MICROCONTROLLER BASED HOME ENERGY MANAGEMENT USING ZIGBEE

Group Members:

HAMID AYUB **091420125**

MUHAMMAD ZUBAIR YASIN **091420120**

HAMMADALVI **081220101**

Project Advisor:

AYESHA IQBAL

Department of Electrical Engineering,

School of Engineering,

University of Management and Technology, Lahore.

MICROCONTROLLER BASED HOME ENERGY MANAGEMENT USING ZIGBEE

By

HAMID AYUB (091420125) ,MUHAMMAD ZUBAIR YASIN(091420120) and HAMMAD ALVI (081220101)

This thesis is submitted to Department of Electrical Engineering, University of Management and Technology, Lahore, Pakistan, to fulfill the requirement of Bachelor.s degree

In

Electrical Engineering

Supervised by

AYESHA IQBAL

_____ _____

AYESHA IQBAL **(External Examiner)**

Department of Electrical Engineering

University of Management and Technology, Lahore

September, 2013

Dedication

To All of Our Respectful Teachers and Dear Friends,

Thank you for everything.

To Our Families,

Thank you for your continuous encouragement and support.

ACKNOWLEDGEMENTS

In the name of ALLAH, who is the most merciful, the most compassionate; the one and only supreme power, the one who makes everything possible and the one without whose will the simplest is impossible.

All thanks to our beloved Family members for their prayers, guidance, support and care. They dreamed for our future and advised us to work hard to fulfill their dreams. Without their financial and moral support it would not have been possible for us to become supreme professionals. Actually we can.t express their wills, wishes and efforts by just a bunch of words.

We are really thankful to Mam Ayesha Iqbal our teacher and project supervisor for her kind support and guidance during each and every phase of this project.We will always remember her in our professional carrier and life.

We are also indebted to the University of Management & Technology, Lahore which supported us throughout our stay by providing their best teachers, equipped labs and with suitable conditions for us to work on the project.

We appreciate the guidance of our class fellows and friends who provided us great help and moral support in each step.

Hamid Ayub

Muhammad Zubair Yasin

Hammad Alvi

Abstract

In this project, a flexible and low cost automated system based on ZigBee technology is proposed. It uses ZigBee technology to facilitate home energy management.. The system consists of a number of components .System consists of sensors, microcontroller and ZigBee transceiver. They have ability to communicate transmitter to receiver.The sensors here are of different types which will be helpful for home energy management.

The idea of home automation has existed and worked on by several researchers.The idea of controlling devices, around a home, in way to provide improved comfortand security has been in the way since early 19th century.Current advancements in computing and communication technology allow for designing smart home automation systems that can manage several devices from onecentral locatio n. Several researchers have been working in designing one that canmanage, maintain and process data with very little user interaction. Therefore, the aim of this thesis is to design and implement a low-cost home automation system thatis independent of networking protocol, is scalable and easy to deploy & maintain.The system works as several modules operating independently while coordinating with a central gateway. Zigbee protocol was used provided wireless communication to devices that require low-power and not a whole lot of computing. Lastly a discussionwas made to use Open-source software to keep cost to minimum.

Table of Contents

Chapter

Introduction

In the recent years there has been increase in researchers developing various systems that provide improved comf ort, convenience, security and efficiently manage energy in a standard home. Even with such growth and contribution, this technology is still absent in an average home today as such systems are often custom designed at the time of construction. This tends to put a hefty price tag to attract an average home owner. Several standards, such as X10, OSGi, Zigbee, that support in building an automated home already exists, however, both the end-user and the designer needs to discipline themselves to one of these standards. This not only puts limitations on scalability but also can be very limiting in-terms of future proofing. It is clear that establishing a high level of interoperability among these several standards is very important. Users need to be able to purchases several devices and be able to easily deploy and install them with limited technical knowledge. Among several researchers, only f ew suggest the idea of retro-fitting smarts into an existing home. Retro-fitting becomes very important as several users who wish to add smarts to their existing home do not need to go through an expensive refurbishing or upgrading. It would be an understatement to say that internet has become the back-bone to our modern day-to-day society. Several researches such as have tried to integrate their smart home system, using a centralized control that is accessible over the internet. This provides way for the users to gain control of their devices from any were on the planet. However, not many have addressed the possibility of internet disconnections, security. To attract the general populace, these central systems need manage un-expected events gr acefully without impeding the overall function. All the devices in a home automation environment are networked using some type of networking protocol. While several of these protocols already exits, some offer better performance while others offer better economical value Wireless technologies are preserved as being mor e flexible in terms of deployment and management. In recent years, there has been a huge growth across both the industry and academia giving rise to several of wireless standards that are both low power and low- cost while offering features, such as mesh-networking, which are usually seen in wired networks surveys the main current and emerging architecture and technologies tailored to or suitable for Wireless home automation networks.

1.1 Literature Review:

In the recent years there has been an exponential growth and advancements incomputing technology. There has also been an increase in use of these technologies,even, among non-technical users as they are no longer limited to a personalcomputers that occupy fixed desk space. Instead, there has been increasing trend towardsubiquitous computing that integrates seamlessly into peripheral environmentto assist with ones day-to-day life.
In many cases, end-users are not aware of thisnetwork of devices as they seamlessly serve required information.Several standards are been proposed each day promising to solve other standards

issues. Home automation is no different. At a very basic level, home automation has been around as early as 19th century with the introduction of water supply and energy distribution systems. Since then, several solutions were presented by both the industr y and the academia but the progress has been relativity slow Few systems aim to solve issues such as ease of access \and scalability, while others look into making several different standards communicate with each other seamlessly. The use of wired standards or technologies, such as X-10, has been slowing losing the momentum to wireless standards . Wireless standards also offer solutions that simplify retrofitting existing homes with new features for a reasonable cost. There have been several advances in both hardware technologies and wireless communications which enable development of robust wireless sensor networks that can be used in home automation.

1.2 Background

In 1991, Ad van Berlo setup a consultancy office for assistive technology in the care sector. He switched from the world of medical technology (cure) to the world of care technology. The field of „geron technology. was strongly emerging, which is technology aimed at making the lives of older people easier and more comfortable. Eindhoven University of Technology started gerontechnology in the 90s as a new research area and home technology was one of the main sub-disciplines. Later, this was called home automation. France and Belgium use the term „domotique. and in the Netherlands it is called „domotica.. In the early 90s, people could not yet imagine what home automation would entail. There were PCs but nobody knew about mobile telephones and the internet. In the 1990s, various projects took place in which older people could actually experience what home automation had to offer.

In 1998, Corien van Berlo, Ad.s partner, setup S mart Homes together with her husband. The aim was primarily to further the promotion of home automation, execute demonstration projects and start experiments. To this end, Smart Homes provided support to all pilots commissioned by the Brabant province. These demonstration projects were finished in 2000 and 2001, but the importance of these projects is still enormous. The necessity of a system integrator's participation has been demonstrated. Partly because of this, the supply of technology offering better and cheaper solutions has taken off strongly. Perhaps the most important thing is: we have learnt a lot from the most critical consumer group, the older people who may not have a lot of financial resources at their disposal.

The breakthrough in home automation, which emerged tentatively in 2001, saw the Van Berlos employ staff for Smart Homes for the first time and build The Smartest Home of the Netherlands. Through cooperation with many participants, to whom Smart Homes is very grateful, the significantly renewed demonstration home was opened in Tilburg at the end of 2001. The exceptional thing about this completely inhabitable home is the integration of the four pillars: industrial, flexible and demountable (IFD) building, home automation, durability, and accessibility. The home has already attracted many thousands of visitors in Tilburg, Almere, Duiven, Heerlen, Dokkum, Amsterdam, and Eindhoven.

1.3 Problem Statement

The home automation theme continues in this project, that originates from ideas gained through these projects. The rest of this chapter accounts for the problem I will solve in this project and is organized as follows:

. gives a brief introduction to home automation.
. discusses what potential benefits home automation offer and some of the
. problems that still exist in home automation.

. identifies one problem and state a hypothesis on how to solve the problem.
. present goals that needs to be reached during an implementation of a
. solution.

1.4Objectives of the Project

Objectives of this project are stated as follows:

- To minimize the wastage of ener gy
- To ensure the effective utilization of electricity
- Automatic controlled switching
- Detection of presence or absence of persons

1.5 Scope of the Project

Scope of the project includes following applications:

- Designing a signal conditioning circuit which consists of voltage sensor and current sensor.

- Optimizing the usage of features that exist in that microcontroller such as serial communication (SCI) and analog to digital converter (ADC).

- Designing appliance interfacing circuit which is interfaced with appliances that apply the switching concept based on r elay that is controlled by microcontroller.

Potential Benefits

The potential benefits we can gain from home automation are almost only limited by imagination and as such it would be infeasible to create a compr ehensive list of them. The short list below exemplifies potential benefits in four areas of home automation. The examples are meant to spark the imagination.

Energy Savings

Through user tracking both in- and outdoors, a home automation system would potentially be able to make sure that, for example, no unnecessary light or heat is turned on in individual rooms.

Convenience

Through Web based access to the home automation system a forgetful user will potentially no longer have to worry about if the coffee machine was left on when he left for work. Simply go to a Web page, check it, and turn it off if necessary.

Security

Tracking user locations can assist in automatic alarm system arming. Also, security cameras might be accessed from a vacation to check that the house is alright.

Home Entertainment

When engaging in movie watching, the lights might be set to an appropriate dimming level. When listening to music, speakers might be changing from room to room for your listening pleasure throughout the house. Digital paintings on the wall might change according to persons currently occupying the room.