DESIGN AND DEVELOPMENT OF ETHERNET CONTROL SYSTEM FOR MONITORING & CONTROL OF HIGHWAY BRIDGES USING EMBEDDED WEB SERVER

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ABSTRACT

Embedded technology is one of the most emerging technologies in the modern era. With the development of network technology and communication technology that needs industrial control can be completed via ethernet has become a trend. Here the proposed system consists of ARM processor with an external Ethernet interface controller and whole system can function as a web server controlling various devices and displaying their status on LCD. The main aim is to develop an embedded web server using ARM processor & real time operating system .For software implementation we have used 'C' language .HTML is used for developing web pages. . Both, the operating system and the web server application are ported on the ARM processor. This embedded web server is tested for its working, using a data acquisition web application hosted over a network of PC's.

This idea is utilized for monitoring & controlling various devices such as Printer, Scanner, fax machine, fan using relay drivers .Ethernet module can communicate to the owner of the overall system ,who is able to manage devices from any location outside. This embedded web server which is developed by using Embedded C language can be beneficial for mission critical applications, remote data acquisition systems, ATM network and more. The developed web server accelerates business performance by automating and orchestrating processes across total enterprises. Enterprise users can collaborate more flexibly and cost-effectively with business and trading partners.

The application of this system is not only limited to electronic field but can also be used in civil infra structures simply by using a SMART SENSOR for montoring and controlling long term degradation. Assessment of structural integrity after catastropjic events such as earthquakes, hurricanes, tornado's ,fires. The ability to continuosly monitor the integrity and control the response of structures in real time can provide for increased safety to the public, particularly with regard to the aging structures widely used today.We describe the application of civil infrastructure for Monitoring and controlling long term degradation & bridge safety is the major concern to the government and the people. Although there are so much safety majors taken to ensure the protection of bridge, still there is no effective system which can monitor and control the status of the highway bridges from a centralized location. Aim of this proposed project is to develop the device that monitor the vibrations on the bridges, control the vehicles traffics on bridge by the traffic signal and carry the appropriate weight of vehicle on bridge. The values of these parameters are updated on the main PC server with the regular span of interval. The administrator helps to monitor the condition from any location in a web page. So it provides the idea related to maximum weight carriage capacity of the bridge & safety of the bridge. So any

emergency situation like natural calamities such as earthquake, hurricanes, tornadoes, fire etc. occurs, the decision can be taken immediately after verifying the live data. This project has ARM processor based embedded system connected to Ethernet module which is connected to router. Personal IP address enters on HTML web page & this address is called from the host which is connected to the router.

Keywords: ARM processor, Accelerometer, Bridge safety, Ethernet, HTML, IP address, Load cell.

I. INTRODUCTION

An embedded system is a device that has computer intelligence and is dedicated toper forming a single task, or a group of related tasks. Embedded systems often perform monitoring and control functions such as gathering and reporting sensor readings or controlling motors and switches. They're called embedded systems because the program code is an integral part of, or embedded in, the devices.

1.1 Aim of the Project

Main aim of this project is to connect a arm processor to LAN or Internet and use it as a web server.

With the rapid development of Internet information technology, those field bus and Industrial Ethernet which are of high-specialization and high cost and are used in control areas are gradually being replaced by Ethernet. Embedded systems and Internet technology are combined to form a new technology - the Embedded Internet Technology, which developed with the popularization of computer network technology in recent years .Without restrictions from devices and systems, this technology could function in the hardware and software as long they are connected. Only by using web browser through the Ethernet and TCP/IP protocol can users get access to variety of information. It brings great convenience to remote video monitoring and equipment management.

The demand for Internet-connected products is growing. According to International Data Corporation, the industry analyst group, the market for Internet-connected goods will be worth around $17.8 billion by 2004. More and more the Internet is seen as the most cost-effective way of remotely monitoring and controlling embedded systems. With the availability of standards-based embedded enabling technology at low cost the entry level for companies looking to gain benefit from Internet-connected technology has been significantly improved.

1.2 Historical Background

Using embedded and Ethernet technology for industrial network has become an important point for technology of measuring and instrument, corresponding to huge development in computer and Internet technology. Industry has been very successful in design and manufacture of complex embedded system. Such as modern vehicles (control, information, entertainment etc), monitor system, telecommunication system, wireless communication systems, and the automation systems.

These embedded systems are becoming more and more complex, distributed, interconnected, and based on distributed computing to a larger extent.

In a world where more services are relying on internet technology, security is an essential. Compromises in the security of servers can affect the quality and integrity of the service being offered. Security breaches include Intrusion, Information Theft, Modification, and Denial of Service

(DoS) and Distributed Denial of Service (DDoS). DoS attacks are the most conspicuous attacks since they keep legitimate users from accessing the service that they are entitled to by consuming the server's resources such as

bandwidth, CPU cycles, data structures, etc. Consequently, providers and consumers suffer because the technology these services are relying upon has been attacked. A DoS attack on a system succeeds by means of exploiting a weakness that leads to the server being overwhelmed. For example, a simple DoS attack can exploit a system's insufficient bandwidth by simply flooding it with packets whose IP addresses are unreachable. In DoS the source of the attack is a single host while in the DoS multiple sources target the same destination. Both forms of attack have the same result but not always the same network traffic behavior.

II. SYSTEM ARCHITECTURE

The architecture of Embedded Web Server consists of client/server, browser/server for easy maintenance, more flexibility, up gradation and low development cost. There is a difference between client/server and browser/server. The difference is that there is a no need of development of client program in browser/server, so that it becomes easy for the developers to concentrate on improvement of the server and this mode is simple to use, easy to extend and convenient to maintain. EWS excels traditional PC server for its low power consumption, small size, high performance, low cost, portable and easy to deploy. It can achieve better performance under flexible environment, which require real time response and high systems net reliability. Fig. shows the proposed concept of monitoring and controlling highway bridges system with architecture of EWS.
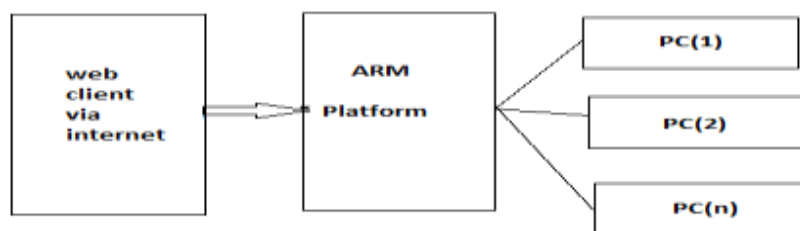

Figure: Architecture of EWS

III. HARDWARE DESIGN

Fig. shows the block diagram of monitoring and controlling highway bridges using Ethernet control system for embedded web server using ARM processor.
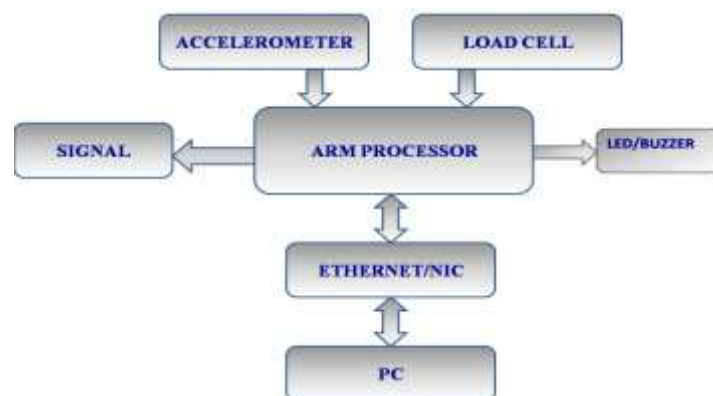

Figure: Block diagram of hardware system

3.1Arm Processor

ARM processor is 16-bit/32-bit ARM 7 TDMI-SCPU having real time emulation and embedded trace support , ARM processor have Embedded flash memory ranging from 32Kb to 512Kb. LPC2148 tiny in size with low power consumption which is ideally used for miniaturization such as access control and point of sale. Serial communication interfaces ranging from a USB 2.0 full speed device, multiple UART's, SPI, SSP to I2C bus and on chip SRAM of 8Kb up to 40Kb.

3.2 Accelerometer

The MMA6361L/MMA7361L is a low power, low profile capacitive a michro machined accelerometer featuring is signal conditioning, a 1-pole low pass filter, temperature compensation and g-select which not require external devices. The MMA6361L/MMA7361L includes a sleep mode that makes it ideal for handheld battery power electronics. For bridge monitoring and controlling 2- axes accelerometer is used that can be interfaced to analog channels of ADC. 1-accelerometer used on the ground floor near the pillar of the bridge and another accelerometer is used on the top of the bridge. The accelerometers are used for the vibration measurement.

3.3 load Cell

Load cell is used to measure the weight carried out by the bridge load cell outputs a low voltage analog output which has to be amplified and then fed to ADC.

3.4 Ethernet Module

The name Ethernet invented from the concept of Ether. The Ethernet is the standard of signal and number of wiring for the physical layer of OSI model through the network access at the media access control (MAC) and data link layer. Ethernet station communicates to each other on the top of the physical layer by transmitting the data packets and small blocks of data. Standard IEEE 802.3 is the standard of Ethernet. Twisted pair is combined versions of Ethernet for connecting the end systems to the network analog with the fiber optic versions for site backbone, is the most wide spread wired LAN technology.

IV. SOFTWARE DESIGN

Embedded C: As the ARM processor used for this concept, it require using the programming language "EmbeddedC". The "Embedded C" is efficient high level gives the low level and high level access to the hardware. It is well defined language. It supports middle level, high level and low level features. The embedded C run time library contains many standard routine such as conversion of numeric formatted output floating point arithmetic. This is a very portable language based on ANSI standard and it is easily obtained for most system.TCP/IP Protocol: TCP/IP protocol suite is the communication protocol which implements the stack of protocol on which the most commercial network and internet executes. TCP provides the reliable sequential delivery of stream of octets from a program on one PC to another program on another PC. TCP protocol is utilized by measured internet application like WWW transferring of file, administration of remote and E-mails. TCP/IP suite is the two layer programming, assembling of messages or a smaller packet file are managed by the higher layer and these of messages or file into smaller packets are transmitted to the internet and received by the TCP layer and that reassembles the packets into the original message and the lower layer that means internet protocol manages the addressing part of the each packets so it will reaches to the correct location. HTTP

protocol: HTTP protocol is used to communicate between web browser and web server this protocol is the frame work of web communication by providing the control information handling request are transmitted between server and browser. Client-server communication: Client access the equipments which are connected to the server then it enters configured IP address and it monitor the equipments through the HTML web page.

V. OUR APPROACH

Our approach is to monitor and control the vibration measurement and load rating on the highway bridges to avoid the accident by using Ethernet control system and EWS. Web server technology is developed for bridge monitoring which is interfaced with both accelerometer and load cell to facilitate vibration sensing of natural calamities on bridge evaluation and load rating on bridges to avoid the accident due to natural calamities and natural troubles related to environment. Put one of the accelerometer on the top of the bridge and another accelerometer on the ground floor near the pillar of the bridge for vibration measurement. Load cell mounted below the pillar of the bridge. So it will identify that how much weight of the vehicles bridge can carry? If the weight on the bridge is more than its limit then it will glow the red LED and passes the message as "bridge is blocked" and if the weight on the bridge is within its limit then the green LED will glow and passes the message as "you may go now" and if accelerometer senses any natural calamities then it will display the web page through Ethernet.
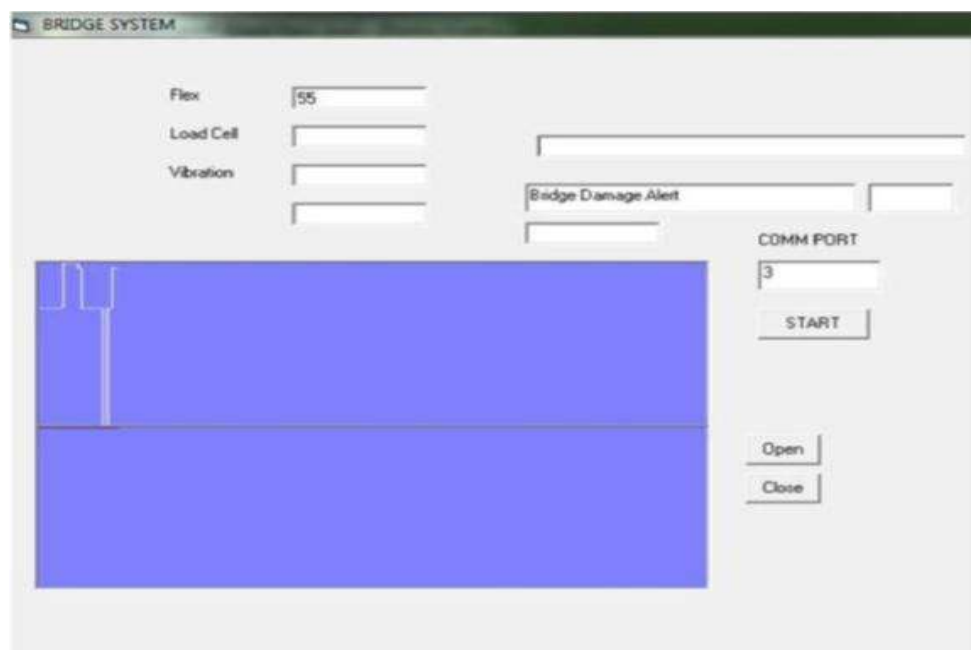

Figure: Web Page of Bridge Monitoring System

VI. CONCLUSION

The embedded web server that has been designed can be used with industrial equipment medical instrument, controlling and monitoring of bridges and dam (civil infrastructures) in many other places. An administrator monitor and control the device with a simple but enhanced and much powerful user interface without additional hardware. Poorly designed and configured software architecture might even generate high response time while the physical resources display low utilization. A remote user only requires common internet browser to carry out experiments on real hardware.

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