HOME AUTOMATION USING X-10 TECHNOLOGY

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DECLARATION

I declare that this project entitled "*Home Automation Using X-10 Technology*" is the result of my own research except as cited in the references. The project has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……..

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Date : NOVEMBER 2008

Specially dedicated to

My beloved parent

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ABSTRACT

X-10 is a power line carrier technology that allows device throughout the home to communicate with each other via the existing mains wiring in the house. X-10 uses 120 kHz bursts timed with the 240VAC power line zero-crossings to represent digital information. Transmitter burst the 120 kHz PWM signal using PIC16F877A into AC power line that have time of zero-crossing. Receiver was function as signal detector. Signal that has been detected from all the receiver circuit will be operated by the PIC16F877A. The X-10 technology is one of the easiest and most popular ways to automate home without re-wire our own house. Without it, we will spend a lot of money and time to do some maintenance in our house. Basic flows of X-10 power line system are input from computer was send to microcontroller using Visual Basic 6 software. Then, the input data send through mains power line by using coupling circuit in the modem transmitter. At the receiving end, data was passed through receiver modem and go to controller. Load was operated by controller depend on the input signal that has been send by the computer at the transmitting before.

ABSTRAK

X-10 adalah teknologi yang membenarkan semua peralatan elektrik di rumah berkomunikasi sesama sendiri melalui talian kuasa(elektrik) yang sedia ada di rumah. X-10 menggunakan pancaran daripada gelombang frekuensi 120 kHz yang mana masanya untuk memancar adalah mengikut perubahan arus ulang-alik 240V dari positif ke negatif bagi mewujudkan informasi berdigit. Di sebelah penghantaraan, gelombang frekuensi 120kHz akan dipancarkan ke dalam arus ulang-alik 240V dengan menggunakan PIC16F877A dengan mengikut masa perubahan positif ke negatif arus ulang-alik 240V. Pada bahagian penerimaan pula, ia akan berfungsi sebagai pengesan gelombang. Gelombang 120kHz yg dihantar dari sistem penghantaran tadi akan dikesan oleh sistem penerima dengan menggunakan litar-litar tertentu. Selepas melalui proses di setiap litar, gelombang tersebut yang telah disaring akan dikesan oleh PIC16F877A dan terus diproses. Teknologi X-10 merupakan salah sebuah sistem yang termudah dan paling terkenal dalam sistem rumah pintar tanpa melakukan pengubahsuaian litar di dalam rumah kita. Tanpa teknologi ini kita akan banyak menghabiskan waktu dan wang untuk membuat penyelengaraan di dalam rumah. Berikut adalah sedikit penerangan tentang asas sistem teknologi X-10. Data masukan akan diterima oleh PIC melalui perisian Visual Basic 6. Data tersebut akan dhantar terus ke talian arus ulang-alik. Ia kemudiannya akan dikesan oleh sistem penerima bagi membolehkan PIC memprosesnya sebelum PIC mengarahkan bebanan(lampu atau kipas) menyala atau padam.

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LIST OF ABBREVIATON

DC	**-**	**Direct Current**

AC	**-**	**Alternate Current**
PWM	**-**	**Pulse Width Modulation**
PIC	**-**	**Programmable Intelligent Computer**
PLC	**-**	**Power Line Communication**
GUI	**-**	**Graphical User Interface**
HCS	**-**	**Home Control System**
VB	**-**	**Visual Basic**
PCB	**-**	**Printed Circuit Board**

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview of Project

This project is about power line communication using X-10 technology to control any electrical home's device. X-10 is a power line carrier technology that allows device throughout the home to communicate with each other via the existing mains wiring in the house. X-10 uses 120 kHz bursts timed with the power line zero crossings to represent digital information. X-10 technology is one of the easiest and most popular ways to automate home without re-wire our own house. X-10 works across home power lines and is extremely low-bandwidth. X-10 devices send about one command per second and these commands require less than 1/1000th of the bandwidth of a dial-up connection. Like a broadcast network, every command is sent through every wire in our house. In this project, Visual Basic 6 software from the computer was used to act as the input. User is able to select which devices that wants to be control from it. The microcontroller also was used in this project. It worked as a controller to receive and transmit data and signals from the input and send through our home existing power line wiring. Basically, this project was fabricated and design in two set of the power line communication using X-10 technology. One will operate as a receiver and the other one will operate as transmitter.

1.2 Objectives

The objective of this project is to;

i. Design and fabricate power line communication system to control house devices.
ii. Control house devices using Graphical User Interface (GUI).

1.3 Scope of Project

i. To design power line communication modem using X-10 technology.
i. To design Graphical User Interface using Visual Basic 6.

1.4 Problem Statement

Home Control System (HCS) helps to monitor and control the home appliances. Let say a house that have size larger than 2000 square feet (185 square meters). How we going to control home electrical devices which is located anywhere and everywhere in our house. X-10 technology is the best way that we can use for home control system using existing power line wiring. Without this technology, we may face many problems in setting up a Home Control System to control our home devices such as:

- Do a re-wiring in our house in a way to control devices.
- Waste our money to buy remote sensor to interfaces with each devices.
- Some home control system product may not match with our home devices specification.
- Our home devices lifetime may not be longer.
- Waste our time in case; we must turn back home if we forget to switch off any devices that may be danger to our house.
- Waste electricity in case; we forget to switch off any home devices.

So, X-10 power line communication can solve all the problem state above. The advantages of using this technology are:

- It is ideal for applications in existing houses.
- No extra wiring is necessary which means low-cost solutions.
- Saves power - with more control and automation over lights and heating you can cut down unnecessary use of power.
- Easy to use.

CHAPTER 2

LITERATURE REVIEW

2.1 Home Automation

X-10 Technology normally has been applying with Home Automation. It perfectly matches with the entire specific needed by the home automation work.

2.1.1 Definition

Home automation (also called domotics) is a field within building automation, specializing in the specific automation requirements of private homes and in the application of automation techniques for the comfort and security of its residents. Although many techniques used in building automation (such as light and climate control, control of doors and window shutters, security and surveillance systems, etc.) are also used in home automation, additional functions in home automation can include the control of multi-media home entertainment systems, automatic plant watering and pet feeding, automatic scenes for dinners and parties, and a more user-friendly control interface. When home automation is installed

during construction of a new home, usually control wires are added before the interior walls are installed. These control wires run to a controller, which will then control the environment [1].

An automated home is sometimes called a smart home. Home automation may also allow vital home functions to be controlled remotely from anywhere in the world using a computer connected to the Internet. Besides the functions already mentioned, remote control can be extended to telephones and answering machines, fax machines, amateur radios and other communications equipment, and home robots such as automatic vacuum cleaners [2].

The fundamental components of a well-designed home automation system include a computer (or computers) with the appropriate programming, the various devices and systems to be controlled, interconnecting cables or wireless links, a high-speed Internet connection, and an emergency backup power source for the computer, its peripherals, and the essential home systems [2].

2.1.2 Standards and Bridges

Specific domotic standards include INSTEON, X10, PLC BUS, KNX (standard), System Box, Lon Works, C-Bus, Universal power line bus (UPB), UPnP, ZigBee and Z-Wave that will allow for control of most applications. Some standards use communication and control wiring, some embed signals in the power line, some use radio frequency (RF) signals, and some use a combination of several methods. Control wiring is hardest to retrofit into an existing house. Some appliances include USB that is used to control it and connect it to a domotics network. Bridges translate information from one standard to another (e.g. from X10 to EIB) [1].

Table 2.1: Comparative of Home Automation Bridges

Tecnology	Transmission medium	Transmission speed	Maximum distance to the device
Konnex	TP PL Ethernet Radio	1200bps-9600bps	2100m-3600m
LonWorks	Tp Electric wire Radio Coaxial	1.70Kbps- 1.28Mbps	1500m-2700m
X10	Electric wire	50-60bps	
EIB	TP Electric wire RF Infrared	1200bps-9600bps	300m-1000m
EHS	Electric wire TP	2.4Kbps-48Kbps	
Batibus	TP	4800bps	200m-1500m
Zigbee	wireless	20Kbps-250Kbps	10m-75m

2.2 Power Line Communication

Standard power that has been supply in our county is 240VAC with 50 Hz of frequency.

2.2.1 Definition

Power line communication (PLC), also called power line carrier, mains communication, power line telecom (PLT), or power line networking (PLN) is terms describing several different systems for using electric power lines to carry information over the power line [3].

2.2.2 Introduction

Electrical power is transmitted over high voltage transmission lines, medium voltage distribution, and inside buildings at lower voltages. Power line communications can be applied at each stage. Most PLC technologies limit themselves to one particular set of wires (for example, premises wiring), but some systems can cross between two levels (for example, both the distribution network and premises wiring) [3].

All power line communications systems operate by impressing a modulated carrier signal on the wiring system. Different types of power line communications

use different frequency bands, depending on the signal transmission characteristics of the power wiring used. Since the power wiring system was originally intended for transmission of AC power, the power wire circuits have only a limited ability to carry higher frequencies. The propagation problem is a limiting factor for each type of power line communications [3].

Data rates over a power line communication system vary widely. Low-frequency (about 100-200 kHz) carriers impressed on high-voltage transmission lines may carry one or two analog voice circuits, or telemetry and control circuits with an equivalent data rate of a few hundred bits per second; however, these circuits may be many miles (kilometers) long. Higher data rates generally imply shorter ranges; a local area network operating at millions of bits per second may only cover one floor of an office building, but eliminates installation of dedicated network cabling [3].

2.3 Home Control System

Home Control System (HCS) helps to monitor and control the home appliances as well as security aspects of the digital home that is expected to be the standard for the future home. Chiefly, HCS is an integration of Home Appliance Control Systems (HACS) and Home Security Systems (HSS). HACS enables the home-owner to control appliances such as stove, refrigerator, air-conditioner, and the like, remotely, while the HSS helps to monitor the status of various networked security devices in the home and control certain aspects of the devices. Monitoring and control may be done by a personal digital device such as a laptop, PDA, telephone, or even a cell phone. For this to work there is at least one home controller in the house that is connected to other appliances and equipments that need to be [7].