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A STUDY COMPARISON OF DIFFERENT TYPES OF HOME AUTOMATED SYSTEM

Pawan Kumar[1], Tilak Raj[2]
[1]PG Student, [2]Assistant Professor
ECE Department, S(PG)ITM Rewari, Haryana, India

ABSTRACT: A"smart home" typically is a domestic environment that has been partially automated. Home automation includes centralized control for lighting, HVAC (heating, ventilation and air conditioning), appliance management, and others. Home automation aims to enhance the comfort, energy consumption efficiency and security in domestic scenarios. Generally, houses are equipped with independent control panels to control all of the systems and appliances present in the house. Moreover, those control panels are often not related each other. The main purpose of a smart home is to centralize the control of all the devices into a single control unit which can be programmed to do specific tasks suitable for the owner and the home in question. The goal of a smart home is not only convenience but also to reduce the consumption of resources such as power, gas, etc. Due to the current pricing on energy, resource conservation has become a part of a persons day-to-day life. If a person has the possibility to control his home automation remotely he can reduce the consumption of energy and thus cutting down on expenses. Furthermore, environmental sustainability has gained relevance in the latest years. If a person is away from home there is no need for the air conditioner or ventilation to operate. The same principle applies to illuminations, heating and other appliances. Some smart homes systems pause the operation of applicances until they are needed again. Furthermore, there are several different technologies for implementing such smart homes. Some standards utilize complex communication protocols and control wiring, others rely on embedded signals in the existing power circuit of the house.

Keywords: GSM; Arduino; Bluetooth; Z-Wave; ZIG BEE; Insteon; X10

I. INTRODUCTION

Smart home is an emerging concept that attracts the synergy of several areas of science and engineering. A lot of research has been going on for more than a decade now in order to increase the power efficiency at the consumer level of the power management systems. Smart Home is the term commonly used to define a residence that integrates technology and services through home networking to enhance power efficiency and improve the quality of living .Smart house is not a new term for science society but is still far more away from people's vision and audition. This is because although recent various works has been done in designing the general overview of the possible remote access approaches for controlling devices or in cases simulating the smart house itself and designing the main server the design and implementation of an off-the-shelf smart house remote control application has been limited to simply the computer applications and just in cases mobile and web applications development. The "smart house" technology is one realization of home automation ideals using a specific set of technologies. It's a house that has highly advanced automatic systems for lighting, temperature control, security, appliances, and many other functions. Coded signals are sent through the home's wiring to switches and outlets that are programmed to operate appliances and electronic devices in every part of the house. Smart home appears "intelligent" because its computer systems can monitor many aspects of daily living. Smart house can also provides a remote interface to home appliances or the automation system itself, via telephone line, wireless transmission or the internet and android application, to provide control and monitoring via a smart phone or web browser. The growing numbers of elderly population and increasing life expectancy have brought enormous challenges to many aspects of human life, especially in health and healthcare. According to the United Nations online database, currently the percentage of elderly population is 7.6% which is projected to rise as high as 16.2% in 2050. Home automation becomes more advantageous for safety, security. An embedded board physically connected all home automation devices and through integration with a personal computer (PC) based web server, provided remote access to the system. This Thesis presents smart house controlled by various micro controller systems. The designed system consists of five parts which are connected to both X10 and Arduino software .The first sub-system in SHS is a while review on the system .The second sub-system is the security systems that includes a fire alarm system used in announcing the outbreak of a fire and working to extinguish it remotely, and burglar alarm system that signals the occurrence of a burglary. The third sub-system is lighting control system (energy saving) which includes the internal house lighting, and the ceil lighting outside the house. The fourth sub-system is the remote control system for house controlling. The fifth sub-system is the temperature sensing system for air conditioner. SHS has been designed and implemented through two interfaces which are, computer and remote control unit interfacing. Computer device that provided with microcontroller software is the main controller unit for all systems in the house. It receives data from house sensors, process information and updates data for the different systems, and transmit controlling signal to house systems and switching output devices. Microcontroller makes the ability to monitor the

important system operations. Users can also control the different systems abilities, and chose the best required system. Also remote control interfacing is available to control some applications in the SHS. Radio frequency (RF) signals, and others become hybrids by combining several methods. All of the controlling tasks are done through a microprocessor, for example Arduino, which enables the communication and upon receiving some commands controls the different systems in the house. Finally, the commands to control the appliances in the house are sent by a central control unit such as a computer, remote control or Smartphone (iOS, Android).

II. PROPOSED ARCHITECTURE

GSM based Home Automation System

The system proposed in provides 3 means to control the home: the GSM network, the Internet and through speech. The real time monitoring has been an important feature that can be used in the home automation systems. As a change in the status of the devices occurs, the user can be informed in real time. The user commands are transferred to a server which is usually done by a PC. The server processes the user commands and sends them to the relevant units. This can help control the appliances. GSM is used as a communication medium to help establish connection in places where there may not be proper internet connectivity. The server uses AT commands to communicate with the GSM modem. The mobile interface is developed using J2ME. The server has 4 engines running – the web server, database, main control program and speech recognition program. The system can be controlled using SMS. It can send confirmation messages. Speech processing is done with a dynamic time wrapping algorithm. The voice activation has been tested and found to be too impractical. As a more stable alternative, the voice input can be activated through a wireless unit the user carries along in the house. Each application node has four parts – the transmitter, receiver, I/O device and a microcontroller. The main control program in the server takes status information from the devices' transceiver in real time. The system makes use of a PIC16F887 microcontroller for home appliances control . It makes use of GSM for control of the appliances. This is an SMS based system. GSM has been used due to its high availability, coverage and security. The control of home appliances is done primarily through SMS codes. AT commands can be sent through the GSM network and this controls the home devices. Messages are sent by the device to the user through SMS as well. This system can however incur additional costs for the SMS. There is no UI that the user can use to control the device. This system has the drawback of not being able to program the devices. Also SMS depends on the networks and there is a possibility of delayed delivery. The system does not does not have any state information related to the devices and expects the user to keep track of it.

Bluetooth

Bluetooth is based on a wireless radio system that is designed to remove the need for cables for short-range devices, such as mice, printers etc. A network that includes such devices is called a wireless personal area network. Topologies that are defined in Bluetooth are named Piconet and Scatternet. A Piconet is a WPAN that consists of two or more devices. One of them serves as a master and the other are slaves. All of the devices in a Piconet are synchronized with each other using the clock of the master. Slaves communicate only to the master. Master can communicate with any device. Further, Scatternet comprises of different Piconets that overlap time and space. Two or more Piconets can be connected with each other to form a Scatternet. A Bluetooth device can be a part of different Piconets at the same time. This allows the data to flow beyond the range of a single Piconet. A device can only be a master in one Piconet, but a slave in many Piconets.

Z-Wave

The Z-Wave technology was developed by a company named Zensys. Z-wave consists of four layers and and RF media that is controlled by the MAC layer. 1. Application layer - Controls the decoding and execution of commands within a Z-Wave network 2. Routing Layer - Controls the routing of packets within a Z-Wave network 3. Transfer Layer - Controls the transfer of data between devices - this includes retransmission, acknowledgements and checksum check 4. Mac Layer - Controls the usage of the radio frequency medium.

Fig.1. A Z- wave system

Z-wave uses the RF communication type. It works on the 868 MHZ, 908 MHZ or 2400 MHZ frequency band. The range of RF signals is 30-100 meters and the data rate is 20 kbit/s. Z-wave has two types of devices - they are Controlling devices and Slave nodes. Controlling devices initiate the communication by sending commands to other nodes; further slave nodes forward messages to other nodes or if they are the intended recipients reply on and execute the commands received. Controlling devices have the full routing table of the Z-Wave network and is able to communicate with all the devices in the network. Slave nodes cannot independently send direct messages to other nodes unless they are ordered by the controlling devices. If a slave node receives a command it executes it and after it sends a reply to the controlling device notifying about the successful command execution. If the controlling device does not receive an acknowledge message, the frame is retransmitted with a random delay to avoid a potential

collision. Maximum number of devices supported is 232 .

ZIG BEE

Fig.2. ZigBee sensor

ZigBee is a wireless technology developed by the ZigBee Alliance. Its architecture is composed by four main layers:

1. Physical layer - responsible for sending and receiving commands and data.
2. Medium access control layer - responsible for networking.
3. Network layer - Controls the correct usage of the medium access control layer.
4. Application Layer - consists of APS sub-layer and ZDO:

• APS sub-layer - provides services such as discovery and binding.

• ZDO - defines the roles of devices, initiates and responds to binding requests, and handles security aspects

III. THEORETICAL FRAMEWORK

The Implementation of Wireless-based Home Automation Systems

This chapter addresses the implementation of a home automation systems which rely on two different wireless communication technologies. The home automation systems presented rely on Arduino and Android open platforms. As mentioned earlier the fist idea was to implement Android@Home but since it is not available on the market yet we considered DomoticHome. Arduino was considered because it is open hardware and compared to other prototyping platforms it is the cheapest. Furthermore, it has a strong and active community and it is estimated that there are more than 300000 Arduino devices sold since 2006. Arduino also has a cross-platform open IDE. Other home automation systems are relatively expensive, so the systems tries to be low cost by utilizing Arduino as hardware platform. Furthermore, Android was considered because of its popularity among smartphones nowadays. Google estimated that there are over 300 million activated Android devices and 850 thousand are activated daily. In addition, Arduino is highly Android compatible

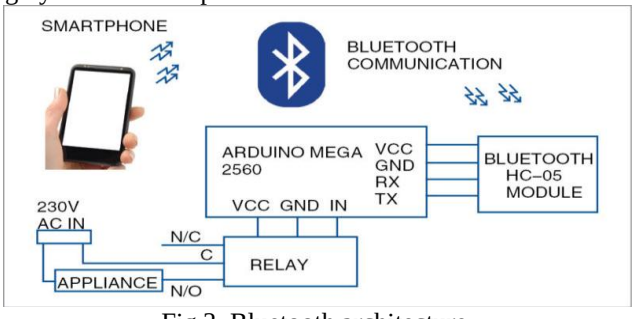

Fig.3. Bluetooth architecture

Insteon

Insteon is a home automation technology developed by SmartLabs. A distinctive features of Insteon is that it uses both radio frequency(RF) and already existing power lines(PLC). Insteon is one of the few home automation systems that works in a dual-mesh network. It is possible to use only RF or PLC but it is also possible to use them both at the same time. The systems RF band operates at the 904 MHz frequency. The data rate is for instantaneous 13,165 bits/sec and for sustained 2,880 bits/sec . All Insteon devices act like repeaters. This means that they can play the role of sender, relayer or receiver. If the devices that are trying to communicate are not within the coverage area transmit messages using a multi-hop strategy. All messages are received by the Insteon devices in the network, and if the message is not intended for the device that receives the message it forwards the message to other Insteon devices. The maximum number of hops for a message is three so avoiding to flood the network. Other devices act the same way until it is received.

Fig4. Insteon Device

IV. IMPLEMENTATION RESULTS AND DISCUSSIONS

In terms of error detection and redundancy all of the discussed systems have strategies and mechanism to guarantee that the messages are delivered and executed correctly. Insteon, Zigbee, Z-Wave and Android@home (assumed to be based on 6LowPAN) employ checksums. The difference is that Insteon and ZWave use 8-bit checksums, but Android@home and Zigbee use the IEEE 802.15.4 defined 16-bit checksum. If a message sent by a controller does not reach the intended device or the command is not initiated, then the end-device does not send a successful message back. If the controller does not get the acknowledge in a specified time window it deploys a retransmission thus the network can be considered as reliable. In contrast, DomoticHome and X10 have only one-way communication capabilities so they do not have error detection or retransmission strategies which makes them

unreliable.

Comparison result of different types of home automated system

Table:1. Zigbee, Z-Wave and Insteon

	Zigbee	Z-Wave	Insteon
Communication type	RF	RF	PLC/RF
RF band (MHz)	865/915/2400	865/918/2400	900
RF range (m)	20-100	50-100	65
Data rate	250 (kbit/s)	20 (kbit/s)	3/13 (kbit/s)
Kit	199-299	74.99 - 829.99	94.99-159.99
Modules	21.50-37.50	20.99-89.95	17.99-49.99
Error detection	YES	YES	YES
Retransmission	YES	YES	YES
One/two-way communication	TWO	TWO	TWO
Message routing	YES	YES	YES
No. Devices possible	6400+	230	1020
Same networks	YES	YES	YES
Other networks	NO	NO	NO

Table:2. X10, Android @home and Domotic Home

	X10	Android @home	Domotic Home
Communication type	PLC/RF	RF	RF
RF band (MHz)	320	865/918/2200	2200
RF range (m)	40	20-100	30
Data rate	20 (kbit/s)	20,40,220 (kbit/s)	10,13 (kbit/s)
Kit	57.99-130.99	NaN	57.6
Modules	4.99- 30.99	NaN	50
Error detection	NO	NaN	NO
Retransmission	NO	NaN	NO
One/two-way communication	ONE	TWO	ONE
Message routing	NO	YES	NO
No. Devices possible	250	NaN	16
Same networks	NO	NaN	NO
Other networks	NO	NaN	NO

V. CONCLUSIONS

Home automation is becoming more popular due to the latest developments in hardware which have significantly reduced the cost and improved the capabilities. It is due to the fact that technology around us evolves and the access to needed information is easier than ever. Consequently, demand for these systems is increasing and different manufacturers have realized that. This has been the motivation for several smart home approaches such as Mattia Lipreris' DomoticHome and sophisticated Insteon. Furthermore, toolkits like Amarino were not intended for home automation but they can be easily adapted to fit the smart environment requirements. Automating your home is feasible these days. Although, it has been around for a while, it has not been a potential option for a lot of people due to its immense cost. However, thanks to the development of Android and Arduino technologies, practically anyone can implement some kind of automation at their home. After the analysis of latest developments, such as Zigbee, Z-Wave, Android@Home, Domotichome, X10, Insteon, we have Furthermore, there are several solutions in the market. The thesis contribution includes the analysis of several solutions to highlight weakness and strengths so one can choose an appropriate solution in terms of installation difficulty, reliability, communication type, scalability and cost. Google

announced the release of Android@Home by summer 2012 and it is expected that this solution will gain popularity in the market. This may revolutionize the home automation domain since a big number of people already have an Android device at their disposal for controlling devices. Furthermore, Google is a billion-dollar corporation that has the knowledge for developing a system that is intuitive and feasible for practically everyone. Lastly, a lot of devices already have Android capabilities so integrating them in a home environment will be easier. However, the problem of standardization remains unresolved. The possibility of a global standard is remote. Finally, we consider that the selection of the automation system depends on the scenario and requirements. In the long term home automation solutions can help in reducing costs, foster the centralization of devices to a single control unit and help in reducing the carbon footprint with intelligent resource utilization highlighted different decision criterions and brought out the advantages and disadvantages of every system. Although microcontrollers have been in home automation solutions for a long time, none of them have been open-hardware and open-source. The emerging of microcontrollers like Arduino fosters the development of smart homes solutions. With the add-on modules Arduino gives us endless opportunities to link and configure different devices in our home. By implementing the wireless-based systems, we showed how Arduino can be adapted in a smart home environment.

REFERENCES

[1] [1] W. H. E. Liu, and D. Pearson, "Consumer-centric smart grid," in Proc. 2011 IEEE Power Engineering Society Innovative Smart Grid Technologies (ISGT) , pp.1-6.

[2] S. Ahmad, "Smart metering and home automation solutions for the next decade," in Proc. 2011 International Conference on Emerging Trends in Networks and Computer Communications (ETNCC), pp.200,204.

[3] F. Suba, C. Prehofer, and J. van Gurp, "Towards a Common Sensor Network API: Practical Experiences," In Proc. 2008 SAINT International Symposium on Applications and the Internet, pp.185,188.

[4] "CES 2014: Samsung and LG showcase their vision of 'smart' homes | NDTV Gadgets," http://gadgets.ndtv.com/others/news/ces-2014-samsung-and-lg-showcase-their-vision-of-smart-homes-469844.

[5] "Google Nest Acquisition: How Nest might transform Google advertising | BGR," http://bgr.com/2014/01/14/google-nest-acquisition-privacy-advertising/.

[6] C. Gomez and J. Paradells, "Wireless home automation networks: A survey of architectures and technologies," IEEE Communications Magazine, vol.48(6,) pp.92-101, Jun. 2010.

[7] J. Walko, "Home Control," Computing & Control Engineering Journal, vol.17(5), pp.16,19, Oct.-Nov. 2006

[8] "X10 devices and standards," http://www.x10.com.

[9] "Z-Wave devices and standards," http://www.z-wavealliance.org/.

[10] "Insteon devices and standards," http://www.insteon.com/.

