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EMBEDDED WI-FI IN COLLEGE

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ABSTRACT

Today we are living in 21st century where automation is playing important role in human life. Currently device with microcontroller has been widely used in industrial field. However, a large number of devices don't have the network interface and the data from them cannot be transmitted in network. A design of Microcontroller based embedded Wi-Fi interface is presented here. In this design, an existing SPI serial device can be converted into a network interface peripheral to obtain compatibility with the network. The design mainly consists of SPI communication module, microcontroller module and Wi-Fi interface module. In the design, communication can take place by using microcontroller and Wi-Fi controller module. It has an excellent prospect in Industry of new automation application. In the existing system it uses serial communication so it is needed to build a network for remote operating, but in case of Wi-Fi communication it can use LAN network which minimizes the cost of network infrastructure. It has an excellent prospect in Industry of new automation application. This system uses microcontroller to store the main application source code, web pages and TCP/IP stack which is a vital element of the system software. Nowadays, Internet has spread worldwide and most of the internet connections use Wi-Fi as media for data transfer. In industries or in home appliances, most of the time we need to monitor and control different parameters using microcontrollers. Once we enable Wi-Fi interface to such systems, we can communicate with them remotely over the internet. This system can access and detect the status of any electrical appliance through specially designed web site using any PC or phone with network access.

Keywords: - Smart College, Smart Environment, Wi-Fi module, PIC16, I/O System, SPI interface.

1. INTRODUCTION

Past many years back, embedded systems and Ethernet networks existed in separate worlds. Ethernet was available only to desktop computers and other large computers [1]. Embedded systems that needed to exchange information with other computers were limited to interfaces with low speed, limited range, or lack of standard application protocol [2]. But developments in technology and the marketplace now make it possible for embedded systems to communicate in local Wi-Fi networks as well as on the Internet. Network communications can make an embedded system more powerful and easier to monitor and control [3].

Wi-Fi solves the problem of remote communication with the embedded application. Challenges like application monitoring, control, diagnostics and data logging can all be accomplished from a remote, centralized location. With the ability to access the application remotely, corporations can eliminate the need to send a service person to the application and thus save labor time and money. There are compelling reasons behind considering Wi-Fi for remote communication [8].Wi-Fi is the most widely deployed network in offices and industrial buildings. Wi-Fi's infrastructure, interoperability and scalability ensure ease of development [6]. Once equipment is connected to a Wi-Fi network, it can be monitored or controlled through the Internet removing any distance barrier that may have inhibited remote communication previously.

2. BLOCK DIAGRAM

2.1 DETAILED BLOCK DIAGRAM DESCRIPTION-

- **Microcontroller:** Acting as a basic control unit which controls the output section as well as the system which will be connected.
- **Wi-Fi module:** Wi-Fi module is use to create connection within the destination which to shrivelled. IP address of the module is to control the elements connected to the system.
- **RJ-45:** This is use only and only if the user is within the reach of the system and connection are possible through wire.RJ-45 connector serve as a bridge between the user panel and the elements.

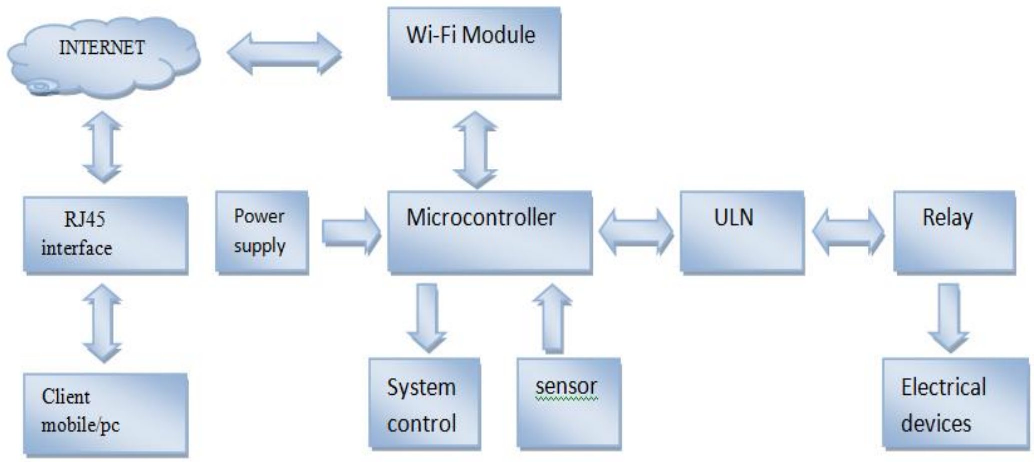

Figure-1. Block diagram of Wi-Fi enabled digital I/O control system.

- **Client/PC:** This is the actual aim where the Wi-Fi provides the mobility of the user to roam anywhere irrespective of the position in the world. IP address and the panel created is controlled through this.
- **System/Control:** This is the output of the micro controller. These are the device s which is to be controlled. For ex. (CNC MACHINE, CONVEYERS).
- **Sensor**: This allows the micro controller with the appropriate information of the particular which is to be taken. For ex.(temperature sensor provides the information about the bearable temperature).
- **Relay**: It is similar to the output element where we can connect any of the device which is to be controlled, It basically act as a switching device.

3. FUNDAMENTAL COMPONENT

This section gives information about various components related to the system and various options available for using them. Some of the important components and protocols are listed below:

- SPI interface
- i/o system

3.1 SPI (Serial Peripheral Interface) Standard

SPI requires 4 signals for bidirectional communication:

- Clock (SCK);
- Data In (SI);
- Data Out (SO);
- Chip Select (CS).

The clock signal is controlled by the master device i.e. the PIC16. All data is clocked in and out using this pin. These lines need to be connected to the relevant pins on the PIC16. Any unused GIO pin can be used for CS, instead pull this pin high.

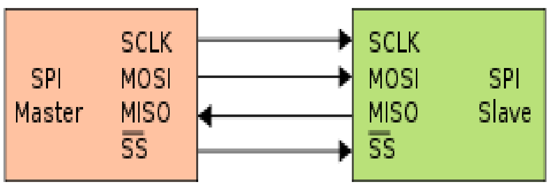

Figure-2. Serial Peripheral Interface

The SPI has a 4-wire synchronous serial interface. Data communication is enabled with a low active Slave Select or Chip Select Signal (SS) or (CS). Data is transmitted with a 3- wire interface consisting of wires for serial data input (MOSI), serial data output (MISO) and serial clock (SCK).

4. HARDWARE ARCHITECTURE

The system utilizes a Stand-Alone Wi-Fi Controller IC which handles most of the network protocol requirements. The IC communicates directly to the microcontroller using a standard SPI interface. The system hardware includes an RJ45 socket with link/activity lights, host microcontroller (A PIC) and input/output devices like sensors and relays for monitoring and controlling purpose. This system enables user to connect a particular embedded device (equipped with SPI support) on to a network. By using this Wi-Fi enabled digital I/O control system, applications like Embedded Web server.

4.1 RJ-45 Connector socket

Wi-Fi uses a bus (old coaxial cable) or star topology (standard UTP cable). Most Wi-Fi networks use unshielded twisted pair (UTP) cable. Category 5 (CA T5) cable widely used, but other variations are available. EIA/TIA specifies RJ-45 connectors - properly called 8P8C - (ISO 8877) for UTP (unshielded twisted pair) cable. A standard LAN cable can be connected here using RJ-45 connector.

4.2MCU PIC16

PIC-microcontroller is commonly used in robotics and control applications. Its potential use is in data acquisition and measurements.

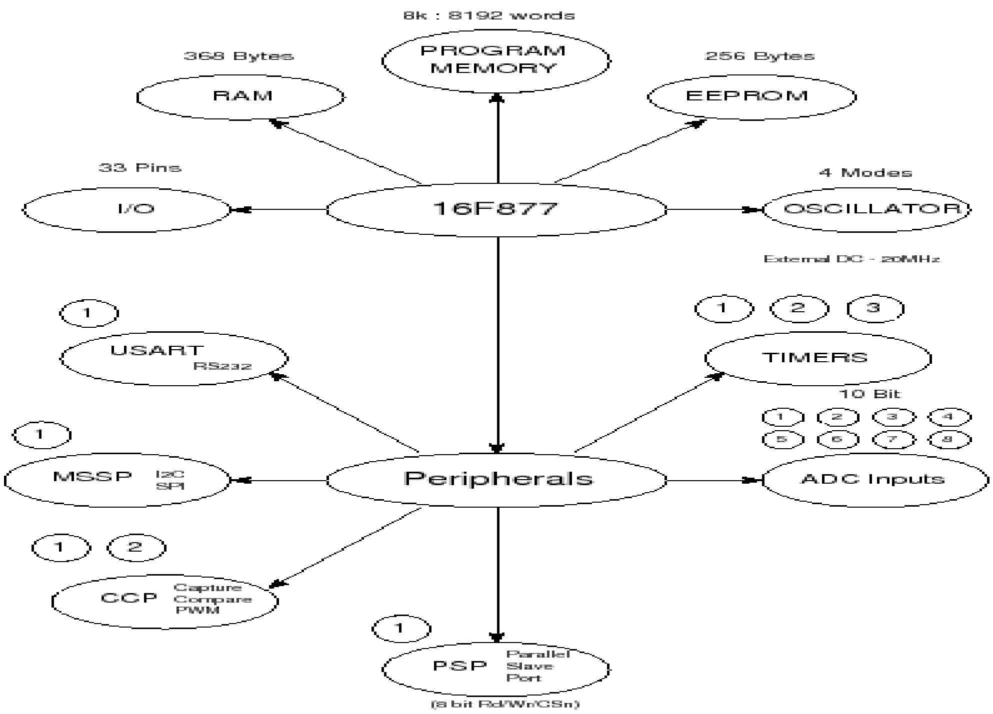

Figure-5. Various features of 16F877A PIC

PIC family is logical choice for many performance applications where cost is preliminary considerations. PIC-microcontroller PIC16F877A having features like, high performance RISC (Reduced Instruction Set CPU) architecture, operating frequency is 20MHz, only 35 single word instructions, two 8-bit and one 16-bit Timers, fifteen Interrupts, built in support for SPI, USART, A/D etc., 8K programmable memory & 368 data bytes, five I/O Ports as A, B, C, D, E etc.

4.2 Data Acquisition and Control system (I/O system)

This is a simple circuitry to monitor and control different parameters and devices on the field. It is interfaced with microcontroller using different ports. Driving circuitry consist of relay drivers, signal conditioners etc. At the end of the system, relays and opto-isolators are used to switch ON or OFF different devices connected to them. Different sensors are used to sense the physical data such as temperature, light etc.

5. SOFTWARE REQUIREMENT

In a Wi-Fi network, the interface to the network is a Wi-Fi controller chip and its driver. The Wi-Fi driver contains program code that manages communications between the controller chip and a higher level in the network protocol stack. For internet communication over Wi-Fi, a Transmission Control Protocol/Internet Protocol (TCP/IP) software stack is necessary. This stack resides on the Host MCU. Microchip's TCP-IP stack, need to be configured according to the host microcontroller use in the system. Microchip provides a driver for the ENC28J60 and a TCP/IP stack including an HTTP web server. Web pages need to be stored in external or internal EEPROM. These pages can be accessed using internet browser by accessing the IP address assigned to the system. The system IP address and server IP address can be configured by making changes in the program. This firmware is written in C (Compatible with Microchip CI8 compiler).

5.1 TCP/IP Download and support

Microchip offers a free licensed TCP/IP stack optimized for the PIC 18, PIC24, dsPIC and PIC32 microcontroller families. The stack is divided into multiple layers, where each layer accesses services from one or more layers directly below it. Per specifications, many of the TCP/IP layers are "live", in the sense that they not only act when a service is requested, but also when events like timeout or new packet arrival occurs. The stack is modular in design and is written in the 'C' programming language. Effective implementations can be accomplished in roughly 25-30 KB of code, depending on modules used, leaving plenty of code space on host microcontroller for the user application.

5.2 IDE for microcontroller 's program development

The Integrated Development Environment (IDE) for developing and debugging embedded PIC application. The IDE gives a seamless and easy-to-use environment to write, build, and debug dynamic C. With the help of Mikro

C compiler the code for PIC16F877A can be written. Mikro C is designed to provide the programmer with the easiest possible solution for developing application for the embedded systems. It allows user to quickly develop and deploy complex application. We can write C source code using the built I code editor. Here Mikro C libraries can be use to speed up the development. The html code is written in the PIC-microcontroller memory as per the requirement and it is transferred to the PC through Wi-Fi controller with the help of the SPI communication.

6. APPLICATION

- Low speed sensors. e.g. Temperature, Pressure
- Common electro-mechanical devices e.g. Relay, Brakes, Solenoids, Valves.
- General automation e.g. Material handling, chemical processing.
- Precise motion control e.g. High speed packaging, Printing, Robotics.
- High speed electrical devices e.g. Synchrophasor measurement.
- Electronic ranging e.g. Fault detection.

7. FUTURE SCOPE AND CONCLUTION

Wi-Fi enabled digital I/O control system is designed for multiple input and output arrangements for industrial as well as non industrial applications. The module is small, simple and flexible which can perform different I/O operations remotely over Wi-Fi. System can be extended for sensing malfunctioning in industrial machines and making corrective measures in it. Wireless Wi-Fi enabled interface can also be developed. There is no limit for future scope in the monitoring and control operation. Industrial automation is no longer limited by the walls of the production facility. More and more automation is being handled via remote communication. This Wi-Fi Embedded system paves the way to numerous applications to be developed in the area of monitoring and automation. There are plenty of applications in which it is so useful that an Embedded System should communicate to the world through internet. For example, a vending machine which sells the cool drinks, can communicate to the distributor through internet to tell that it is going out of stock. Like this Internet communication capabilities of the Embedded Systems will start new avenues in Embedded Automation Industry. This project can be enhanced using CAN controller for processing CAN data and using Wireless sensors to gather parameters. Having been in the starting of 21ist Century, We our- self witnesses the rate of spread of internet throughout the globe. So by giving Internet Communication capabilities to your embedded system, you are providing the capability to your system to communicate with every corner of this planet.

8. REFERENCES

[1] “Using of Ethernet in Embedded application.” By Professor Dr Dogan Ibrahim of the Near East University.

[2] “INTRODUCTION TO STELLARIS WI-FI HARDWARE AND SOFTWARE.” By Texas instrument.

[3] “Wi-Fi Enabled Digital 1/0 Control in Embedded Systems.” By David Potter National Instruments Corporation.

[4] Microchip, “ENC28J60 Datasheet”.

[5] Microchip, “PIC16F87XA Datasheet”.

[6] Jan Axelson ,"Embedded Wi-Fi and Internet Complete", 2003.

[7] Andrew Tanenbaum, "Computer Networks", 4th Edition, 2003, pp.271-292

[8] Behruz A. Forouzan,”Data Communication and Networking”,3rd Edition

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