Development of the Wireless Bridge Monitoring System for Condition Assessment Using Moving Robot

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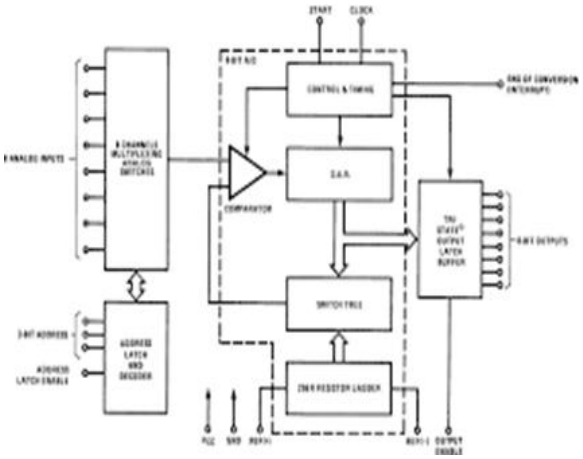
***Abstract*- Our project presents a reconfigurable wireless sensor network for structural health monitoring of bridge. Real-time and periodic structural health monitoring of bridge can reduce the probability of collapse and the consequences of potential life-threatening conditions. The bridge monitoring system is composed the wireless network in which a robot consisting obstacle sensor and crack sensor, then bridge side consisting temperature sensor, vibration sensor and the flux sensor and a central PC that processes and visualizes the data in real-time. The signal from the sensor nodes are plotted as graph in the central PC and abnormal conditions are recorded. Also the data of structural monitoring is processes and stored in the database for future analysis. Also the proposed system overcomes the inconvenience of adding and removing sensor nodes in an existing wired bridge monitoring network.**

INTRODUCTION

Embedded system: It is a combination of hardware and software used to achieve a single specific task. An embedded system is micro controller-based software driven, reliable, real time control system, autonomous or human or network interactive, operating on diverse physical variables an in diverse environments and sole into a competitive and cost conscious market. An embedded system is not a computer system that is used primarily for processing not a software system on PC or UNIX, not a traditional business or scientific application. High end embedded & lower end embedded system. High end embedded system generally 32, 64 bit controllers used with OS. Personal digital assistant and mobile phones etc. Lower end embedded systems generally 8, 16 bit controller used with the specific purpose. Small controllers and devices in our everybody life like washing machine, microwave ovens, where they are embedded in.



FEATURES

- Easy interface to all microprocessors.
- Operates ratio metrically or with 5 VDC or analog span adjusted voltage reference.
- No zero or full scale adjusts required.
- 8 channels multiplexer with address logic.
- 0v to 5v input range with single 5v power supply.
- Outputs meet TTL voltage level specification.
- Standard hermetic or molded 28 pin DIP package
- 28 pin molded chip carrier package.

KEY SPECIFICATION

- Resolution 8 bits
- Total unadjusted error ± ½ LSD and ± 1LSD
- Single Supply 5 VDC
- Low Power 15 mW
- Conversion Time 100 µs

CHARACTERISTICS OF EMBEDDED SYSTEM

Throughput: Our system may need to handle a lot of data in a short period of time.
Response: Our system may need to react to events quickly.
Testability: Setting up equipment to test embedded software can be difficult.
Debugability: Without a screen or a keyboard, finding out what the software is doing wrong is a troubleness problem.
Reliability: Embedded systems must be able to handle any situation without human intervention.
Memory space: Memory is limited on embedded systems, and you must make the software and the data fit into whatever memory exists.
Program installation: You will need special tools to get your software into embedded systems.
Power consumption: Portable systems must run on battery power, and the software in these systems must conserve power.
Power hogs: Computing that requires large amounts of CPU time can complicate the response problem.
Cost: Reducing the cost of the hardware is a concern in many embedded system projects, software often operates on hardware that is barely adequate for the job.

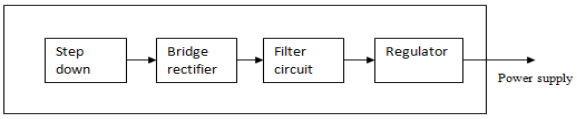
APPLICATION

1. Military and aerospace embedded software application.
2. Communication application.
3. Industrial automation and process control software.

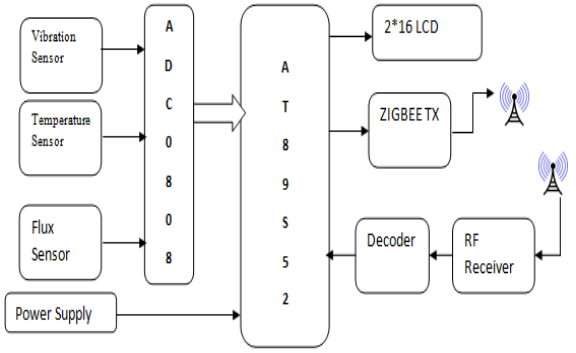
FUNCTIONAL DISCRIPTION

- Multiplexer is the device contains an 8 channel single ended analog signal multiplexer.
- A particular input channel is selected by using the address decoder.
- The address is latched into the decoder on the low to high transition of the address latch enable signal.

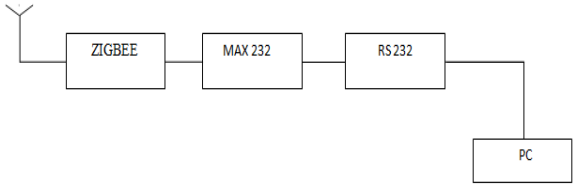
POWER SUPPLY IN ALL SECTION



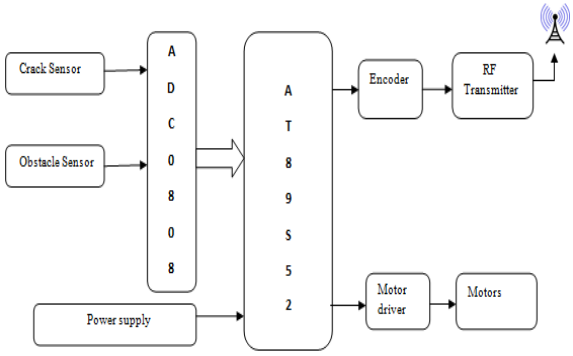
Block diagram of bridge side:



Block Diagram for PC Side:



Block Diagram for Robot Side:



CLASSIFICATION OF EMBEDDED SYSTEM

Real time system: Hard real time systems, soft real time systems.
Hard real time system: Hard real time systems have very narrow response time.
Soft real time system: Soft real time systems have reduced constraints on lateness but still must operates very quickly and repeatable.

LITERATURE SURVEY

Structural health monitoring with wireless sensor network: Nowadays sustainability for both old and new buildings becomes more and more important. Therefore non-destructive test methods are of high interest. Non-destructive test methods for quality control of construction materials, inspection and

analysis of material or structure and are used for continuous monitoring of large construction. A multitude of characteristics values of building structures is measured with conventional wired sensor system nowadays e.g., moisture, temperature and stress, strain or displacement under static or dynamic load. Modal analysis or acoustic emission analysis is used to characterize the condition of the structure. In the future non-destructive test methods in combination with structural health monitoring techniques will help to better understand the structural behavior and to better predict the remaining lifetime. It provides a short insight into the potentially of structural health monitoring using wireless sensor networks, which under development at the institute of construction materials. Such monitoring systems are easy to install and inexpensive that enlarges its application.

A summary review of wireless sensors and sensor networks for structural health monitoring: In recent years, there has been an increasing interest in the adoption of emerging sensing technologies for instrumentation within a variety of structural system. Wireless sensors and sensor networks are emerging as sensing paradigms that the structural engineering fields the begun to consider as substitutes for traditional tethered monitoring systems. A benefit of wireless structural monitoring systems is that they are inexpensive to install because extensive writing is no longer required between sensors and the data acquisition system. Researchers are discovering that wireless sensors are an exciting technology that should not be viewed as simply a synstitute for traditional tethered monitoring system. Rather wireless sensors can play greater roles in the processing of structural response data this reatures be utilized to screen data for signs of structural damage. Also, wireless sensors have limitations that require novel system architecture and modes of operation. This paper is intended to serve as a summary review of the collective experience the structural engineering.

A Wireless structural health monitoring system with multi-threaded sensing devices design and validation: Structural health monitoring has become an important research problem which has the potential to monitor and ensures the performance and safety of civil structures. With the recent advances in wireless communication technology, wireless SHM systems have emerged as a promising alternative solution for rapid, accurate and low cost structural monitoring. This is a newly designed integrated wireless monitoring system that supports real time data acquisition from multiple wireless sensing units. The selected wireless transceiver consumes relatively low power and supports long distance peer to peer communication. In addition to hardware embedded multithreaded software is also designed as an internal component of the proposed wireless monitoring system. A direct result of the multithreaded software paradigm is a wireless sensing unit cable of simultaneous data collection, data interrogation and wireless transmission. A reliable data communication protocol is designed and implemented, enabling robust real time and near synchronized data acquisition from multiple wireless sensing units. An integrated prototype system has been fabricated assembled and validated in both laboratory tests and in a large scale field test condjucted upon the geumdang bridges in icheon, South Korea.

Flexural based mechatronic mobile sensors for structure damage detection: Wireless sensing has been widely explored in recent years for structural monitoring and dynamic testing, due to its advantages in reducing instrumentation time and cost. Limitations of current wireless sensors have been identified in terms of power supply, communication bandwidth, communication range, computing power, etc. To address the above challenges faced by traditional wireless sensor networks with static configuration, this research propose a new approach for structural health monitoring using mobile sensors for the structure damage detection.

EXISTING SYSTEM

- The advancement of the sensor and sensor data processing technologies there is one thing that has not been changed: data communication is through wires and optical cables.
- Manual checking of condition of bridges.
- Timely process
- The complicated wiring also makes the installation and repair/replacement process difficult and expensive.

PROPOSED SYSTEM

- The main objective of our project is to monitor the bridge using sensors to monitor the vibration, flexibility.
- If damage is detected via ZIGBEE communication the damage detection is informed to the base station.
- Crack sensing RF based robot is also designed.

PIN DESCRIPTION

Port 0: It is an 8 bit open drain bi-directional port. As an output port, each pin can sink eight TTL inputs. When is written to port 0 pins, the pins can be used as high impedances inputs. Ports 0 may also configured to be the multiplexed low order address data bus during accesses to external program and data memory. In this mode P0 has internal pull ups.

Port1: port 1 is an 8 bit bidirectional port with internal pull ups. The port 1 output buffers can sources four TTL inputs. When is written to port1 pins they are pulled high by the internal pull ups and can be used as inputs.

Ports 2: Ports 2 is an 8 bits directional port with internal ups. The port output buffers can sources four TTL inputs. That is externally being pulled low will sources current because of the internal pull ups.

Port3: It is an 8 bits bi directional port in internal pull ups. The inputs port 3 pin that are externally being pulled low will sources current because of the pull ups. Port 3 also serves the function of various special features of the listed above.

PORT PIN	ALTERNATE FUNCTIONS
P3.0	RXD (Serial input port)
P3.1	TXD (Serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	WR (external data memory write strobe)
P3.7	RD (external data memory)

PIN DESCRIPTION FOR AT89S52

ADVANTAGES OF MICROCONTROLLER OVER MICROPROCESSOR

1. Gather input from various sensors.
2. Process this input into a set of action.
3. Use the output mechanisms on the microcontroller to do something useful.
4. RAM and ROM are inbuilt in the MC.

BASIC SPECIFICATION OF 2*16 LCD

Power requirements	4.8 to 5.5 dc @ 3Ma
User connector	5-pin header; 0.025 post on 0.10” centers
Connector pin out	+5v GND SERIAL GND +5v
Serial input	RS-232 or inverted TTL,2400/9600,N81
Operating temperature	0^0 to 50^0 C
Initialization	Switches LCD power; perform soft init
Instruction prefix	ASCII 254 (0FE)
LCD type	Supertwist (STN), yellow-green
Optimum viewing direction	6 o’clock

LCD FUNCTION

Function	ASCII Value
Clear screen	1
Home cursor	2
Blank display (retaining data)	8
Hide cursor	12
Show underline cursor	14
Move cursor I character left	16
Move cursor I character right	20
Scroll I character left	24
Scroll I character right	28

ZIGBEE TECHNOLOGY

ZIGBEE is a specification for a suite of high level communication protocols using small, low-power digital radios based on the standard for wireless personal area networks such as wireless headphones connecting with cell phone. A fundamental part of the project is the use of zigbee for remote monitoring purpose. Zigbee has been finding some application in process control Industry. The advantage of zigbee lies in its ease of installation reliable data transfer, low implementation cost and it have a reasonable

battery life span whilst operating on a simple and flexible protocols.

COMPARISION OF ZIGBEE WITH OTHER TECHNOLOGIES

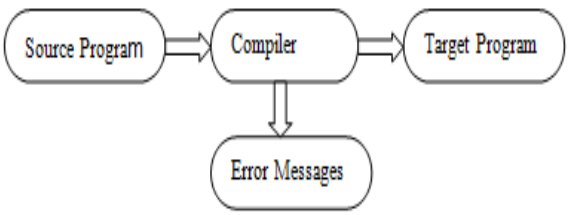
Wireless Technologies	ZIGBEE	WI-FI	Bluetooth
Standard	802.15.4	802.11x	802.15.1
Application Focus	Monitoring & Control	Wireless LAN	Short range cable replacement
Bandwidth	20-250kbps	54Mbps	1Mbps
Network Size	65536	32	7
Transmission Range	10-1000m	50-100m	10m
Power Consumption	very low	High	Medium

Analysis using software tools: Different software tools in this project to display result in a computer screen. There are: Keil software, Visual basic and C programming.

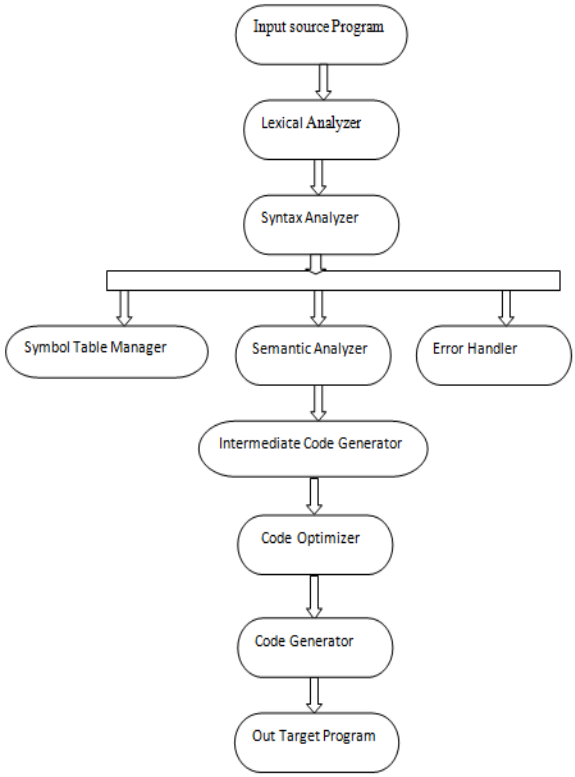
TESTING AND ANALYSIS

Simulator: It is a machine that simulates an environment for the purpose of training or research. We are use a UMPS simulator for this purpose in our project.

Compiler: A compiler is a program that needs a program in one language, the sources language and translates into an equivalent program in another language the target language. The translation process should also report the presence of errors in the sources program.



Phase of compiler: The compiler has a number of phase plus symbol table manager and an error handler



CONCLUSION

Wireless sensor network approach in the field of system identification and condition monitoring for civil structure by using zigbee. Here we were eliminating cables in the monitoring system wireless sensing greatly reduces installation cost and time. Thus design and develop a system for communication the field measurements on real time basis a centralized server using wireless communication. With the merits of low cost, ease customization, flexibility and high accuracy. Damage detection was informed to the base station and permanently store to the database on PC. Crack sensing RF based robot was also designed on bridge side. Experimental results have been shown to validate the guidelines on how to configure wireless network. Future research will be use a climbing robot for real-world structures. For example the robot will be find the nano cracks that can make up or down direction.

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