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AUTOMATIC ROOM LIGHT CONTROL SYSTEM

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ABSTRACT

Electricity is a major part in today's world of advancing technologies and it has become impossible to imagine life without it. Conserving electricity is very important as it's not an unlimited resource to have at our disposal. Many times, we forget to switch off the light/fan when we leave a room/hall. It is because of this recklessness that electricity is wasted. In this paper, different techniques of home automation like GSM, ZigBee, X10 and EnOcean are studied. PIR sensors are also studied because their strategic placements can tell us about the number of people and their locations in a room. Embedded systems with various appliances connected to them are studied which helps us to know about their control. Devices that can alter the intensity of light are also reviewed.

Keywords: Automation, Detection of Movement, Embedded System

I. INTRODUCTION

Energy crisis is one of the main problems that we are facing nowadays. The conservation of energy is of great relevance in these days. It happens many a times that we forget to switch off an appliance when we leave a room. Also, the working of an appliance like a fan/light does not depend on the number of people in the room and their intensity. With advancements in technology, the demand for creating designs that would ease the complexity of life is increasing. Hence, the need for automation is increasing rapidly, which makes monitoring and control of appliances of the utmost importance. One of the biggest advantages of automation is that it reduces the probability of human error. Automation can be done in many ways.

Various papers were thoroughly read and examined to gain knowledge regarding the work related in automation. The literature review is divided into the following sections: Section I gives an overview of automation and its need. Section II describes some of the ways of doing home automation. Section III describes the detection of movement by using PIR sensors. Section IV gives an overview of changing the intensity of light.

II. LITERATURE REVIEW

2.1 Automation

Automation is no longer a dream of the distant future. It is happening today, and it is happening on a large scale. More and more tasks are being completed automatically today, which is a fact [1]. Basic tasks, like turning an appliance on or off can be done in close proximity, or remotely with the help of automation. As the number of tasks being automated are increasing, it is becoming more and more important to monitor and control them to

achieve the desired results. Automation lowers the errors caused by human judgment. Nowadays home automation systems are being used in a large scale to control devices around the home.

A variety of home appliances can be controlled with the help of a home automation system [2]. Home automation systems are being adopted by using the technology available for controlling of the devices. The systems that are being used in the home can also help in the process of automation. The systems used for those purposes are known as home automation systems. The home automation system is nothing, but the house itself, or the people inhabiting it. Various technologies associated with home automation, like GSM, ZigBee, X10 and EnOcean are reviewed in the next section.

2.2 Home automation and its types

There can be various technologies for designing home automation systems. Various communication platforms like [3] internet, cellular networks, satellite communications and radio networks can be used to control and monitor various appliances in a home remotely or in close proximity. In paper [4] a design called the HLCM (Home Light Control Module) was proposed which was installed in every light fixture of a house and consisted of various modules. It used PIR sensors for detection of movement and RF modules for communication. It focused on low power consumption.

GSM (global system for mobile communication) is also used for the purpose of home automation. It is digital standard has [5] many advantages: The wide spread coverage of GSM makes it possible for the system to be online for almost all the time. The GSM network also has a low cost compared to other mobile communication such as satellite communication. It also ensures network security and nobody can access it from the outside. In GSM network, there are a several options such as Dual Tone Multi Frequency (DTMF), Short Message Service (SMS), and General Packet Radio Service (GPRS). This makes it more flexible and user friendly. Paper [3] proposed the implementation of a home automation system where communication technologies like GSM, Internet and speech recognition were used. All of these techniques were clubbed to make a single wireless home automation system. This system was low cost, powerful and a user friendly way of monitoring and controlling of a house remotely.

Many wireless methods like Bluetooth and ZigBee [6] are also used in the field of home automation. A ZigBee network [7] is highly reliable, secure, has a low data-rate, low power consumption, low costs, and fast reaction, which is why it gets more attentions than others. ZigBee is a protocol for wireless sensor networks based on the IEEE 802.15.4 specification [8].

It has an open standard, low cost and low power characteristics [7], due it which it is gaining popularity very rapidly. In paper [7], to develop ZigBee-based end devices, it was integrated with an RF communication module which was designed by following up the rules for PHY and MAC layers from IEEE 802.15.4 [9] and NWK layer from ZigBee Alliance [8] for the purpose of interoperability. However, ZigBee-based approaches are [10] not efficient for realizing bidirectional communication in a multi-hop communication environment.

X10 [11] is one of the oldest available home automation standards. Despite tough competition from newer standards, it's still being used. Some of the advantages of X10 are that it can use either wireless communication methods or wired ones and it is low in cost. However, it can transmit only one command at a time. This can lead to mixing of signals which can result in some of the data getting lost.

EnOcean is one of the latest [11] technologies that has been emerging in the field of automation. One of the most lucrative things about this technology is that it has zero energy consumption because it harvests energy. Hence, it can work without a battery. Despite of that, it can still communicate wirelessly. It is done with the help of micro energy converters. Initially, EnOcean used piezo electric generators for this purpose, but they have been replaced by electromagnetic energy sources now. They don't require much maintenance as they are self-powered.

2.3 Detection of Movement

Pyroelectric Infrared (PIR) sensors have low cost, low power consumption and small form factors. Hence, they have been used in tracking movement [12] for a really long time. PIR sensors belong to the class of thermal IR detectors and use materials having a pyroelectric effect which are spontaneously polarized in the crystal structure. A polarized crystal is one that absorbs incident infrared radiation which leads to a change in the temperature of the crystal. That alters the spontaneous polarization of electrical dipoles in the crystal. Ions in the air neutralize the unbalanced charges sometime later. Accordingly, the unbalanced charge distribution in the crystals can be measured as electrical signals.

A passive infrared (PIR) based motion sensor [13] has a low-power design. A PIR sensor detects movement of a person based on the induced temperature changes. In paper [13], a Panasonic PIR motion sensor (PaPIR) was chosen. PaPIRs sensing circuits were enclosed in a metallic can to minimize adverse effects of external electromagnetic fields and to minimize sensitivity to false tripping under various operating environments. The PaPIR used a digital motion sensor and its output had two binary states which indicated the presence or absence of an occupant.

2.4 Changing the Intensity of Light

In paper [3], an analogue light sensor was used as they were low in cost and consumed less power since they were passive components. They were modelled by either a capacitor or resistor. A type of analogue light sensor is a light dependent resistor (LDR). An LDR has low current consumption (3 μA to 60 μA) and is inexpensive. It provides good output linearity across a wide illumination range and has an ultra-small package design, making it suitable for lighting control applications. Its supply voltage varies from 2.4 V to 5.5 V, and can be powered by the general purpose input/output (GPIO) pin of the MCU. Hence, the MCU could be programmed to power the light sensor only when it was necessary in order to lower the energy consumption. A 1k load resistor was connected to the light sensor output in order to convert photo-current to voltage.

III. OVERVIEW OF CONTRIBUTIONS

Here is a table of some of the papers that were read and examined which will help us in implementing our project.

Table I Overview Of Contrbutions

S No	Title	Author(s)	Inference
1	An Internet Based Wireless Home Automation System for Multifunctional Devices	Ali Ziya Alkar Member, IEEE and Umit Buhur	In this paper, the design and implementation of a low cost, yet flexible and secure internet based home automation system was presented.
2	Design and Implementation of Touchscreen and Remote Control Based Home Automation System	Nazmul Hasan1, Abdullah Al Mamun Khan1 ,Nezam Uddin1,Abu Farzan Mitul1	Home automation system is developed which is remote controlled and also touch screen enabled. Regulation of load, control of temperature and humidity are the major features.
3	A GSM, Internet and Speech Controlled Wireless Interactive Home Automation System	Baris Yuksekkaya, A. Alper Kayalar, M. Bilgehan Tosun, M. Kaan Ozcan, and Ali Ziya Alkar	In this paper, GSM network, internet and speech were used for the interaction between user and the device by using RF communication protocols.
4	Automatic Room Light Intensity Detection and Control	Ying-Wen Bai and Yi-Te Ku	An arrangement of PIR sensors, light sensor, microprocessor, and RF module detected human presence and measured the light intensity and switched on the lights accordingly.
5	Design and Implementation of Home Automation System	A. Alheraish, Member, IEEE	This paper presented design and implementation of remote control system by means of GSM cellular

S No	Title	Author(s)	Inference
			communication network.
6	Home Network Configuring Scheme for All Electric Appliances Using ZigBee-based Integrated Remote Controller	Il-Kyu Hwang, Member, IEEE and Dae-Sung Lee, Jin-Wook Baek	The ZigBee protocol and infrared remote controller technology were used to control electric appliances in the home network with no extra attachment of communication device to the appliances.
7	Building a Remote Supervisory Control Network System for Smart Home Applications	Yu-Ping Tsou, Jun-Wei Hsieh, Cheng-Ting Lin, Chun-Yu Chen	This paper showed us that the ZigBee technology represents high reliability, multi-hop network, secure, low power consumption, low costs, and fast reaction.
8	Interactive Remote Control of Legacy Home Appliances	Hyung-Bong Lee, Lae-Jeong Park, Sung-Wook Park, Tae-Yun Chung, and Jung-Ho Moon	This paper proposed a bidirectional network protocol for home automation which enabled the user to control appliances and to receive feedback on the result of the action.
9	A Comparison of the Popular Home Automation Technologies	Chathura Withanage, Rahul Ashok, Chau Yuen, Kevin Otto	Various protocols like Z-wave, Zigbee, X10 INSTEON EnOcean were tested and compared.
10	Detecting Direction of Movement Using Pyroelectric Infrared Sensors	Jaeseok Yun and Min-Hwan Song	Relative direction of human movement was detected by PIR sensors whose dual sensing elements were aligned with four directions.
11	Light-Harvesting Wireless	Ashish	Illuminance is measured

S No	Title	Author(s)	Inference
	Sensors for Indoor Lighting Control	Pandharipande and Shuai Li	by sensors which operate on photovoltaic cell based on incident ambient light.
12	Cooperative and Progressive Design Experience for Embedded Systems	J.W. Bruce, James C. Harden and R.B. Reese	This paper gave an overview of microcontroller-based projects composed of embedded systems and digital integrated circuits and the methodology involved in their design.
13	An Integral and Networked Home Automation Solution for Indoor Ambient Intelligence	Miguel A. Zamora-Izquierdo, José Santa, and Antonio F. Gómez-Skarmeta University of Murcia	Home automation module (HAM) consists of an embedded computer that's connected with all appliances, sensors, and actuators and this way intelligence is centralized. EIB and Zig-bee are the main technologies used.
14	Learning Situation Models in a Smart Home	Oliver Brdiczka, James L. Crowley, and Patrick Reignier	With the help of a situation describing the environment, users and their activities, human behavior can be modelled in accordance.
15	Component-Based Software Systems for Smart Environments	Charles Herring and Simon Kaplan	A scenario was developed to illustrate how smart environments could be designed, implemented and deployed based on software components.
16	Design Issues and Solutions in	Mattia Gamba,	XBee based home

S No	Title	Author(s)	Inference
	a Modern Home Automation System	Alessandro Gonella, Claudio E. Palazzi	automation system is made which is fully customizable and scalable. For cost efficiency XBee is used with the microcontroller.

IV. CONCLUSION

In this paper, various techniques on home automation were reviewed. All of them have certain advantages and disadvantages. ZigBee is an open standard and is available to all. It also offers high data security and reliability. Hence, its demand has been growing rapidly. However, it is not compliable with all manufacturers, which is a disadvantage.

GSM is another way for doing home automation. It is an excellent choice if we want to cover an extensive area. It can cover up to 35 kilometers.

As EnOcean is self-powered, it has a very low energy usage. But its reliability is low. However, it has a lot of scope for improvement as it is a new technology and various research activities are going on in this field.

X10 is one of the oldest home automation technologies and it has a very low cost. However, this advantage might not prevail if other newer technologies have comparable costs.

Home automation industry is expanding rapidly and there are many technologies to choose from based on the user's requirements.

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