Intelligent Network
Design of intelligent multinode Sensor networking

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Abstract:. The paper deals with the self configured intelligent sensor networking. The individual sensors are acting on the body or an object to measure different parameters. Although the sensors are measuring parameters accurately, but they are failed to act depending on different situations. For example a robot is moving on a surface can take decision to turn left or right when an obstacle come across. But the same robots take wrong decision when the obstacle is not static. The robot can wait till the obstacle passed away from its way. But the robot still follows the traditional way, which is turning left or turn. In this case the robot is failed to take correct decision depending on the situation. If we consider other example such as traditional automatic water supply to plants or crops, the system supplies the water at regular intervals of time with accurate quantity. But the system takes same decisions in all seasons irrespective of the soil type and crop type. In our system we are proposing a Wireless Distributing sensor system design which is able to take wise decisions as a farmer. A farmer can understands how much water the soil needs and at what time it need to apply. In our work, we are developing, (1) Home Area Networking (2)software supporting above functions; (3) Wireless Sensor Networking.

Introduction: My paper describes about advanced self configured Wireless Distributed Sensor networking. My project support universal sensors, network management, GUI software, house area network (HAN) [1]. The smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The smart environment needs information about its surroundings as well as about its internal workings. Our wireless sensor networks is involved with challenging issues wireless sensor systems, self-organization, signal processing and decision-making, and finally some concepts for home automation, We have identified some facts are :

1. Most networks are application specific, extensive secondary development is necessary to adapt to different circumstances.
2. Most of them are run by developers - professionals rather than end users.
4. It is difficult for end users to configure and deploy a practical sensor network.
5. Systematic compatibility for diverse sensors and communication channels is limited.
6. The aquatic sensor network technology lags behind terrestrial development in terms of use of modern technology.

Often, a single sensor cannot fully capture the measured phenomenon, so researchers develop multi-sensor systems to obtain more accurate information, as shown in Figure 2-1. *Smart Sensor* Enhanced functions include *"compensation of secondary parameters (e.g. temperature), failure prevention and detection, self-testing, auto-calibration"*.

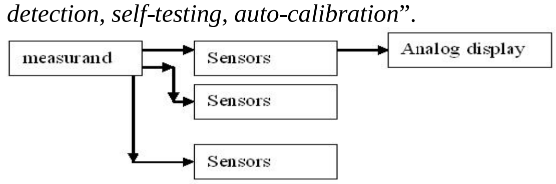


Figure 2-1: Multi-sensor Sensing Model

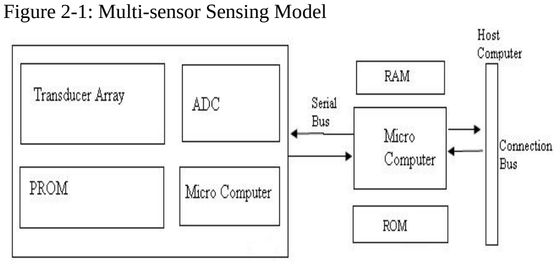


Figure 2-2: Smart Sensor Network

A sensor network consists of multiple detection stations called sensor nodes [3].The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver, which can be hard-wired or wireless, receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from the electric utility or from a battery.

The observations made against the characteristics of DSN are:

- Extended wider coverage of the environment
- Better fault tolerance
- Higher quality of measurements
- Eliminate ambient interference.
- Shorter response delay for changing events.
- Flexible size of network

Wireless House Area Network - WHAN

The research group started related investigations under Low Power Wireless Sensor networking. We are integrating DSN with WHAN in house area network system. Based on this DSN platform, we are implementing wireless house area network design.

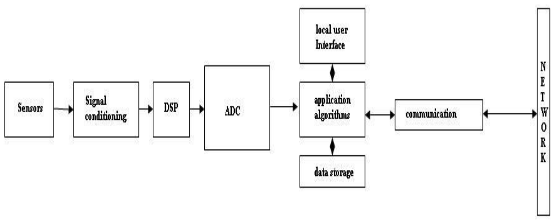
Research Issues and Challenges

Many research issues and challenges have been exposed. Design considerations for sensor networks [7].

• Sensing aspect • Computation part • Wireless Sensor Networking • HAN • Faster algorithm for data tranceiving.

Signal Conditioning [2]

Smart Sensor includes basic blocks for signal conditioning (SC), digital signal processing (DSP), and A/D conversion.



Signal conditioning [6] is performed using electronic circuitry analog low pass filter.

Temperature compensation can also be added during the Signal Conditioning stage. A basic technique for improving the signal-to-noise ratio (SNR) is low-pass filtering, since noise generally dominates the desirable signals at high frequencies. Shown in the figure is an analog LPF that also amplifies, constructed from an operational amplifier. The transfer function of this filter is

$$H(s) = ka/(s+a)$$

with 3 dB cutoff frequency given by $a = 1/\tau$ rad.

and gain given by

$$k = R2/R1.$$

Here, s is the Laplace transform variable. The cutoff frequency should be chosen larger than the highest useful signal frequency of the sensor.

Alternatively, one may use a digital LPF implemented on a computer after sampling. A digital low-pass filter transfer function and the associated difference equation for implementation is given by

Digital filter:

$$Sk1 = K(z+1)/(Z-a)Sk$$

Difference equation:

$$sk1+1 = \alpha sk + K(sk+1+sk)$$

Here, z is the z-transform variable treated as a unit delay in the time domain, $S_k$is the measured signal, and s_k is the filtered or smoothed variable with reduced noise content. The filter parameters are selected in terms of the desired cutoff frequency and the sampling period.

The Wheatstone bridge may also be used for differential measurements (e.g. for insensitivity to common changes of two sensors), to improve sensitivity, to remove zero offsets, for temperature compensation, and to perform other signal conditioning.

Decision-Making and User Interface:

We have developed software to interact intelligent sensor network, WHAN, HAN, decision assistance and alarm indication.

Designing Home Automation [2] :

The figure7 shows how networks of various sorts might interact in the smart home environment. We have developed some protocols for networking of the smart home (House area Network (HAN)). H**AN** is a serial communications protocol developed for automotive multiplex wiring systems. HAN supports intelligent self configured network, distributed real-time control with a high level of security, and is a MultiMate protocol that allows any node in the network to communicate with any other node. Supported are user-defined message prioritization, multiple access/collision resolution, and error detection. The prioritization of slaves of a master can be decided by programmable interrupt controller [8]. We have developed a model to set the priorities of interrupts using PIC8259. The Tranceiving is controlled by PPI8255.We have developed a small algorithm to transmit and receive the data in simple mode. This will help the microcontroller to access the data fast and consumes less power [8].

Address Mapping:

A15 A14 A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0	Port	Address
1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0	A	FFE0
1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 1	B	FFE1
1 1 1 1 1 1 1 1 1 1 1 0 0 0 1 0	C	FFE2
1 1 1 1 1 1 1 1 1 1 1 0 0 0 1 1	Control reg.	FFE3

Figure 2: Address decoding for 8255 ports

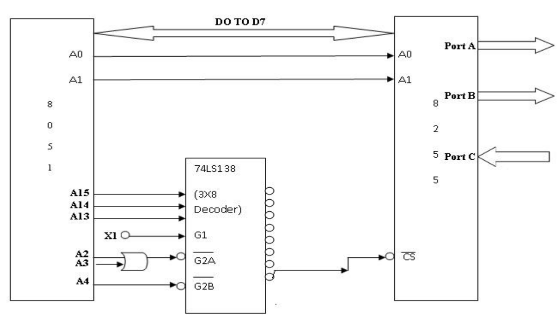


Figure3: Parallel port action at Transmitter

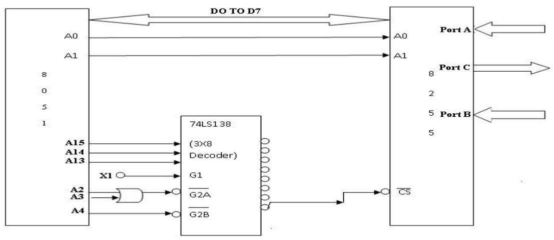


Figure4: Parallel port action at Receiver

Algorithm for Transceiver:

Step1: Initialize mode of operations

1. Transmitter
2. Receiver

Step2:

IF (mode==1) Control goes to Transmitter
IF (mode==2) Control goes to Receiver
ELSE
Invalid mode and goes to exit

For Transmitter:

The program is developed and tested in Microsoft Assembler (MASM).

Algorithm:

Step 1: Initialize the length of the data to be transferred

Step 2: initialize the PortA and PortB as out put ports and PortC as input port.

Step 3: Initialize starting memory location.

Step 4: Clear the Acknowledgement at PB0 and send it to receiver PB0.

Step 5: Read one byte from memory and send through parallel port A

Step 6: Read Acknowledgement from receiver through Port C and mask higher bits (PC1 to PC7) and compare PC0=0 or 1.

IF (PC0==1)

Byte transmission is successful and goes to the next address in the data pool

ELSE

Byte transmission is not successful repeat step5&6

Step7: Decrement the length of the file after one byte transfer and check the length of the file. If length is not zero repeat step4, 5, 6 and 7. If lengths==0 send a specific byte to receiver to represent data transmission is completed.

For Receiver algorithm:

Step 1: Initialize system Port A and Port C as output ports and Port B as input port.

Step 2: Initialize the starting memory location.

Step 3: Clear the Acknowledgement at PC0 and send it to transmitter PC0 to indicate receiver not yet received any data or next data.

Step 4: Read the data from Port A. Now data will be available in accumulator.

Step 5: Store the accumulator data in the memory.

Step 6: Send acknowledgement to transmitter to indicate one byte is received successfully.

Step 7: Read Acknowledgement from transmitter to synchronize the speed between transmitter and receiver.

IF (PB0==1)
Go for next byte
ELSE
Repeat step7

Step 8: compare Port B with specific byte ‘FF’.

IF(PB==FF)
Receiver received all the data from the transmitter. Then go to exit.
ELSE
Repeat step7

Step 9: Increment the memory address for next data and repeat from step 3 to step 9.

Interrupt priority and slave control control [8]

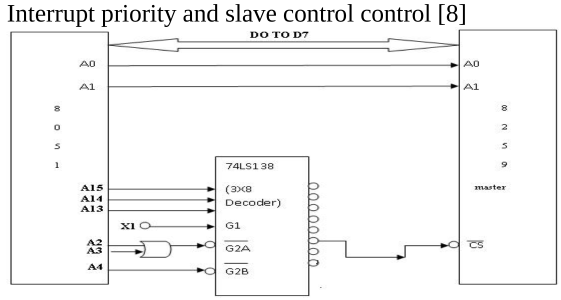


Fig5: Interfacing of a master 8259

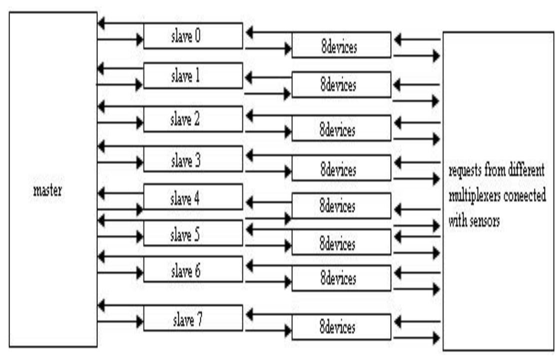


Fig6: Priority resolver and slave control design

Various smart sensors are placed in and around the building. The Set points and control variables can be manipulate and verified using a GUI Window as shown in fig.sim.2.The temperature in the room is able to control by our automated system in different weathers. If the system fails due to misconnections and power failures an emergency message will be displayed and alarming as shown in fig.sim.8.The temperature is maintained exactly at the set point. When the measured value reaches set point it switches off the room heater to coolen the room temperature. Again it takes few minutes to reach the desired value. When the desired point reaches, it again switches on the heater. The multiple sensors are prioritized depend upon the previous situations it learned and stored in the data Files. The sensor devices are prioritized and masked as shown in fig.sim6. The fig.sim5 are showing different levels in the tank in different situations. The situations are decided by the number of persons in a building. Sensors are placed at doors of individual houses in a building. The sensors will help the system to maintain the level of the water in a tank. In a busy day level is set at 1000ltrs. In a normal day level is set at 600 liters. This avoids the stagnant of water in tank and over flow from the tank further reduces the wastage of water. It is also able to control the water level when water is sprinkling to plants in which case it need more water to pump. The function of elevator in the building is able monitored and controlled as show in fig.sim.12. The system also provides a support to extend the number of applications using ADC & DAC interfacing slots represents a seven segment display to display different messages.

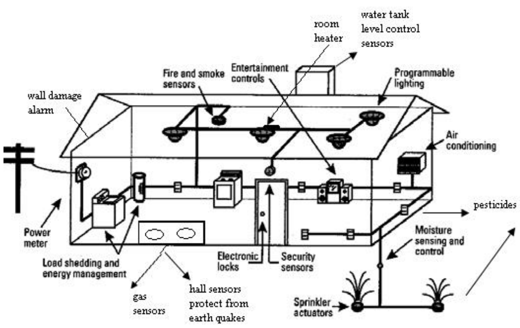


Fig 7. Home Area Network

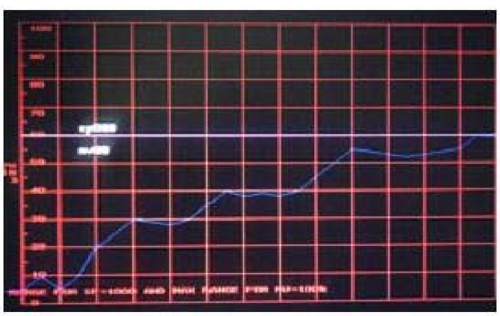


Figure 1.sim5.Level in the tank on a minimum usage day

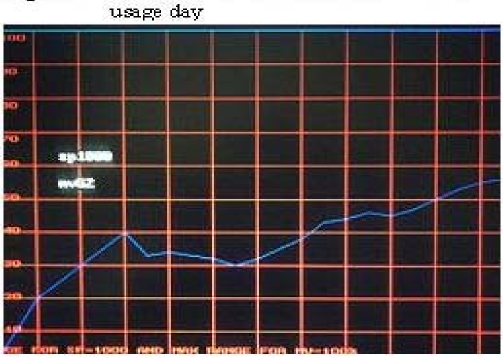


Fig.sim4.Level in the tank on a busy (maximum usage) day

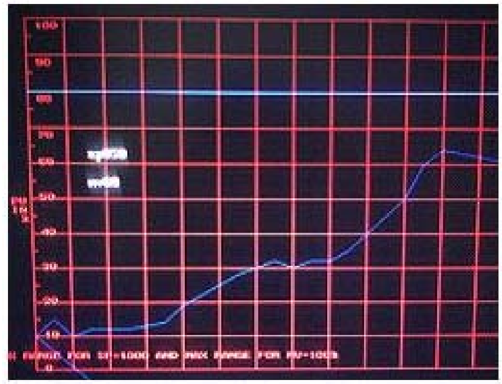


Fig.sim 3.Level in the tank on an average usage day

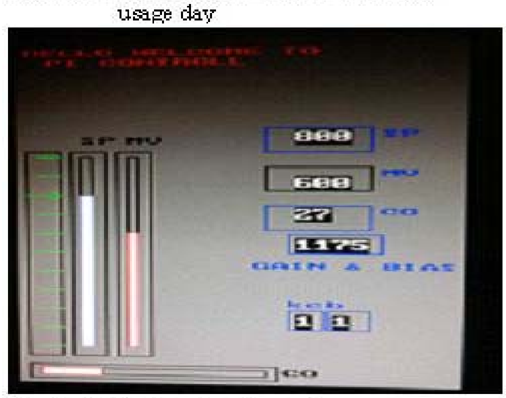


Fig.sim2.window to enter set point and to monitor measured variable and control variable and bar graph

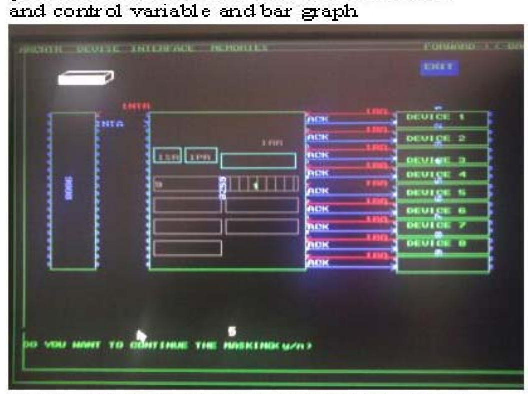


fig.sim.16.Priority resolving when multiple I/O devices are connected to the system.It is showing Device 5 is masked and running under fixed priority mode.


fig.sim7.The window giving a warning that the measured value is above the setpoint.The readings are taken on a hot day.The error will be send back to controller to maintain the desired temperature.

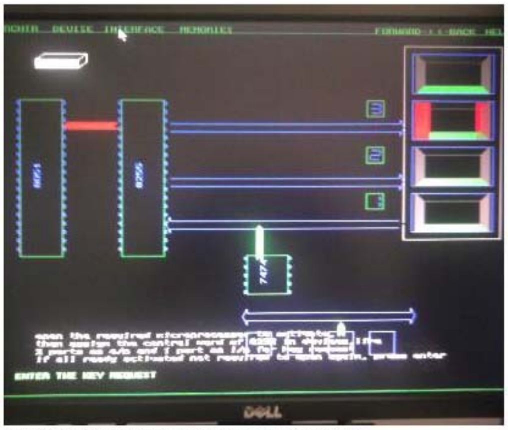


fig.sim12. monitoring an elevator door security at 3rd floor.

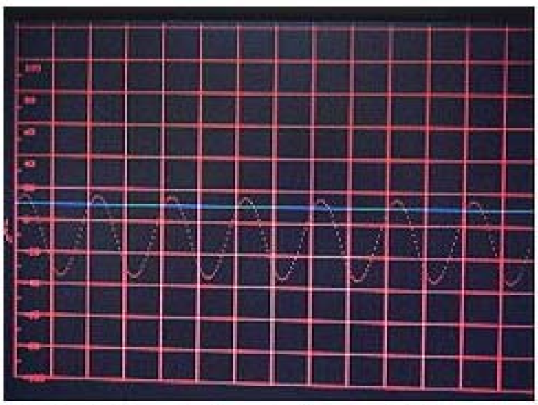


Fig.sim.8showing temerature variation around blue indication set point

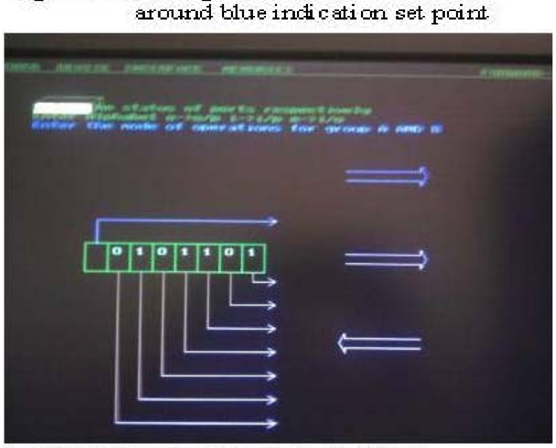


fig.sim10.Setting the control word to set the direction of PPI ports

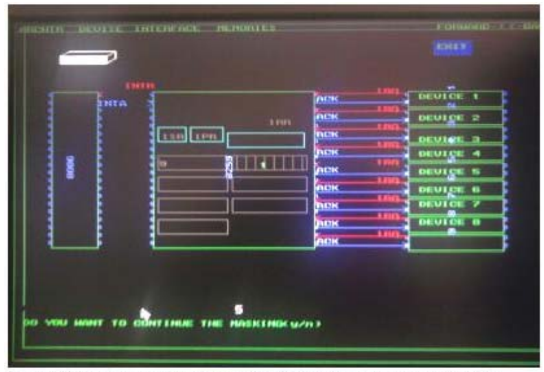


fig.sim.16.Priority resolving when multiple I/O devices are connected to the system.It is showing Device 5 is masked and running under fixed priority mode.

Conclusion:

Much research in Smart Sensors, Distributed Sensor Networks, and Wireless House Area Networks emphasizes common themes. Practical applications need multiple sensors, both in type and location, with different communications and networking. End users expect ease of use, and flexible generic solutions, not one-off solutions. the sensor shall" provide interactivity with the network to allow flexible operations, including remote setting of operation parameters such as observation frequency, signal gain, calibration frequency, etc. and transmission of appropriate operational and housekeeping metadata to the network. Each sensor should provide a self-description capability to the network."

References:

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