

# An Inexpensive Universal Serial Bus Interfaced Home Automation System

M D G M Abeyratne<sup>1</sup>, I U Kalupahana<sup>1</sup>, W A P Buddhika<sup>1</sup>, S D Kumara<sup>1</sup>, N W K Jayatissa<sup>1</sup>,  
L B D R P Wijesundera<sup>1</sup>, J C. Harambearachchi<sup>2</sup>, and S. R. D. Kalingamudali<sup>1</sup>

<sup>1</sup>Department of Physics, University of Kelaniya, Kelaniya 11600, Sri Lanka

<sup>2</sup>Sri Lanka Telecom, 5<sup>th</sup> Floor, Headquarters Building, Lotus Road, Colombo 1, Sri Lanka  
kalinga@kln.ac.lk<sup>1</sup>, jana@eng.slt.lk<sup>2</sup>

**Abstract**—There were many standards of communication between host computers and peripherals, but the goal was to create a technology that combines low and high speed bus activity. Today USB has become a very popular expansion to the PC. An inexpensive USB interfaced home automation system is designed as an alternate for available expensive similar systems. The newly designed system consists with a wireless communication unit, to avoid complicated wiring of electrical circuits directly connected to the USB interface, and to control them remotely in automatic/manual modes. PICmicro<sup>®</sup> 16F876A and 18F4550 microcontrollers are controlling the operations of the designed system.

**Keywords**—component; PC; USB; home automation; PIC

## I. INTRODUCTION

Universal Serial Bus (USB) is a standard used for connecting devices such as computers, set-top boxes, game consoles, PDAs and peripherals among other devices. Single USB port in the computer may be linked to 127 external devices. The plug and play capability enables automatic detection of a new device, which is attached into the system, an automatic configuration of it by the host, and an automatic detection of it's detachment from the system. The flexible attachment and detachment of devices to and from the system allows mobility and adjustment of the system to new devices without the need of restarting the whole system each time a new device is connected.

Home automation may include various things such as control of lighting, heating, ventilation, air conditioning, security and etc., which will provide improved convenience, comfort, energy efficiency and security for residents. This is an essential requirement for the people living in this busy world. In addition to that this system may improve the quality of life of the elderly and disabled people who might otherwise require assistance.

The main task of this work is to design an inexpensive USB interfaced home automation system to control home appliances remotely in automatic or manual modes.

In order to avoid complicated wiring the designed home automation system consists of a wireless communication unit to control peripheral devices remotely, using either automatic or manual modes preferred by the user.

The main parts of the designed system are USB interface, RF transmitter and receiver circuits, and a relay system. User interacts with the system using software on the computer which was developed using Visual C++.net, which can control the electronic system on the home or through automatic mode to

control the functions of home appliances automatically. USB interface interact with the software and provides appropriate signals to transmitter circuit to control the external devices connected with receiver circuit.

The RF transmitter and receiver circuits are tuned to operate at 433MHz. The receiver circuit is attached to the peripheral device, and when it received the 4-bit data signal according to the specific function, the circuit decoded and passed it to the Peripheral Interface Controller (PIC) to control the devices according to the received signal code.

## II. PROCEDURE

### A. USB Interfacing Circuit

The main component in the USB interfacing circuit [1] is PIC18F4550 [2] microcontroller since it incorporate a fully featured USB communication module which is compliant with the USB 2.0 [3]. This module includes a USB type B connection and a single push switch to represent the input device, and also supports both low-speed and full-speed communication for all supported data transfer types. This incorporates its own on-chip transceiver and 3.3V regulator and supports the use of external transceivers and voltage regulators. Since this module is bus powered, external power regulation is not required and the device will draw its power from the USB host, Personal Computer (PC). However, 470nF capacitor is connected so the PIC can operate the internal USB circuitry and helps with regulating the USB voltages required by the on-board USB interface in the PIC. The Microchip<sup>®</sup> free downloadable USB stack was used to write and compile firmware needed to connect the USB device to the computer. Circuit diagram of the USB interfacing unit is given in Fig. 1.

### B. Device Enumeration

The device enumeration [1] is the initial communication with the USB host when the device request the host what it is and how it wishes to communicate. USB communication is performed using “endpoints” which send information either to the host or to the device. To setting up the communication channels, the device must also pass its name and two other important values namely the VID and PID. The VID is the Vendor ID and identifies the manufacturer of the device. For development and testing purposes Microchip<sup>®</sup> VID was used. The PID is the Product ID and together with the VID they form a unique identifier for the device. When the device first enumerates Operating System (OS) will store the VID and PID combination for the device and this will be valid even a generic driver like the Human Interface Device (HID) is connected since it cuts down on the amount of time OS needed to get the