Bridge Condition Monitoring System Using Wireless Network

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Abstract - The proposed system and implemented using a real time wireless network for bridge monitoring system the main advantage of this system is of lossless data transmission over several minutes of continuous. This system is use mainly transmit the environment parameters for observation and to maintain the condition of the bridges. The major challenge is to ensure that the condition of the civil infrastructure bridge is capable of can withstanding the cumulative weight of all the vehicles that travel in the bridge.

Keywords - ZigBee, flex sensor, vibration sensor, load cell, GSM, ARM.

I. INTRODUCTION

Bridge condition monitoring systems leads to the function of safety maintenance and extending the life time of real time bridges. Long term bridge condition monitoring system have been implemented to provide secured and safety operation. In addition to that it also provides the functionality of an early alert on the damage of the bridges. The existing development of bridge monitoring mainly focus on the special structure and transmitted and vulnerable component of the bridge. The technology of wireless sensor network (WSN) and takes advantage the characteristics of multiple-hop relay to disseminate environmental data. Furthermore, it makes use of wireless sensor nodes as a backup scheme of bridge monitoring. For short distance (among sensors in the bridge) ZIGBEE is used as wireless network, and GSM is used for long distance (between the bridge and the management Centre) data communication. This technology can be called MBM (Monitoring Based Maintenance) that enables the bridge maintenance engineers monitor the condition of the bridge in real time. The sensors installed on various parts of the bridge as shown in Fig. monitors the bend, beam sustainability, weight of the vehicles etc. At any point of time if any of these parameters cross their threshold value the communication system informs the management centre giving an alarm for taking precautionary measures. The complete parameters of the bridge are taken by a ARM microcontroller and sent to another module which is located in a short distance. Here the communication established is using ZIGBEE that uses wireless Transmitter and Receiver circuitry. The receiver module as shown in Fig.2 takes the parameters from the transmitter and sends a message with all the parameters to a database centre. The communication established between the intermediate module and the database centre is using GSM technology. The sensory inputs are process to represent the condition of the bridge against loads, seismic loads etc.

II. DESIGN OF THE PROJECT

The design explains about the various components being used in the project and even description of each of them with their specifications. The design includes block diagram and the hardware implementation of the complete project.

A. ZIGBEE

ZigBee protocol is an open standard for low power wireless networking of monitoring and control devices. IEEE 802.15.4 standard focus on low-rate personal area networking and defines the lower protocol layers. ZigBee uses the IEEE 802.15.4 physical and Medium Access Control layers to provide the reliable Wireless data transfer. ZigBee adds network structure routing, and security to complete the communications suite. 802.15.4 as the physical radio and ZigBee like the logical network and application software. . The 2.4 GHz band is used worldwide and has 16 channels and a maximum over the-air data rate of 250 Kbps. Lower frequency bands are also specified. The path between the transmitter and receiver has become less reliable or there is any failure in network has occurred and then the ZigBee provides the signal with self-healing capabilities when alternate base station paths can be established separately.

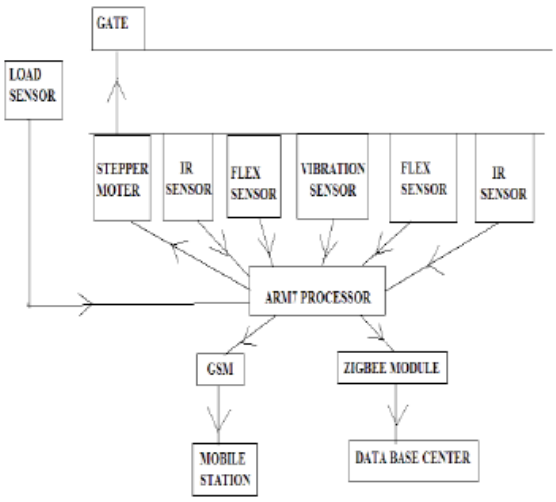
B. ARM PROCESSOR (LPC2148)

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very

low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory.

The ARM7TDMI-S processor also employs a unique architectural strategy known as



Thumb, which makes it ideally suited to high-volume applications with memory restrictions or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set.

C.GSM

The GSM Modem comes with a serial interface through which the modem can be controlled using AT command interface. An antenna and a power adapter are provided. The basic segregation of working of the modem is as under: Voice calls, MS, GSM Data calls, GPRS

III.RELATED SENSOR WORKING

Flex sensor is changes the resistance depending on the amount of bend on the sensor. This sensor will convert the change in bend to electrical resistance – the more the bend, the more the resistance value. They are usually in the form of a thin stripfrom 1"-5" long that vary in resistance from approximately 10 to 50 kilohms.

A property of bend sensors worth noting is that bending the sensor at one point to a prescribed angle is not the most effective use of the sensor. Bending the sensor at one point to more than 90˚ it may permanently damage the sensor. The Load Cell converts the applied force into electrical signals.

Vibration is an oscillatory motion. A body is said to vibrate when it describes an oscillating motion about a reference position. Motion is a vector quantity, exhibiting a direction as well as a magnitude. The extent of the oscillation determines the magnitude of the vibration and the repetition rate of the cycles of oscillation determines the frequency of vibration. The piezoelectric transducer is displaced from the mechanical neutral axis, bending creates strain within the piezoelectric element and generates voltages. The Vibration Sensor Detector is designed for the security practice, When Vibration Sensor Alarm recognizes movement or vibration, it sends a signal to either control panel developed a new type of Omni-directional high sensitivity Security Vibration Detector with Omni directional.

IR Sensor is a general purpose proximity sensor used for obstacle detection The IR signal at TX and RX are compared The output of sensor is high when the frequency of RX signal is low (indicating presence of obstacle) The sensitivity of IR sensor is tuned using the potentiometer

A. LIQUID CRYSTAL DISPLAY.

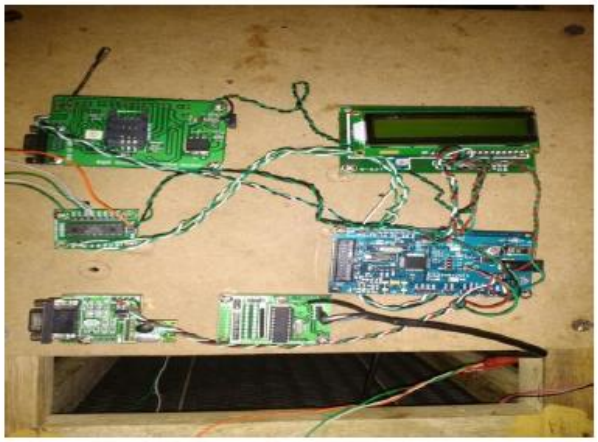
Major task in LCD interfacing is the initialization sequence. In LCD initialization you have to send command bytes to LCD. Set the interface mode, display mode, address counter increment direction, set contrast of LCD, horizontal or vertical addressing mode, color format. This sequence is given in respective LCD driver datasheet. Studying the function set of LCD lets you know the definition of command bytes. It varies from one LCD to another.

Next step after initialization is to send data bytes to required display data RAM memory location. Firstly set the address location using address set command byte and then send data bytes using the DDRAM write command. To address specific location in display data RAM one must have the knowledge of how the address counter is incremented.

Liquid Crystal Displays (LCD) which combine the properties of both liquids and crystals. LCD is a flat electronic visual display. Light modulating properties of liquid crystals are being used for the video display in the LCD. The Liquid Crystal Display is intrinsically a passive device and it is a simple light control device. The managing and control of the data to be displayed is performed by one or more circuits. An LCD consists of two glass panels, with the liquid crystal materials and switched between them LCD are more reliable and energy efficient. Its low power energy consumption makes it to be used in battery powered electronic devices. LCD

Consists of array of small pixels. Each pixel of an LCD consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axis of transmission is perpendicular to each other.

IV. EXPERIMENTAL VALIDATION



The operation of the system is as follows:

1. The LPC 2148 detects and monitors the changes in sensors by displaying the values in LCD.
2. All the changes of sensors will be passed to the IC LPC 2148 which is detected by the LCD.
3. The detected values will be transferred to ZigBee/GSM transceiver from the IC and it pass the data to the antenna..
4. The base Station (BS) receives the signal from the ZigBee/GSM receiver and alerts condition of the bridge

V. IMPLEMENTATION AND RESULTS

Here, the flex sensor work is implemented and it is indicate the internal damage detection in bridges.

Here, the IR sensor work is implemented and itis indicates the crossing limit in bridges.

Here, the vibration sensor work is implemented and find the external damages in bridge.

The load cell implemented and the weightage is calculated to find the capacity of the vehicle.

VI.CONCLUSION

This paper is mainly to apply the technology of the WSN to bridge monitoring. And the WSN is set as a backup monitoring system to alert the internal and external damages and the maximum load capacity that can be tolerated by bridge is monitored by Flex, Vibration and Load Cell, IR Sensor respectively. The changes of the sensing values will be displayed in the LCD.

There are still many problems need to be overcome, such as the usage of the bandwidth etc. Therefore the future study should be focused on the improvement to these topics.

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