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DOMOTICS CONTROL USING GSM MODULE

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ABSTRACT

With advancement of technology things are becoming simpler and easier for us. Automatic systems are being preferred over manual system. The purpose of this project is to design and construct A GSM based home automation using AVR. Using GSM networks, in this project a home power control system has been proposed that will act as an embedded system which can monitor and control appliances and other devices locally using built-in input and output peripherals. The system has a delay of 2 minutes after the first call to initiate the next command. This project is made up of four vital units. These units are as follows: GSM module unit, peripheral interface control (PIC) unit, driver unit and a power monitoring and control unit. The GSM module is a GSM transceiver which gives the system access to the GSM service provider. The peripheral interface control (PIC) is programmed to carry out the OFF/ RESET operation according to the GSM commands while the driver and control unit consist of capacitors, resistors, diodes, regulators and electromagnetic relay is to effect power switching. The major component that performed the power control of 220v main supply and the automatic voltage regulation(AVR) is the automated electromagnetic relay. The project was realized.

INTRODUCTION

The use of mobile phone is highly prevalent nowadays. Although the main aim of the mobile phone is to enable communication between two mobile phone users, recent advancement in embedded technology have made it possible to use mobile phones to control home and office appliances, monitor and control vehicles, and for several other applications. Advancement in technology has made life more efficient and comfortable. The comfort of being able to take control of devices from one particular location has become imperative as it saves a lot of time and effort. With the advancement and breakthroughs in technology over the years, the lives of people have become more complicated and thus they have become busier than before. This paper presents embedded system that comprises mobile phone, DTMF decoder, microcontrollers and relays. The system makes it possible to remotely control home and office appliances. In the event that someone forgot to switch off an appliance, instead of going back to manually put off, the user's mobile phone can be used to turn off the device, thereby preventing the likelihood of electrical fire. The appliance can be controlled by pressing a corresponding key in the user mobile and the tone transmitted to the receiver mobile attached to the device. By means of the DTMF decoder the tone is decoded, the signal is then processed by the microcontroller, which activates the particular relay to control the device.

PROBLEM STATEMENT

The field of Automation has well advanced in Industries, as majority of automobile industry plants as well as bottling plants have Automated assembly lines. But automation has not yet penetrated in the homes especially in Nigeria. If automation was to be used in homes than everyday life would be get eased. Simple example of use of automation in home can be seen in the transfer of water from the under-ground water tank to the over-head water tank, by sensing the level of water in both the tanks. This process eases the every time effort the user has to put in for filling the tank and also helps in saving water. Also people are getting more acquainted daily with the use of Smartphone and tablets which are capable of doing much of PC's work handy. So the decision to make a low cost Embedded System in which the smart phones can be used to help

automate entire home. In this system the user will have remote access and control over all the subsystems present in the house.

SIGNIFICANCE OF THE STUDY

GSM Home Automation is necessary in that the user can enjoy the user-friendliness of the system in the control of their home appliances from in or outside home. By using this system, anyone can simply maintain all the home appliances without physical attendance at home. In addition, it helps to save time and energy.

MATERIALS

The first machines to be operated by remote control were used mainly for military purposes. Radio-controlled motorboats, developed by the German navy, were used to ram enemy ships in World War I. Radio controlled bombs and other remote control weapons were used in World War II. Once the wars were over, United States scientists experimented to find non-military uses for the remote control. In the late 1940's automatic garage door openers were invented, and in the 1950's the first TV remote controls were used. Zenith began playing around with the idea of a TV Remote control in the early 1950's. They developed one in 1952 called "Lazy Bones," which was a long cable that was attached to the TV Set. Pushing buttons on the remote activated a motor that would rotate the tuner in the set. This type of remote wasn't popular for long considering that, at the time, there were very few channels to choose from.

HOME AUTOMATION SYSTEM

A common definition of Home Automation is of an "electronic networking technology to integrate devices and appliances so that the entire home can be monitored and controlled centrally as a single machine"(Pragnell et al., 2000). Another term that describe the same technology is "domotics", which derives from the Latin word domus, meaning home, and informatics, meaning the study of the processes involved in the collection, categorization, and distribution of data. However, since this technology is still very much in flux, other terms are also used in the literature with equivalent meaning, such as: "smart home", "smart house", "digital home" or electronic home".

Furthermore, note that although the terms "house" and "home" have different meaning in the English language, they are often used alike in this context. (Delgado, et al., 2006) consider the problems with the implementation of home automation systems. Furthermore the possible solutions are devised through various network technologies. Several issues affecting home automation systems such as lack of robustness, compatibility issue and acceptability among the old and disabled people are discussed. (Ciubotaru-Petrescu, et al., 2006) present a design and implementation of SMS based control for monitoring systems. The paper has three modules involving sensing unit for monitoring the complex applications. A processing unit that is, microcontroller and a communication module that uses GPRS modem or cell phone via serial port RS-232. The SMS is used for status reporting such as power failure. In their paper, (Scaradozzi et al., 2003) view home automation systems as multiple agent systems (MAS).

In the paper home automation system has been proposed that includes home appliances and devices that are controlled and maintained for home management. The major task is to improve performance. In their paper, (Alkar et al., 2005) propose an Internet Based Wireless Home Automation System for Multifunctional Devices. This paper proposes a low cost and flexible web-based solution but this system has some limitations such as the range and power failure.

Murthy (2008) explores primary health-care management for the rural population. A solution proposes the use of the mobile web-technologies providing the PHC services to the rural population. The system involves the use of SMS and cell phone technology for information management, transactional exchange and personal communication. (Jawarkar, et al., 2008) propose remote monitoring through mobile phone involving the use of spoken commands. The

spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS takes a decision of a particular task. (Potamitis, et al., 2003) suggest the use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real- life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition.

The first question that might come to mind is why we would need a Smart Home and why we would want to find different ways of doing ordinary things, such as washing clothes, cooking, or even turning a light on or off. A similar question could have been asked at the beginning of the 20th Century, at the dawn of what can be called the "mechanical revolution". In late 1800's, the middle class was experiencing a shortage of domestic servants which created the need to find new ways to provide help in the home (Harper, 2003). Such necessity was the initial driving force behind the inventions of the first domestic appliances, which had the purpose of making household chores easier and do more with less. In 1911, Frederick Winslow Taylor published "The Principles of Scientific Management", which advocated the use of efficiency to maximize results through minimal effort. This theory is today known as Taylorism and, though it was originally intended to be applied in industrial settings, this concept soon spilled over into the domestic realm due to the need at hand. Christine Frederick (1911) was one of the first to recognize that the challenges tackled by Taylorism were also directly applicable to domestic issues and captured these in her book "Household engineering: Scientific Management in the Home", published in 1915. In her book, Frederick predicts that mechanical appliances would be the ones which were to take up the work originally performed by servants "where every possible purely manual task is done by arms of steel and knuckles of copper". She also puts forward the idea of a Smart Home where she foretells that "such machinery will be far more unified than at present with various pieces related to one another", as reported by D. Heckman (2008).

THE ELECTRICAL EVOLUTION

In spite of the first inventions, most of this new domestic technology would have still been easily recognized by people who had lived in the previous Century. However, electricity, the driving force behind the electrical revolution, would soon change this familiar landscape beyond recognition. Electrical energy first arrived in the homes around 1920s and, although initially used for lightning purposes only, by 1940s mains electricity was readily available to around 65 per cent of the total of houses in the UK. (Harper, 2003). Soon after it reached a critical mass, producers of electrical appliances inundated the market with all sorts of items. Although some of them were nice-to-have-devices, such as electric popcorns poppers, egg cookers and waffle irons, others were really life changing for the household: refrigerators, washing machines, electric cookers, vacuum cleaners, just to mention the most important. Regardless of their importance, all these electrical appliances were still made with the original need in mind, which was often reminded to people as producers marketed these products with time-saving slogans such as "no longer tied down by housework" or "automatically gives you time to do those things you want to do" (Heckman, 2008). It is interesting to note how some later devices could be hardly classified as time savers and how, in spite of this, they were still quite readily adopted. By early 1980s, around 65 per cent of UK homes had a colour television set and half of them a video recorder (Harper, 2003). More interesting still, the adoption curve was different from one to another, sometimes regardless of the comfort that they could bring.

SMART HOME TODAY

The Oxford Dictionary defines "smart" as both "stylish and fresh in appearance, having a quick intelligence", and "being fashionable and up market". Sony was among the first companies to attach the "smart" buzzword to a computer when, in 1982, it marketed the "Smart Sony" computer: no longer advertised simply as a "home" computer, but tried to cash in on the smart

concept by selling it as a device which could "help you make smarter business decisions" (Heckman, 2008). The "smart" concept has become since a marketing catchword, still employed today, to sell a wide range of products, hence: "smart phones", "smart cameras", "smart design", "smart bombs" and "smart homes". Usually, the word define devices that are reportedly based on cutting-edge design that unite innovation with practical simplicity, However, as this would soon be demonstrated, sometimes marketing buzzwords alone cannot guarantee the sell. Xanadu was the first example of a mass-produced Smart Home. Built throughout the 1980s in the US around the original EPCOT idea, these houses were commercially built dwellings that made extensive use of Smart Home technologies. To look even more futuristic, the actual house was made entirely of polyurethane foam. The Xanadu home had a computer that monitored and controlled all its systems: the kitchen, living room, bathrooms, and bedrooms all had their own electrical and electronic devices to control the appliances present in the house. For example, the shower could be set to be turned on at a specific time and a set temperature. The ad campaign eloquently described the house as "Xanadu: the Computerized House of Tomorrow" and its peculiar appeal was set by the advertisement campaign: a "house with a brain – a house you can talk to, a house where every room adjusts automatically to match your changing moods" (Heckman, 2008). As the time moved on, and most of the houses were still unsold, the technology contained soon became obsolete. One by one, these Xanadu houses started to get demolished to make space for more "commercially viable" projects and, by October 2005, they were all gone. In spite of the commercial setback provided by the Xanadu homes, the concept was sound and a combination of elements such as computers, robotics and Artificial Intelligence (AI) were to push the Smart Home concept further, even if sometimes only in research laboratories. Throughout the 1980s, several innovative ideas provided a clear indication that the technology might have been finally mature enough to deliver commercially viable solutions. As an example, a device named Waldo, which interfaced with an Apple computer, could use voice recognition and speech synthesis technology to control appliances.

ASPECTS OF AUTOMATIC SPEECH RECOGNITION (ASR) DEVICE

Automatic speech recognition (ASR) is the process by which a computer maps an acoustic speech signal to some form of abstract meaning of the speech. Automatic speech recognition (ASR) applications focus on public services such as operator automatic operator assistance voice activated information retrieval, voice doing and many other similar tasks. Speech recognition should not be confused with a dial tone (DTMF) application where the user must select from numbered options or spell out and account number using the telephone keypad. A speech recognition application allows the user to answer questions and provide information using a normal speaking voice many companies have already invested easily in human powered call centers or DTMF (touch- tone) interactive voice response (IVR) systems. They are changing or adapting to ASR applications, because of cost savings and improvement in customer satisfaction and experience. It has been shown that automatic speech recognition application is far more popular with callers than DTMF menu systems. In general, ASR system consist of (i) A signal processing front-end (ii) Acoustic modeling (iii) Language modeling

TECHNICAL DETAILS OF GSM- GSM is a cellular network, which means that mobile phone can be connected to it by searching for cells in the immediate vicinity. GSM network operate in four different frequency ranges. Most GSM network operates in the 900Mh2 or 1800 MHz bands. In 900 MHz band, the uplink frequency band is between 890-915 MHz and the downlink frequency band is 935-960 MHz. In the 1800mz band, the uplink frequency is between 1710-1785 MHz and the downlink is between 1805-1880Mh2. also in 1900 MHz band, the uplink frequency band is 1850Mhz- 1950 MHz. In GSM 900 MHz, the band allocation is 25 MHz band width which is subdivided into 24 carrier frequency channels, each spaced 200 kHz apart. Time division multiplexing is used to allow eight-fall rate to sixteen half-rate speech channels per radio

frequency channel. There are eight-radio time slots (giving eight burst penods) grouped into what is called TOMA frame. Half rate channels use alternate frames in the same time slot. The channels data rate is 270 833kbit/s and the frame duration is 4.615ms. The transmission power in the handset is limited to a maximum of 2 crafts in GSM 900 and I waH in GSM 1800/1900.GSM has used a variety of voice codes.

SUBSCRIBER IDENTITY MODULA (SIM) AS A GSM FEATURE

One of the key features of GSM is the subscriber identity module (SIM). It is usually known as SIM card. The SIM is detachable smart in appearance and is used for the subscription of information and phonebook. This allows the retrieval of information after switching handset on. The SIM card also enables users to link each other irrespective of different network operation. For the purpose of this project work to be achieved a SIM card on any network is required to establish a link between a user and its household equipments to squeeze 3.1Kh2 audio between 5.6 and 13kbits/s.

METHODOLOGY

Circuit Design and Procedure

The block diagram of this work is shown blow in the fig. It is an outline description of how we have implemented the project and the various steps involved in it. From the block diagram given below, the first mobile station is used as a transmitting section from which the user sends a code that contains commands and instructions to the GSM modem which is based on a specific area where our control system is located through GSM network. The received code is an SMS.

The GSM MODEN converts it into digital signal and sends it to the microcontroller interfaced to it. The microcontroller processes the code and carries out the specific operation. The transistor BC547 is used to drive the relay circuits which switches the different appliance connected to the interface. After connecting the circuit properly and assuming all the connections are right, the following steps are to be followed.

The remote user sends authenticated signal including commands to the receiver GSM modem. Through the GSM network the signal is received on the device. Then the command is passed to the controller to convert it to the digital signal and it sends them to microcontroller. Controller issues commands to the appliance and the device connected will switch ON/OFF The GSM module is set on SMS Mode, the signal send in the form of SMS is send to the GSM module and then microcontroller command the relay to switch the device.

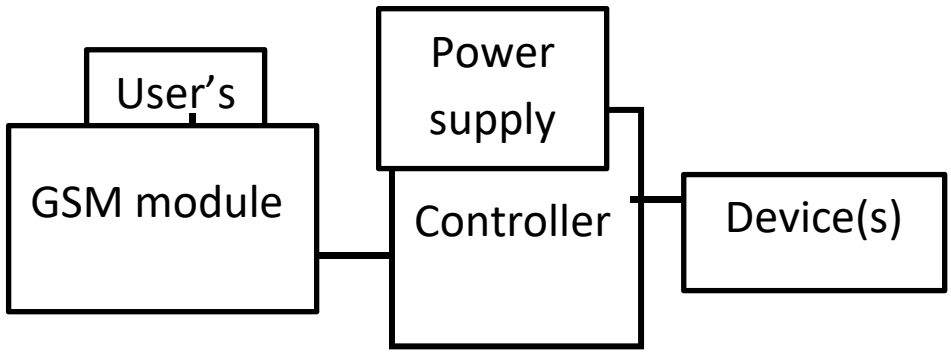

Fig. 1: BLOCK DIGRAM

Power Supply

Basically, any electronic circuit runs with a power supply. Here we are giving a 5v power supply to the various ICs used in the design presented here. We get a 240v power supply in our house at any instant. So in order to provide our circuit with appropriate supply voltage, a different power circuit is designed based on our requirement. The various steps included in the circuit are

explained below stepwise. And also, various precautions are to be taken for the safety of the electronic circuit designed. The different stages of the design of the circuit are given below.

TRANSFORMER

We need a step down transformer of 220/12v output to supply all the electronics involved. Her in this device, all the equipment require a D.C input of 5v and since the regular input to the houses is 220-240, we need a transformer to step down the voltage to the appropriate required voltage of the components.

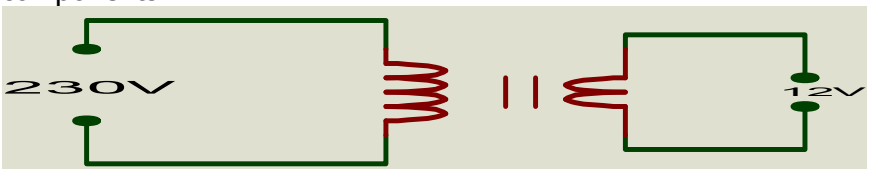

Fig 2: Transformer

Bridge Rectifier

The equipment needs a D.C supply so the output from the transformer is connected to a bridge rectifier to make it D.C. A bridge rectifier basically has four diodes connected as shown below to provide rectification. This configuration is widely used both with individual diode wired as shown and with single component bridges where the diode bridge is wired internally.

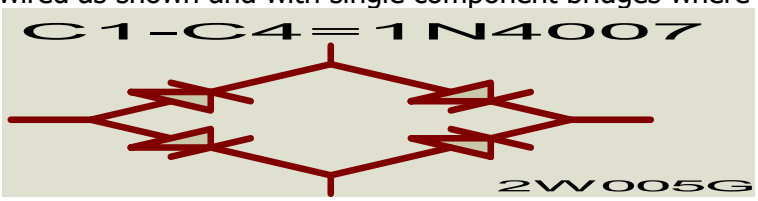

Fig. 3: Bridge Rectifier

Filter Circuit

The filter circuit is simply a capacitor of 1000μf associated in parallel to the power circuit. It goes about as a filter that seems to be, it filters out the ripples present in the circuit brought on throughout the rectification from the diodes in the bridge circuit. Regardless of the amount, consideration is taken where there are still ripples in the output voltage of the circuit, which is destructive for the ICs utilized. So, filter capacitor evolves them, along these lines helping keeping up security in the outlined circuit.

Voltage Regulator

Then at last, voltage controllers are associated over the circuit to secure the supplies from any kind of voltage variances. All the gadgets we utilize are delicate and sensitive, so protection from any kind of variance is very important. A voltage controller is intended to naturally keep up a consistent voltage level.

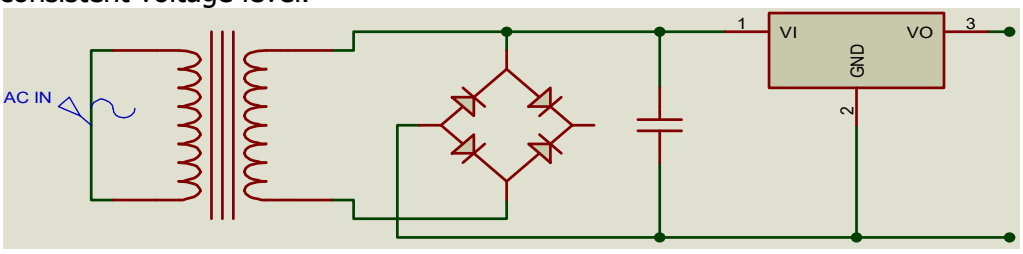

Fig. 4: Power Supply Circuit

Control Circuit SMS Based Design

The control circuit basically contains all the electronic parts and ICs and its design is as follows;

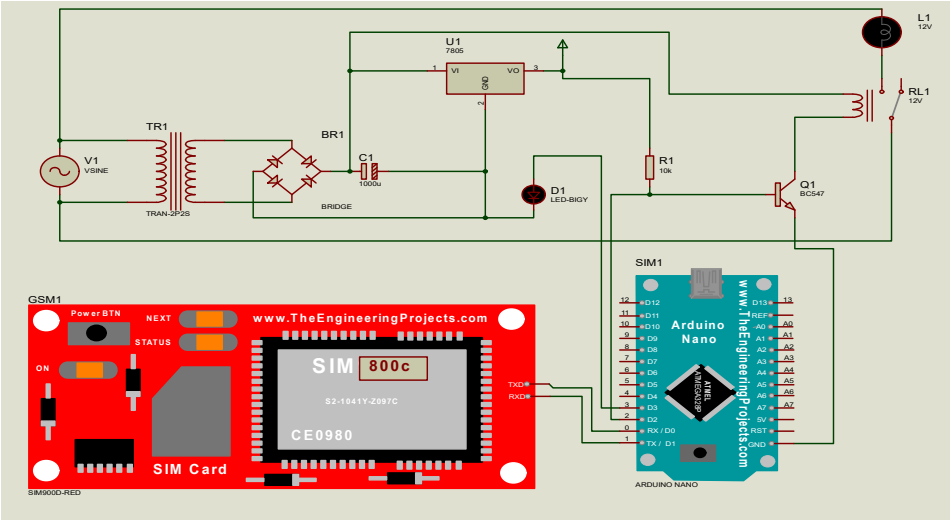

Fig. 5: Circuit Diagram **ATmega328p**

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

Fig. 6: ATmega328P in 28-pin narrow dual in-line package (DIP-28N)

Fig. 7: ATmega328P in 32-pin thin quad flat pack (TQFP-32)

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

Key parameters- Table 1 shows the parameters needed for the operation.

Table 1

Parameter	Value
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz[2]
Flash memory	32 KB
SRAM	2 KB

EEPROM	1 KB
Pin count	28 or 32 pin: PDIP-28, MLF-28, TQFP-32, MLF-32
Maximum operating frequency	20 MHz
Number of touch channels	16
Hardware QTouch Acquisition	No
Maximum I/O pins	23
External interrupts	2
USB Interface	No
USB Speed	–

Relays

The relays are final stage of this device which plays a very prominent role to control the final appliance. The principle on that the relays work is electromagnetic force. When electricity starts flowing through a coil, it becomes an electromagnet, steel plate are attracted by these electromagnetic coils which is attached to a switch. So the switch's motion (ON or OFF) is controlled by current flowing through the coil, or not respectively.

A relay's very useful feature is that it can be used to isolate different parts of a circuit electrically. It allows a low voltage circuit (e.g 5v DV) to switch the power in a high voltage circuit (e.g 100v AC or more).

Limitations

The proposed system only works in the places of good reception of signal and remote areas where there is no strong GSM signal, the equipment does not respond always. There should be always continuous power supplied to the equipment so that the microcontroller and phone connected to it works.

RESULTS

Simulation Result

Proteus software has been used for the circuit discussed above. The simulation circuit is shown in fig 5 above

Equipment Required – Table 2 shows the required equipment for the operation

Table 2

Serial no	Equipment	Device	Quantity
1	AVR	ATMEL328P	1
3	Crystal Oscillator	3579545MHz	1
4	Crystal Oscillator	110592MHz	1
5	Relays	SPDT	3
7	LEDs		4
8	Voltage regulators	LM7805	2
9	Transformer		1
10	Bridge rectifier		1
11	Capacitors		

12	Resistor		
13	GSM module	SIM800c	1

In addition to these, a cellular phone is required which has to be connected to the device to receive the code from the user's phone. The resistors and capacitors are to be selected according to the ratings of this equipment selected and also for the efficient performance of the device. The software required for the programming of the AVR microcontroller is ARDUINO IDE vision to program the microcontroller. The basic things like the Vero board, input pins, sockets, soldering gun etc were used.

SUMMARY

Home automation is building automation for a home, called a smart home or smart house. A home automation system will control lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems

CONCLUSION

The GSM based home automation using AVR was designed and constructed to CONTROL 230V+5% ac load. It is rated 2500VA 50Hz.

RECOMMENDATION

It is a fact that this is not exhaustive. It can still be improved to get a more sensitive and precise output voltage control.
For this reason I recommend the following.
1. Two layers circuit board can be designed and used in place of single layer circuit board for easier soldiering work and neatness.
2. Further research in the field of electronics switching will go a long way in getting better house control system.
3. Engineering students need early exposure to the use of electronic components for practical work; this will enable them to be more innovative.

ADDED KNOWLEDGE

Using Smart Devices, users can quickly and efficiently get digital access to manage their thermostat, lighting, security, access, etc. Each of these devices comes with a well-developed and easy to use app that allows you to efficiently control and monitor them using your smart phone.

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