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Design and Implementation of Supervising Robot Using GSM

[1] Prof. S. V. Viraktamath [2] Neha Vernekar [3] , Nivedita Patil, , [4] Priyanka Angadi, [5] Shruti Kulkarni
[1][2][3][4][5]Department of Electronics and Communication Engineering
SDM College of Engineering and Technology,
Dharwad, INDIA

***Abstract:* - The hot emergence of remote monitoring and control systems in recent years is closely related to the outstanding advance in electronics and instrumentation techniques. In the present scenario, there were many recent developments of robotics and communication on a large scale. The objective of designing this robot is simply to facilitate the humans in the future for security purposes. As robotics plays an integral role in all aspects of manufacturing, medicine, industries, home basic and more and it will take on even greater importance in the future. Controlling the robot by using GSM module is a most suggested mechanism for mobile robot which has the capability of changing directions for the long range distances & effectively allows control from a remote area to the desired location. The main aim of the work will be to design a SMS electronic robot control toolkit which can replace the traditional robot control devices. The toolkit receives the short message service (SMS), validates the sending mobile identification number (MIN) and performs the desired operation after necessary code conversion. The system is made efficient by SIMs so that the SMS can be received by number of device boards in a locality using techniques of time division multiple access. The need to be physically present in order to control the robot of a certain location is eliminated with the use of our system.**

***Keywords*— Arduino, Robotics, GPRS, robot control devices, SMS, GSM module.**

I. INTRODUCTION

GSM and GPRS based designs have developed another innovative and Public utility product for mass communication [1]. This is a robot control device which controls the robot through messages received as SMS or GPRS packets and also send acknowledgement of task. Such devices can be used at different areas of the human being life. Such as offices, houses, factories etc. Sent command from mobiles or PCs to these devices move the motor left, right, and stop. These devices are designed to remotely control the Robot from anywhere and anytime. Wireless communication has announced its arrival on big stage and the world is going mobile [2]. We want to control everything and without moving an inch.

This remote control of robot device is possible through embedded systems. The use of "Embedded System in Communication" has given rise to many interesting applications that ensures comfort and safety to human life [3]. The main aim of the work will be to design a SMS electronic robot control toolkit which can replace the traditional robot control devices.

The main components of the toolkit include microcontroller and GSM modem. These components are integrated with the device board and thus incorporate the wireless features. The GSM modem receives the SMS. The AT commands are serially transferred to the modem. In return the modem transmits the stored message through the wireless link. The microcontroller validates the SMS and then perform specific task on the device. The microcontroller used in this case is AT Mega 328[4]. SIM 900 is used as the GSM modem. "GSM based Control System" implements the emerging applications of the GSM technology. Using GSM networks, a control system has been proposed that will act as an embedded system which can monitor and control appliances and other devices locally using built-in input and output peripherals. Remotely the system allows the user to effectively monitor and control the house/office appliances and equipment's via the mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The main concept behind the work is receiving the sent SMS and processing it further as required to perform several operations. The type of the operation to be performed depends on the nature of the SMS sent. The principle in which this work is based is fairly simple. First, the sent SMS is stored and polled from the receiver mobile station and then the required control signal is generated and sent to the intermediate hardware that is designed according to the command received in the form of sent message.

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II. INTRODUCTION TO ROBOTICS

The word 'robot' is one of those elusive terms that have defied unique definition. One reason for this is that its use changes all the time. Initially, a robot was a humanoid or human-like being. The word 'robot' was derived from the Czech word meaning 'slave labor' and was coined by Kapec in his play, Rossum's Universal Robots in 1921. These robots were biochemical – what we would now call androids. This was followed soon after by a number of films featuring robots such as Fritz Lange's 1922 Metropolis that excited the imagination of both the public and the science and engineering communities. Science fiction books such as Asimov's 'I Robot' [3], from where we got the term robotics, were also popular at this time. These robots were easy to define as non-living machines that looked and acted like humans.

The major distinction is now between non-mobile robots such as arms and actuators and mobile robots, which may be wheeled, legged or may even be propelled through water or air. Another important distinction is between autonomous and non autonomous robots. Originally, robots would only be considered to be a robot if it was autonomous [5]. That is, they could operate on their own without human intervention. It is now perfectly acceptable to call any autonomous vehicle a mobile robot even if it looks like a car, a plane or a horse. It is also becoming increasingly acceptable to use the term robot for remote controlled vehicles. This started off with tele- robotics, robots operated at a distance, like those used by emergency services for bomb disposal and fire fighting. Then came the remote controlled robot used in television contests like robot wars, techno games and mechanoids.

III. SYSTEM DESIGN

A mobile controlled robot is a mobile device, which provides wide-range of wireless control ability to the robot. In this design, fire detection and controlling method is proposed. A block diagram of the proposed supervising robot using GSM module is shown in Fig.1. Fire is detected by the fire sensor, these sensed signals are conditioned and given to the controller circuit and also the exact fire location information is sensed through the GPRS system to the controller. Immediately an SMS that consists of latitude & longitude values of the fire is sent to the user by the GSM module. User can control the robot by the use of GSM module i.e., through SMS. A motor is used for driving the robot i.e., whenever the signals are given by the user the robot moves forward, backward, right, left with the help of the motor. When the robot reaches the exact location of fire accident, a water pump which is already connected to the robot sprinkles the water on the fire & the fire gets extinguished. An L293D motor driver is used for driving the motor and to step up the voltage from 5v to 12v. The relay circuit is used to driving the water and to step up the voltage from 5v to 12v the voltage. UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port.

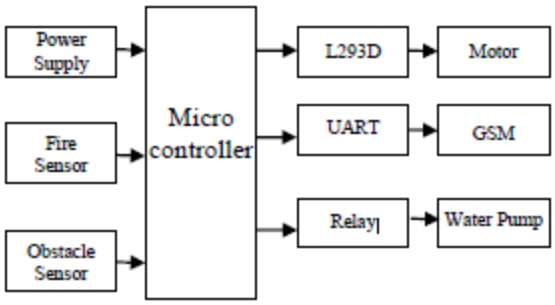

Fig.1. Block diagram of supervising Robot

IV. SENSORS

Much of the information a robot requires to perform its job comes from sensors. These are devices that collect information about the robot itself or some part of the world around it, and transmit it to the robot's computerized controller. Sight, hearing, touch and other senses, give it the means to think for itself. Sensors are transducers that convert a certain measurable quantity in the real world into an electric signal.

A. Ultrasonic Sensor

Ultrasound is very high frequency sound that cannot be heard by humans. Ultrasonic sensors rely on a principle known as echo-location to locate an obstacle. An ultrasonic sensor has two parts, a transmitter and a receiver. The transmitter sends out a signal as continuous pulses of ultrasound. If the pulses hit an obstacle they are reflected back towards the sensor. The time it takes for the signals to bounce back is converted into an exact measure of distance [6]. Ultrasonic sensing depends on the reflective surface or object's density, which affects its ability to reflect sound. Providing an object is dense enough to return the sound signal, ultrasonic sensors can tell whether the object is there, whether it is see-through or not. So ultrasonic sensors are the best choice for industrial robots designed to work with clear glass or plastic bottles and containers.

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The ultrasonic module measures the distance accurately which provides 0cm - 400cm with a gross error of 3cm. Its Fire compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping. The module can easily be interfaced to micro controllers where the triggering and measurement can be done to pin. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated.

B. Temperature Sensor

Temperature is the most-measured variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature sensors are the key to read temperatures correctly and to control temperature in industrials applications [9]. A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of environmental temperature.

In the temperature functional module we developed, we use the LM34 series of temperature sensors. The LM34 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Fahrenheit temperature. The LM34 thus has an advantage over linear temperature sensors calibrated in degrees Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Fahrenheit scaling. The LM34 does not require any external calibration or trimming to provide typical accuracies of ±1.2°F at room temperature and ±11.2°F over a full -50 to +300°F temperature range. The LM34 is rated to operate over a -50° to +300°F temperature range [9].

V. GSM TECHNOLOGY

GSM is a global system for mobile communication. GSM is an international digital cellular telecommunication. The GSM standard was released by European Telecommunication Standard (ETSI) back in 1989. The first commercial services were launched in 1991 and after its early introduction in Europe the standard went global in 1992. Since then, GSM has become the most widely adopted and fastest-growing digital cellular standard, and it is positioned to become the world's dominant cellular standard [7]. Today's second-generation GSM networks deliver high quality and secure mobile voice and data services (such as SMS/ Text Messaging) with full roaming capabilities across the world.

The GSM network architecture is now well established and with the other later cellular systems now established and other new ones being deployed, the basic GSM network architecture has been updated to interface to the network elements required by these systems. Despite the developments of the newer systems, the basic GSM system architecture has been maintained and the network elements described below perform the same functions as they did when the original GSM system was launched in the early 1990's GSM network architecture elements [8].

The GSM network architecture as defined in the GSM specifications can be grouped into four main areas:

- Mobile station (MS)
- Base-Station Subsystem (BSS)
- Network and Switching Subsystem (NSS)
- Operation and Support Subsystem (OSS)

The different elements of the GSM network operate together and the user is not aware of the different entities within the system.

A basic diagram of the overall GSM system architecture with these four major elements is shown in Fig. 2.

A. Mobile Station (MS)

Mobile stations (MS), mobile equipment (ME) or as they are most widely known as cell or mobile phones are the section of GSM cellular network that the user sees and operates. In recent years their size has fallen dramatically while the level of functionality has greatly increased.

A further advantage is that the time between charges has significantly increased. There are a number of elements to the cell phone, although the two main elements are the main hardware and the SIM. The hardware itself contains the main elements of the mobile phone including the display, case, battery, and the electronics used to generate the signal, and process the data receiver and to be transmitted. It also contains a number known as the International Mobile Equipment Identity (IMEI). This is installed in the phone during manufacture and "cannot" be changed. It is accessed by the

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network during registration to check whether the equipment has been reported as stolen [8].

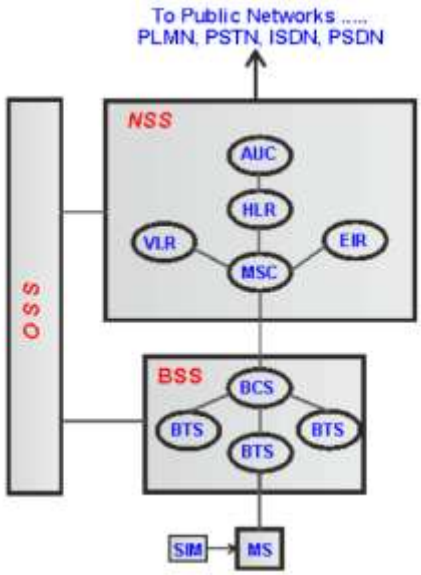

Fig.2. GSM architecture

B. Bast Station Subsystem (BSS)

The Base Station Subsystem (BSS) is the section of GSM network architecture that is fundamentally associated with communicating with the mobiles on the network. It consists of two elements:

- Base Transceiver Station (BTS): The BTS used in a GSM network comprises the radio transmitter receivers, and their associated antennas that transmit and receive to directly communicate with the mobiles. The BTS is the defining element for each cell.
- Base Station Controller (BSC): The BSC forms the next stage back into the GSM network. It controls a group of BTSs, and is often co-located with one of the BTSs in its group.

C. Network Switching Subsystem (NSS)

The GSM system architecture contains a variety of different elements, and is often termed the core network. It provides the main control and interfacing for the whole mobile network. The major elements within the core network include:

- Mobile Switching service Center (MSC)
- Home Location Register (HLR)
- Visitor Location Register (VLR)
- Equipment Identity Register (EIR)
- Authentication Center (AuC)
- Gateway Mobile Switching Center (GMSC)
- SMS-Gateway (SMS-G)

D. Operation and Support Subsystem (OSS)

The OSS or operation support subsystem is an element within the overall GSM network architecture that is connected to components of the NSS and the BSC. It is used to control and monitor the overall GSM network and it is also used to control the traffic load of the BSS. It must be noted that as the number of BS increases with the scaling of the subscriber population some of the maintenance tasks are transferred to the BTS, allowing savings in the cost of ownership of the system.

VI. ARDUINO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing, Max-MSP). The boards can be assembled by hand or purchased preassembled. The open-source IDE can be downloaded for free. The arduino programming language is an implementation of wiring, a similar physical computing platform, which is based on the processing multimedia programming environment.

VII. RESULTS

The circuit consists of AT mega 328 micro controller IC, motor driver LM293D IC, 7805 IC regulator, 12 V DC power supply, and 11.059 Mhz crystal oscillator. The circuit connections are made and the working of the robot is observed. The AT mega 328 micro controller requires a power supply of 5V DC. In order to provide regulated 5V DC voltage to the controller we use 7805 IC regulator. A 9V battery is used for giving the supply to the circuit and to run the DC motors. L293D IC is a motor driver, used to step up the

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voltage from 5 V to 12 V. The arduino software is used to run AT-mega 328 IC. The main feature of the arduino is its ability to read the data from sensors and send and receive digital signal from the GSM modem. Assuming that the control unit is powered and operating properly, the process of controlling a device connected to the interface will proceed through the following steps:

- The remote user sends text messages including commands to the receiver.
- GSM receiver receives messages sent from the user cell phone.
- GSM receiver decodes the sent message and sends the commands to the microcontroller.
- Microcontroller issues commands to the appliances and the devices connected will switch ON/OFF. And PCB design is done using "Express PCB" software.

Fig.3. System design

VIII. CONCLUSION

The research work that we have undertaken has helped us gain a better perspective on various aspects related to our course of study as well as practical knowledge of electronic equipments and communication. We became familiar with software analysis, designing, implementation, testing and maintenance concerned with the work. The system design is as shown in Fig. 3.

The prototype of the GSM based robot control device was efficiently designed. This prototype has facilities to be integrated with a robot thus making it truly mobile. The toolkit accepts the SMS, stores it, validates it and perform specific operations. The SMS is deleted from the phone each time it is read, thus making room for the next SMS. The end product will have a simplistic design making it easy for users to interact with. This will be essential because of the wide range of technical knowledge.

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