ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol. 3 , No.1, Pages : 112– 116 (2014)
Special Issue of ICETETS 2014 - Held on 24-25 February, 2014 in Malla Reddy Institute of Engineering and Technology, Secunderabad– 14, AP, India

BORDER SECURITY USING WINS

1. K.B.Madhavi, Assistant professor, St. Peters Engineering College, mdhvmdhv@gmail.com

2. M.G.R. Rishikesh, Systems Engineer, Microsoft India Limited, rishi4ur@gmail.com

Abstract

Wireless Integrated Network Sensors (WINS) now provide a new monitoring and control capability for monitoring the borders of the country. Using this concept we can easily identify a stranger or some terrorists entering the border. The border area is divided into number of nodes. Each node is in contact with each other and with the main node. The noise produced by the foot-steps of the stranger are collected using the sensor. This sensed signal is then converted into power spectral density and the compared with reference value of our convenience. Accordingly the compared value is processed using a microprocessor, which sends appropriate signals to the main node. Thus the stranger is identified at the main node. A series of interface, signal processing, and communication systems have been implemented in micro power CMOS circuits. A micro power spectrum analyzer has been developed to enable low power operation of the entire WINS system. Thus WINS require a Microwatt of power. But it is very cheaper when compared to other security systems such as RADAR under use. It is even used for short distance communication less than 1 Km. It produces a less amount of delay. Hence it is reasonably faster. On a global scale, WINS will permit monitoring of land, water, and air resources for environmental monitoring. On a national scale, transportation systems, and borders will be monitored for efficiency, safety, and security.

Introduction to Wireless Integrated Network Sensor.

Wireless Integrated Network Sensors (WINS) as shown in figure 1, combine sensing, signal processing, decision capability, and wireless networking capability in a compact low power system. Compact geometry and low cost allows WINS to be embedded and distributed at a small fraction of the cost of conventional wireline sensor and actuator systems**.**

For example, on a global scale, WINS will permit monitoring of land, water, and air resources for environmental monitoring. On a national scale, transportation systems, and borders will be monitored for efficiency, safety, and security

On a local, wide area scale, battle field situational awareness will provide personal health monitoring and enhance security and efficiency. Also, on a metropolitan scale, new traffic, security, emergency, and disaster recovery services will be enabled by WINS. On a local, enterprise scale, WINS will create a manufacturing information service for cost and quality control.

WINS for biomedicine will connect patients in the clinic, ambulatory outpatient services, and to medical professionals to sensing, monitoring and control. On a local machine scale, WINS condition based maintenance devices will equip power plants, appliances, vehicles, and energy systems for enhancements in reliability, reductions in energy usage, and improvements in quality of service. The opportunities for WINS depend on the development of a scalable, low cost, sensor network architecture. This requires that sensor information be conveyed to the user at low bit rate with low power transceivers. Continuous sensor signal processing must be provided to enable constant monitoring of events in an environment. Thus, for all of these applications, local processing of distributed measurement data is required for a low cost, scalable technology. Distributed signal processing and decision making enable events to be identified at the remote sensor. Thus, information in the form of decisions is conveyed in short message packets. Future applications of distributed embedded processors and sensors will require massive numbers of devices.

Figure 1 : Wireless Integrated Network Sensor.

Conventional methods for sensor networking would present impractical demands on cable installation and network bandwidth. By eliminating the requirements for transmission of all measured data, the burden on communication system components, networks, and human resources are drastically reduced.

The opportunities for WINS depend on the development of scalable, low cost, sensor network architecture. This requires these sensor information be conveyed to the users at low power transceivers. Continuous sensor signal processing must be provided to enable constant monitoring of events in an environment.

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol. 3 , No.1, Pages : 112– 116 (2014)
Special Issue of ICETETS 2014 - Held on 24-25 February, 2014 in Malla Reddy Institute of Engineering and Technology, Secunderabad– 14, AP, India

Distributed signal processing and decision making enable events to be identified at the remote sensors. Thus, information in the form of decisions is conveyed in short message packets. Future applications of distributed embedded processors and sensors will require massive number of devices. In this paper i have concentrated in the most important application, border security.

WINS SYSTEM ARCHITECTURE

The primary limitation on WINS node cost and volume arises from power requirements and the need for battery energy sources. As will be described, low power sensor interface and signal processing architecture and circuits enable continuous low power monitoring. However, wireless communication energy requirements present additional severe demands. Conventional wireless networks are supported by complex protocols that are developed for voice and data transmission for handhelds and mobile terminals.

Conventional wireless networks are supported by complex protocols that are developed for voice and data transmission for handheld and mobile terminals. These networks are also developed to support communication over long range (up to 1Km or more) with link bit rate over 100Kbps. In contrast to wireless networks, the WINS network support large number of sensors in a local area with short range and low average bit rate communication (less than 1Kbps). The networks design must consider the requirement to service dense sensor distributions with an emphasis on recovering environment information. Multihop communication yields large power and scalability advantage for WINS network. Multihop communication therefore provides an immediate advance in capability for the WINS narrow Bandwidth device. The figure 2 represents the general structure of the wireless integrated network sensors (WINS) arrangement.

Multihop communication yields large power and scalability advantages for WINS networks. First, RF communication path loss has been a primary limitation for wireless networking, with received power, PREC, decaying as transmission range, R, as PREC µ R-a (where a varies from 3 – 5 in typical indoor and outdoor environments). However, in a dense WINS network, multihop architectures may permit N communication link hops between N+1 nodes. In the limit where communication system power dissipation (receiver and transceiver power) exceeds that of other systems within the WINS node, the introduction of N co-linear equal range hops between any node pair reduces power by a factor of Na-1 in comparison to a single hop system. Multihop communication, therefore, provides an immediate advance in capability for the WINS narrow bandwidth devices. Clearly, multihop communication raises system complexity. However, WINS multihop.

The Wins node architecture shown in figure is developed to enable continuous sensing, event detection, and event identification at low power. Since the event detection process must occur continuously, the sensor, data converter, data buffer, and spectrum analyzer must all operate at micro power levels. In the event that an event is detected, the spectrum analyzer output may triggered the microcontroller may then issue commands for additional signal processing operation for identification of the event signal. Protocols for node operation then determine whether a remote user or neighboring WINS node should be alerted. The WINS node then supplies an attribute of the identified event, for example, the address of the event in an event look-up-table stored in all network nodes. Total average system supply currents must be less than 30 A.

Primary LWIM applications require sensor nodes powered by compact battery cells. Total average system supply currents must be less than 30mA to provide long operating life from typical compact Li coin cells. Low power, reliable, and efficient network operation is obtained with intelligent sensor nodes that include sensor signal processing, control, and a wireless network interface. The signal processor described here can supply a hierarchy of information to the user ranging from a single-bit event detection, to power spectral density (PSD) values, to buffered, real time data. This programmable system matches its response to the power and information requirements.

Distribute network sensor must continuously monitor multiple sensor system, process sensor signals, and adapt to changing environments and user requirements, while completing decisions on measured signals. Clearly, for low power operation, network protocols must minimize the operation duty cycle of the high power RF communication system.

Unique requirements for the WINS node shown in figure 3 appear for sensors and micro power sensor interfaces. For the particular applications of military security, the WINS sensor systems must operate at low power, sampling at low frequency, and with environmental background limited sensitivity.

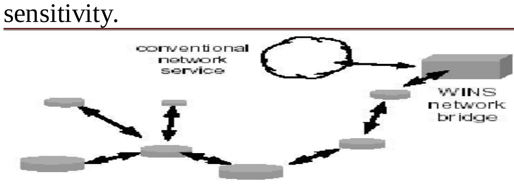
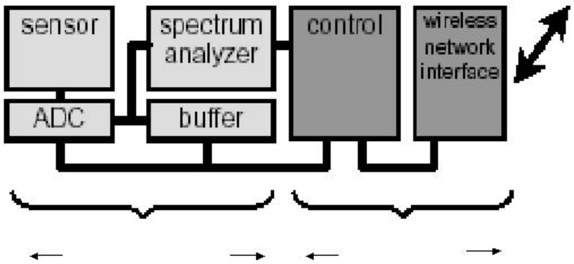


Figure 3: WINS Nodes

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol. 3 , No.1, Pages : 112– 116 (2014)
Special Issue of ICETETS 2014 - Held on 24-25 February, 2014 in Malla Reddy Institute of Engineering and Technology, Secunderabad– 14, AP, India

Figure 2: WINS Architecture



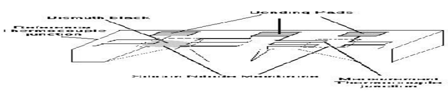


Figure 4: Thermal Infrared Detector

WINS MICROSENSORS

Source signals (seismic, infrared, acoustics and others) all decay in amplitude rapidly with radial distance from the source. To maximize detection range, sensor sensitivity must be optimized. In addition, due to the fundamental limits of background noise, a maximum detection range exists for any sensor. Thus, it is critical to obtain the greatest sensitivity and to develop compact sensors that may be widely distributed. Clearly, microelectromechanical systems (MEMS) technology provides an ideal path for implementation of these highly distributed systems. The sensor-substrate “sensor rate” is then a platform for support of interface, signal processing and communication circuits. Examples of WINS Micro Seismometer and infrared detector devices are shown in figure 4. The detector shown is the thermal detector. It just captures the harmonic signals produced by the foot-steps of the stranger entering the border. These signals are then covered into their PSD values and are then compared with the reference values set by the user bonding pads.

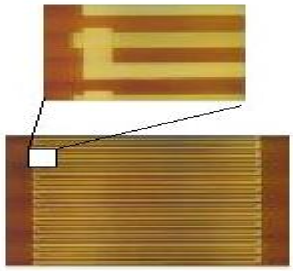


Figure 5 : A micrograph of the thermopile junction array

WINS MICROSENSOR INTERFACE CIRCUITS

The WINS microsensor systems must be monitored continuously by the CMOS micropower analog-to-digital converter (ADC). As was noted above, power requirements constrain the ADC design to power levels of 30 W or less. Sensor sample rate for typical microsensor applications is less than 1kHz (for example the infrared microsensor bandwidth is 50Hz, thus limiting required sample rate to 100 Hz). Also, it is important to note that the signal frequency is low. Specifically, the themopile infrared sensor may be employed to detect temperature, presence, of motion at near dc signal frequencies. Therefore, the ADC must show high stability (low input-referred noise at low frequency). For the WINS ADC application, a first order Sigma-Delta (S-D) converter is chosen over other architectures due to power constraints. The S-D architecture is also compatible with the limitations of low cost digital CMOS technologies.

The analog components of the ADC operate in deep subthreshold to meet the goal of micropower operation . This imposes severe bandwidth restrictions on the performance of the circuits within the loop. A high oversampling ratio of 1024 is thus chosen to overcome the problems associated with low performance circuits. The possible increased power consumption of digital components in the signal path including the low pass filter is minimized with the use of low power cell libraries and architecture.

Implementation of low noise ADC systems in CMOS encounters severe “1/f” input noise with input noise corner frequencies exceeding 100 kHz. The WINS ADC applications are addressed by a first-order converter architecture combined with input signal switching (or chopping). The chopper ADC heterodynes the input signal to an intermediate frequency (IF) before delivery to the S-D loop. An IF frequency of 1/8th of the ADC sampling frequency is chosen. The low thermopile sensor shown in figure 5 source impedance limits the amplitude of charge injection noise that would result from signal switching. The required demodulation of the IF signal to the desired baseband is accomplished on the digital code modulated signal, rather than on the analog signals. This both simplifies architecture and avoids additional injected switching noise. The architecture of the chopped S-D ADC .

The first order S-D ADC has been fabricated in the HPCMOS 0.8m process. Direct measurement shows that the converter achieve greater than 9 bit resolution for a 100 Hz band limited signal with a power consumption of only 30 W on a single 3V rail. This chopper ADC has been demonstrated to have a frequency-independent SNR from 0.1 – 100Hz shown in figure 6 .This resolution is adequate for the infrared sensor motion detection and temperature measurement application.

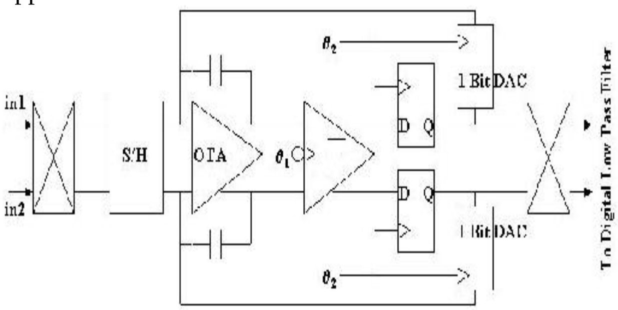
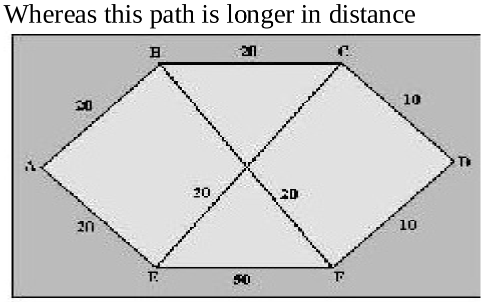


Figure 6: A block diagram of a pulse code modulator

the major node. This routing is done based on the shortest distance. As shown in figure 9 That is the distance between the nodes is not considered, but the traffic between the nodes is considered. This has been depicted in the figure 4. In the figure, the distance between the nodes and the traffic between the nodes has been clearly shown. For example, if we want to route the signal from the node 2 to node 4, the shortest route will be from node 2 via node 3 to node 4. But the traffic through this path is higher than the path node 2 to node 4. Whereas this path is longer in distance



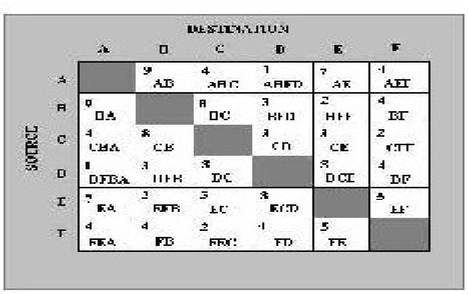


Figure 8 : Subnet with line capabilities , Figure 9 : Routing Matrix

SHORTEST DISTANCE ALGORITHM

In this process we find mean packet delay, if the capacity and average flow are known. From the mean delays on all the lines, we calculate a flow-weighted average to get mean packet delay for the whole subnet. The weights on the arcs in the figure 8 give capacities in each direction measured in Kbps.

In the routes and the number of packets/sec sent from source to destination are shown. For example, the E-B traffic gives 2 packet/sec to the EF line and also 2 packet/sec to the FB line. The mean delay in each line is calculated using the formula

$$T_i = 1/(\mu c - \lambda)$$

Ti = time delay in seconds

C = Capacity of the path in Bps

λ = Mean flow in packets/sec

μ=Mean packet size in bits

i	Line	λ_i(pkts/s)	C_i(kbps)	μC_i (pkts/sec)	T_i(msec)	Weight
1	AB	14	20	25	91	0.171
2	BC	12	20	25	77	0.146
3	CD	6	10	12.5	154	0.073
4	AE	11	20	25	71	0.134
5	EF	13	50	62.5	20	0.159
6	FD	8	10	12.5	222	0.098
7	BF	10	20	25	67	0.122
8	EC	8	20	25	59	0.098

The mean delay time for the entire subnet is derived from weighted sum of all the lines. There are different flows to get new average delay. But we find the path, which has the smallest mean delay-using program. Then we calculate the Waiting factor for each path. The path, which has low waiting factor, is the shortest path. The waiting factor is calculated using

$$W = \lambda i / \lambda$$

λi = Mean packet floe in path

λ = Mean packet flow in subnet

WINS DIGITAL SIGNAL PROCESSING

The WINS architecture relies on a low power spectrum analyzer to process all ADC output data to identify an event in the physical input signal time series. Typical events for many applications generate harmonic signals that may be detected as a characteristic feature in a signal power spectrum. Thus, a spectrum analyzer as shown in figure 10 must be implemented in the WINS digital signal processing system. The spectrum analyzer resolves the WINS 8-bit ADC input data into a low resolution power spectrum. Power spectral density (PSD) in each of 8 frequency “bins” is computed with adjustable band location and width. Bandwidth

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol. 3 , No.1, Pages : 112– 116 (2014)
Special Issue of ICETETS 2014 - Held on 24-25 February, 2014 in Malla Reddy Institute of Engineering and Technology, Secunderabad– 14, AP, India

and position for each power spectrum bin is matched to the specific detection problem. Since this system must operate continuously, as for the ADC, discussed above, the WINS spectrum analyzer must operate at mW power level.

If a stranger enters the border, his footsteps will generate harmonic signals. It can be detected as a characteristic feature in a signal power spectrum. Thus, a spectrum analyzer must be implemented in the WINS digital signal processing system. The spectrum analyzer resolves the WINS input data into a low-resolution power spectrum.. The WINS spectrum analyzer must operate at W power level. So the complete WINS system, containing controller and wireless network interface components, achieves low power operation by maintaining only the micro power components in continuous operation. The WINS spectrum analyzer system, contains a set of parallel filters.

The complete WINS system, containing controller and wireless network interface components, achieves low power operation by maintaining only the micro power components in continuous operation. The WINS spectrum analyzer system, contains a set of 8 parallel filters. Mean square power for each frequency bin, is computed at the output of each filter. Each filter is assigned a coefficient set for PSD computation. Finally, PSD values are compared with background reference values (that may be either downloaded or learned). In the event that the measured PSD spectrum values exceed that of the background reference values, the operation of a microcontroller is triggered. Thus, only if an event appears does the microcontroller operate. Of course, the microcontroller may support additional, more complex algorithms that provide capability (at higher power) for event identification.

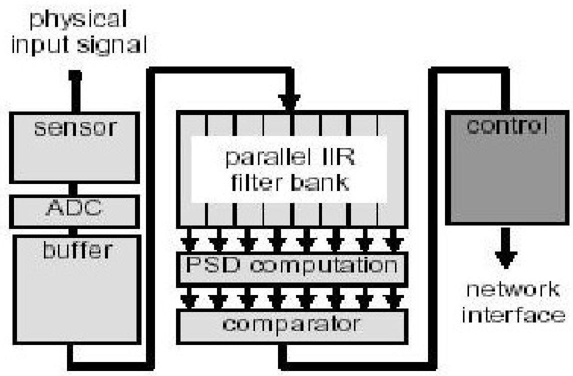


Figure 10 : WINS micro power spectrum analyzer architecture

HISTORY

Earliest research effort in WINS was low power wireless integrated micro sensors.

The (LWIM) projects at UCLA founded by DARPA [98]. The LWIF project focused on developing devices with low power electronics. It enable large, dense wireless sensor net work.This project was succeeded by the WINS project.

APPLICATION

SUPPORT PLUG-IN LINUX DEVICES: other development will include very small but limited sensing device that interact with WINS NG node in heterogeneous network.

SMALL LIMITED SENAING DEVICE: interact with WINS NG node in heterogeneous network
SCAVENGE ENERGY FROM THE ENVIORNMENT: small device might scavenge there energy from the environment by means of photocells and piezoelectric materials, capturing energy from vibration and achieving perpetual lifespan

Advantages and Disadvantages :
Advantages :
1.It avoid hell lot of wiring
2.It can accommodate new devices at any time
3.Its flexible to go through physical partitions
4.It can be accessed through a centralized monitor

5.It is very cheaper,faster,can be accessed in shorter distances,having less amount of delay,and also power consumption is in the order of microwatt

Disadvantages
1.Its damn easy for hackers to hack it as we cant control propagation of waves
2.Comparatively low speed of communication
3.Gets distracted by various elements like Blue-tooth
4.Still Costly at large

CONCLUSION

A series of interface, signal processing, and communication systems have been implemented in micro power CMOS circuits. A micro power spectrum analyzer as shown in figure: 10 has been enabled to low power operation to the entire WINS system. Thus WINS require a Microwatt of power. But it is very cheaper when compared to other security systems such as RADAR under use. It is even under used for short distance communication less than 1 Km. it produces a less amount of delay. Hence it is reasonably faster. On a global scale, WINS will permit monitoring of land, water, and air resources for environmental monitoring. On a national scale, transportation system, and borders will be monitored for efficiency, safety, and security.

REFERENCES

WWW.WINSNET.COM

WWW.WIKIPEDIA.COM

WWW.SEMINARONLY.COM

WWW.12BURST.COM

WWW.SCIENCEDAILY.COM

WWW.SCRIBED.COM