is controlled by turning the switch between provide and cargo on and off at a quick pace. The longer the switch is on compared to the off periods, the upper the facility provided to the load is.

The main advantage of PWM is that power loss within the switch devices is incredibly low. Once a switch is off there's much no current, and once it's on, there's virtually no free fall across the switch. Power loss, being the merchandise of voltage and current, is so in each case near zero. PWM additionally works well with digital controls, which, due to their on/off nature, will simply set the required duty cycle

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VI. SYSTEM HARDWARE:

A. Gas Sensor:

Ideal sensor for use 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.

Fig: 6 gas sensor

1. Applications:

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

2. 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

B.Ultrasonic sensor:

Ultrasonic sensors service the market by providing a cost effective sensing method with unique properties not possessed by other sensing technologies. By using a wide variety of ultrasonic transducers and several different frequency ranges, an ultrasonic sensor can be designed to solve many application problems that are cost prohibitive or simply cannot be solved by other sensors.
Long range detection: In industrial sensing, more and more applications require detection over distance. Ultrasonic sensors detect over long ranges up to forty feet, while limit switches and inductive sensors do not.Broad area detection: While some photo electric sensors can detect over long distances they lack the ability to detect over a wide area without using a large number of sensors. The advantage of Migatron's ultrasonic sensors is that both wide and narrow areas can be covered. All it takes is the proper ultrasonic transducer selection. Widest range of target materials: Only ultrasonic sensors are impervious to target material composition. The target material can be clear, solid, liquid, porous, soft, wood and any color because all can be detected.
Non contact distance measuring: Because sound can be timed from when it leaves the transducer to when it returns, distance measuring is easy and accurate to .05% of range which equates to +or- .002 of an inch at a distance of 4inches. It is Migatron's continuing goal to provide ultrasonic sensors in industrially hardened packages that are electrically and electronically compatible with standard controls used in today's industrial marketplace.

Fig: 7 ultrasonic sensors

1.Advantages of ultrasonic:

When used for sensing functions, the ultrasonic method has unique advantages over conventional sensors. Measures and detects distances to moving objects.

- Impervious to target materials, surface and color.
- Solid-state units have virtually unlimited, maintenance-free lifespan.
- Detects small objects over long operating distances.
- Resistant to external disturbances such as vibration, infrared radiation, ambient noise
- and EMI radiation.
- Ultrasonic sensors are not affected by dust, dirt or high-moisture environments.

2.The Sound Course of Action
Design for Applications:

- High Volume, Low Cost Manufacturing
- Private Labeling
- Short Development Cycles
- Exclusive Custom Designs for OEMs

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- Short Range Communications and Positioning
- *Collision Avoidance Systems*
- Obstacle Detection and Ranging
- On/Off Road Vehicles, Tracked Vehicles
- Factory Automation

C.Transducers:

Massa Transducers and Sensors are used in a wide variety of applications:

- Range Finding
- Proximity Sensing
- Presence/Absence
- Converting Systems
- Level/Fill
- Warning Devices

D.Buzzer:

Buzzer can be made using piezoelectric crystal such as Quartz and an oscillating circuit. When voltage is given, oscillating circuit makes crystal to vibrate to make sound.

FIG : 9 BUZZER

VII. CONCLUSION

In this project we are going to demonstrate the GSM based bi-directional robot controlling is as follow:

- The command based robot controlling system by using GSM.
- Any object is coming near to the robot is detected by using ultrasonic sensors to identify that buzzer sound will produce.
- Additionally any gas is found near to the robot it will detected by using gas sensor and send the information to the user by using GSM.
- In this way we have demonstrated the robot controlling bi-directional by using GSM.

VIII. RESULT

Here we have shown a Gsm based control Robot which is very useful in day to day life Because man cannot risk his life to go there in the crictical places so we are sending the robot which user can utilize by giving the commands to the robot which can enhance the task. Here in this Project the robot also communicate with the user by sending the messages to the user so here it interacts as an bi directional. Generally, Suppose the gas leakage has occurred at certain place then we are sending the robot it may detect through gas sensors and it sends the messages to the user then user responds with commands.

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