Sensing System using GSM & GPS.

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***Abstract*—Real-time wireless embedded sensing system demands platforms with a wide range of size, cost, power consumption, connectivity, performance, and flexibility also the improvement in the transmission range in wireless applications without the use of batteries remains a significant challenge. This paper discusses platform design techniques through the trade-offs of sensing devices, wireless interfaces, and a heterogeneous wireless network mostly powered by kinetic energy of animals reducing the number of batteries of the system. The system relies on radio communications and a global positioning system. The system allows tracking based on contextual information obtained from statistical data.**

***Keywords*— WESS, MCU, GPS, GSM, Kinetic energy harvesting.**

I .INTRODUCTION

Wireless embedded sensing systems (WESS) are innovations in science and engineering. Their applications range from defense and environmental monitoring to health, structural and business. Real-world wireless sensing applications are quite diverse and they impose a wide range of constraints on the system platforms, including the size, cost, power availability, wireless connectivity, performance, memory, storage, and flexibility.

End users of a real-world WESS application must often face the question of whether to purchase and use one of the existing sensor platforms or to build their own new platform. Existing platforms range from sensor nodes on the low end, such as with an 8-bit microcontroller (MCU) running thin software layer, to sensor computers on the high end, such as the 32-bit CPU running Linux. The lack of generally accepted quantifiable metrics for WESS platforms has made it nearly impossible to measure progress in this field [1].

In most wireless sensor networks, power is a constraint from both the technological and the ecological point of view. On the one hand, in a battery operated system, the system life-Time is directly related to the node battery lifetime. Moreover, in an animal tracking case, if thousands of animals must be monitored, the thousands of nodes must be battery operated. Therefore, high maintenance costs result and a tedious task of battery replacement will come up during a long term experiment. On the other hand, working in an outdoor large environment, the use of batteries might be harmful for the ecosystem. If we spread a large amount of battery-powered nodes throughout the environment, there is a great possibility that some nodes get lost, and therefore an unexpected pollution might arise.

The implementation tries to minimize the use of battery-powered nodes. This minimization is achieved by taking advantage of kinetic energy of animals. During the day, animals perform different actions which generate kinetic energy because of their movement [2].

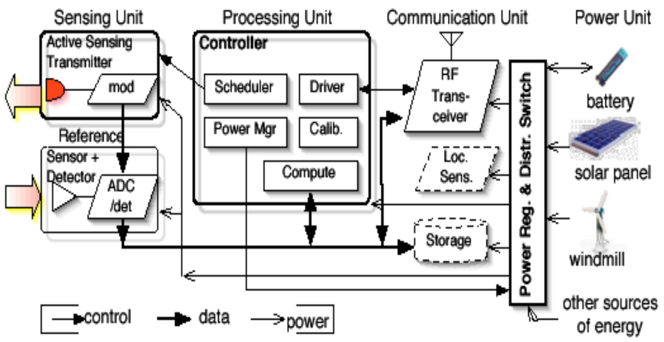

Fig. 1 General Architecture of Wireless Embedded Sensing System.

Fig.1 shows general WESS consisting analog sensors to collect data, ADC to convert analog data into digital form to save the power , processor for data acquisition , processing and to save processed data, power generator like battery, solar panel and windmill for biasing and transceiver (GSM) for communication with remote base station.

II. WESS CHARACTERIZATION

WESSs can be categorized into

- Event detection vs. Data acquisition vs. Data aggregation
- Passive vs. Active sensing
- Data logging vs. Real-time monitoring

A. Event detection Vs. Data acquisition Vs. Data aggregation

Examples of event detectors include temperature detectors, motion detectors, and pressure detectors, whose purpose is to determine the presence of temp., motion, and pressure above a chosen threshold, as opposed to their actual values. On the other hand, data acquisition sensors must report the magnitude of the event being monitored. And for Data aggregation [4] need only aggregated data. Such a WESS first collects data from sensing devices, stores them in the local memory, and runs aggregation algorithms. Then, the aggregated result will be transmitted. This scheme can save transmission power but requires more hardware resources such as a faster microprocessor and larger amount of memory for running relatively complex aggregation algorithms.

B. Passive vs. Active sensing

A passive sensor measures the readily observable signals on the subject. For a passive sensing system, all sensor devices look alike, as long as they have a voltage interface. As a result, some WESS platforms make sensor devices part of interchangeable modules that can be plugged in to the expansion slot. An active sensor emits a signal directed at the subject and measures its reflection. The signal may be an impulse, sinus social, or some constant intensity light, sound, or electromagnet netic wave. The sensor device may still output a voltage or a current, but its value over time must be further interpreted in order to extract any information encoded in the reflection. An example is sonar, which emits an impulse of sound and measures its echo to determine the distance from the subject. In this case, the *magnitude* of reflection is not important; it is the *time delay* of the echo that determines the distance [1].

C. Data logging Vs. Real-time monitoring

Virtually all wireless sensing applications require the collected data or detected event to be reported back to a base station. The difference is how urgently the reporting function must be executed. In case of hard real-time the response should be near-real-time that is, preferably instantaneous but tolerable up to a few seconds. For other applications such as habitat monitoring or Zebra net [4] where the goal is to collect statistics, then it is unnecessary to transmit data immediately. Instead, by logging the data or events in some nonvolatile memory and transmit in batch at a later time, it can potentially save energy through reduced communication overhead as well as better tracking of using harvested energy such as solar power [1].

III. CASE STUDIES OF SENSING APPLICATIONS

A. Habitat Monitoring

In the habitat monitoring application, sensor nodes are employed as miniature weather stations. They collect climatic data including humidity, air pressure, temperature, radiation and infrared at a wide range of locations ranging from tree tops to underground settings [5]. Existing system platforms for this application achieve energy-efficient operations through low duty cycling. This is possible because climate conditions are not expected to change dramatically within a short period of time, and thus monitoring applications sleep most of the time to conserve energy, waking up periodically for very short runtimes. Energy efficiency is achieved primarily through software control by maximizing the sleep time of the MCUs, GPS and the RF modules. Most MCUs today support low-power sleep mode and other low-power modes.

In recent decades different systems (Fig.2) have been designed for animal tracking. Some of them make use of satellites which locate the animal's position [12]. These systems allow the determination of the position of animals which have been equipped with a satellite emitting system. They have been widely used in turtle [13], duck [14] or whale [15] track- in. However, its use is extremely expensive and requires all the satellite transmitters in the animals to be updated in the satellite database. Moreover, satellites are not able to take more than some tens of measurements per day. Other implementations are based on GPS devices which allow a larger data rate update [16]. However, commercially available track- in systems lack the data storage capacity needed to collect animal location data frequently .These systems download data via satellite, mobile communications (GSM) or radio comma- inactions. However, satellite systems are excessively expended- save and GSM coverage is extremely limited in some areas within the Globe. Different researchers are working on energy harvesting systems which allow animal tracking systems to take advantage of renewable energy, avoid battery replace- mint, or reduce its use to a minimum. When energy harvest- in is applied to mobile sensor networks, the energy from ex- eternal power sources can be used to power the nodes and in- crease their lifetime.

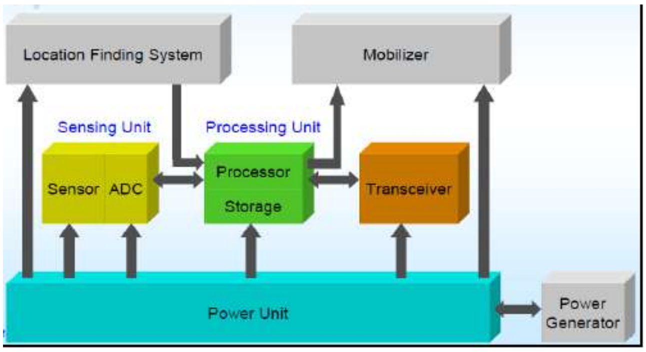

Fig. 2 Architecture of Wireless Embedded Sensing System with GPS.

The network architecture proposed is made up of three different elements: primary nodes, secondary nodes and base stations (see Figure 3). Primary and secondary nodes are mounted on animals and therefore are mobile nodes, while base stations are static nodes. Secondary nodes take kinetic energy from the animal movements which produce just enough power to create and transmit a unique identification (ID) to the environment. If a primary node is within the range of transmission, it receives and stores the transmitted ID. Moreover, primary nodes are able to obtain their global position thanks to a Global Positioning System (GPS) which can be switched on and off depending on the final application needs. Moreover, while the primary node is moving in the environment, it creates a table with the different secondary nodes IDs received, their approximated position and the time when the transmission was produced. When a primary node enters within the base station communication range, it downloads all the information acquired from the secondary nodes along with its own trajectory information. A base station is a static battery-powered node which has access to the Internet and is able to offer the data to a final monitoring system. Therefore, once the base station receives the data dumped by the primary node, it will send it to the monitoring system. This monitoring system will receive information from different base stations; hence it will merge all the information and supply it to the final user.

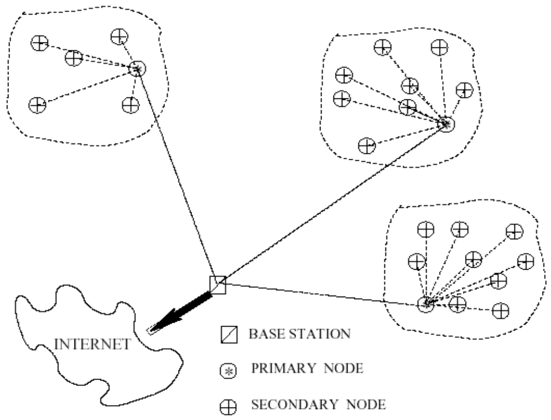

Fig. 3 Network
Architecture

B. Structural Health Monitoring

Structural health monitoring refers to sensing and extract ion of features that quantify the integrity of a structure and its ability to perform its intended function given aging and degradation over time. They are applicable to a wide range of systems from airplanes and many mechanical structures, highway bridges and skyscrapers. Proposed techniques analyze strain or ambient vibration on the order of milli-g (where g is a unit of acceleration that is equal to the earth's gravity). WESSs for this application belong to data acquisition, real-time monitoring, and passive sensing. Unlike habitat monitoring, the much higher duty cycling requirement means there is little or no opportunity for dynamic power management. Another limiting factor is the noise problem in the sampled signal. Noise can be reduced by use of regulators.

IV. ENERGY CONSUMPTION

This section discusses techniques for achieving energy efficiency on the consumption side. The power consuming side of WESS system architecture consists of the MCU, sensor devices, and RF. The RF and the actuator normally consume the most power. Even though the MCU is usually not the highest power consumer, and more generally the processing elements (PE) and the associated architecture, can make the greatest difference in improving system-level energy efficiency. This section discusses the selection of PE and wireless interfaces for efficient energy consumption.

A. Processing Elements

To define a system architecture, designers typically starts by selecting an MCU. The choices can be based on considetions for performance, software, built-in I/O interfaces, and power management capabilities.

1) Performance: We divide WESS architectures into sensor nodes and sensor computers. A sensor node normally uses an 8-bit or 16-bit MCU with limited memory and the primary purpose is to control the other modules in the system. On the other hand, sensor computers are modeled after general purposes computers with a 32-bit CPU running an OS. (ARM Controller LPC-2148) these powerful CPUs are used to support Linux or a real-time OS.

2) Integrated I/O: Many low-power 8-bit MCUs have built in I/O interfaces. For sensor nodes that are size-constrained, hav ing extra I/O resources will waste valuable board area, while not having sufficient I/O will require external components and extra power for the glue logic. ARM controller having 10-bit single ADC and 45 fast GPIO.

3*) Memory:* MCUs like any computer require both program memory and data memory. Programs usually reside in flash memory, which may be on-chip or off-chip. RAM sizes are usually much smaller because of the high power consumption, but RAM is faster than flash. In fact, although it is possible to run many MCU programs directly out of flash, one can see significant speedup by loading program from flash into RAM and run from RAM.

B. Wireless Connectivity

Wireless is usually the highest power consumer in passive sensing systems. Most WESSs use radios for wireless communication. Infrared (IR) can have a peak bandwidth of 4Mbps. It is inexpensive, does not cause and is immune to electromagnetic interference that may be present in the sensing environment. IR is works particularly well for very dense, mainly indoors deployment. One advantage is that nodes in adjacent rooms do not interfere with each other. However, IR is prone to interference by fluorescent light and sun light. The choice of RF interface is determined by the requirements on transmission range, data rate, usage pattern and purpose, and the power and energy budget. We focus our discussion on the choice of radios and their interactions with the battery.

1) Choice of Radios: Today's approaches can be divided into three groups: custom radio, commercial off-the shelf (COTS). Some researchers implement custom radios for ultra-low power, better integration, or scalability, while others choose commercial off-the-shelf interfaces. Higher data rates are allowed in the 902–928MHz, 2400–2483MHz, 5725–5875MHz, and 24–24.25GHz bands, though not exceeding 1mW; or up to 1W if spread spectrum is used [6]. Many sensor nodes use commercial off-the-shelf radios such as 802.11 and Bluetooth. Class 1 Bluetooth can transmit up to 100m at up to 721kbps, while Classes 2 and 3 are up to 10m. Bluetooth devices can form a piconet with one master and up to seven active slaves.

2) Radio Power: Because radio is usually the largest power consumer, optimizing radio power can result in significant improvement at the system level. Many radios allow the user to set the power level. For instance, the CC1000 has 23 levels of transmission power, from -20 dBs to +10 dbs. Setting the transmission power high will result in higher SNR (signal to-noise ratio) and lower BER (bit-error rate), but at the same time it could increase interference with farther radios More importantly, drawing higher current than the rated current of the given battery will decrease the battery efficiency, due to the rate capacity effect. On the Mica2DOT sensor node, the CR2354 lithium coin battery has a rated current of 0.2mA. [7].

V. ENERGY SUPPLIES

A. Maximum Power Point Tracking (MPPT)

WESSs are powered by mostly non-ideal sources. Ambient sources such as solar and wind tend to have a much wider dynamic range and unpredictable availability. Impedance mismatch wastes available power by drawing current at a sub- optimal level. If not impedance matched, then the system can easily get <1W of power even though up to 3W may be avail- able at the given light intensity. For a given light intensity of a solar panel, the voltage/current level that maximizes the out- put power is called the maximum power point (MPP). Numerous methods proposed to date for tracking the solar cell include the hill climbing method; short-circuit method, and open-circuit voltage method [8]–[11]. The hill climbing method of sweeping solar voltage while measuring the current requires a great deal of circuitry in the form of a DSP, FPGA, or MCU to calculate the MPP. The power needed to run those chips is too high to keep the converter efficient. The short circuit method entails shorting the solar cell and measuring the short circuit current, which directly determines the MPP Finally, the open-circuit voltage method simply requires disconnecting the solar cell from any load and measuring the open- circuit solar voltage, which again is directly related to the MPP. The latter two methods are not as accurate as the hill climbing method, but the complexity and overhead power make the former inefficient. Once the MPP is found, then the problem becomes how to make the system draw the optimal current. One way is to keep the system's duty cycle the same while varying the power drawn from the solar panel or battery. Another approach is to vary the system's duty cycle or algorithms, to the extent allowed by the application.

B. Systems with Multiple Power Sources

Some sensor nodes now include multiple power sources to replenish the charge over time. They include solar panels, windmills, and other energy scavenging mechanisms. For in- stance, Zebra net [4] contains a solar that generates up to 5W, in addition to 14 Sony Li-ion polymer cells. It requires this much power mainly for long distance communication, even though the duty cycle is relatively low.

Partitioning the power supplies between sensors and digital parts can also help reduce noise. One way to reduce power fragmentation is a combination of a power distribution switch and a source-consumption matching algorithm that maximizes the total utility of the available power from these ambient power sources. The switch contains power transistors that enable each power source to be connected to a set of power consumers. This scheme has been reclaim 25%–50% of the power that would be wasted by conventional designs. By making more efficient use of the available power, the system can be designed to be more compact, operate for longer time, and even slow down the aging process of batteries due to frequent recharge cycles.

C. Super capacitors

One solution that slows down battery aging is to place a super capacitor in parallel with the battery so that transient power is delivered by the capacitor rather than the battery. Fewer and shorter current pulses drawn from the battery allow more efficient use of battery capacity and increase the number of charge cycles possible. Super capacitors have received wide attention recently due to their power density, low equivalent series resistance (ESR), and very low leakage current. A typical super capacitor offers more than half a million charge cycles and a 10-year operational lifetime until the capacitance is reduced by 20%. One could not simply replace a battery with a super capacitor because of the very different electrical characteristics and efficiency considerations.

D. Kinetic energy harvesting module

The kinetic module is divided into a magnetic-coil generator and a regulator circuit. The generator is designed with a cylindrical tube with two coils located at each end of the tube and a "Neodymium-Boron-Iron" magnet inside the tube (see Figure 4).When the generator is tilted, the magnet moves through the coils and it generates a voltage which follows Lenz law.

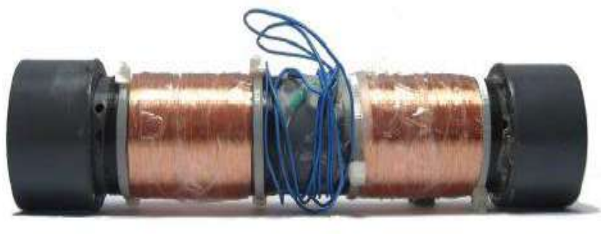

Fig. 4 The magnetic kinetic energy module.

As the magnet goes through one of the coils, a voltage cycle occurs. Figure 5 shows the voltage waveform at the coil output in a swing of the magnet. Notice that the magnet starts at one end of the tube, and passes through the first coil (first positive cycle), moves out of the first coil (first negative cycle), passes through the second coil (second positive cycle) and finally comes out of the second coil (second negative cycle).

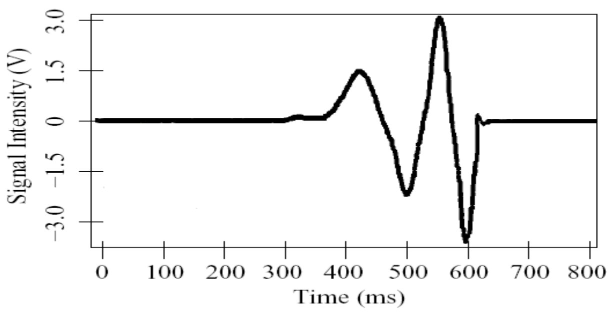

Fig. 5 Waveform at the output of the magnetic kinetic generator module, after a full swing.

VI. CONCLUSION

This paper highlights issues to consider when choosing an existing WESS platform or building one's own. Many challenges remain in the cross-disciplinary optimization. It also describes a heterogeneous mobile sensor network for animal tracking. The system tries to minimize the use of battery- powered nodes to a minimum which satisfies future real animal experiments and provides the means for animal localization. The system is based on the assumption that animals car- rying kinetic-powered (secondary) nodes are tracked by their neighbors and their positions are approximated by the ones carrying battery powered (primary) nodes. Therefore, primary nodes keep track of the information sent by secondary nodes and can download it to a base station when they enter its coverage range, a GPS to obtain its position periodically to communicate with the base station with GSM.

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Controlling Applications using Pico Blaze based Embedded System with FPGA Device.

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***Abstract*—Xilinx has developed an 8-bit core microprocessor Pico Blaze that can be synthesized in the following FPGA families (in its KCPSM3 version): Spartan3, Virtex-II and Virtex IIPro. This paper presents different peripherals that can be developed to interface with Pico Blaze: LCD control, VGA control, serial communication, PS/2 keyboard and USB port. The complete embedded system has been implemented by using Pico Blaze and some typical control and monitoring systems have been developed using Spartan-3 FPGA board to demonstrate its functionality and capabilities. The design approach of the peripherals and details of the integration of the systems are explained.**

***Keywords*— FPGA, LCD, VGA, PS/2, USB.**

I. INTRODUCTION

Design of mid-to high-complexity systems has become fairly manageable in the digital system design arena with the advent of programmable logic, in the form of Complex programmable Logic Devices (CPLD), Field Programmable Gate Arrays (FPGA) and hardware description languages, such as Verilog and VHDL languages.

While customizable embedded systems are currently available in the form of FPGA boards [2], designers are required to have a solid working experience in the FPGA intricacies as well as mastering a set of design tools for customizing hardware and software components of the system. For the implementation of embedded systems devoted to basic control and monitoring applications, the requirements of design experience and tool mastering are far excessive.

Xilinx has come up with a solution for those designs that have modest processing requirements and yet require the presence of a microprocessor: Pico Blaze [3]. Pico Blaze is an 8-bit microprocessor soft core aimed to replace large finite-state machines in low- to mid-complexity designs. In its current release, Pico Blaze comes equipped, among other features, with a basic interrupt handling module, generic input/output communication ports and a hardware stack, giving the opportunity to be fully customized according to the designer's needs.

This paper consists of the customization of an embedded system by adding a set of peripherals, described in VHDL, that are intended to extend the capabilities of Pico Blaze. It also consists of the implementation of basic monitoring tasks built around this Pico Blaze based embedded system.

The paper is organized as follows. Section two briefly reviews the capabilities and features of Pico Blaze. Section three provides details of the design of the peripherals that interact with Pico Blaze. Section four presents the characteristics of the complete embedded systems. Section five lists the specification of the monitoring systems that are to be built around the Pico Blaze embedded system. Section six draws conclusions and outlines future work.

II. PICOBLAZE MICROPROCESSOR

The Pico Blaze soft microcontroller is an 8-bit Reduced Instruction Set Computer (RISC) microprocessor from Xilinx Corp., which supports an 8-bit data bus and 16-bit instruction bus. It has the Harvard architecture with separate data and instruction ports. It currently supports 49 instructions that operate within any one of several Xilinx Cool Runner™-II CPLDs (complex programmable logic device); it has 100% digital core with low power consumption and high-speed execution. Its speed will vary depending on executed instructions and the implementation platform. However, since it is tiny and has small instruction space, its functionality is not as strong as the traditional single chip computer. Although it has its own assembler, it does not have C/C++ compiler. So a user has to learn its assembly language, which is close to the 8086/8088 or M68K instruction set. Because of these characteristics, the Pico Blaze is a compact structure suitable for the neural network implementation in hardware.

We can use the Pico Blaze KCPSM3 (Programmable State Machine) processor designed by Ken Chapman, Xilinx which is freely available The KCPSM3 processor is a simple 8bit CPU that can be synthesized in the following FPGA families (in its KCPSM3 version): Spartan3, Virtex-II and Virtex II Pro [4].The KCPSM3 version of the Pico Blaze core has 16 registers, 64 bytes of scratch pad memory, interrupts, fixed-size stack and a very simple 8bit I/O bus. The only function not included is the instruction store. All instructions execute in exactly 2 clock cycles, and there is a HW support for interrupt handling. The Pico Blaze microcontroller is optimized for efficiency and low deployment cost. It occupies just 96 FPGA slices, or only 12.5% of an XC3S50 FPGA and a miniscule 0.3% of anXC3S5000 FPGA. In typical implementations, a single FPGA block RAM stores up to 1024 program instructions, which are automatically loaded during FPGA configuration. Each Pico Blaze instruction is 18 bits wide. Even with such resource efficiency, the Pico Blaze microcontroller performs a respectable 44 to 100 million instructions per second (MIPS) depending on the target FPGA family and speed grade. Fig. 1. Shows the internal components of Pico Blaze. Pico Blaze consists of three VHDL modules. Two internal components: (1) KCPSM3 module contains the Pico Blaze ALU, register file, scratchpad RAM, etc. encapsulates the operation of the microprocessor and (2) Some form of internal memory typically a block RAM, provides the Pico Blaze instruction store. To effective create an on-chip ROM, the block RAM's write enable pin, WE, is held Low, disabling any potential write operations. Both components are encapsulated by a third parent component.

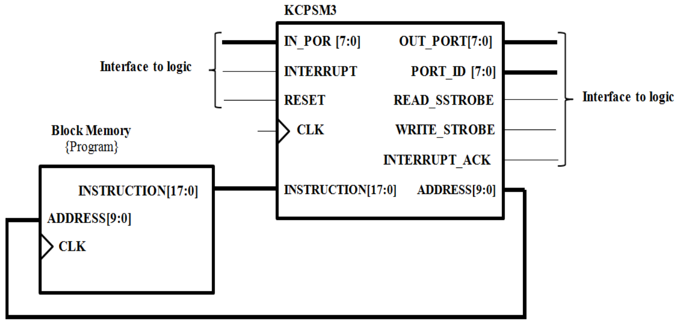


Fig. 1 Internal components of Pico Blaze (after [4])

A. Assembly programming

In its current release, Pico Blaze is programmed in assembly language. The instruction set is composed of fifty seven instructions, which can be classified as:
Program control, arithmetic, logic, interrupt and input/output.

B. Microprocessor capabilities and Features

- 16 byte-wide general-purpose data registers.
- 1K instructions of programmable on-chip program store, automatically loaded during FPGA configuration.
- Byte-wide Arithmetic Logic Unit (ALU) withCAR-RY and ZERO indicator flags.
- 64-byte internal scratchpad RAM.
- 256 input and 256 output ports for easy expansion and enhancement.
- Automatic 31-location CALL/RETURN stack.

- Predictable performance, always two clock cycles per instruction, up to 200 MHz or100 MIPS in a Virtex- II Pro FPGA.
- Fast interrupt response; worst-case 5 clock cycles.
- Optimized for Xilinx Spartan-3 architecture - just 96 slices and 0.5 to 1 block RAM.
- Support in Spartan-6, and Virtex-6 FPGA architectures
- Assembler, instruction-set simulator support.

C. Development flow and tools

The assembly language code that is to be run by Pico Blaze is developed as a text file with a asm extension. This file is fed into the KCPSM3 program to generate the program memory as a VHDL module, which can then be attached to the microprocessor. This way, the debugging process of the microprocessor can entirely be conducted in the hardware side.

III. INTERFACING PERIPHERAL BLOCKS

The selection of the peripherals that had been added [8] to the system has been based on the capabilities of the Spartan-3 FPGA board [5], a schematic of which is shown in Fig. 2.Among the main features of the board are: eight LED, eight slide buttons, four push buttons, 1 Megabyte of static RAM, PS2 keyboard socket and three 40-pin expansion connectors. The peripherals that had been developed [8] are: an LCD controller, a PS/2 keyboard controller, a VGA controller and a serial communication module. Details of design are given next.

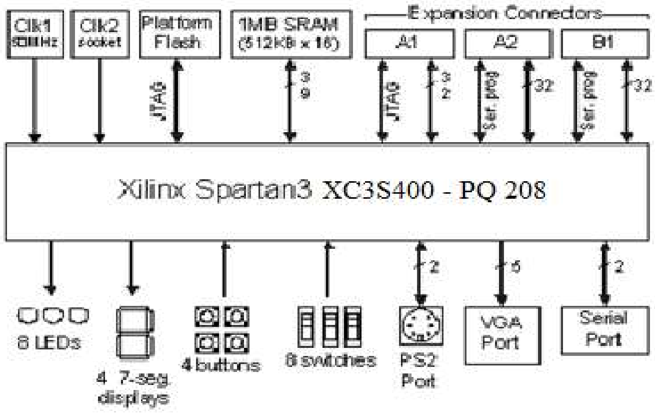
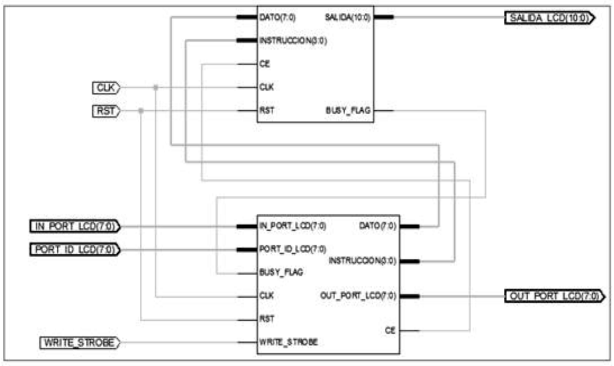


Fig. 2 Schematic diagram of the Spartan-3 FPGA board (after [5])

A. LCD controller

This peripheral is composed of two blocks: (1) a FSM that handles the initialization and low-level communication with the LCD and (2) registers and a basic decoder, which drive the FSM and allow the interfacing with Pico Blaze. Figure 3 shows the diagram of the LCD controller, as generated by the synthesis tools [6] [8].



It can be seen from Fig. 3. The ports of Pico Blaze that the LCD controller is expected to be attached to. The outputs of the LCD controller are mapped to coincide with some pins of the expansion connector B1 of the Spartan-3 board [5].

B. Serial communication

The Pico Blaze development kit provided by Xilinx includes a VHDL description of a basic UART. Likewise, Spar-tan-3board provides all the facilities to enable serial communication: a DB-9 port and a voltage-level shifter circuit.

In order to enable Pico Blaze to handle a UART as a peripheral, both the transmitter (TX) and receiver (Rx) modules have been encapsulated along with an interface module. This interface allows Pico Blaze to operate the UART by accessing a set of registers.

The register-based interface of the UART supports the following features

- Enabling/disabling TX interrupts
- Enabling/disabling Rx interrupt
- Clearing TX and Rx interrupt flags
- Writing the TX data
- Reading the Rx data

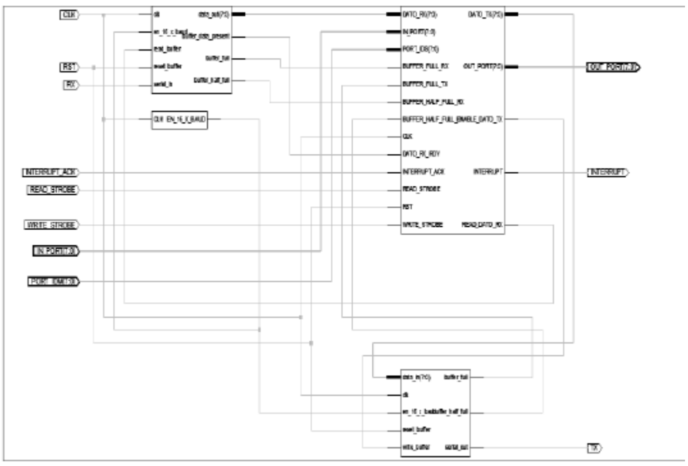


Fig. 4 Serial communication peripheral

C. VGA controller

The VGA controller is made up of three blocks: a Pico Blaze interface block, a refreshing controller and the SRAM. The interface block allows Pico Blaze to address any pixel in the frame in terms of position and color by accessing a set of registers. The refreshing controller is an autonomous controller that drives the screen continuously complying with the raster scan scheme. Fig. 5. Shows the external view of the VGA controller [8]. At the Right-hand side of the block are the pins that communicate with Pico Blaze and at the left hand side are the pins that control the SRAM and the synchronization and video signals of the screen.

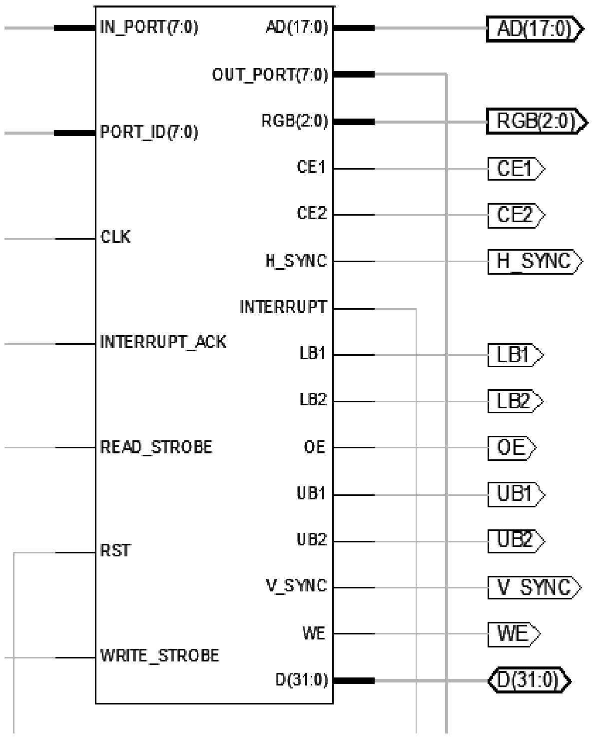


Fig. 5 Keyboard controller

D. PS/2 keyboard controller

A controller that allows the communication between Pico Blaze and a PS/2 keyboard has been developed. This design is based on a controller that has been previously reported [7]. However, a set of registers has been added to the controller to facilitate the communication with Pico Blaze. Fig. 6. Shows a diagram with the internal organization of the keyboard controller [8], as generated by the synthesis tool.

The implemented communication with the keyboard has only one direction: from the keyboard to Pico Blaze. The communication routine in assembly language code is based on the interrupt capability of Pico Blaze.

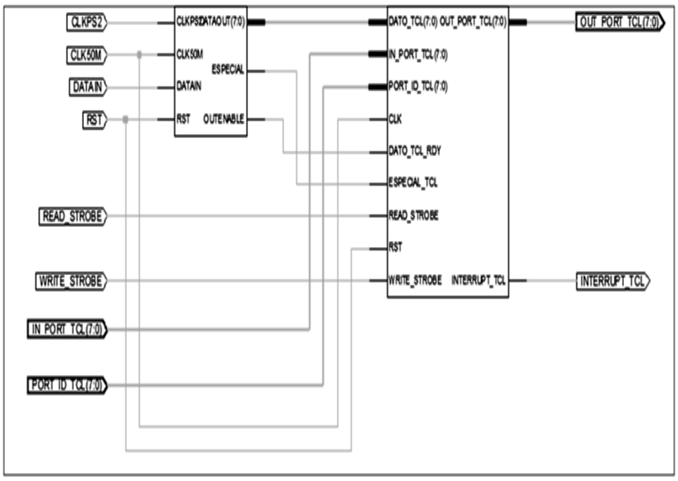


Fig. 6 Keyboard controller

E. Complete embedded system

The four peripherals presented in the previous section have been integrated along with a single instantiation of Pico Blaze. Since each peripheral is provided with a set of registers that Pico Blaze can access, all the registers have been given an identifier so that Pico Blaze can use it to access a specific register.

The complete embedded system has been used in the implementation of five traditional monitoring tasks to demonstrate its functionality. The working environment of these monitoring applications are as follows: keyboard and VGA monitor represent the workstation where the system is allocated, while the serial communication module enables a remote access to the system in order to either query the present condition of the task or reconfigure the operation of the system. Next session provides brief discussion about monitoring applications.

IV. MONITORING APPLICATIONS

Each application can be synthesized by Xilinx ISE and implemented in the FPGA board of Fig. 2.

A. Temperature monitoring system

This system emulates the deployment of four temperature sensor in a house. The temperature measured by the sensors is visually shown in the screen of the system and in text format sent to a remote computer via serial communication.

Sensors can be switched on and off via commands from a Keyboard and from a remote computer.

B. Light Control

This system controls the lights of a house. Switching on and off a light is commanded via the keyboard or serial communication. The current state of each light can be visually verified on the screen of a monitor. Additionally, each light can be assigned a timer that after an expiration time can switch the light on or off.

Fig. 7. Shows the real life example to control the electrical appliances in home in which Computer / Pico Blaze situated in bedroom number 1 is acting as a master and other electrical devices like bulbs, tube lights, TV, fans etc. are acting as a slaves to the main master. The Pico Blaze sends the command to the computer which controls the switching of all electrical devices in and out of the room. Every electrical device will be having relay at the main power supply which is controlled by the master Pico Blaze. So by sending the data from Pico Blaze we can control the electrical appliances in home.

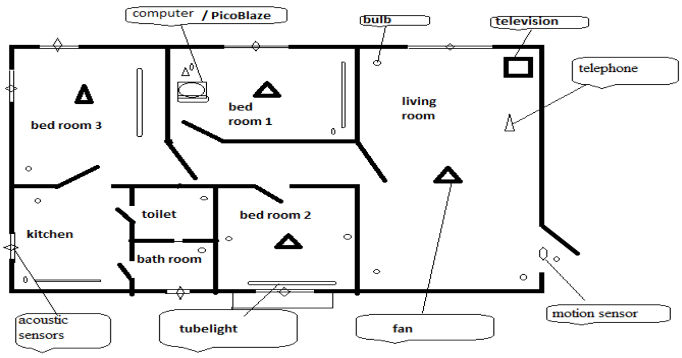


Fig. 7 Light control and security system for house using Pico Blaze

C. Sensor activity control

A deployment of four proximity sensors in a house is emulated. The activation and deactivation of the four sensors is under control of either a remote computer via serial communication (GUI) or in situ via keyboard.

When activated, a sensor that detects a person in a room sends an alert message to the remote computer and to the screen of the system. This message consists in highlighting the room both in the GUI and in the screen of the system. .Fig. 7 also shows security system for our house using Pico Blaze or the master computer. When the owner or nobody there in house the master computer will secure the whole house using sensors at different parts of the house like windows and doors. In case of burglar the master computer will sense the sensor and using the telephone lines will dial the control room of police and set the alarm.

D. Speed control of DC motors.

The Pico Blaze system is in charge of controlling the speed of four DC motors using the PWM technique. Each motor can be in one of three conditions: switched off, PWM controlled and full speed. The condition of the four motors and the percentage of the PWM control can be visually shown in the screen of the system and in text format in a remote computer via serial communication.

E. Temperature alarm system

The real-time measurement of four temperature sensors can be shown in the screen of a Pico Blaze system. The screen can be evenly divided in four regions and in each region a grid is drawn to facilitate the visual measurement of the temperature.
In fig. 7 some of the sensors can be assigned a temperature threshold. If the temperature measured by a sensor surpasses the threshold value then alarm in a text format is sent to a remote computer via serial communication.

V. CONCLUSION AND FUTURE WORK

The design of four peripherals for Pico Blaze soft core microprocessor has been presented. The design approach consisted in VHDL descriptions and register based interfaces. Five monitoring and control applications can be developed around Pico Blaze and also the designed peripherals can be implemented in the Spartan-3 FPGA board.

The Spartan-3 FPGA family is optimized for lowest cost. Unless the end application requires absolute performance, there is no need to operate the Pico Blaze microcontroller at its maximum clock frequency. In fact, operating slower is advantageous. Often, the Pico Blaze microcontroller is managing slower peripheral operations like serial communications or monitoring keyboard buttons, neither of which stresses the FPGA's performance. A lower clock frequency reduces the number of idle instruction cycles and reduces total system power consumption.

A limitation that some of the applications faced were the program memory of Pico Blaze. This led to the inclusion of more Pico Blaze instances in the system. Exploration of schemes of communication between microprocessor instances is underway.

Most of the Microcontrollers available in the market are equipped with built in UART circuit. USB is a highly growing technology applied for implementing high speed serial data transfer. The availability of a Microcontroller with a USB interface is limited. Several techniques may be used to build a microcontroller circuit with USB.

ACKNOWLEDGEMENTS

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We also extend our thanks to VJTI Staff, library staff for providing every possible help to write this paper.

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Vehicle Identification by Plate Recognition

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Abstract- **License Plate Recognition is an effective form of AVI systems. In this study, a smart and simple algorithm is presented for vehicle's license plate recognition system. The proposed algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. For extracting the plate region, edge detection algorithms and smearing algorithms are used. In segmentation part,smearing algorithms, filtering and some morphological algorithms are sed. And finally statistical based template matching is used for recognition of plate characters. A Graphical User Interface has been created and the algorithm is experimented successfully on a variety of real images, both single as well as double line plates. The sample results obtained on testing with various images are also detailed.**

Keywords- **Character recognizer, license plate recognition, plate region extraction, segmentation, smearing, template matching.**

I. INTRODUCTION

Vehicle identification is an essential stage in intelligent traffic systems. Nowadays vehicles play a very big role in transportation. Also the use of vehicles has been increasing because of population growth and human needs in recent years. Therefore, control of vehicles is becoming a big problem and much more difficult to solve. Automatic vehicle identification systems are used for the purpose of effective control. License plate recognition (LPR) is a form of automatic vehicle identification. It is an image processing technology used to identify vehicles by only their license plates. Real time LPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads [1]. Since every vehicle carries a unique license plate, no external cards, tags or transmitters need to be recognizable, only license plate. So many researches of car identification have been approached by car license plate extracting and recognition, some of the related work is as follows. Lotufo, Morgan and Johnson [2] proposed automatic number-plate recognition using optical character recognition techniques. Johnson and Bird [3] proposed knowledge-guided boundary following and template matching for automatic vehicle identification. Fahmy [4] proposed bidirectional associative memories (BAM) neural network for number plate reading. It's appropriate for small numbers of patterns. Nijhuis, Ter Brugge, Helmholf J.P.W. Pluim, L. Spaanenburg, R.S. Venema and M.A.Westenberg [5] proposed fuzzy logic and Neural networks for car LPR. This method used fuzzy logic for segmentation and discrete-time cellular neural networks (DTCNN'S) for feature extraction. Choi [6] and Kim [7] proposed the method based on vertical edge using Hough transform (HT) for extracting the license plate. E.R. Lee, P.K. Kim and H.J. Kim [8] used neural network for color extraction and a template matching to recognize characters. S.K. Kim, D.W. Kim and H.J. Kim [9] used a genetic algorithm based segmentation to extract the plate region. Tavsanoglu and Saatci [10] proposed an approach to form orientation map as recognition feature using a Gabor filter for recognizing characters.

Yoshimura and Etoh [11] used Gabor jets projection to form a feature vector for recognizing low resolution gray- scale character. Hontani et.al. [12] proposed a method for extracting characters without prior knowledge of their position and size in the image. Park et. al. [13] devised a method to extract Korean license plate depending on the color of the plate. H.J. Kim, D.W. Kim, S.K. Kim, J.V. Lee, J.K. Lee [14] proposed a method of extracting plate region based on color image segmentation by distributed genetic.

II.PLATE REGION EXTRACTION

Plate region extraction is the first stage in this algorithm. Image captured from the camera is first converted to the binary image consisting of only 1's and 0's (only black and white). by thresholding the pixel values of 0 (black) for all pixels in the input image with luminance less than threshold value and 1 (white) for all other pixels. Captured image (original image) and binarized image are shown in Figure 1(a) and 1(b) respectively.

Fig. 1 (a) Captured image

Fig. 1 (b) Binarized image

To find the plate region, firstly smearing algorithm is used. Smearing is a method for the extraction of text areas on a mixed image. With the smearing algorithm, the image is processed along vertical and horizontal runs (scan-lines). In this system, threshold values are selected as 10 and 100 for both horizontal and vertical smearing. If number of 'white' pixels < 10 ; pixels become 'black' Else ; no change If number of 'white' pixels > 100 ; pixels become 'black' Else ; no change After smearing, a morphological operation, dilation, is applied to the image for specifying the plate location. However, there may be more than one candidate region for plate location. To find the exact region and eliminate the other regions, some criteria tests are applied to the image by smearing and filtering operation. The processed image after this stage is as shown in Figure 2(a) and image involving only plate is shown in Figure 2(b).

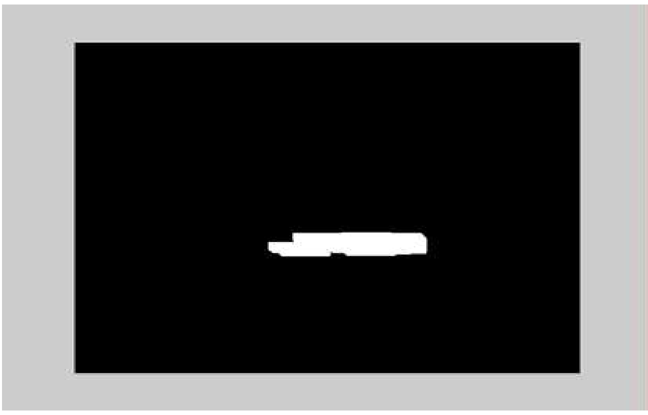

Fig. 2 (a) Plate region

Fig. 2 (b) image involving only plate

After obtaining plate location, region involving only plate is cut giving the plate as shown in Figure 3.

Fig. 3 Plate Image

III. SEGMENTATION

Then dilation operation is applied to the image for separating the characters from each other if the characters are close to each other. After this operation, horizontal and vertical smearing is applied for finding the character regions. The result of this segmentation is in Figure 4.

Fig. 4 Locations of plate characters

The next step is to cut the plate characters. It is done by finding starting and end points of characters in horizontal direction. The individual characters cut from the plate are as follows in Figure 5.

Figure 5.The individual characters cut from the plate

IV. CHARACTER RECOGNITION

Before recognition algorithm, the characters are normalized. Normalization is to refine the characters into a block containing no extra white spaces (pixels) in all the four sides of the characters. Then each character is fit to equal size as shown in Figure 6.

Fig. 6 Equal-sized characters

Fitting approach is necessary for template matching. For matching the characters with the database, input images must be equal-sized with the database characters. Here the characters are fit to 36 18. The extracted characters cut from plate and the characters on database are now equal-sized. The next step is template matching. Template matching is an effective algorithm for recognition of characters. The character image is compared with the ones in the database and the best similarity is measured. [15] This method measures the correlation coefficient between a number of known images with the same size unknown images or parts of an image with the highest correlation coefficient between the images producing the best match. There are two forms of correlations: auto-correlation and cross-correlation. Auto-correlation function (ACF) involves only one signal and provides information about the structure of the signal or its behavior in the time domain. Cross-correlation function

(CCF) is a measure of the similarities or shared properties between two signals.This system used the database as the Turkish license plates characters all 33 alphanumeric characters (23 alphabets and 10 numerals) with the size of 36 18. The database formed is shown in Figure 7.

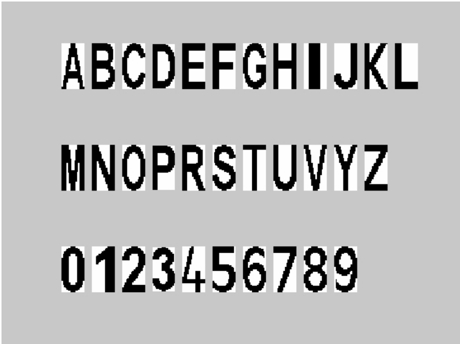

Fig. 7 The database characters

Because of the similarities of some characters, there may be some errors during recognition. The confused characters mainly are B and 8, E and F, D and O, S and 5, Z and 2. To increase the recognition rate, some criteria tests are used in the system for the confused characters defining the special features of the characters.

V. EXPERIMENTALRESULTS

Experiments have been performed to test the proposed system and to measure the accuracy of the system. The system is designed in Matlab 6.5 for recognition of Turkish license plates. The images for the input to the system are colored images with the size of 1200 1600. The test images were taken under various illumination conditions. The results of the tests are given by Table I.

Table I. The results of the tests

Units of LPR system	Number of Accuracy	Percentage of accuracy
Extraction of a plate region	332/340	%97.6
Segmentation	327/340	%96
Recognition of character	336/340	%98.8

It is shown that accuracy for the extraction of plate region is %97.6, %96 for the segmentation of the characters and %98.8 is the percentage of accuracy of the recognition unit.

VII. CONCLUSION

In this paper, we presented application software designed for the recognition of car license plate. Firstly we extracted the plate location, then we separated the plate characters individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters. This system is designed for the identification Turkish license plates and the system is tested over a large number of images. Finally it is proved to be %97.6 for the extraction of plate region, %96 for the segmentation of the characters and %98.8 for the recognition unit accurate, giving the overall system performance %92.57 recognition rates.

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An Exploration of RTOS with QNX

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Abstract— **Maximum performance is key to every computer OS. However, different operating systems are optimized to provide high performance in different areas. Picking a RTOS requires a great deal of research in order to find the right match. Look for a RTOS that is scalable and modular so that you can easily adapt it to fit your needs. This paper gives more valuable information about QNX as Real time operating system and how it become important in today's real time embedded applications. QNX is modular and scalable, reliable. QNX is optimized to handle interrupt service quickly and predictably. Predictably means that the programmer can calculated exactly how long it will take the OS to start servicing an interrupt once it has occurred**

***Keywords*— RTOS, LynxOS, RTLinux, the QNX Neutrino real time OS, Microkernel architecture.**

I. INTRODUCTION

Many people associate real-time with fast. However, this is not the definition of real-time. Real-time means a known amount of work will be done in a known amount of time [13]. For example, a signal comes into a port from an I/O device requesting more data. Within 5 ms, a new block of data is sent to the I/O device. In a real-time system, the I/O device will get that data within 5 ms every time it asks for it. In a non-real-time system, this 5ms response time could not be guaranteed.

According to the official FAQ of the company real- time newsgroup, a real-time operating system must have five core features [3]. It must be multi-threaded. There must be thread priority. The OS must support thread synchronization [14]. A priority inheritance system must exist. All OS behavior must be known. Thus, the manufacturer should be able to give you three specific values. They are interrupt latency, the time required to complete each system call, and the amount of time that interrupts are masked (disallowed) [14].

A good RTOS, or any OS for that matter, should have good documentation, a good set of development tools, and have support for as much hardware as possible [9]. A kernel can only be as good as the applications and hardware that it is running [9].

II. SYSTEM PERFORMANCE

Maximum performance is key to every computer OS. However, different operating systems are optimized to provide high performance indifferent areas. Previous versions of LynxOS had the standard monolithic-type kernel architecture and QNX have microkernel architecture [10]. However, instead of starting different processes to handle system tasks, Lynx OS glues additional plug-ins onto the kernel. This cuts down on the amount of process context switching that has to be done [1]. However, this does cut down on the modularity somewhat. With Lynx, you can pick what parts of the original kernel you want to load, but it does give you the expandability the QNX does, such as the ability to run multiple file systems concurrently [2]. Both QNX and LinuxOS attempt to look like UNIX, more specifically, Linux. Actually, Linux is not a real-time operating system. It simply cannot always react quickly enough to an interrupt. Under RT-Linux a new real-time kernel is added in-between the hardware and the original kernel [12]. The new kernel assigns the lowest priority to the old kernel. Interrupts are handled on a real-time basis and then the Linux kernel is allowed to run user processes in the remaining time. Since Linux is such a large OS and the RT kernel only makes it larger, RT-Linux is probably not the right choice for embedded systems [4][12].

QNX is optimized to handle interrupt service quickly and predictably [11]. Predictably means that the programmer can calculated exactly how long it will take the OS to start servicing an interrupt once it has occurred. This has three components. First there is interrupt latency.

Interrupt latency is the time it takes for the OS to start to do anything after an interrupt has occurred [14]. Second, scheduling latency is the time it takes for the OS to decide which process should have control of the CPU next. Third, context switching is the time it takes for the OS to unload one process from the CPU and to load the next process [14]. On the following page, Table 1 gives some information about these times as found at QNX's web site [5]. Interrupt Response is the time it takes for the interrupt service routine to start running after the interrupt occurs. Task Response with five interrupts is the time that it takes for five interrupt service routines in a row to finish executing.

Table I

QNX Performance Data for Interrupt Handling and Process Switching [11].

Context switching	3.1 microseconds (full, user-level switch)
Interrupt latency	4.3 microseconds
Scheduling latency	7.8 microseconds (based on 16384 byte records)
Disk I/O	4 Mbytes/second (Read) 5.3 Mbytes/second (Write)
Network throughput	6.4 Mbyts/second (100 Mbit Ethernet)

The performance profile is measured on a Pentium133 with an Adaptec 2940 Wide SCSI controller, Barracuda SCSI-Wide disk drive and 100 Mbit PCI-bus Digital 21040 Ethernet card and a 10 Mbit ISA bus NE2000 Ethernet card.

III. QNX SYSTEM ARCHITECTURE

Every platform needs a solid foundation. The QNX real time platform is built on the QNX Neutrino real time OS, the most advanced RTOS on the market. The QNX Neutrino RTOS enables the design of highly reliable, scalable, and deterministic systems [7].

QNX Neutrino, of course, offers superior real time response. With features like multitasking, threads, priority-driven pre-emptive scheduling, synchronization, and fast context switching (0.55 µsec on a Pentium III), the RTOS provides the serious real time performance demanded by today's embedded systems [7].

With QNX Neutrino it all comes down to architecture-microkernel architecture. The microkernel includes only a small set of core services within the kernel, including thread services, message passing, mutexes, condition variables, semaphores, signals, and scheduling. The kernel can be extended by dynamically plugging in service-providing processes, such as file systems, networking, POSIX message queues, and device drivers [7].

Each process runs in its own memory-protected address space, which makes QNX Neutrino inherently reliable [7]. Embedded systems developers can also rely on other reliability-enhancing features of microkernel architecture, including support for both software and hardware hot swapping, and the ability to distribute components across a networked environment.

Although latencies are very important in judging a real-time operating system, they certainly don't give the whole picture. System architecture is also extremely important. System architecture describes how the OS is put together and how it interacts with both user processes and the hardware.

Virtually all operating systems start with a kernel. The kernel is the heart of the OS and contains the code essential for the OS to run. In most cases, the kernel has to be in physical memory at all times.

QNX uses microkernel architecture. This means that the kernel is as small as possible. In QNX, all that the kernel handles is inter process communication and process scheduling. Processes outside the kernel handle all other OS services. These processes and regular user processes are seen identically by the operating system.

As shown in Fig.1 Operating system service processes include device managers, file system managers, network managers and process managers [14]. Because these services are contained within separate processes, it is completely up to the user which of these services will be loaded. For example if there is no disk drive connected to the computer, there is no need to load a file system manager.

If there is no network, there is no need to load a network manager. If a network cable is attached to the computer while it as running, a network manager can be loaded on the fly and network services are immediately available

This use of separate processes to handle OS services makes QNX extremely efficient. There is no time or resources wasted on useless code. The user gets everything he/she needs and nothing he/she does not. This is the main principle behind the idea of scalability

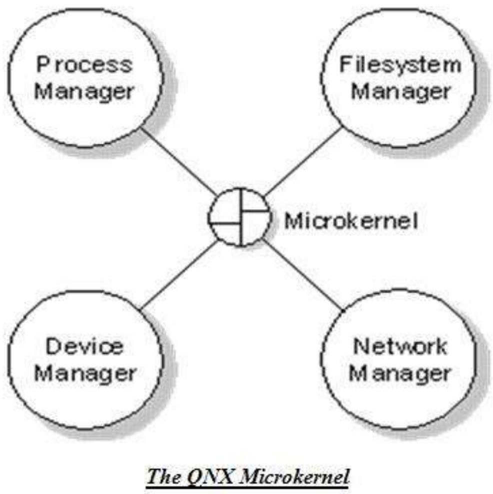


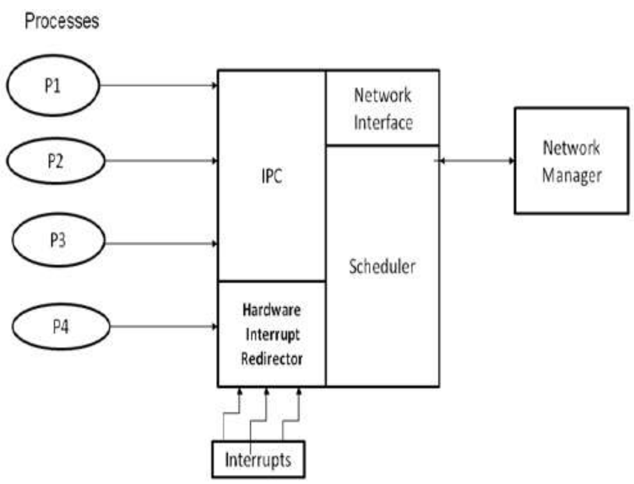
Fig.1 The QNX Microkernel

As shown in Fig.2 the kernel has four internal parts [11]. They are inter process communication (IPC), the network interface, interrupt redirection, and the scheduler. The main method of inter process communication in QNX is called message passing. The principle is user-level process wants to store a file on disk. So, it sends out a message indicating what the file system manager saves in file to disk. This message goes to the kernel, which then redirects it to the file system manager.

The sender allocates memory to hold both the message and a reply. After the message is sent, the sender becomes send blocked. The receiver must issue a receive command when it is ready to receive a message. If there is now message waiting for the receiver, if becomes receive blocked. It becomes unblocked when a message comes in. After the receiver issues a reply, it keeps running and the sender becomes unblocked. Thus, both processes return to normal scheduling.

The second form of IPC is by proxy. With a proxy, the sender sends a message but does not wait for any reply. In order for proxies to work, the receiver must first enable its ability to receive proxies via a system function call.

The third form of IPC is by signal. I signal can best be described as an interrupt caused by one process and sent to another process. The signaled process must have a signal handler set up in order to deal with it. Otherwise, the process will fail. The set of signals in QNX is similar to the set of signals in UNIX except QNX has a few of its own and UNIX has a few of its own.



Internal Structure of QNX kernel (from QNX web site)

Fig.2 Internal structure of QNX kernel

This IPC seems straightforward enough on a single CPU, but what if one process on one CPU wants to communicate with another process on another CPU? Well actually, that's just as straightforward. A process actually has to go out of its way to find out that another process is on a different node. In QNX, when a message is sent to a process that happens to be on another node, the kernel sends the message to the network manager that then transmits it across the network. In this way, QNX becomes a fully distributed multiprocessor operating system [11].

There are three main possible ways to schedule process, first-in-first-out (FIFO), round-robin, and adaptive [14]. QNX handles all these types of scheduling simultaneously on a per process basis. QNX always schedules the next highest priority process that is ready to run from the three groups.

The file system in QNX is also unique. This is due mainly to the fact that the file system manager is just another process in the system. Because of this, you can choose from a set of several file systems. This set includes POSIX, Embedded, DOS, Block, CD-ROM, NFS, and SMB. What makes QNX even more unique is that multiple file system managers can be running at the same time. This means that you can load a UNIX partition and a DOS partition at the same time and the user processes can't tell which is which.

The device manager in QNX handles all I/O. It takes care of terminals, disk drives, network connections, etc. One of its features is that all writes are fully buffered. This means that the CPU doesn't have to crawl along one byte at a time. This greatly increases overall speed and performance. Its other big feature is that it can do network load balancing and path switching on the fly without the user processes even knowing what's going on. It can even work seamlessly over network connections of differing types such as Ethernet and arcnet.

The process manager is the next major part of the QNX system architecture. The process manager shares its address space with the kernel even though it is a complete stand-along process that is scheduled by the kernel. The process manager performs process creation, loading, and termination. The process manager takes care of process inheritance also. Inheritance includes such things as priority, list of open files, and environment variables.

The process manager also takes care of timers and interrupts handlers. A timer causes an interrupt to occur at a specified time in the future. Interrupt handlers are packaged together inside a standard QNX process, but each handler operates independently of other handlers. Interrupt handlers have the same priority as the corresponding interrupt. Interrupt handlers can be pre-emptively interrupted by another interrupt handler, but only if the pre-emptor has a higher priority. The only exception to this rule is that the pre- emptor must wait until the preempted process is out of a critical section

IV.APPLICATIONS

Control system run nonstop with QNX [10], Daewoo selected QNX for in-car navigation [5], system telecom OEMs (Original equipment manufacturer) scale up with QNX, A Dialysis machine is acting as a kidney is used in MGM hospital which is based on QNX, QNX Neutrino RTOS powers the Neptec Laser Camera System for NASA's Return to Flight mission [6], QNX is the OS of choice for Neptec's mission-critical space applications because of its ultra-reliability [6].

V.CONCLUSION

As you can see, your choice of a real-time operating system is very important. You can't just pick one out of a hat and decide that one is the best. You should look for one that has the features that you need for your particular application. However, it should not be overloaded with features which you have not need for but which still take up resources in the system.

In general, look for a RTOS that is scalable and modular so that you can easily adapt it to fit your needs [9]. QNX is modular and scalable, but that doesn't make it the RTOS for you [7] [11]. There may still be some features built in which you don't need or some features that you require which are not available. Its high reliability and its microkernel architecture make QNX different from other operating system.

As you can see, picking a RTOS requires a great deal of research in order to find the right match. However, as you know, research is often a necessity in engineering fields and is not new.

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Number Portability - Ensuring Convenience in Telecommunications

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***Abstract* – The purpose of this paper is to identify and explore the issues, challenges and potential solutions related to number portability in India, with an emphasis on service provider's portability, commonly referred to as local number portability (LNP). Number portability is a circuit-switch telecommunications network feature that enables end users to retain their telephone numbers when changing service providers, service types, and/or locations. When fully implemented nationwide by both wire line and wireless providers, portability will remove one of the most significant deterrents to changing service, providing unprecedented convenience for consumers, and encouraging unrestrained competition in the telecommunications industry.**

***Keywords*–Number Portability(NP), Mobile Number Portability(MNP), Local Number Portability (LNP) Architecture, Service Order Administration (SOA), Number Portability Administration Center (NPAC), Local Service Management System (LSMS), Service Control Point Management System (SCP MS), Signal Transfer Point (STP), Service Switching Point/Mobile Switch Center (SSP/MSC)**

I.INTRODUCTION

Currently in India, subscribers are required to change their telephone numbers when changing operators. Changing a telephone number can be a major inconvenience and a barrier preventing them from exercising the choice of changing operators. As a result, the customer may be unable to take full advantage of the growing competition among operators or the introduction of new services and technologies. Number portability allows customers not only to move from one mobile service provider to another within the global system for mobile communications (GSM) but also from GSM to code-division multiple access (CDMA) services (you have to change your phone in this case), and also from landline to wireless phones. Subscribers with number portability are able to avoid the costs of reprinting stationary, informing callers, changing signs and lost business. Other benefits arise out of efficiency and service quality improvements and any associated price reduction resulting from increased competition. Callers to porting users also benefit from this, which are able to avoid the need to change entries in their diaries, directories and databases. They would also dial fewer wrong numbers and make fewer directory inquiries. So portability benefits subscribers and increases the level of competition between service providers, rewarding service providers with the best customer service, network coverage and service quality.

II. TYPES OF NUMBER PORTABILITY

Number portability is not only limited to operator switchover but also enables a subscriber to switch between services or locations while retaining the original telephone number, without compromising on quality, reliability and operational convenience.

So there are three basic types of number portability: operator, location and service portability.

A. Operator portability.

This is the ability of a subscriber to retain within the same service area an existing telephone number even if he changes from one service provider/operator to another. This type of portability is for the same service, i.e., fixed-to-fixed or mobile-to-mobile. Different categories of operator portability follow from these different types of numbers, and fixed-number portability (FNP) is the portability of landline telephone numbers and mobile number portability (MNP) is the portability of mobile telephone numbers.

B. *Fixed-number portability.*

The main hurdle in the implementation of fixed-number portability is that it requires again a change in the national numbering plan, which may not be a small issue for a country like India. So at this stage it is easy to go for mobile number portability and then look for fixed-number portability.

C. Mobile number portability.

MNP is operator portability applied to a mobile-to-mobile porting process. There is a latent demand for MNP in India. Competition between mobile service providers in India is already intense. The beneficiary of this competition would be the Indian consumer, and MNP may increase the level of competition further.

D. LOCATION PORTABILITY.

Location portability is the ability of a subscriber to retain an existing telephone number when changing from one physical location to another. Location portability has varying levels of complexity depending on whether the porting is occurring within or outside an exchange area and/or charging area. There might be differing impacts of routing and billing depending on the new location of the number. Location portability is not required in the existing mobile services as long as the subscriber moves within the service area, i.e., circle or metro.

E. SERVICE PORTABILITY.

Service portability is the ability of a subscriber to retain the existing telephone number when changing from one service to another service, say, from fixed to mobile services. In the Indian context, service portability will encourage the introduction and adoption of new telecom services and technologies. This will not only benefit users but also those service providers who continually upgrade and innovate. However, there might be concerns about possible confusion for callers about the charges for different phone calls, i.e., tariff transparency is affected.

III. IMPLEMENTING MOBILE NUMBER PORTABILITY

The technical solution adopted for the implementation of number portability is important as it will have cost implications on service providers/network operators, and will affect the services offered and the performance of these services made available to the subscriber. Number portability can be provided by two broad categories of methods: off-switch solutions or on-switch solutions.

A. OFF-SWITCH SOLUTIONS.

Off-switch solutions require the use of database to acquire the information of ported numbers and route the query to concerned switches depending upon the result of query. This type of solution allows for efficient routing of the call towards the recipient switch. The originating switch (the switch where the calling party is connected) can intercept a call to a ported number by querying the database that contains the list of all ported numbers plus routing information associated with each ported number. There could be two ways to access the database: the all-call-query and the query-on-release methods.

B. ALL-CALL-QUERY METHOD.

The originating network first checks the location of the dialed number in the central database and then routes the call directly to the recipient network (the network where a number is located after being ported).

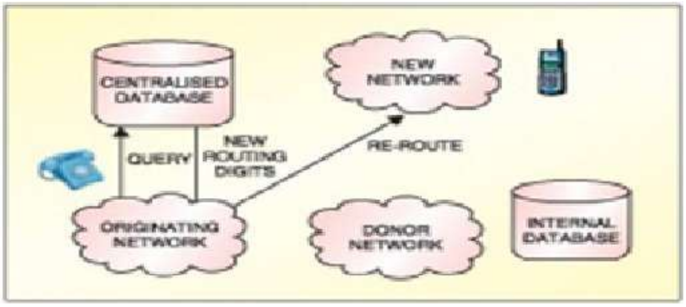


Fig.1 All call query method

The originating network first checks the status of the dialed number with the donor network (the initial network where the number was located before ported). The donor network returns a message to the originating network identifying whether the number has been ported or not. The originating network then queries the central database to obtain the information regarding the recipient network and routes the call directly to the recipient network

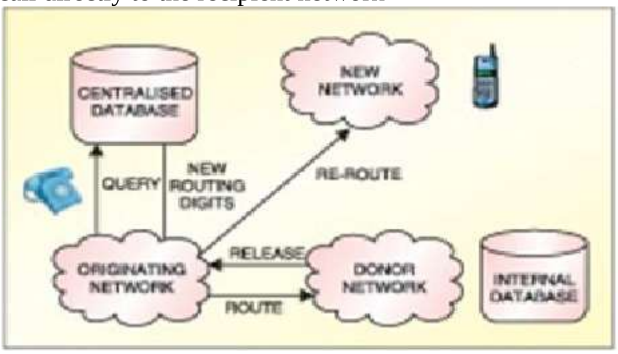


Fig.2 Query on release

C. ON-SWITCH SOLUTIONS.

In the case of on-switch solutions, the donor network manages the routing information for a ported number. Thus, the donor switch performs the interception, either routing the call itself, or providing routing information to the originating network that then routes the call to the recipient network. Consequently, this involves the use of internal databases. The two ways to implement on-switch solutions are: onward routing (call forwarding) and call-drop back.

Onward routing (call forwarding). Here the originating network connects to the donor network. If the dialed number has been ported, the donor network itself routes the call to the recipient network.

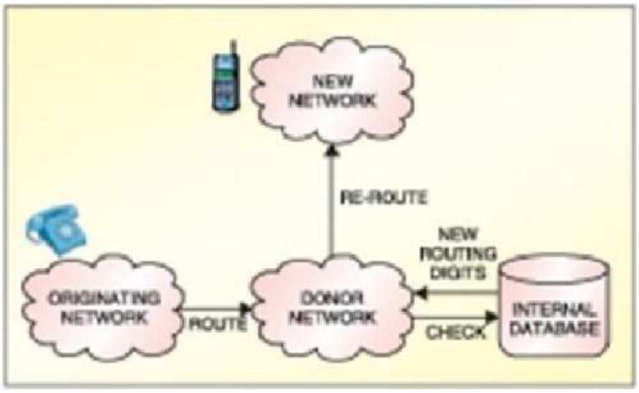


Fig.3 Onward Routing

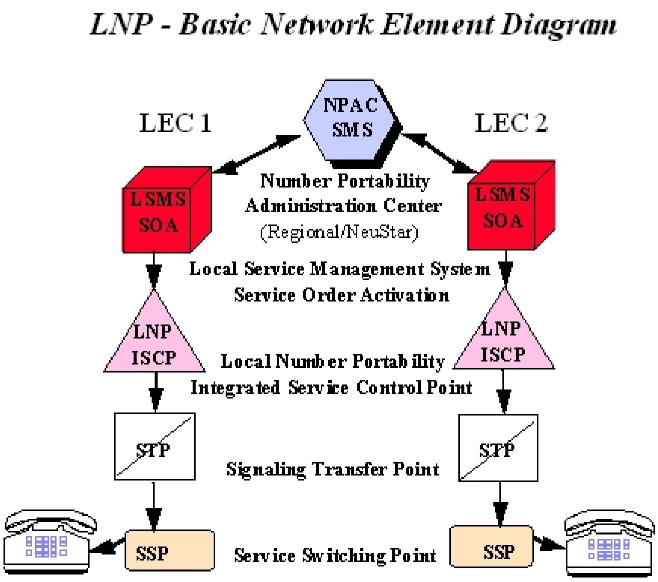
IV. WIRELINE LOCAL NUMBER PORTABILITY (LNP) ARCHITECTURE AND PROCESSES

There are many components and processes involved in a Local Number Portability system.

A. Network Elements

Architecturally, seven basic components are required to deploy local number portability (LNP):

- Service order administration (SOA)
- Number portability administration center (NPAC)
- Local service management system (LSMS)
- Service control point management system (SCP MS)
- Number portability database (NPDB)
- Signal transfer point (STP)
- Service switching point/mobile switch center (SSP/MSC)



B. Service Order Administration (SOA)

Service order administration provides the functionality to interface to carriers' order and provisioning systems in order to update the NPAC for access by all other carriers. The SOA's primary functions include subscription audit request/management; data administration; data transfer to the NPAC; report generation; bulk-file parse and upload; subscription tracking; legacy order entry interface; and logging. Depending on an individual service provider's requirements, the SOA may interface with multiple NPACs to allow for nationwide number portability

C. Number Portability Administration Center (NPAC)

The database is designed to receive information from both the incumbent and new service providers, validate the information received, and download the new routing information when an activate message is received indicating that the customer has been physically connected to the new service provider's network. Each ported number is a subscription version within NPAC that contains the new service provider's ID, the location routing number (LRN) associated with the new switch, and routing data associated with additional services the customer may request (for example, line information database (LIDB), calling name delivery (CNAM), and so on[3]. The NPAC also maintains a record of all ported numbers and a history file of all transactions relating to the porting of a number.

D. Local Service Management System (LSMS)

The local service management system is a fault-tolerant hardware and software platform that contains the database of information required to enable routing and call completion to ported telephone numbers. The primary functions of the LSMS are subscription management, network data management, service provider data management, error processing and notification, transaction event logging and reporting, transmission of activation/deactivation events to the network elements, and audits. The LSMS interface with the NPAC provides real-time activation/deactivation information upon download from the NPAC and can send responses to the NPAC once a message or subscription version is processed.

E. Service Control Point Management System (SCP MS)

The service control point management system provides interface services between the LSMS and the SCP. The SCP MS may or may not be physically integrated with the SCP.

F. Number Portability Database (NPDB)

The number portability database contains the routing information necessary to support number portability. The NPDB provides the LNP association between the called party and the carrier LRN, identifying the switch to which the call should be routed. The NPDB stores all ported numbers within the ported domain. Carriers can choose between two different LNP databases architectures for accessing the LRN associated with a particular directory number: an integrated STP/SCP configuration or an STP with an adjunct SCP.

G. Signal Transfer Point (STP)

The signal transfer point receives the LRN query from the SSP/MSC and routes the query to the appropriate LNP SCP. The STP returns the SCP response to the SSP/MSC.

H. Service Switching Point/Mobile Switch Center (SSP/MSC)

The exchange carrier owns and operates the service switching point/mobile switch center. Service switching points must be able to generate an LNP query to the SCP (via the STP network) when a call is placed to a telephone number in a ported domain [5].

V. CONCLUSION

By removing one of the most significant barriers to unrestrained competition, number portability is perhaps the most exciting opportunity in the telecommunications industry since divestiture. The challenges and opportunities created by number portability, especially LNP, are enormous, with over ₹ 100 billion in local revenues at stake [7]. The competitive carriers that are able to carefully analyze their network and administrative infrastructures, select the best NP solution for their needs, successfully deploy number portability, and exploit the new-found freedom of customer choice that number portability enables, will position themselves for success in a truly competitive environment.

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SOLAR THERMALWIND HYDRO HYBRID POWER PLANT

(Non-Conventional Renewable Energy source)

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Abstract: **The Solar, Wind and Hydro power plant is the combine multiple cycles one is the natural power production in day time and Night time but it's limited. The solar light available 5 hours only and the wind power day and night other Hydro plant for power production round the clock 24 hours as per design the plant capacity. And it is man maid artificially (UN Natural plant) The Solar Thermal Hydro, Wind power plant is the combine multiple cycles technology use in one power plant. These are the natural power production in day time and Night time but it's limited. The solar light available 5 hours only and the wind power day and night other Hydro plant for power production round the clock 24 hours as per design the plant capacity. And it is man maid artificially (UN Natural plant). To increases plant efficiency. Artificial and Natural hybrid technology here use for power generation in this power plant for feature power solution. We have cost free natural energy as solar heat and light intensity to generate power in the form of electrical energy directly by the PVC and Heat energy in five hours a day. These are unlimited energy source. Another free energy source is the wind. But wind is not continually able to generate power. all natural energies are not able to full fill up our demand working in independent they have limitation and irregularity so we made one power plant work on these are energy source make together and made synchronization and utilize as per our requirement as demand . Thus we use here multiple natural and artificial energy sources in one power plant that is hybrid technology for the unlimited power generation.**

KEYWORD-

I. INTRODUCTION

Solar power plant dependent on sun light rays. In this power plant we convert light energy in to electrical energy by help of the photo voltaic cell (PVC). This PVC made by silicone metal and sulfur semiconductor in particular combination light energy absorb and converted in to electrical energy. This electrical power is DC power. And this power is small value generated in mill volt per cell number of cell make together in series and parallel thus will get 1.24 volt per cell 12volts per 12 cell per panel. This solar energy is unlimited for long years as per the sun and earth life. This solar power currently store in battery and that stored electrical energy use to our appliances rating power like supply voltage rating 220 volts / 240 volts by help if the Invertors. These Invertors is convert AC DC power in to the AC power for our Utilization. In whole process major expansive is the Battery and Invertors. The power loses and replacement of the battery is compulsorily after every 3 years. Wind mill is natural energy source and life cycle is 20 years. This multiple energy source is feature power solution. The thermal heat of the solar is most power full and reliable instead of Solar PVC, The Solar Thermal Hydro, & Wind Power Plant(STHWPP) is the combine multiple cycle's technology use in one power plant. These are the natural power production in day time and Night time but it's limited. The solar light available 5 hours only and the wind power day and night other Hydro plant for power production round the clock 24 hours as per design the plant capacity. And it is man maid artificially (UN Natural plant). To increases plant efficiency. Artificial and Natural hybrid technology here use for power generation in this power plant for feature power solution. We have cost free natural energy as solar heat and light intensity to generate power in the form of electrical energy directly by the PVC and Heat energy in five hours a day. These are unlimited energy source. Another free energy source is the wind. But wind is not continually able to generate power. all natural energies are not able to full fill up our demand working in independent they have limitation and irregularity so we made one power plant work on these are energy source make together and made synchronization and utilize as per our requirement as demand . Thus we use here multiple natural and artificial energy sources in one power plant that is hybrid technology for the unlimited power generation. This plant life cycle is 20 years so the seven times need to bear that battery replacement expenditure. In the project we never use the battery storage system. But utilization of the solar DC power direct use to store the hydro water instead of Battery. In this storage system no any other replacement expenditure Civil and steel work life cycle is more than 50 years. Calculation: Solar thermal heat absorbs modular available in open market as per our requirement here we consider a small size solar heat panel use to collect solar heat gas and run the turbine and mechanical energy convert in to the electrical power generation by help of the alternator. And this is most efficient from the P.V.C. Penal. Description: The parabolic modular and simple heat collector used in this power plant model. It is very compact and maintenance free due to atmosphere temperature.

Fig.1 Simple heat absorber penal

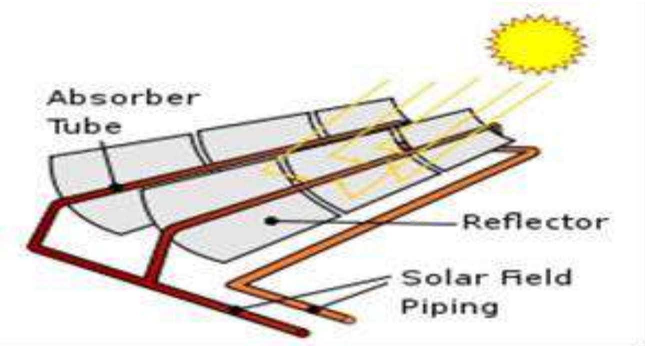

Fig 2.Parabolic heat concentrator

II. APPLICATION

This hybrid power plant designed for constant power supply round the clock as per requirement. Capital investment only. Not running expenditure USD $ 2400 per watt only. Commercial Power plant for Industries, College, Institute, Society etc…….Solar, Wind and Hydro these are three different technologies. Solar and wind both are 100% natural energy source and irregularly have particular time limits. And Solar power available only in day time for five hours, Wind power also depending on wind blowing specific velocity to generate power. If wind velocity 11m/second (100km/ hour) available will get 100kw power by wind turbine blade length 1meter and 1.5 meter total diameter of the wind turbine at the altitude 30-100 meter. A wind turbine is a device that converts kinetic energy from the wind into mechanical energy. If the mechanical energy is used to produce electricity, the device may be called a wind generator or wind charger. If the mechanical energy is used to drive machinery, such as for grinding grain or pumping water, the device is called a windmill or wind pump. Developed for over a millennium, today's wind turbines are manufactured in a range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging or auxiliary power on sailing boats; while large grid-connected arrays of turbines are becoming an increasingly large source of commercial electric power. As the wind does not blow all the time nor does the sun shine all the time, solar and wind power alone are poor power sources. Hybridizing solar and wind power sources together with storage batteries to cover the periods of time without sun or wind provides a realistic form of power generation. The system creates a stand-alone energy source that is both dependable and consistent. The hybrid solar wind turbine generator uses solar panels that collect light and convert it to energy along with wind turbines that collect energy from the wind. Solar wind composite power inverter contains the required AC to DC transformer to supply charge to batteries from AC generators. Hence the power from the solar panels and wind turbine is filtered and stored in the battery bank. The PV-wind hybrid system returns the lowest unit cost values to maintain the same level of DPSP as compared to standalone solar and wind systems. For all load demands the liveliest energy cost for PV- wind hybrid system is always lower than that of standalone solar PV or wind system, while this system has still not achieved market maturity, in future the PV-wind hybrid option is expected to be techno-economically viable for rural electrification. Obviously, hybrid solutions are not feasible in non- windy locations. Besides, hybrid solar-wind solutions are mainly applied to electricity production. In applications as water heating (where solar is widely used)

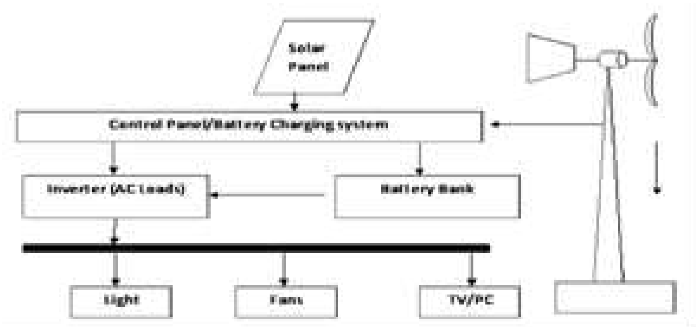

Fig3. . STWHHPP

Pumping water is a universal need around the world and the use of photovoltaic power is increasing for this application. PV powered pumping systems offer simplicity, reliability, and low maintenance for a broad range of applications between hand pumps and large generator driven irrigation pumps. The solar PV powered water-pumping system (DC Surface suction, DC floating, and DC or AC submersibles) can offer a veritable panacea to the problem of finding power to pump water for irrigation in India. Typical pump systems in India are of the DC surface suction type (approximately 86% of solar pumping systems installed in India), DC submersible type (2%), DC floating type (2%), and AC submersible (10%). The system for solar pumping depends on the nature of the well: deep well, bore well, open well etc. Regardless of the type of pump used, water is usually stored in a tank or reservoir for use at other times. Most pumping systems do not include batteries for on-demand water. However, batteries are sometimes used in systems where pumping time must be controlled because of low water demand or low source capacity. India has about 15 million grid-powered pump-sets and close to 7 million diesel-powered pumps. However, only about 7500 solar pumping systems have been installed for agricultural use in India. The problems with the grid-powered pumping systems are

• Demand for electrical energy far outstrips supply, and the gap continues to widen

• It is proving increasingly difficult for the government to continue subsidizing the rising costs of generation, transmission and distribution losses, pilferage, etc. (to deliver 3600 kWh to a farmer to pump water, 7000 kWh is required to be generated, assuming a diversity factor 2). The loss of revenue to the government is colossal.

• The capital cost to the government to provide an electrical connection for a single pump-set of 3 hp capacity (sufficient for 2 hectares) is estimated at Rs 1.37 lake by Andhra Pradesh Transco (2002 figures)

• The costs and tariffs of electricity continue to rise – the marginal farmer is unable to pay for the electricity)

• Grid power is unreliable and of poor quality, often leading to motor burnouts at the tail end.

• In a coal-fired thermal generating station, 1 kWh of electrical energy generated translates to 11.2 tons of carbon dioxide emission a year.

The working model of

(STWHHPP) SOLAR THERMAL WIND HYDRO HYBRID POWER PLANT

Wind speed 3.5 m/s to 11 m/s constantly required to generate power and major roll of altitude (height) from the ground or sea level. Wind power unstable and fluctuated so we cannot direct utilized to appliances until used the battery and Invertors.

Wind mill Configuration: 350 watts 10 meter height

3 blade 120 degree angle, Rotary Governor.

Rotor: Multiple pole brush less single phase winding

220 volts low rpm 450, automatic mechanical rotary governor mounted.

A) Motor pump (technical Description)

Power ratting 12 volts, 0.125 HP / 0.094 kW (Actual by Manufacture.)

Head – 15 meter, Discharge- 525 LPH (8.75 LPM, 0.145 LPS)

B) Total storage by pump

525 liters x 5 hours = 2625 Liters (2.6 meter cube)

Total power consumption = 0.094 x 5 = 0.47 KW in 5 hours per day.

C) Design for 15 hours power plant

Discharge = 2625 liters / 15 hours = 175 LPH flow rate (0.04861 liters Per Second LPS.)

At the height of 15 meters head.

D) Power Generation by hydro power plant.

P = h Q g k =watt. Where is P = power in watt, h = head of the discharge in meter, Q = total discharge volume in liter per second, g = Gravity of the earth 9.81, k = Constant 0.75 efficiency of turbine, d = Overall loses 0.95 Of the plant P = 15 x 0.04861 x 9.81 x 0.75 x 0.95 = 5 watts Total power in 15 hours x 5 watts = 75 watts per day (0.075 Unit)

E) Hybrid power plant efficiency

Total output power / Input power x 100 = Plant efficiency %

Efficiency % = 75 watts / 480 watts x 100 = 15.625 %

F) Solar power PVC plant

1.24 volts per Cell, 12 volts per 10 PV Cell in one Solar Panel

12 volts x 1 amp = 12 watts per panel.

Total output power = 10 Solar panel x 12 watts = 120 watts.

Solar Power generation in 5 hours a day as per light intensity and temperature maintain 22 centigrade to 24 centigrade.

Power generation by solar power plant at the Net output power = PF 0.8 x 120 watts = 96 watts at 12 volts / hours

96 watts x 5 hours = 480 watts / day

G) Costing of the plant

1. Solar plant

3500/- per panel x 10 = 35000/-

Wiring and switches = 5000/-

Total : 40000/-

2. Wind power plant

Pole 10 meter: 20000/-

Hub & blade : 25000/-

Alternator brushes: 65000/-

Battery 12volts 150Ah. : 13000/-

Switches: 3000/-

Total : 126000/-

3. Hydro power plant

Turbine: 6000/-

OH tank	: 3000/-
Ground Tank	: 800/-
Pipe fittings	: 2500/-
Valve	: 1500/-
Meter	: 1200/-
Alternator or	: 1500/-
DC generator	: 1200/-
CFL Load	: 560/-
Motor Pump	: 3500/-
Others	: 1200/-
Total	: 22960/-

4. Hybrid power plant costing is INR 225000/- plus fabrication and civil works if required.

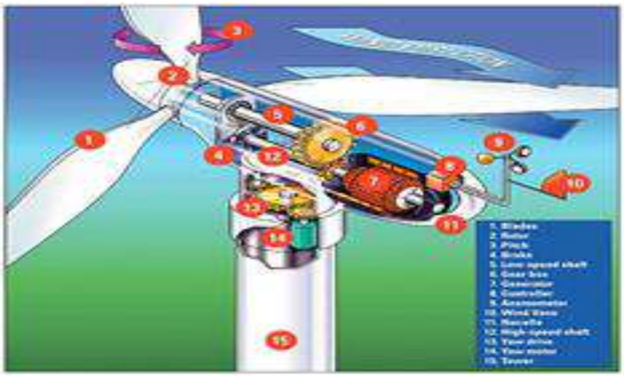

Fig4. Virtual Diagram of STWHHPP

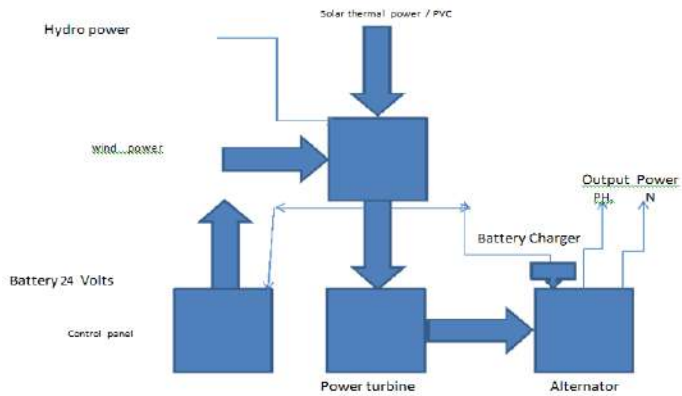

Fig5. Block diagram of STWHHPP

Wind Energy Basics: Basic information on wind energy and wind power technology, resources, and issues of concern. Wind Energy and Wind Power Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by modern wind turbines, can be used to generate electricity. How Wind Power Is Generated? The terms "wind energy" or "wind power" describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity to power homes, businesses, schools, and the like. Wind Turbines: Wind turbines, like aircraft propeller blades, turn in the moving air and power an electric generator that supplies an electric current. Simply stated, a wind turbine is the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity. Wind Turbine Types Modern wind turbines fall into two basic groups; the horizontal-axis variety, like the traditional farm windmills used for pumping water, and the vertical-axis design, like the eggbeater-style Dairies model, named after its French inventor. Most large modern wind turbines are horizontal-axis turbines. Turbine Components: Horizontal turbine components include: Blade or rotor, which converts the energy in the wind to rotational shaft energy a drive train, usually including a gearbox and a generator; a tower that supports the rotor and drive train; another equipment, including controls, electrical cables, ground support equipment, and interconnection equipment.

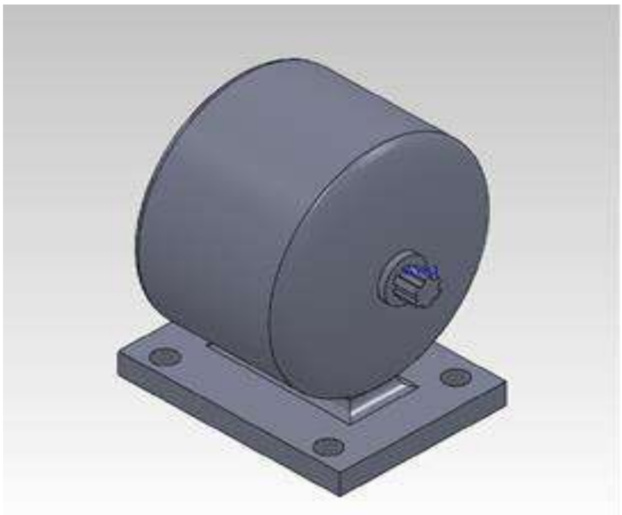

Fig6. Brush less Alternator

The above equipment is Brush Less Multi Pole Low

Speed High Efficient (BLMPLSHE) Alternator for round the clock running. 350-450 rpm ratings output 440/500 volts 3 phase four wire system.

Application: Commercial captive power plant for power generation production of electricity by 100% green Natural and Artificial energy source. It can be used for Institute, Factory, Society, etc….

Specialty: The specialty of the power plant is fuel

Sound less, Pollution less, Total green power.

REFERENCE

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[2] CWT

[3] Wikipedia

Computer Aided Diagnosis System to Detect the Arrhythmias by Analyzing the ECG Signal

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***Abstract*-An arrhythmia is a disorder of the heart rate (pulse) or heart rhythm, such as beating too fast (tachycardia), too slow (bradycardia), or irregularly, So the early detection of arrhythmia is very important for the cardiac patients. This is done by analyzing the electrocardiogram (ECG) signals and extracting some features from them .This paper represents different types of methods used to extract features from the ECG signal such as Fourier Transform (FFT), Autoregressive modeling (AR) and Principal Component Analysis (PCA). These extracted features can be used in classification of different types of Arrhythmias. The classifiers used will be Artificial Neural Network (ANN).**

***Keywords*-Electrocardiogram (ECG), Fourier Transform (FFT), Principal Component Analysis (PCA) Artificial Neural Network (ANN), Autoregressive modeling (AR)**

I.INTRODUCTION

An arrhythmia is an irregular heartbeat - the heart may beat too fast (tachycardia), too slowly (bradycardia), too early (premature contraction) or too irregularly (fibrillation). Arrhythmias are heart-rhythm problems - they occur when the electrical impulses to the heart that coordinate heartbeats are not working properly, making the heart beat too fast/slow or inconsistently. So, the early detection of arrhythmias is a very important task specially for the critically ill patients with ventricular arrhythmias like ventricular tachycardia (VT), and ventricular fibrillation (VF), which cause severe deterioration of hemodynamic efficiency, and are thus life threatening. This paper will concentrate in building a computer aided diagnosis system to classify the different arrhythmias and normal sinus rhythm (NSR) signals by analyzing the electrocardiogram (ECG) signals. The proposed techniques were applied to a large number of independent 3 second intervals of ECG signals consisting of 192 training samples and 96 test samples from the MIT-BIH database [1].In this project, three types of features will be extracted from the ECG signals to make three different systems which are Fourier Transform (FFT) based features, Autoregressive modeling (AR) based features, and Principal Component Analysis (PCA) based features. Then we will compare the results between the three systems to get which one of them is the best.

II. LITERATURE REVIEW

The ECG feature extraction has been studied from early time and lots of advanced techniques have been proposed for accurate and fast ECG feature extraction. There are different techniques used for classification of arrhythmias such as:

In [2], SziWen Chen used the Prony modeling method to discriminate between ventricular fibrillation (VF), ventricular tachycardia (VT) and super ventricular tachycardia (SVT). In this algorithm, two features are extracted from the total least squares (TLS)-based Prony model which are dubbed energy fractional factor (EFF) and predominant frequency (PP). The EFF is used to discriminate the SVT from VF and VT, and then the PP is used to discriminate VF from VT. The accuracy of detecting SVT, VF, and VT were 95.24%, 96.00%, and 97.78% respectively by using this algorithm.

In [3], Thakor et al. used the complexity measure method to discriminate between Sinus rhythm (SR), ventricular tachycardia (VT) and ventricular fibrillation (VF). The authors presented a fast method for detecting the previous types of arrhythmias by getting the complexity measure suggested by Lempel and Ziv (1976). In this study for a specific window length, the method firstly generates a string of zeros and ones by comparing the ECG data to a suitable threshold then the complexity measure can be obtained from the string of zeros and ones by comparison and accumulation.

In [4], Dubowik extracted some features from the ECG signal such as: intervals between R peaks, the variance of the intervals, the average heart rate. These features were used in the classification of arrhythmia using an expert system. This is done by extracting the QRS complexes from the ECG signal then classify between the normal and abnormal QRS complexes after that getting a window which contains five QRS and extracting from it the previous features and fed the feature into an expert fuzzy system. In [5], Minami et al. used the power spectrum of the extracted QRS complex of the ECG signal in the classification. This technique extract the QRS complex from the ECG signal then each QRS complex is Fourier transformed then calculated the power spectrum of it and getting five spectral components with central frequencies at 3.9, 7.8, 11.7, 15.6, and 19.5 Hz which fed into the neural network as 4, 8, 12, 16, and 20 Hz spectra, respectively. It is used to discriminate between VT, VF, and NSR. This method achieved high sensitivity and specificity (>0.98) in the classification.

In [6], Tsipouras et al. used only the RR-interval signal extracted from ECG recordings in the arrhythmias classification. This technique consisted of two stages. Firstly, the arrhythmic beat classification which is done by using three R-R intervals sliding window and performed for four categories of beats: normal, premature ventricular contractions (PVC), ventricular flutter/fibrillation (VF) and 2 heart block. The arrhythmic beat classification is then used as input of a knowledge-based deterministic automaton to achieve the second stage of this technique which is the arrhythmic episode detection and classification and this is done to classify six types of rhythms which are: ventricular bigamy, ventricular triggering, ventricular couplet, ventricular tachycardia, ventricular flutter/ fibrillation and 2 heart block. This technique achieves 98% accuracy for arrhythmic beat classification and 9400 accuracy for arrhythmic episode detection and classification.

In [7], M. I. Owis et al. utilized the nonlinear dynamics of ECG signals for arrhythmia characterization. They reconstruct the phase space trajectory of the ECG by using the delay time embedding theory, and then calculate the correlation dimension and the largest lyapunov exponent for each type of arrhythmia which were used as feature for classification. This technique discriminates between PVC, VB, VT, and VF.

In [8], Povinelli et al. used the frequency sub-bands with reconstructed phase spaces (RPS) to distinguish between normal and abnormal atrial activity. This study use two second ECG Holter recordings of sinus rhythm (SR), atrial flutter (AFL), atrial fibrillation (AF), supraventricular tachycardia (SVT), and ventricular tachycardia (VT) which were filtered into four sub-bands and embedded into 3-dimensional RPS, then Gaussian mixture models of the sub banded RPS were learned.

III.PROPOSED SYSTEM FOR ARRHYTHMIAS DETECTION.

This paper concentrates in building a Computer Aided Diagnosis System to Detect the Arrhythmias by Analyzing the ECG signals. This system will consist of two stages. The first stage will be the features extraction, and the second stage will be the classification of these features. In this technique whole 3 second intervals of the training and testing data will be used not like the previous works that deal with the classification of the QRS only.

A.Feature Extraction.

Significant features of ECG waveform:

A typical scalar electrocardiographic lead is shown in Fig. 1, where the significant features of the waveform are the P, Q, R, S, and T waves, the duration of each wave, and certain time intervals such as the P-R, S-T, and Q-T intervals.

Fig. 1 Typical ECG signal

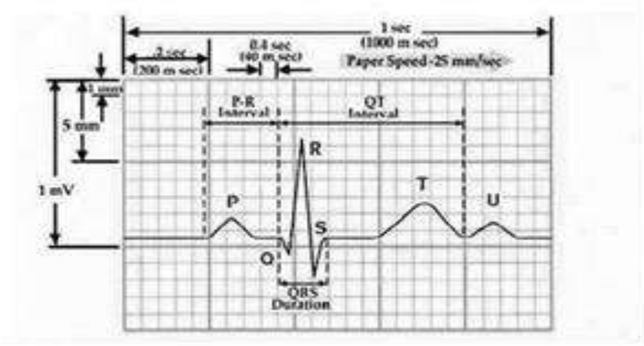

Fig. 1 Typical ECG signal

Different types of methods are used to extract features from ECG signals such as FFT, AR and PCA.

In FFT, each ECG signal is Fourier transformed but before computing the Fourier transform, Hamming window is used with Fourier Transform because of their better side lobe suppression characteristics [10]. The length of the window is taken as the number of samples within the selected 3 second interval. The selection of the FFT coefficients that used in the classification is a critical subject. So the best number of FFT coefficients will be determined by trial and error.

Autoregressive modeling is a mathematical modeling of a time series based on the assumption that each value of the series depends only on a weighted sum of the previous values of the same series plus noise [9]. There exist different methods used to extract the Autoregressive coefficients but Burg's method in used as it minimize the sum-squared of both the forward and the backward prediction error. The selection of the AR order that used in the classification is a critical subject. So we use different orders of autoregressive method to get different numbers of autoregressive coefficients as inputs to the classifier and get the accuracy of each of them.

Principal Component Analysis (PCA) is used to compute the basic components of the ECG signals as PCA is an efficient technique for dimensionality reduction in multivariate statistical analysis. So, but before using it the ECG signals will be pre- processed to obtain the magnitude of their Fourier transformation, to reduce the number of components resulting from different shifts of the same signal. Hamming window will be used with Fourier Transform because of their better side lobe suppression characteristics [10]. Then the feature vector from all signals in the training database will be collected and used to define the feature space of the problem, then making the PCA on the feature space to get the basic components of it to reduce its dimension. The principal components are calculated as the eigenvectors of the covariance matrix of the data [11].The selection of the number of PCA coefficients that used in the classification is a critical subject. So we will use different numbers of principal components as inputs to the classifier and get the accuracy of each of them.

*B. Classification of different types of Arrhythmias***.**

The classification of different types of Arrhythmias like VT and VF and Normal sinus rhythm (NSR) is performed by using neural network toolbox in Matlab.

There are different types of artificial neural networks, so we used a feed forward multilayered neural network. The number of input neurons is fixed by the number of elements in the input feature vector. The output layer will be 3 neurons for all methods which determine the number of classes desired (NSR, VT, and VF). The number of neurons in the hidden layer is being varied according to the method that will be used for classification and will be determined by a trial-and-error method. The data set which will be used for training the network will consist of 192 samples (64 for each type of ECG signals) and the data set which will be used for testing the network will consist of 96 samples (32 for each type of ECG signals).

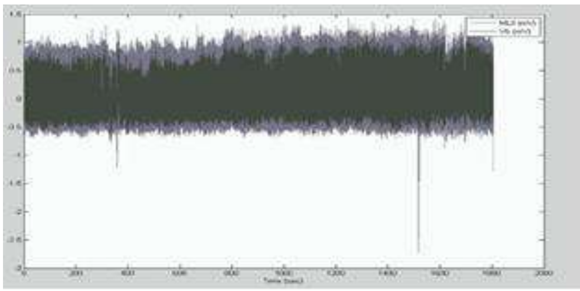

Fig 2. ECG Waveform

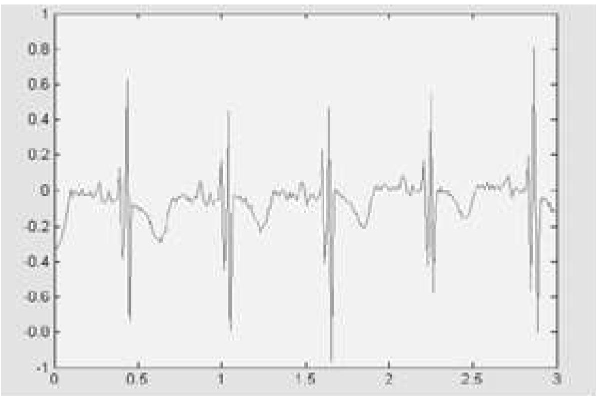

Fig 3. Original signal

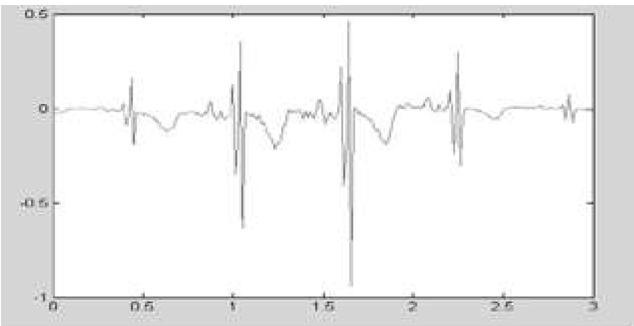

Fig-4. Signal after applying hamming window

VI. CONCLUSION

This paper is based on feature extraction of ECG signals using Fourier Transform , Autoregressive modeling and Principal Component Analysis and Classifying them using ANN. These extracted features of the ECG will be used for diagnosing many cardiac diseases.

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