DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

HOME AUTOMATION

by
Kamil ÇETİN

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İZMİR

HOME AUTOMATION

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"HOME AUTOMATION"** completed by **KAMİL ÇETİN** under supervision of **ASST.PROF.DR. ÖZGE ŞAHİN** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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HOME AUTOMATION

ABSTRACT

The growing tendency in the need of more comfortable life standards occurred within the terms of smart living systems on behalf of the parallel rapid improvements in the automation technologies. On the point of these technologies has arrived, the building management technologies not only survive the giant buildings but also turns all kinds of habitat into an intelligent life area.

The aim of this study is to show the benefits of the smart living systems, their areas of usage that bring into our lives and the standards about the application process of the study. Details about the technical substructure and application of the designed house automation with phone call will be described. It will be also explained the supreme points of the system against others.

Home automation which constructs the main concept of the study is shown in the modelled scenarios with control panels, environment units, and sensors. A microcontroller based circuit is designed in order to control electrical devices and get feedback from home. Almost every home has its own telephone line. That's why phone line is selected for sending and receiving information. Voice recording and playing system is integrated with the system for getting audible feedback and warning messages. A Liquid Crystal Display (LCD) and keypad is added to the system to attain ease of use. A power supply is also included against power interrupts or voltage drops.

Key words; Home automation, microcontroller, sensor, telephone, voice integrated.

EV OTOMASYONU

ÖZ

Günümüz otomasyon teknolojilerindeki hızlı gelişmelere paralel olarak, insanların güvenliğe ve daha rahat bir yaşam standardına olan ihtiyaçları akıllı yaşam sistemi dediğimiz kavramın ortaya çıkmasına sebep olmuştur. Otomasyon teknolojisinin geldiği bu noktada bina yönetim sistemleri, yalnızca büyük boyutlu binaları değil, her türlü yaşam alanını akıllı hale getirebilme özelliği sunuyor.

Bu çalışmanın konusu akıllı yaşam sistemlerinin günlük hayatımıza getirdiği kolaylıklar, kullanım alanları ve ayrıca çalışmanın uygulama alanı olan ev otomasyonu standartlarından bahsedilecektir. Tasarlanmış olan telefon kontrollü ev otomasyonunun teknik ve uygulamasına ait ayrıntıları açıklanacaktır. Bu sistemin diğer sistemlerden üstünlükleri ele alınacaktır.

Bu çalışmanın ana kavramını oluşturan ev otomasyonu, uygun senaryolar dahilinde bir modele oturtularak, kontrol paneli, çevre birimleri ve sensörler ile bir arada gösterilmiştir. Bu modelin temsil ettiği evdeki cihazları çalıştırmak ve sensörlerden bilgi almak için mikrodenetleyici kontrollü bir kontrol devresi tasarlanmıştır. Çoğu evde sabit telefon hattı olduğu için telefonla kontrol tercih edilmiştir. Sistem ile haberleşebilmek için ses kayıt ve çalması yapabilen ses entegresi eklenmiştir. Bu sistemin kolaylığı ve kullanılabilirliği için LCD ve tuş takımı devreye eklenmiştir. Sistem arıza ve sabotaj anında da çalışabilmesi için şebeke gerilimi dışında ayrı bir kesintisiz güç kaynağı ile beslenmiştir.

Anahtar kelimeler: Ev otomasyonu, mikrodenetleyici, sensör, telefon, ses entegresi.

CONTENTS

CHAPTER ONE

INTRODUCTION

The impact of home automation on domestic lifestyles will be as far ranging as was that of factory automation on industry and its benefits will be available to all sectors of society. Home automation can be achieved not only with the household robot but with embedded computing power and memory within dozens of pieces of domestic equipment, each of which can communicate with the user and with other equipments. Within the integrated home system the communication media will include infra-red, radio, mains wires, installed twisted wires and coaxial cable, and later perhaps optical fibre. Applications will include security, lighting, heating, cooking, washing appliances, audio and video systems, energy management as well as a number of new applications such as health monitoring, home publishing and entertainment.

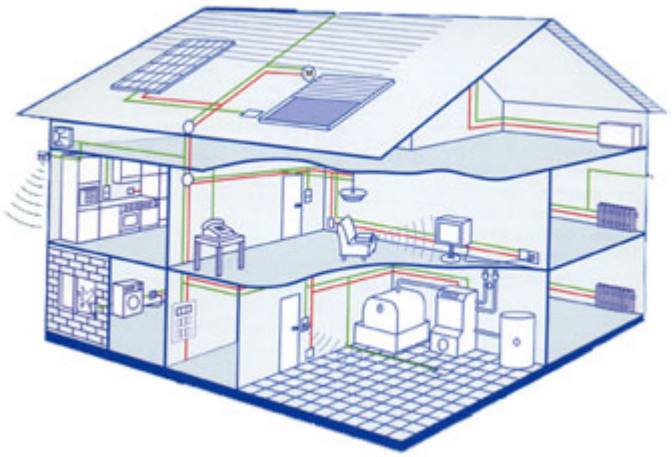


Figure 1.1 A sample home which has the automation system.

In chapter two, the most common and recently released home automation standards will be mentioned. In the chapter three, it will be discussed about manufacturing, circuit components and sensors used in the phone controlled home automation hardware. Software and operation of the system will also be explained in Chapter four.

1.1 Advantages and Utilities of Home Automation

Home automation provides a lot of benefits on human lifestyle. Remote controlling or monitoring can be achieved with this system. So life may be more comfortable and more secure. This system also provides added security for people in regular days. For example, a person can check the complete house before leaving through a display unit in the entranceway.

It can be used to perform numerous functions that protect human life. Take the movement detectors for instance. The entranceway and other specific areas can be monitored from outside for security purpose. Unwanted guests trigger the automatic alarm lighting, discouraging them from going any further. Via door and window contacts, alarm messages are displayed in house or at an external location. And if garage door has been forgotten to shut, it can tell owner that it is still open or it can show owner if it is opened at night. All these precautions make human life and house even safer.

When the heating system is linked to home automation, home always keeps the room temperature at the level set by the owner and money is saved on top of that. That way humans not only always have a healthy climate at home, but also economize on costs; saving up to %30 a year just from a heating system with individual room control and window monitoring. Consumption management is good for even more, though, such as automatically switching high-consumption devices on like the washing machine during those times of the day when rates are the lowest. Some applications are shown in Figure 1.2.

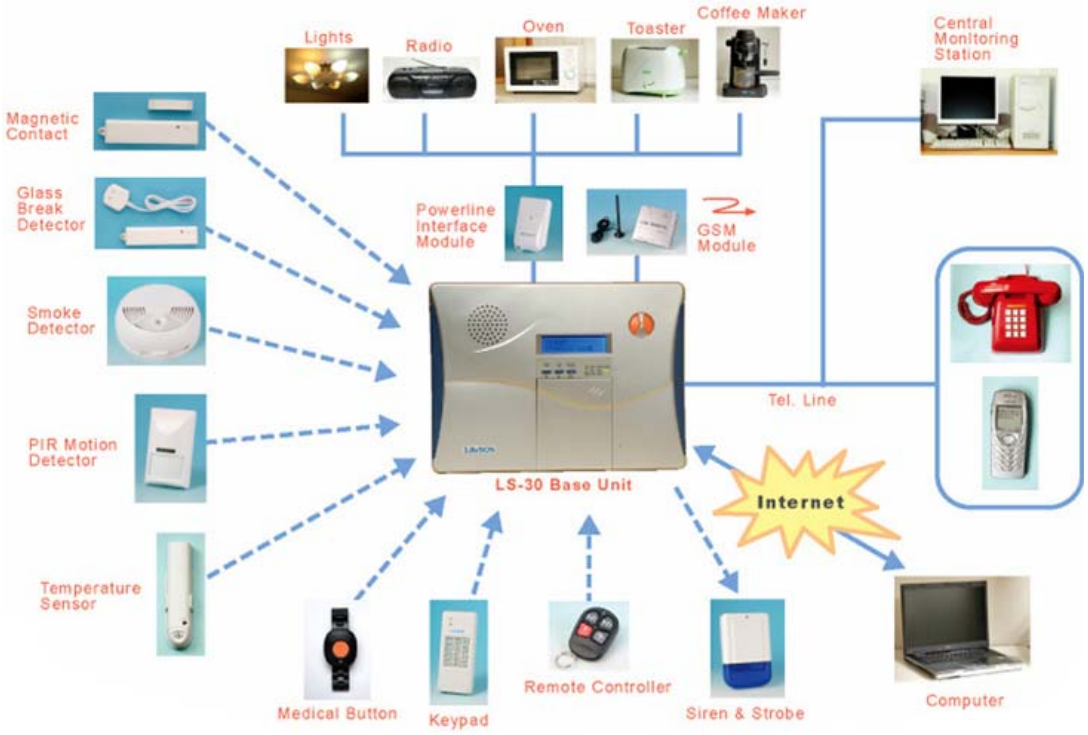


Figure1.2 A sample home automation system.

1.2 The Last Innovations at Home Automation

Nowadays home automation has much innovation. Some of these are bluetooth home control, neural fuzzy, USB home control network system, RF network, wireless home automation networks etc.

A neural fuzzy system controlling home appliances are to provide an efficient and convenient integration and inter-operation among appliances in households. The necessary software tools should present a comfortable user interface. One suitable programming method for home automation systems is the definition of linguistic rules that can be processed by a fuzzy system. It is assumed that the home system adapts itself to the occupants' lifestyle. Based on this idea, an appropriate neuro fuzzy controller has been presented by author. An implementation of this artificial intelligent based controller under the MATLAB/SIMULINK development environment has been used. It consists of functions that upgrade MATLAB/SIMULINK to a tool with hardware and Internet access. This tool is not

only restricted to home automation, it can also be applied to control non time-critical processes (Zainzinger, H.J., 1998).

Bluetooth wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The key features of Bluetooth technology are robustness, low power, and low cost. The Bluetooth RF (physical layer) operates in the unlicensed Industrial, Scientific and Medical (ISM) band at 2.4GHz. The system employs a frequency hop transceiver to combat interference and fading, and provides many frequency hopping spread spectrum (FHSS) carriers. RF operation uses a shaped, binary frequency modulation to minimize transceiver complexity. The symbol rate is 1 Megasymbol per second (Msps) supporting the bit rate of 1 Megabit per second (Mbps) or, with Enhanced Data Rate, a gross air bit rate of 2 or 3Mb/s. These modes are known as Basic Rate and Enhanced Data Rate respectively. Bluetooth wireless technologies are useful to keep home comfortable and to support the elderly and the disabled people. Wireless home automation has been developed mostly subject of security.

Figure 1.3 Security system through easy wireless installation.

Home Automation Control System that has constructed a consortium currently has models on the home network market. Also, cellular phones have tried home networking by using not only the wired Internet, but also broadband wireless communication. Regardless of the many solutions to home networking that are being

developed, few can be applied to real life because a standard protocol has not been developed. Therefore, the home network system was developed using USB (universal serial bus) that provides a standard protocol for home networking. The mobile USB home control system is expandable and portable. Also it provides a low cost and stable technology using an embedded system (Yong-Seok Kim, Hee-Sun Kim & Chang-GooLee, 2004).

Recent innovations in home automation have been mentioned at home automation standards section.

CHAPTER TWO

HOME AUTOMATION STANDARDS

Most proposals for home automation communications have been derived from other industries. The choice of protocol is important because it can impact network performance and appliance costs. This is explained by discussing progress by the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) at establishing a worldwide standard for home automation (Wacks, K.P., 1992).

The world has complex standards and specifications as home technologies expand to encompass computer and communication networks. International home automation standards can be separated into two groups depending on working as groups and proprietary. A sample home automation system that has many standards, is shown in Figure 1.2. Some of these standards are given as examples.

2.1 Home Automation Standards of Alliances and Working Groups

2.1.1 Consumer Electronics Bus

The CEBus Standard (EIA-600) is a protocol specification developed by the Electronic Industries Association (EIA) to support the interconnection and interoperation of consumer products in a home. Specifically, the communications protocol as used for the control channel, the command and control portion of the CEBus network, is considered.

The CEBus twisted pair (TP) network is described. The TP network is one of several `hard' media supported by the CEBus home automation standard for consumer device communications in the home. The network development is a result of a desire to have a dedicated, high-speed medium, easily installed in the home at low cost that could support the communication needs of devices which are normally interconnected by low-voltage wiring. The author covers the development goals, network topology, media, media frequency use, coexistence with other services, and device interfaces (Evans, G., 1991).

2.1.2 Home Audio Visual Interoperability

Home Audio Visual Interoperability (HAVI) is a home networking standard that links consumer electronics and computing devices in the home. The HAVI network is restricted to the IEEE (International Electric Electronic Engineering) 1394 physical layer, and this paper describes an approach for executing HAVI applications outside the IEEE 1394 layer from any internet-enabled device such as a laptop or a web pad. The feasibility of this approach has been demonstrated with a prototype implementation in which the entire HAVI Java Application Programming Interface (API) can be executed remotely. This approach enables applications such as remote monitoring with a home security camera or remote control of a Video Cassette Recorder (VCR) (Wendorft, R.G., Udink, R.T. & Bodlaender, M.P., 2001).

The HAVI architecture is a set of APIs, services, and an on-the-wire protocol specified by an industry initiative. HAVI facilitates multivendor interoperability between consumer electronics devices and computing devices and simplifies the development of distributed applications on home networks. The HAVI architecture strikes a balance between the demands of consumers and vendors by facilitating both device interoperability and the innovation and introduction of new features or refinements. A key feature of HAVI is that each physical device has an associated software proxy. Adding new proxies to a home system makes new features or devices accessible even to applications running on older devices (Lea, R., Gibbs, S., Dara-Abrams, A. & Eytchison, E., 2000).

HAVI is a CE industry standard that will ensure interoperability between digital audio and video devices from different vendors and brands that are connected via a network in the consumer's home.

2.1.3 BatiBUS

Intelligent buildings are a concept that was derived from theory of AI and has been realized by the increasing coverage and reliability of telecommunication equipment and information technology. Many of the intelligent building systems however, are derived from either building automation technologies such as Profibus(R), American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) Building Automation Control Networks (BACNET) or home automation protocols like X10, Batibus, EIB, HomeBus, CEBus and perhaps the more remarkable Echelon's LonWorks. Most of these networks do not offer enough bandwidth for voluminous data except for BACNet, and Profibus. Robustness under harsh conditions has yet to be addressed by the above technologies (Teoh Chee Hooi Singh, M., Siah, Y.K. & bin Ahmad, A.R., 2001).

BatiBUS and European Installation Bus (EIB) networks typically link sensors and actuators to building systems that control Heatin Ventilating and Air Conditioning (HVAC), security, access, and life safety. The message sent between a building system controller and such devices are relatively simple, such as 'set a value' and 'read a state'. Therefore, the languages in both protocols support read and write commands for single internal elements.

2.1.4 European Installation Bus

European Installation Bus (EIB) is an important standard in home automation area. This is a new framework for the development of local and remote EIB applications for monitoring and controlling EIB systems. On top of an EIB bus communication system that serves for the communication between an EIB system

and an external computer an EIB object server system is introduced, that offers common access to EIB systems by setting up and maintaining a virtual shared group object space, thus reducing bus traffic significantly. Read and write requests of local and remote EIB applications are performed as local operations on corresponding virtual shared group objects (Kastner, W., Tumfart, W., 2002). While conventional EIB applications are based on traditional message passing, the author proposes an approach on virtual shared group objects.

2.2 Proprietary Home Automation Standards

2.2.1 X10

Powerline networking is increasingly becoming an important component of home networking systems. Its reliability is however still a problem. Model-based fault detection system achieves completeness of coverage for X10 faults. A finite state automatoin has been developed experimentally that models all legal sequences of X10 commands. The task of detecting every violation of this model is complicated by the presence of hidden state and unobservable illegal transitions. This problem is addressed by deducing the model state indirectly from the sequence of X10 commands that is observed on the powerline. To this end, the model state deduction task in terms of the observability of the model has been formulated, a concept which arises in discrete-event dynamic systems. Based on the observability property of designed X10 model, the detection of model violations is performed in current implementation via regular expressions on observable X10 command sequences. (Arora, A., Jagannathan, R. & Yi-Min Wang, 2002).

X10 is a communications "language" that allows compatible products to talk to each other using the existing electrical wiring in the home. Most X10 compatible products are very affordable and the fact that they talk over existing wires in the home means that no costly rewiring is necessary. Installation is simple, a transmitter plugs (or wires) in at one location in the home and sends its control signal (on, off,

dim, bright, etc.) to a receiver which plugs (or wires) into another location in the home. Advantages of X10 are in the following.

- Inexpensive
- No new wiring is required -- perfect for retrofit
- Simple to install
- 100's of compatible products
- Control up to 256 lights and appliances
- Time proven - it has been around for over 20 years

2.2.2 LonWorks

The fieldbus systems in centralized or distributed control systems have been widely used in the area of industrial automation for several years. Among those fieldbus systems, the LonWorks is becoming regarded as a new promising way to implement the industrial network systems. The LonWorks is a universal control network system developed by Echelon Corporation in 1990. In this author's study, a distributed control system has been introduced for industrial applications based on LonWorks technology and has been proposed the rate-based traffic control of industrial control networks employing LonWorks. The LonWorks network systems are composed of a network node called a LonPoint containing Neuron Chip. Each LonPoint communicate based on LonTalk protocol which is a kind of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocol. Throughout this author's study, the lab-scale LonWorks network system has been implemented and a rate-based traffic controller has been synthesized. Basically, the proposed rate-based traffic control system is in closed-loop by utilizing the feedback channel errors, which shows improved performance compared with other industrial control networks commonly operated in open-loop. To this end, an additional network node, called monitoring node, is introduced to check the channel status without increasing the channel load (Byoung-Hee Kim, Kwang-Hyun Cho & Kyoung-Sup Park, 2000).

LonWorks is a control network technology which uses a control network protocol called LonTalk. Since LonTalk is different from Transmission Control Protocol and Internet Protocol (TCP/IP), LonWorks itself cannot support IP networks automatically. Therefore, TCP/IP and LonTalk must been merged to implement LonWorks over IP networks. In this author's study, the experiments used to test interoperability between TCP/IP and LonWorks are explained. The steps taken to set up experiments, such as building a LonWorks node, LonWorks network, and LonWorks over IP networks are described as well (Shahnasser, H., Quan Wang, 1998). Based on these experiments carried out to route information between LonWorks and IP networks, authors have concluded that it is possible to control appliances and industrial devices over interconnected networks which use TCP/IP and LonTalk.

2.2.3 Z-Wave

Zensys' Radio Frequency (RF) based technology Z-wave is designed specifically for full home control, enabling power outlets and switches, thermostats, access control, intruder and fire alarms, and other home control networks to go wireless. Zensys offers a family of low-cost, low-power, integrated Microcontroller Unit (MCU) / Transceiver chips embedded with Z-Wave, as well as a suite of development tools and services making it easy for companies to develop wireless products for residential and light commercial applications including lighting and appliance control, energy management, access control, security, and building automation. Z-Wave makes the reliable, affordable, and completely wireless control of and communication between everyday home lighting, appliances, temperature control and other home systems possible, with no new wires.

2.2.4 ZigBee

There has been increased interest in the ZigBee standard, in particular for building automation and industrial controls. The ZigBee Alliance has identified six application spaces for ZigBee: consumer electronics, PC and peripherals, residential/light commercial control, industrial control, building automation and personal healthcare. Increasingly, companies developing monitoring and control applications in industrial and commercial building environments are looking to wireless technologies like ZigBee to save the cost of wiring and installation and also allowing more flexible deployment of systems (Egan, D., 2005).

IEEE based ZigBee technology which is developed for remote control and monitoring, is combination with a multicast routing algorithm from literature and is constituted a platform which is contribution to adopting the ZigBee to medical sensor networks (Kartal, B., 2006).

In respect of authors' opinion, the ZigBee Alliance is an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard.

CHAPTER THREE

HARDWARE DESIGN OF TELEPHONE CONTROLLED HOME AUTOMATION

A circuit is designed that can control devices at home and conditions of sensors can been sent to any phone by it. Therefore, the circuit may be separated into two parts as control and alarm circuits. Both of them are programmed by using microcontroller. A Peripheral Interface Controller (PIC) is used as the microcontroller device. Its code was written in Assembly language. Telephone controlled home automation system is designed as shown in Figure 3.1. Block diagram and top view of system are shown in Figures 3.2 and 3.3. Detailed and printed schematics of main circuit are shown in Appendix B and C.

Figure 3.1 Designed Telephone Controlled Home Automation.

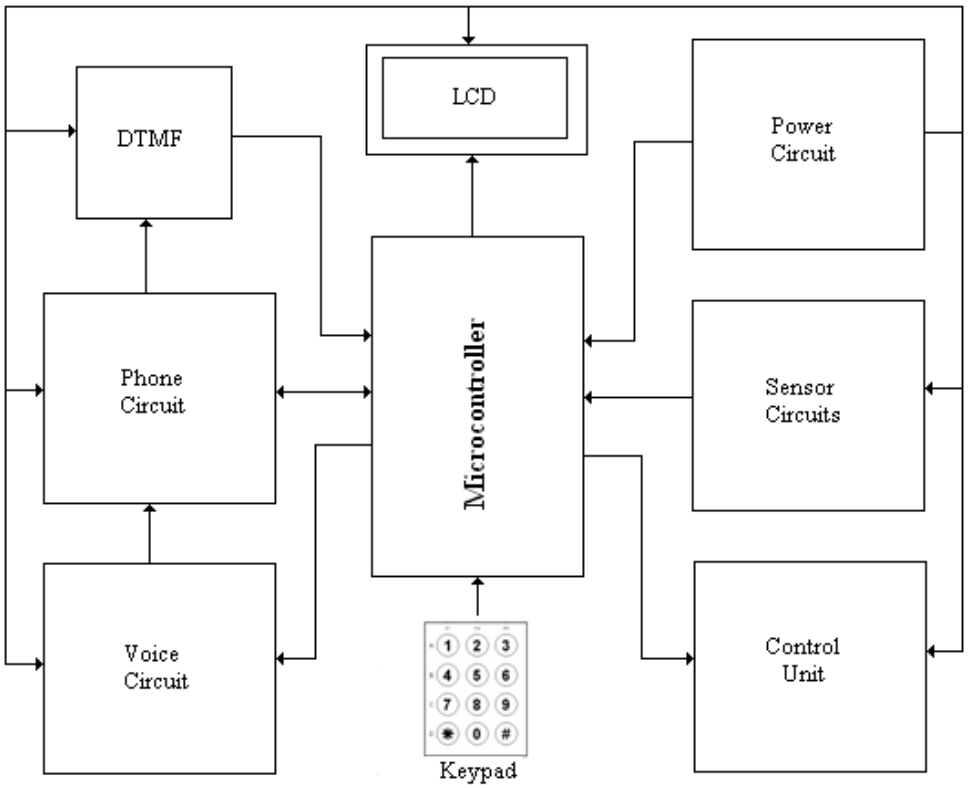


Figure 3.2 Block diagram of the system.

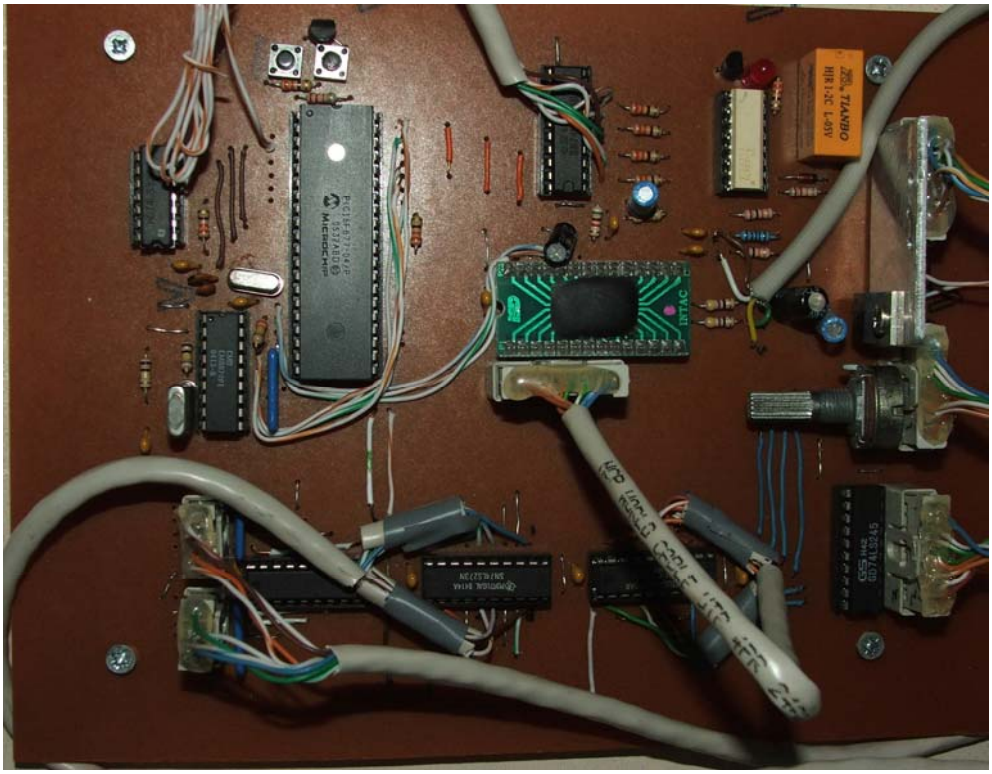


Figure 3.3 Top view of the main board.

The system has two main circuits that has mentioned. When the system connected to phone line that was called an outside phone, voice circuit sends “şifreyi giriniz” message to phone line. After password is entered, voice circuit sends “cihazı tuşlayınız” message to phone line. The control circuit can control eight devices according to the keys pushed. The system uses smoke sensor, motion sensor, temperature sensor, electrical and water detectors. Alarm circuit can inform six different states. When the system detected emergency state, alarm circuit sends the situation to the microcontroller. Telephone circuit calls defined phone numbers. Voice circuit sends related message to phone line. Control, alarm and voice units are explained in detail in sections 3.2, 3.3 and 3.4.

3.1 Used Integrateds

3.1.1 Microcontroller

PIC16F877 was used as microcontroller. Its code was written at the assembly code. Pin diagram and block diagram of PIC16F877 are shown in Figure 3.4 and 3.5. Microcontroller core features are those.

- High performance Reduced Instruction Set Computer Central Process Unit (RISC CPU)
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input
- DC - 200 ns instruction cycle
- Up to 8K x 14 words of FLASH Program Memory,
- Up to 368 x 8 bytes of Data Memory (RAM)
- Up to 256 x 8 bytes of electrically erasable programmable read-only memory (EEPROM) Data Memory
- Pinout compatible to the PIC16C73B/74B/76/77
- Interrupt capability (up to 14 sources)

- Eight level deep hardware stack
- Direct, indirect and relative addressing modes
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low power, high speed Complementary Metal Oxide Semiconductor (CMOS) FLASH/EEPROM technology
- Fully static design
- In-Circuit Serial Programming (ICSP) via two pins
- Single 5V In-Circuit Serial Programming capability
- In-Circuit Debugging via two pins
- Processor read/write access to program memory
- Wide operating voltage range: 2.0V to 5.5V
- High Sink/Source Current: 25 mA
- Commercial, Industrial and Extended temperature ranges
- Low-power consumption:
    - < 0.6 mA typical @ 3V, 4 MHz
    - 20 μA typical @ 3V, 32 kHz
    - < 1 μA typical standby current

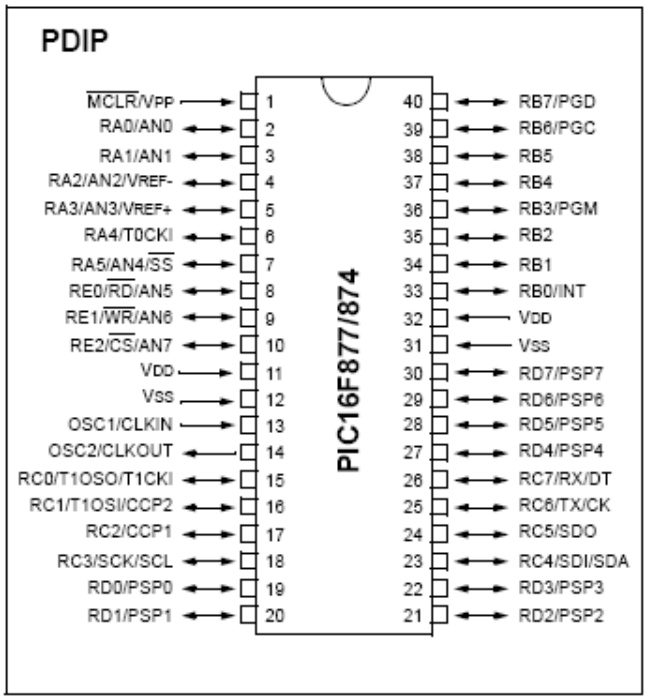


Figure 3.4 Pin diagram of 16F877.

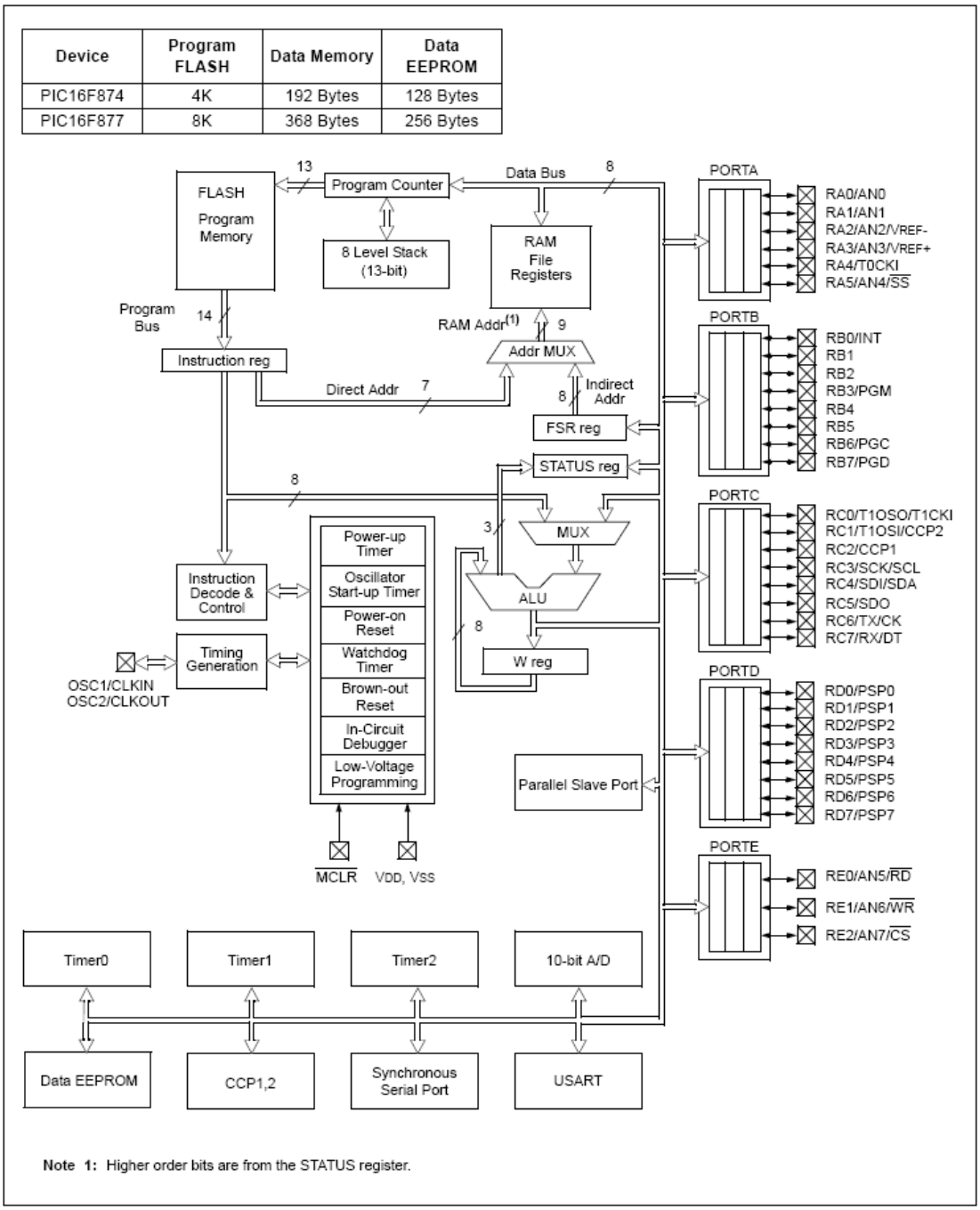


Figure 3.5 Block diagram of PIC16F877.

3.1.2 Voice Record/Playback Device

ISD2500 ChipCorder Series of Winbond provides high-quality, single-chip, and Record/Playback solutions for 60 to 120 seconds messaging applications. The CMOS devices include an on chip oscillator, microphone preamplifier, automatic gain

control, antialiasing filter, smoothing filter, speaker amplifier, and high density multi-level storage array as shown block diagram of ISD2560 in Figure 3.6. In addition, the ISD2500 is icrocontroller compatible, allowing complex messaging and addressing to be achieved. Recordings are stored into on chip nonvolatile memory cells, providing zero-power message store. This unique, single-chip solution is made possible through Winbond's patented multilevel storage technology. Voice and audio signals are stored directly into memory in their naturel form, providing high-quality, and solid-state voice reproduction. 60 seconds record is enough for this system. Set voice circuit in main circuit is shown in Figure 3.7.

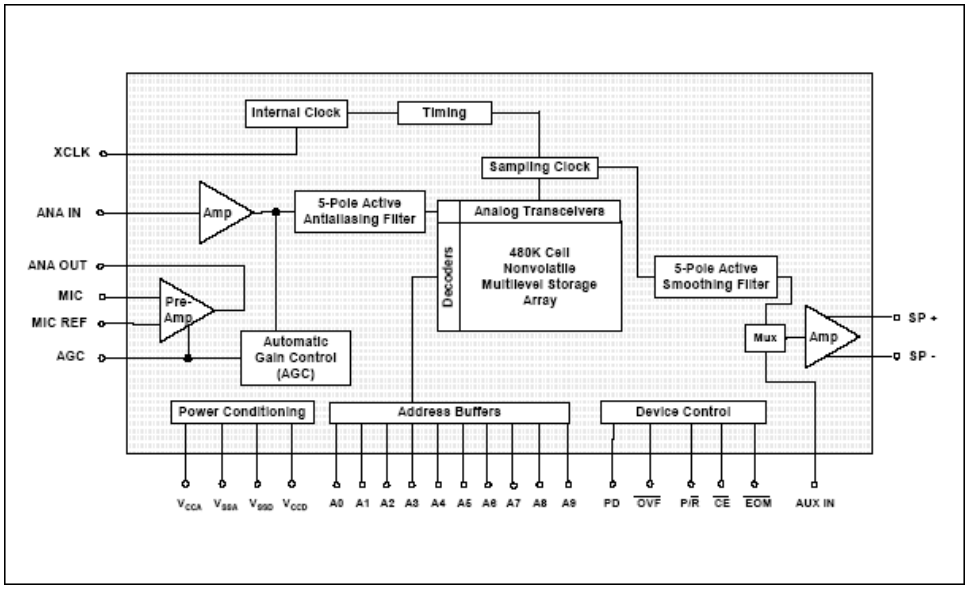


Figure 3.6 Block diagram of ISD2500.

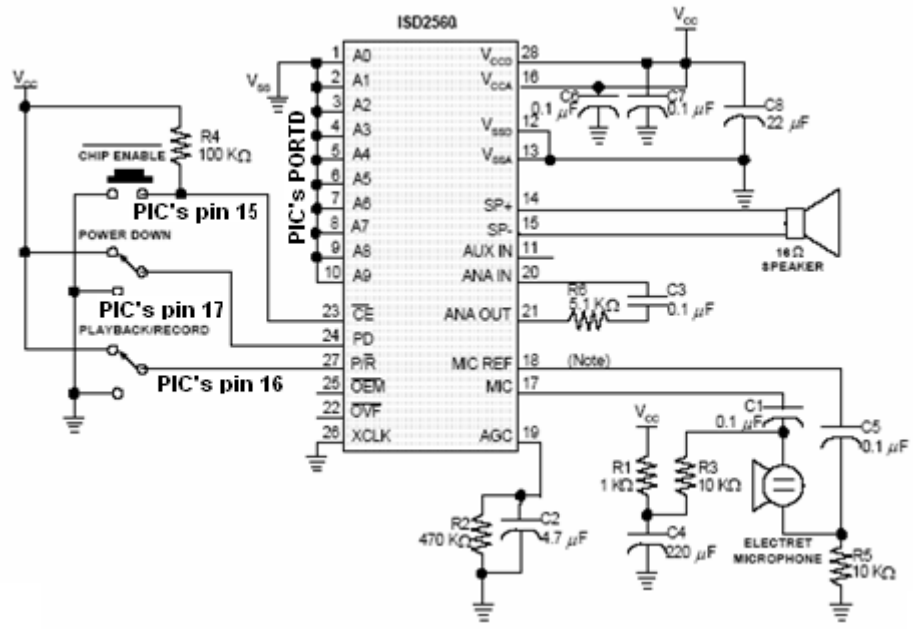


Figure 3.7 Voice circuit.

3.1.3 Dual Tone Multi Frequency Code Decoder

The CM8870/70C provides full Dual Tone Multi Frequency (DTMF) receiver capability by integrating both the band-split filter and digital decoder functions into a single 18-pin DIP, SOIC, or 20-pin PLCC package. The CM8870/70C is manufactured using state-of-the-art CMOS process technology for low power consumption (35mW, MAX) and precise data handling. Block diagram of CM8870 is shown in Figure 3.8. The filter section uses a switched capacitor technique for both high and low group filters and dial tone rejection. The CM8870/70C decoder uses digital counting techniques for the detection and decoding of all 16 DTMF tone pairs into a 4-bit code. This DTMF receiver minimizes external component count by providing an on-chip differential input amplifier, clock generator, and a latched three-state interface bus. The on-chip clock generator requires only a low cost TV crystal or ceramic resonator as an external component. Used DTMF circuit in main circuit is shown in Figure 3.9. Key and output of DTMF table as to frequency is shown in Figure 3.10. Its applications are those.

- PABX
- Central office
- Mobile radio
- Remote control
- Remote data entry
- Call limiting
- Telephone answering systems
- Paging systems

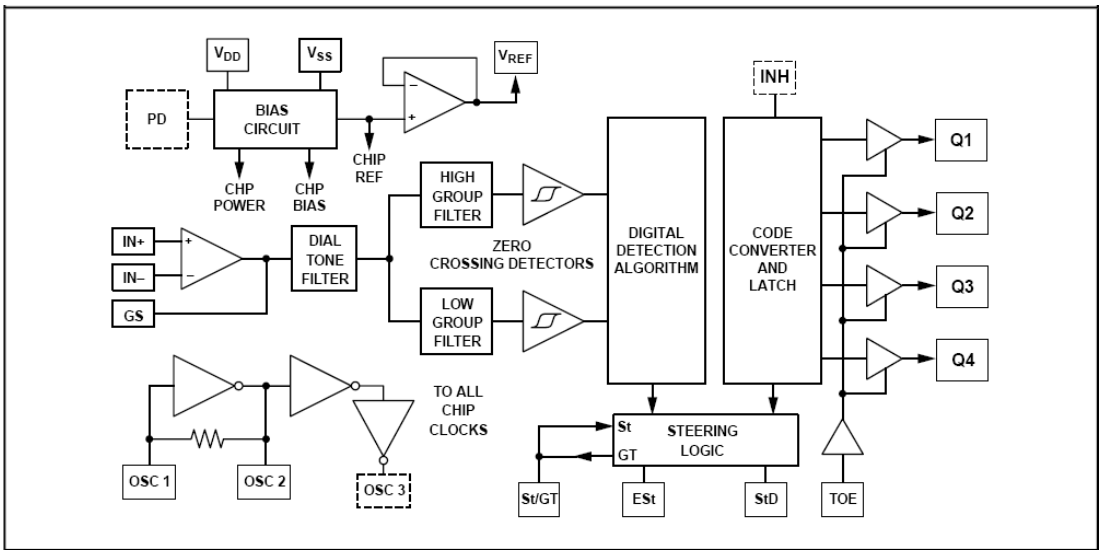


Figure 3.8 Block diagram of CM8870.

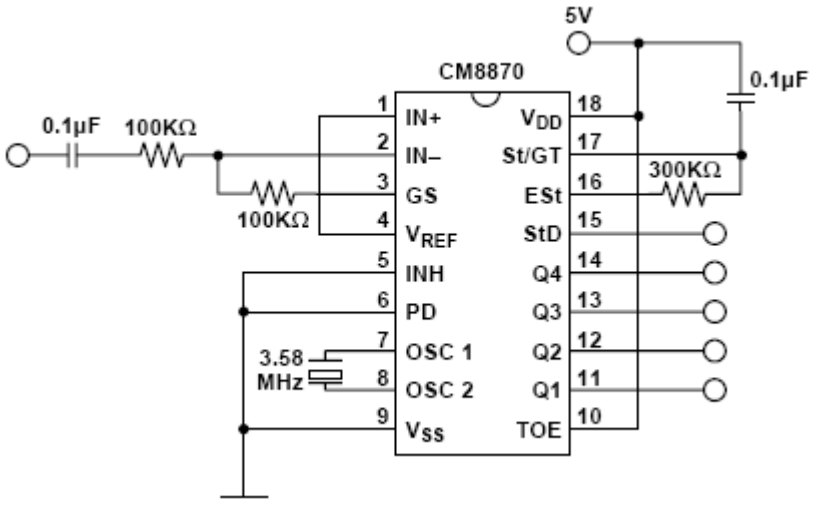


Figure 3.9 DTMF circuit.

F_{LOW}	F_{HIGH}	KEY	TOW	Q_4	Q_3	Q_2	Q_1
697	1209	1	H	0	0	0	1
697	1336	2	H	0	0	1	0
697	1477	3	H	0	0	1	1
770	1209	4	H	0	1	0	0
770	1336	5	H	0	1	0	1
770	1477	6	H	0	1	1	0
852	1209	7	H	0	1	1	1
852	1336	8	H	1	0	0	0
852	1477	9	H	1	0	0	1
941	1336	0	H	1	0	1	0
941	1209	*	H	1	0	1	1
941	1477	#	H	1	1	0	0
697	1633	A	H	1	1	0	1
770	1633	B	H	1	1	1	0
852	1633	C	H	1	1	1	1
941	1633	D	H	0	0	0	0
-	-	ANY	L	Z	Z	Z	Z
L Logic Low, H = Logic, Z = High Impedance							

Figure 3.10 Functional diode table.

3.1.4 Octal D Flip Flop

The 74LS273 is a high-speed 8-Bit Register. The register consists of eight D-Type Flip-Flops with a Common Clock and an asynchronous active Low Master Reset. This device is supplied in a 20-pin package featuring 0.3 inch lead spacing. Pin diagram of 74LS273 is shown in Figure 3.11.

- 8-Bit High Speed Register
- Parallel Register
- Common Clock and Master Reset
- Input Clamp Diodes Limit High-Speed Termination Effects

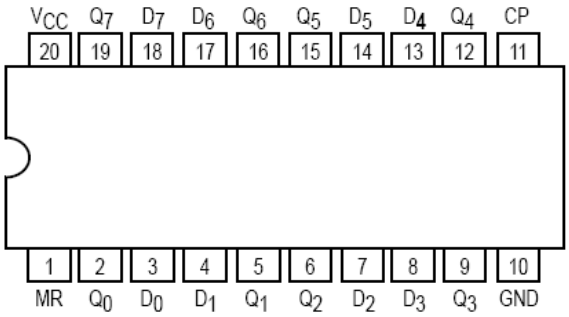


Figure 3.11 Pin diagram of 74LS273.

$\overline{MR}$	CP	D_X	Q_X
L	X	X	L
H	⎍	H	H
H	⎍	L	L

H = HIGH Logic Level
L = LOW Logic Level
X = Immaterial

Figure 3.12 Truth table.

3.1.5 Tri-State Octal Buffers

These octal buffers and line drivers are designed specifically to improve both the performance and density of three-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The designer has a choice of selected combinations of inverting and noninverting outputs, symmetrical, active-low output-control (G) inputs, and complementary output-control (G and G) inputs. These devices feature high fan-out, improved fan-in, and 400-mV noise margin. The 74LS244 devices can be used to drive terminated lines down to 133 Ω. Block and pin diagram of 74LS244 is shown in the following Figure 3.13.

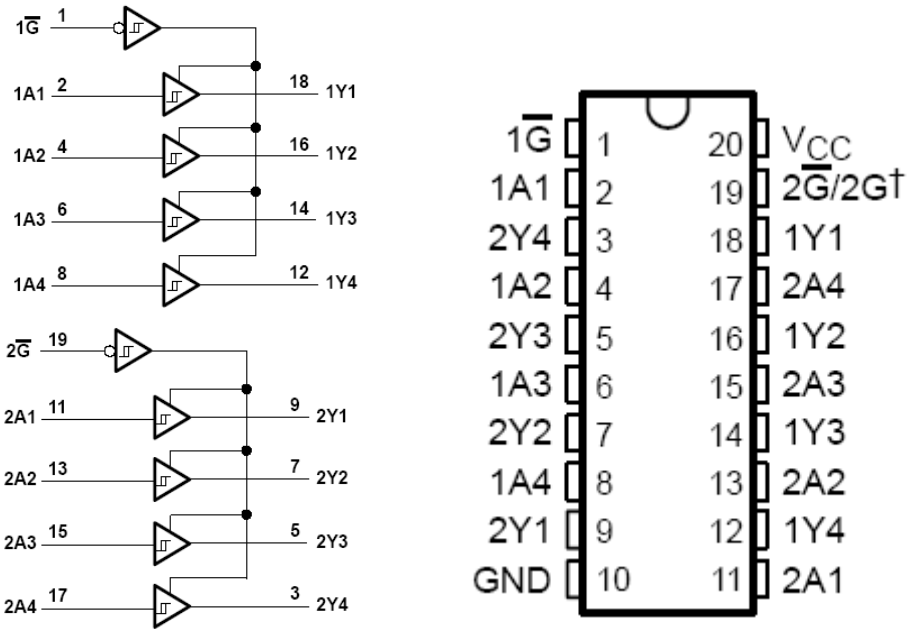


Figure 3.13 Block and pin diagram of 74LS244.

3.1.6 Octal Bus Tranceiver

The 74LS245 is an Octal Bus Transmitter/Receiver designed for 8-line asynchronous 2-way data communication between data buses. Direction Input (DR) controls transmission of Data from bus A to bus B or bus B to bus A depending upon its logic level. The Enable input (E) can be used to isolate the buses. Pin and block diagram is shown in Figure 3.14.

- Hysteresis Inputs to Improve Noise Immunity
- 2-Way Asynchronous Data Bus Communication
- Input Diodes Limit High-Speed Termination Effects
- ESD > 3500 Volts

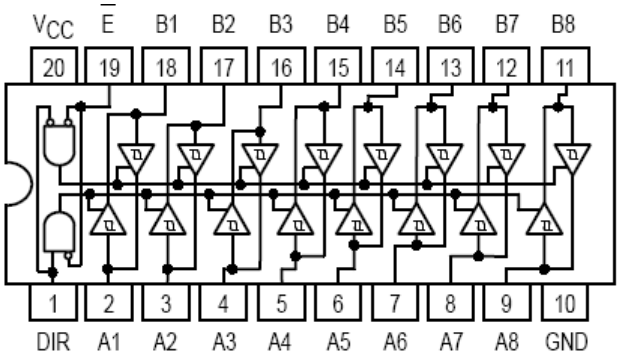


Figure 3.14 Pin and block diagram of 74LS245.

INPUTS		OUTPUT
E	DIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	Isolation

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Figure 3.15 Truth table of 74LS245.

3.1.7 Tone Ringer with Bridge Diode

The KA2418B/28 is a monolithic integrated circuit telephone tone ringer with bridge diode, when coupled with an appropriate transducer, it replaces the electromechanical bell. This device is designed for use with either a piezo transducer or an inexpensive transformer coupled speaker to produce a pleasing tone composed of a high frequencys (fH1, fH2) alternating with a low frequency (fS) resulting in a warble frequency. The supply voltage is obtained from the AC ring signal and the circuit is designed so that noise on the line or variation of the ringing signal can not affect correct operation of the device. Block diagram of KA2418B is shown in Figure 3.16. Tone ringer circuit in telephone circuit is shown in the following Figure 3.17.

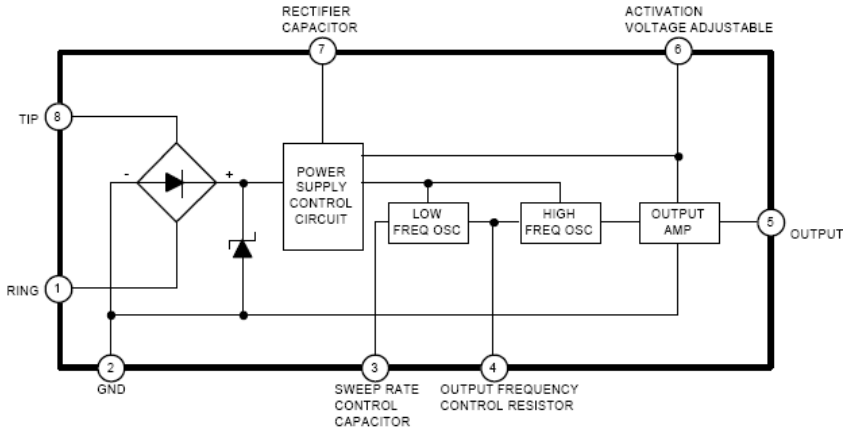


Figure 3.16 Block scheme of KA2418B.

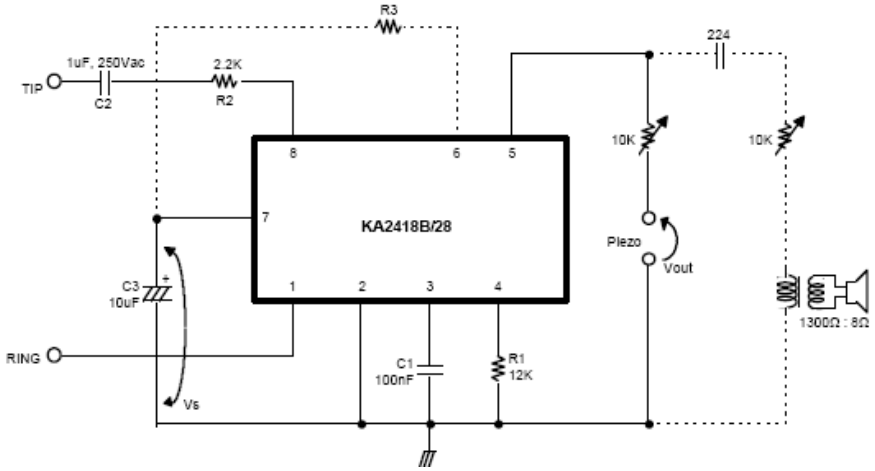


Figure 3.17 Tone ringer circuit.

3.1.8 Tone Pulse Dialer with Redial

The KS58006 is DTMF/PULSE switchable dialer with a 32-digit redial which can be done using a slide switch. Its block diagram is shown in Figure 3.18. All necessary dual-tone frequencies are derived from a 3.579545 MHz TV crystal or ceramic resonator providing very high accuracy and stability. The required sinusoidal wave form for each individual tone is digitally synthesized on the chip. The generated wave form has very low total harmonic distortion (7% max). A voltage reference is generated on the chip which is stable over the operating voltage and temperature range and regulates the single levels of the dual tone to meet telephone industry specifications. CMOS technology is applied to this device, for very low power requirements high noise immunity, and easy interface to a variety of telephones requiring external components. Shown pulse mode timing in the following Figure 3.19 is important for software.

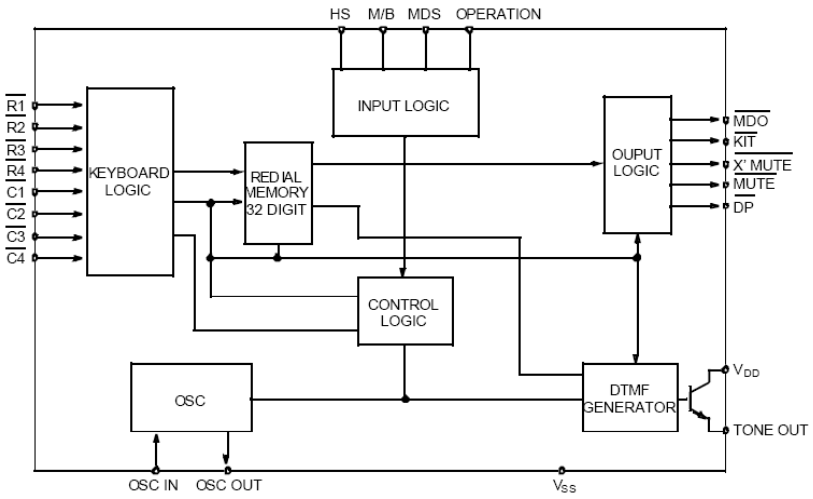


Figure 3.18 Block scheme of KS58006.

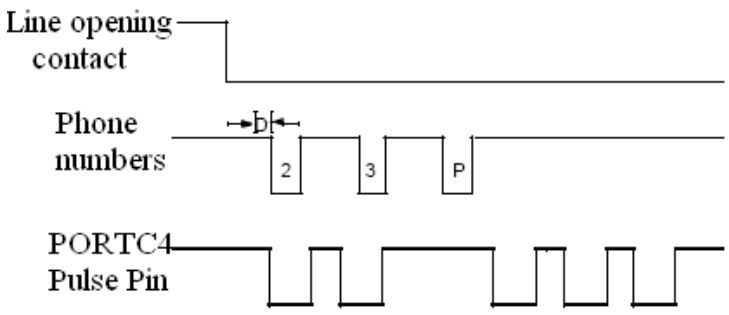


Figure 3.19 Pulse mode timing.

3.1.9 Speech Network with Dialer Interface

The KA2425A is telephone speech network integrated circuit which includes transmit amp, receive amp, side tone amp, DC loop interface function, DTMF input, voltage regulator for speech, a regulated output voltage for a dialer, and equalization circuit. Pin diagram and application circuit of KA2425A are shown in Figures 3.20 and 3.21.

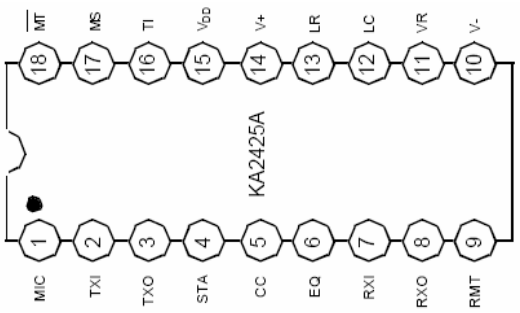


Figure 3.20 Pin diagram of KA2425A.

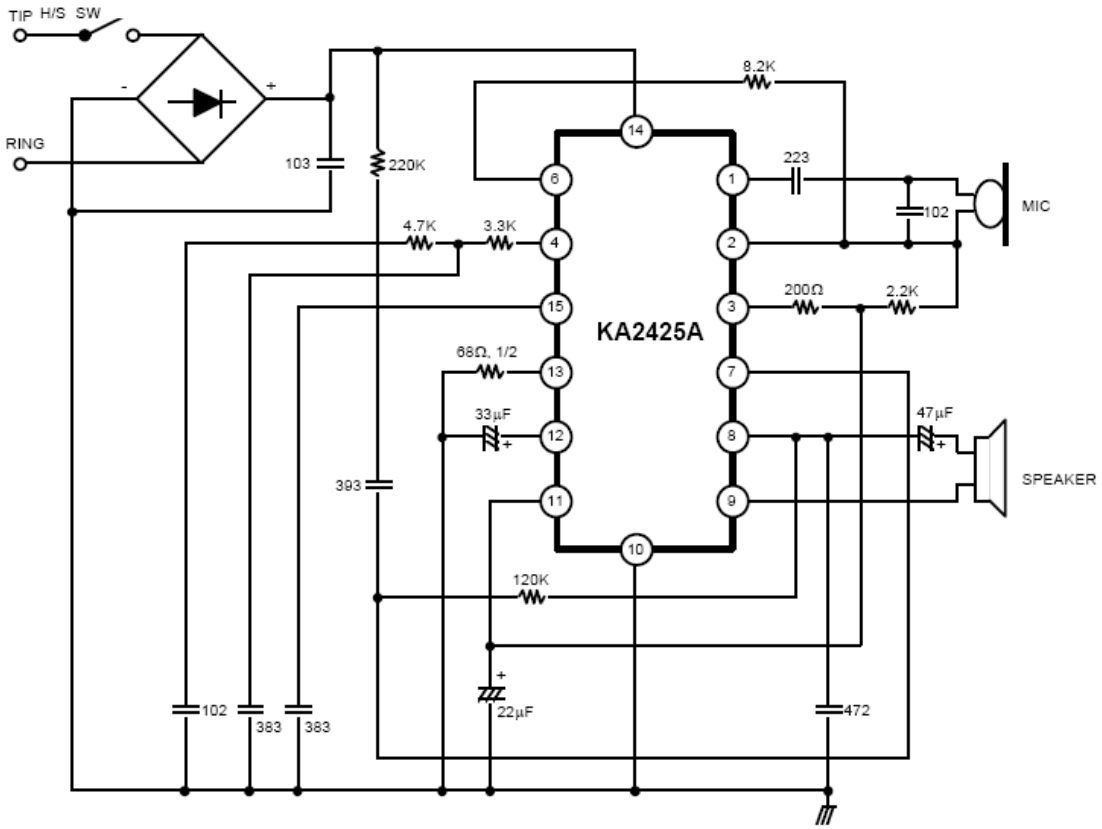


Figure 3.21 Application circuit in telephone circuit.

3.2 Control and Telephone Circuit

Ring signals which come as pulse from first pin of KA2418B integrated in telephone circuit; are read by PORTB0 pin of PIC. When telephone ringed, program ramifies to interrupt cycle. PORTB0 pin becomes 1 for each telephone ring. When telephone ringed six times, PORTE0 pin is 1. Then transistor is triggered by PORTE0 pin. After then line opening contact is connected to onhook switch in telephone circuit that is started by transistor. Finally line is opened.

When line opened first, 01 message “şifreyi giriniz” in voice integrated is given on phone line. Wanted password has four numbers. Entered keys are read by CM8870. PORT B3, B4, B5, B6, B7 pins of PIC have connected to STD, Q1, Q2, Q3, Q4 pins of CM8870 integrated. PIC compares entered password with password in its EEPROM. If entered password is wrong, phone line is closed. If it is right, 02 message “cihazı çalıştırınız” in voice integrated is given on phone line. Pushed button is perceived from line by CM8870 for wanted device’s opening or closing. Buttons are to ‘8’ from ‘1’ that has started devices. ‘0’ button should be pushed before device’s button to close wanted device. When ‘0’ button was pushed two times all starting devices are closed. When ‘#’ button was pushed phone line is closed. If any buttons have not been pushed in about fiveteen seconds after line is opened, phone line is closed automatically.

Eight devices’ opening and closing processes are provided by eight relays. These relays can be connected to wanted devices. 74LS273 as eight bits D flip flop is connected to PORTD port of PIC for controlling of relays. That flip flop has transferred data to relays from PORTD port when required moment. So PORTE2 pin of PIC is connected to clock pin of D flip flop. When PORTE2 pin was ‘1’, D flip flop gives data to its output from its input. TEMPD register is used in PIC’s program to remember which of device’s started or finished. Value of TEMPD register is changed firstly when Devices’ starting or finishing processes. Then data are given to PORTD port of PIC.

Two reset circuits have been built. Circuit can be reseted by push button connected to MCLR pin of PIC. MCLR pin is ‘1’ at normal. When push button was pushed, MCLR pin is ‘0’. This process is used when program was locked at any time. Second reset process is made by push button connected to PORTA5 pin of PIC. PORTA5 pin is ‘0’ at normal. When push button was pushed, PORTA5 pin is ‘1’. Then program has ramified sub reset program. After then password is default as ‘1234’.

3.3 Alarm Circuit and Used Sensors

Six different alerts can be controlled. These alerts are electrical state, water state, flood, safety entry, fire, garage door and temperature. The cases of these sensors are controlled continuously. When sensors were triggered, data are read from PORTD port of PIC through 74LS244 has used as tri-state buffer. Firstly which of sensor has triggered that has determined. Then program has ramified to that subprogram of sensor. Firstly phone call processing is made in all subprograms. How line opened that has mentioned. Three phone numbers can be called in system. System will call three numbers step by step until answering from destination phone. If third phone has not answered after other phones’ calling, line is closed and phone call processing is finished. Phone number is received from EEPROM. This number has sixteen numbers. These numbers load to registers (TELX1, TELX2…TELX16). Then each numeral is sent pulse to KS58006 integrated’s 14th DP (Dial Pulse) pin in telephone circuit from PIC’s PORTC4 pin. When phone dialling was finished, CM8870 has started to read codes and destination phone is controlled it’s conscious by host phone. If destination phone open the line and push ‘1’, message in voice IC in interested case of sensor is transmitted on line. Then phone line is closed. At each phone dialling, if any button has not been pushed in about fiveteen seconds after line opened, line is closed.

PORTD port of PIC is used for four different processes. These processes are cases of sensors, LCD starting, addressing of voice integrated, and starting or closing of devices. When PORTD port was made input for cases of sensors, it is made output

for others. These four processes should not be confused. Therefore 74LS32 as two inputs or gate is used. When sensors are triggered, data are received through tri state buffer by PORTD. When data from case of sensor would not been liked to receive, inputs of 74LS244 tri state buffer are closed by three or gates connected to PIC. So these four processes have complicated.

3.3.1 Temperature Sensor

This system can measure environment temperature. LM35 integrated has been used as temperature sensor. It has transmitted temperature of environment as analog value is between 0 and 5 Volts. Each degree has increased linearly 10mV. Analog signal has come from LM35 to PORTA0 pin of PIC. Analog signal is converted to digital data by Analog Digital Converter (ADC) in PIC. Obtained eight bits digital data is loaded to 'heat' register. Determined minimum (10^oC) and maximum (30^oC) values are compaired measured value. Temperature of environment is decided as heat, cold or normal by PIC. If it is heat or cold, "sıcaklık yüksek" or "sıcaklık düşük" messages interested in air condition of environment is transmitted to destination phone by dialling. Pin and block diagrams are shown in Figure 3.22.

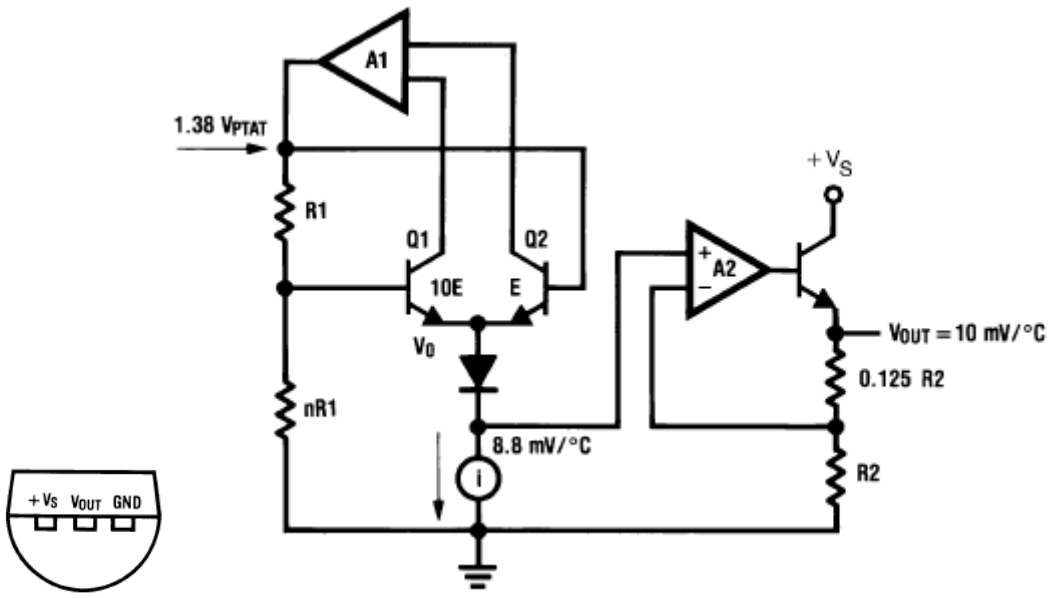


Figure 3.22 Pin and block diagram of LM35.

3.3.2 Infrared Motion Sensor

MB-009 infrared motion sensor has been used in this system that is shown in Figure 3.23. Its power source is 220 V AC. Infrared filter and its circuit are fed 5 Volts. So MB-009 has capacitors and transformator. Its output is connected through a relay to PORTD3 pin of PIC. When Pyroelectric Infrared (PIR) has detected any motion in home, PORTD3 pin is '1'. So "evde hırsız var" message is transmitted.

Figure 3.23 Infrared motion sensor.

PIR dedector is made of a crystalline material that generates a surface electric charge when exposed to heat in the form of infrared radiation. When the amount of radiation striking the crystal changes, the amount of charge also changes and can then be measured with a sensitive Field Effect Transistor (FET) device built into the sensor. The sensor elements are sensitive to radiation over a wide range so a filter window is added to the TO5 package to limit incomong radiation to the 8 to 14mm range which is most sensitive to human body radiation.

Typically, the FET source terminal pin 2 connects through a pulldown resistor of about 100 K to ground and feeds into a two stage amplifier having signal conditioning circuits. The amplifier is typically bandwidth limited to below 10Hz to reject high frequency noise and is followed by a window comparator that responds to both the positive and negative transitions of the sensor output signal. A well filtered power source of from 3 to 15 volts should be connected to the FET drain terminal pin 1. Principle of PIR is shown in Figure 3.24.

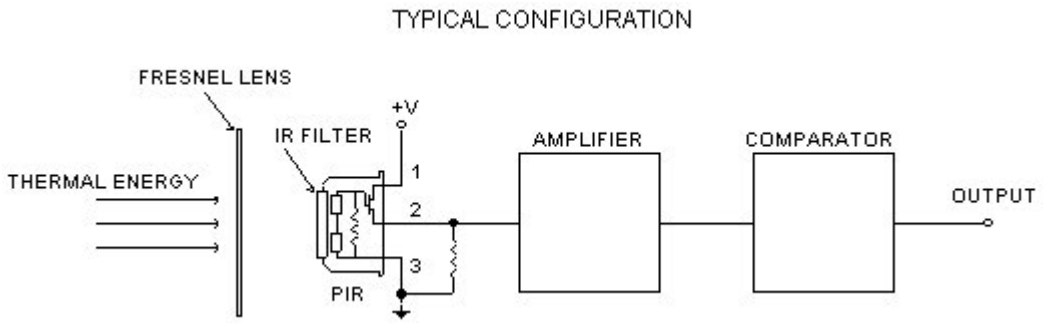


Figure 3.24 Principle of PIR.

3.3.3 Smoke Sensor

MGR4000 dedector of Maviguard firm as smoke sensor has been used in this system that is shown in Figure 3.25. This dedector has relay. Its power input is 12 V DC. Working principle has been mentioned at below. Output of relay with 5 Volts is sent to PORTD4 pin of PIC. When smoke sensor has detected any fire event, output of relay is 0 Volt. So “evde yangın var” message is given because of PORTD4 pin is ‘0’.

In one type of photoelectric device, smoke can block a light beam. In this case, the reduction in light reaching a photocell sets off the alarm. In the most common type of photoelectric unit, however, light is scattered by smoke particles onto a photocell, initiating an alarm. In this type of detector there is a T-shaped chamber with a light-emitting diode (LED) that shoots a beam of light across the horizontal bar of the T. A photocell, positioned at the bottom of the vertical base of the T, generates a current when it is exposed to light. Under smoke-free conditions, the light beam crosses the top of the T in an uninterrupted straight line, not striking the photocell positioned at a right angle below the beam. When smoke is present, the light is scattered by smoke particles, and some of the light is directed down the vertical part of the T to strike the photocell. When sufficient light hits the cell, the current triggers the alarm.

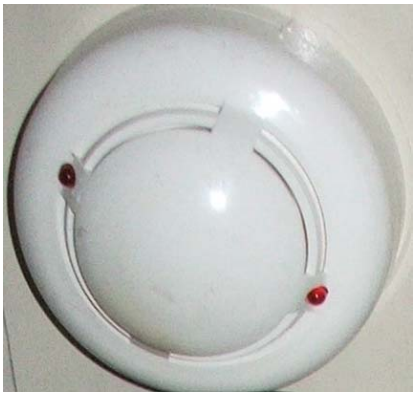


Figure 3.25 Smoke sensor.

3.3.4 Electrical Detector

A basic method is attempted in there. Electrical sensor is shown in Figure 3.26. Input of 5V DC adaptor is connected to 220 V external from accumulator. Its output is sent to PIC's PORTD0 pin. If there are electrical in home, PORTD0 pin of PIC is '1'. So it is normal. If there are not electrical in home, PORTD0 pin is '0'. "Elektrik gitti" message is informed and data is held by 74LS244. When PORTD0 pin is '0', if electrical comes to home, "elektrik geldi" message is informed.

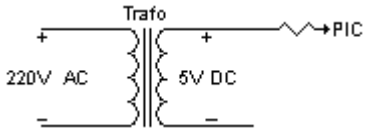


Figure 3.26 Electrical detector.

3.3.5 Water detector

T pipe has been used in there. Principle of water sensor is shown in Figure 3.27. While water comes to tap from source, water contact two cables in top of T pipe by means of pressure. T pipe is located between hidrofor and check valf because of when water is cutted, hidrofor has absorbed water until check valf. One of contacted two cables is connected to 5 V. Other cable is connected to PIC. If there is not water in home, PORTD1 pin is '0'. "Su gitti" message is informed and data is held by 74LS244. When PORTD1 pin is '0', if water comes to home, "su geldi" message is transmitted.

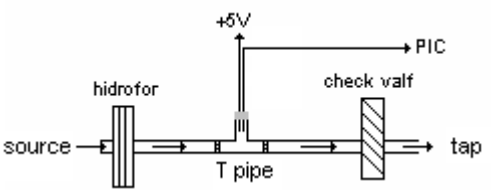


Figure 3.27 Principle of water detector.

When water has flooded in home, the same method is realized. This time, when two cables are contacted, PORTD2 pin is ‘1’ and “evi su bastı” message is given. Water sensor is shown in Figure 3.28.

Figure 3.28 Water detector.

3.4 Voice Circuit

The most important advantage of this system is to guide by voice. Therefore, ISD2500 is preferred as voice integrated circuit. 60 seconds was enough and the duration is divided into two seconds parts. Eleven voice messages in order to get feedback and warning have been loaded as default. But, they can be recorded and played repeatedly. Table of voice messages are shown in Table 3.1.

Type of Message	Which sensor	Voice Message	Message Number
Feedback	-	“şifreyi giriniz”	01
	-	“cihazı tuşlayınız”	02
Warning	Motion	“evde hırsız var”	03
	Smoke	“evde yangın çıktı”	04
	Electrical	“elektrik geldi”	05
	Electrical	“elektrik gitti”	06
	Water	“su geldi”	07
	Water	“su gitti”	08
	Water	“evi su bastı”	09
	Temperature	“sıcaklık yüksek”	10
	Temperature	“sıcaklık düşük”	11

Table 3.1 Type and number of voice messages.

Voice recording can be made only from software menu. It can not be confirmed by telephone. PORTC1 pin of PIC is made ‘0’ to record voice. Address data is sent to PORTD port. PORTE1 pin connected to clock pin of first D flip flop is made ‘1’. Data at input the first D flip flop is sent to voice integrated’s address port. PORTC0 pin of PIC is made ‘0’ to make ‘0’ chip enable pin of voice integrated. So voice recording has started. Voice is recorded until record button has not been stopped.

Voice playback process has indicated differences as to telephone’s open or close states. PORTC1 pin has made ‘1’ to run at playback mode of voice integrated. Address of voice in PIC is sent to D flip flop from PORTD. Clock pin of D flip flop is activated by triggering from PORTE1 pin of PIC. CE (chip enable) pin of voice integrated is started by making ‘0’ PORTC0 pin. So voice is played from voice integrated. Duration of messages is two seconds. Voice playback is finished at the end of messages.

Two relays connected to PORTE0 pin of PIC are used to give voice on phone line. PORTE0 is connected to line opening pin. When phone line was opened, two relays are activated. So microphone and speaker pins of voice IC are connected to

microphone and speaker pins at circuit when phone line was closed. When phone line was opened, speaker pin of voice IC is connected to microphone pin of telephone circuit.

3.5 LCD and Keypad Circuits

HY-1602B-203 was used as Liquid Crystal Display (LCD) that is shown in Figure 3.29. It has 16*2 characters. Its operating voltage is 5 V. Its blacklight emission diodes are yellow and green. 0-20K ohm potansiometer was used for blacklight's brightness.

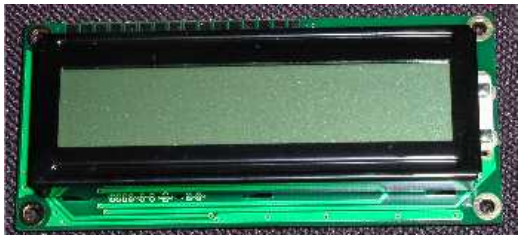


Figure 3.29 HY-1602B-203 LCD circuit.

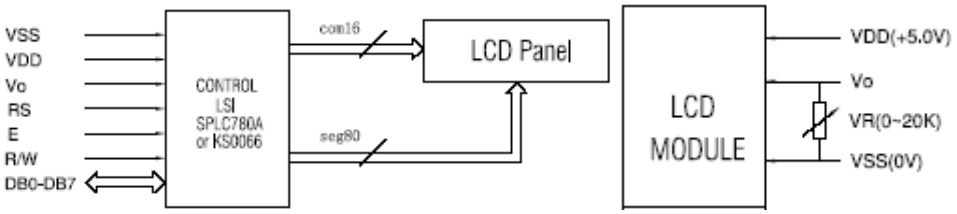


Figure 3.30 Inputs and Outputs of LCD.

Enable pin (E), Read/write selection pin (R/W), Register Selection pin (RS) and Data Bus Lines (DB0-DB7) are connected to PIC16F877. Software menu can be produced as an image by LCD. Inputs and outputs of LCD are shown in the above Figure 3.30.

When PIC was started firstly, required data are written to registers and PORTs are set as input or output. About two second delay is realized for LCD. When LCD was run first, temperature, time and date are shown.

PORTB port of PIC is used for two difference processes. First when phone line has opened, PORTB has read code through DTMF code decoder. Second process is to read keypad. 74LS244 as tri state buffer is used between PORTB port and keypad to not confuse these processes. PORTE0 pin as used phone line opening signal is connected to output enable pin of 74LS244 integrated. So when line has opened, keypad is read.

Keypad has 4*3 characters. Matrix system is used to read keypad. Columns are 1, 2 and 3 that are activated by PORTB1, B2 and B3 pins of PIC. Lines are A, B, C and D that are read by PORTB4, B5, B6 and B7 of PIC.

Figure 3.31 LCD and Keypad.

When any key was pushed, program can be determined that. Then process interested in that key is realized. LCD and Keypad are shown in Figure 3.31.

3.6 Power Circuit

Above all circuits are fed by DC +5 Volts. Therefore 6 Volts accumulator and its charge device are required. Used charger and accumulator devices are shown in Figure 3.33. The charge device loads the 6 Volts accumulator all times. When the 6 Volts accumulator was loaded full, the charge device is stopped automatically.

L7805 is used for +5 Volts as positive voltage regulator. Power circuit is shown in Figure 3.32.

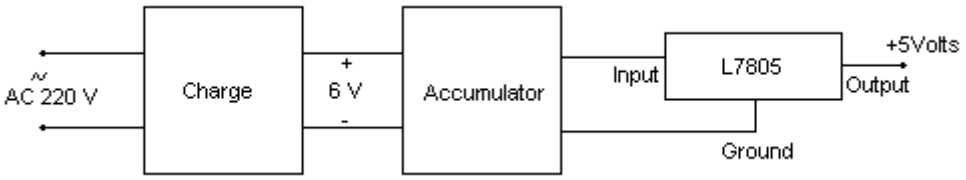


Figure 3.32 Power circuit.

Figure 3.33 Used charger and accumulator devices.

CHAPTER FOUR

SOFTWARE DESIGN OF TELEPHONE CONTROLLED HOME AUTOMATION

Assembly language is used to program the PIC microcontroller. Assembler was required to compile assembly codes to hexadecimal codes as PIC. Software has been written at MPLAB program for 16F877 integrated of Microchip firm as microcontroller has been used. Programmed PIC assembly code is attached in appendix A.

4.1 Flowcharts of Software

Flowcharts of INIT and BEGIN are shown in Figure 4.1. When system was started first, registers are cleaned by software. I/O ports, ring interrupt, clock interrupt are set. Ports and registers are downloaded their values. LCD panel and first code are set. After, software goes to BEGIN. In here, time and date are calculated. Open message is written. Temperature, keypad and sensors are read. If line is open, software goes to READD. Else it goes to BEGIN.

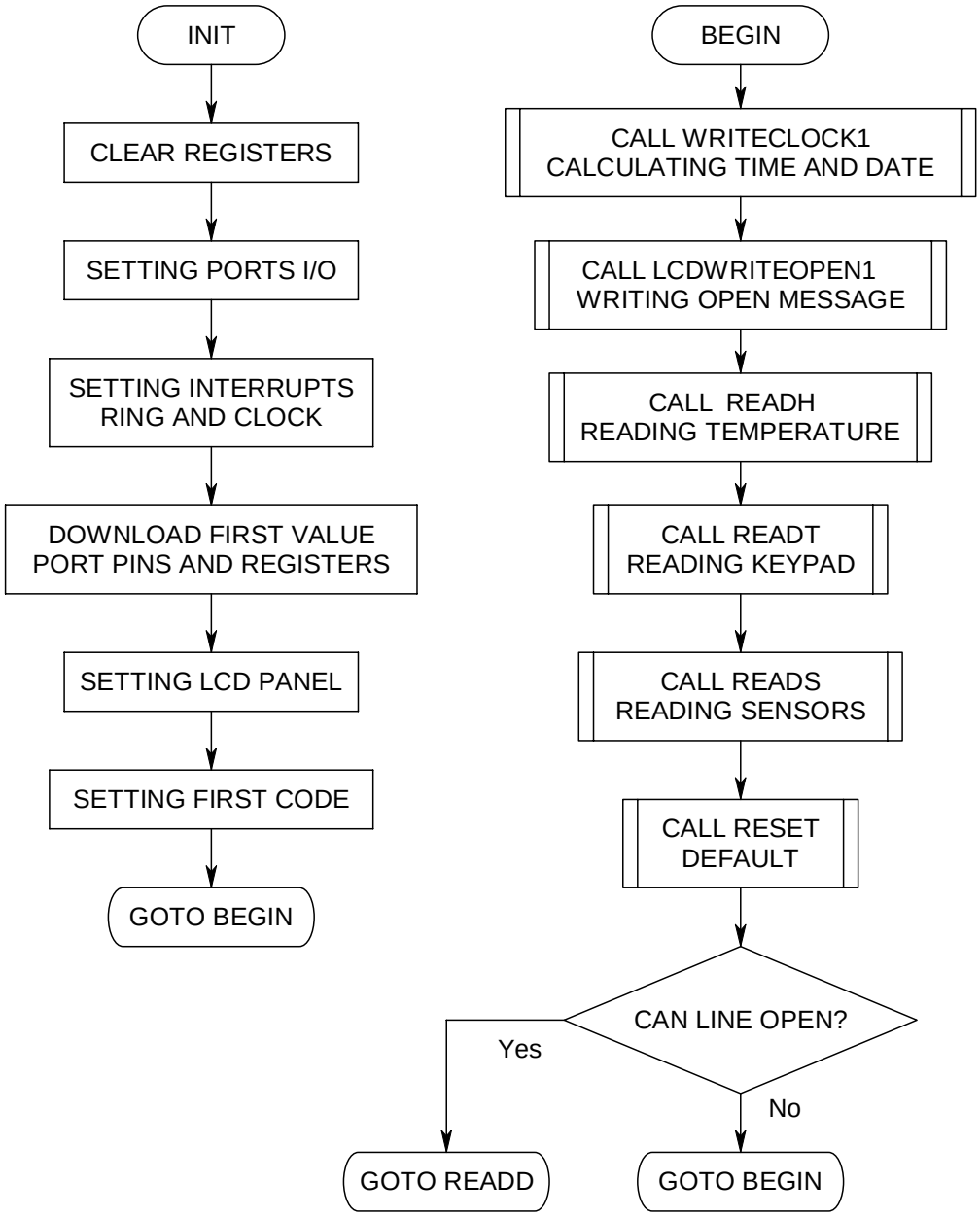


Figure 4.1 Flowcharts of INIT and BEGIN.

Ring and clock interrupts are controlled everytime. When phone is called, clock stops. Interrupt is shown in Figure 4.2.

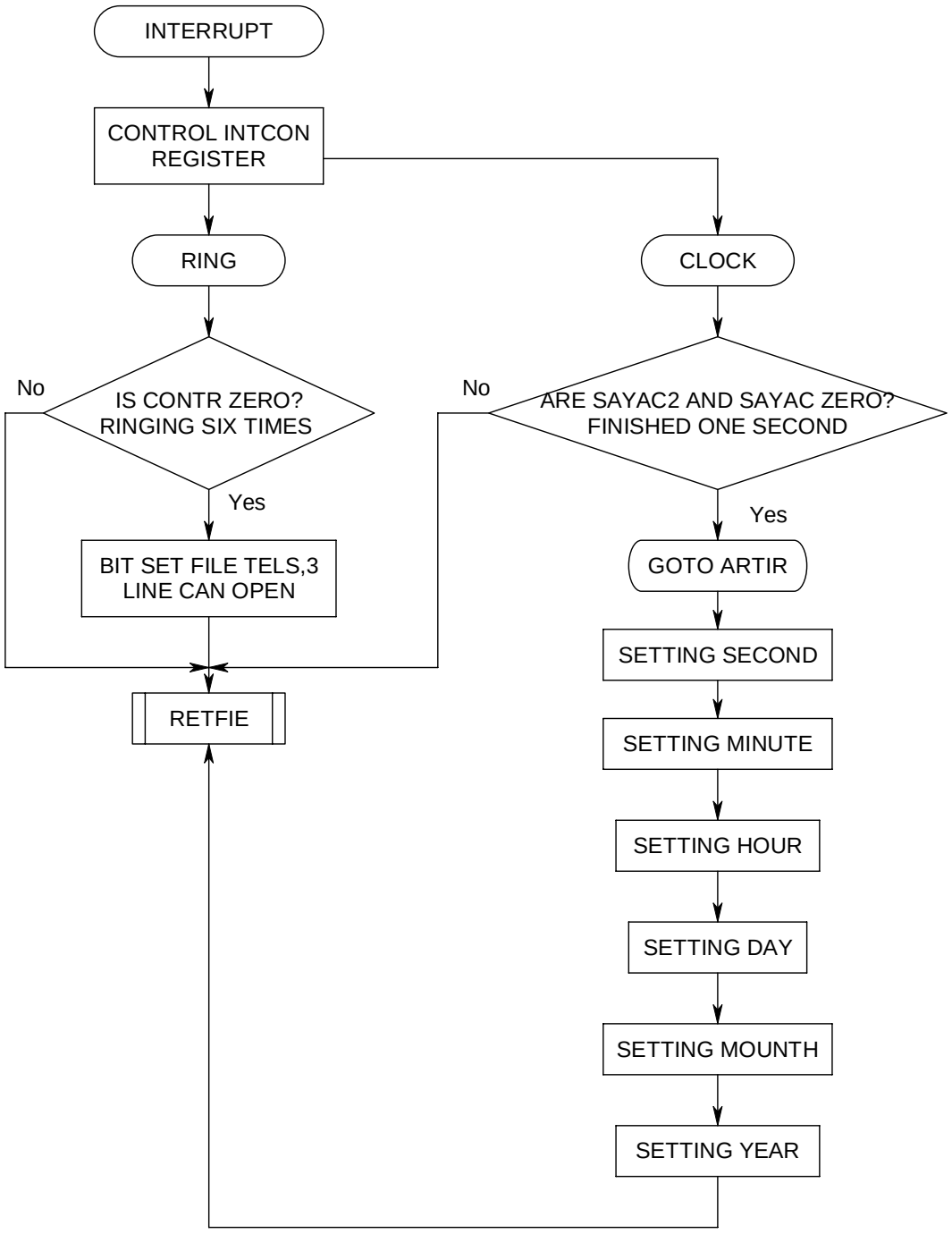


Figure 4.2 Flowchart of INTERRUPT.

Here, READH subprogram goes to HESAP. Analog/digital converter is set and started. PortA0 reads heat value from LM35 integrated. Temperature is loaded to HEAT register. And it is written to LCD. Range of temperature is controlled. TEMPC register is set. Flowchart of READH subprogram is shown in Figure 4.3.

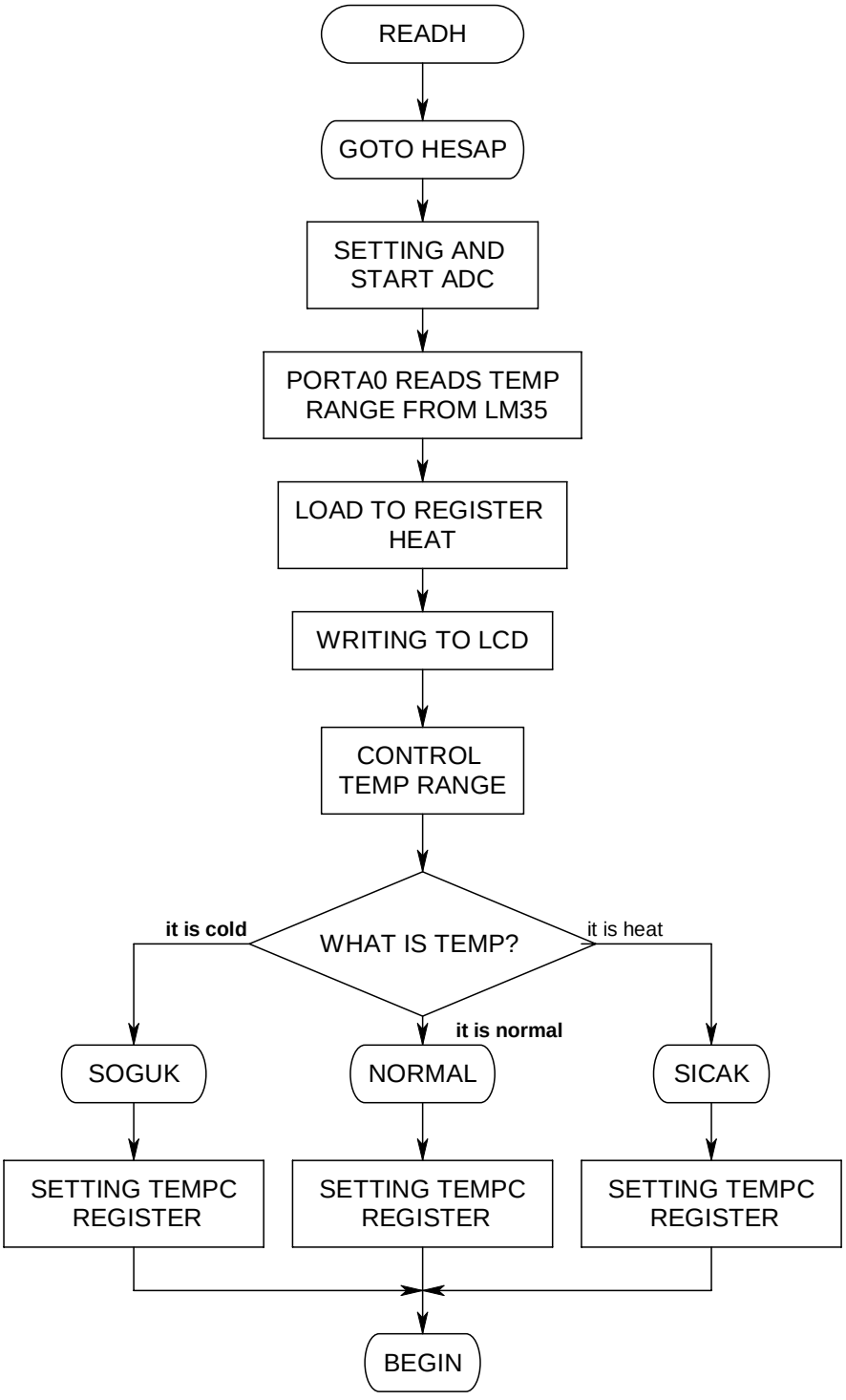


Figure 4.3 Flowchart of READH.

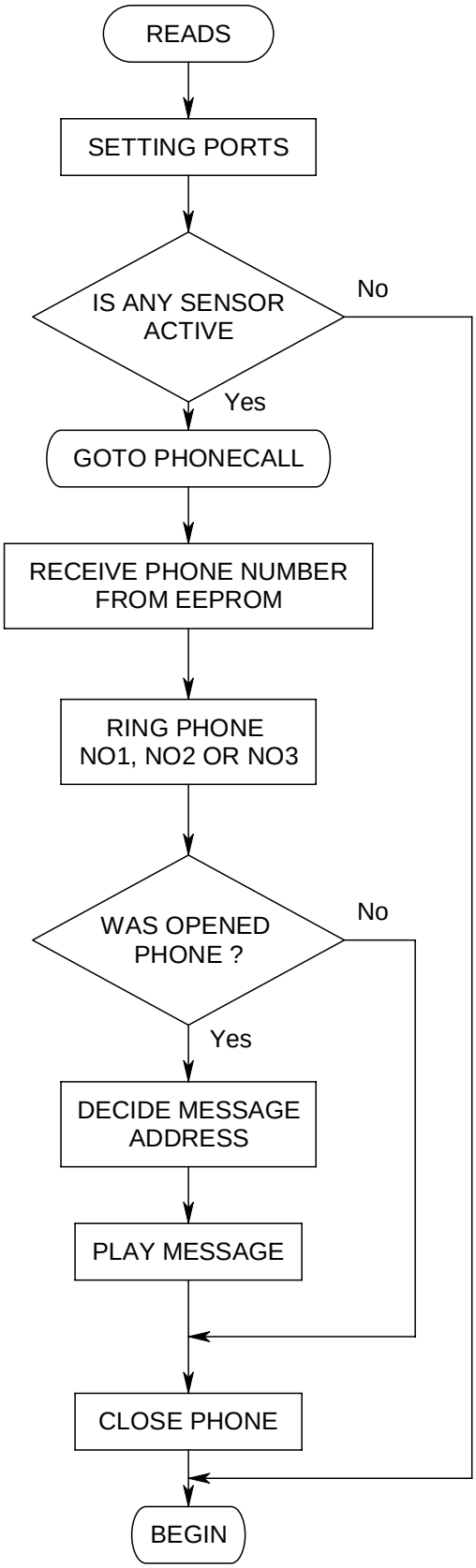


Figure 4.4 Flowchart of READS.

In READS subprogram, ports are set. When any sensor was active, software goes to PHONECALL subprogram. Phone number is received from EEPROM. Phones are ringed successively. Phone was opened, suitable message address of sensor are decided. Voice message are played, and phone is closed. Flowchart of READS is shown in Figure 4.4.

Flowchart of ALARMCONT subprogram is shown in Figure 4.5. When software came in ALARMCONT, keypad is read. Software goes to concerned subprogram according to pushed button.

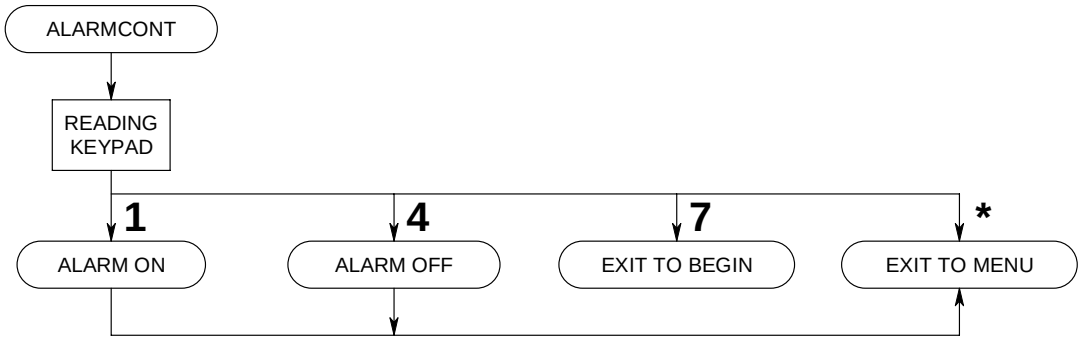


Figure 4.5 Flowchart of ALARMCONT.

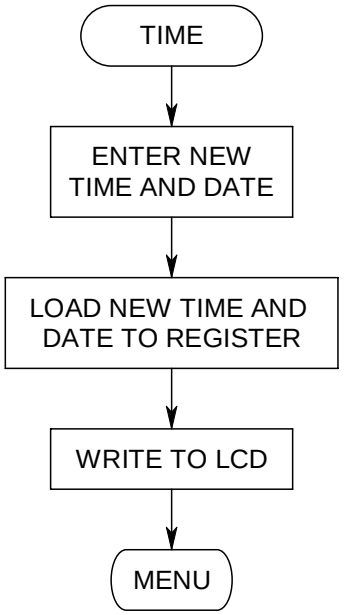


Figure 4.6 Flowchart of TIME.

When software went to TIME subprogram, new time and date are entered. After, they are loaded to register and written to LCD. Flowchart of TIME is shown in Figure 4.6.

Flowchart of PHONE subprogram is shown in Figure 4.7. Here, a new telephone number is entered to EEPROM, or an old telephone number is cleaned from EEPROM.

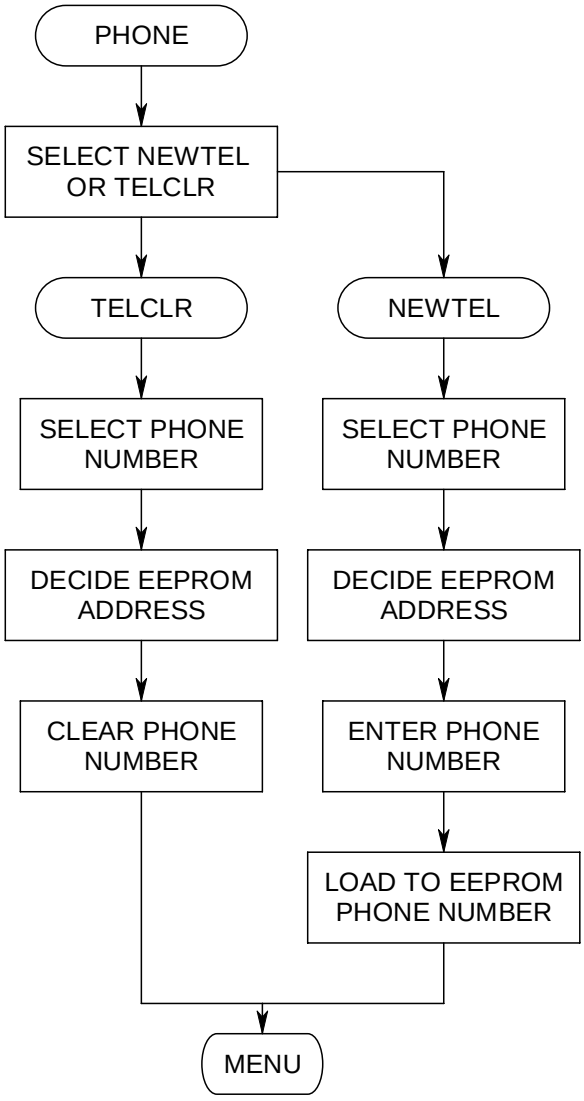


Figure 4.7 Flowchart of PHONE.

Flowchart of NEWCODE subprogram is shown in Figure 4.8. Password is entered two times. After, two codes are compared. If they are same, new password is written to EEPROM.

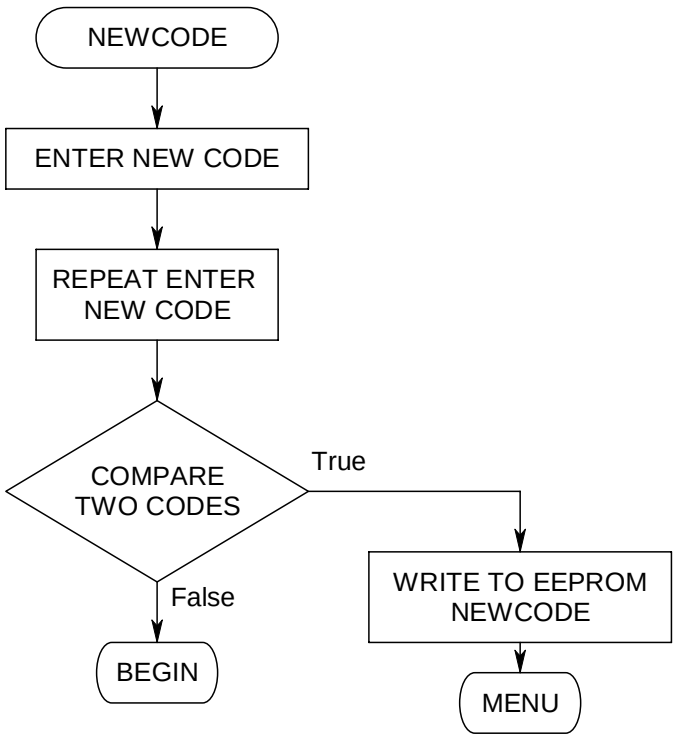


Figure 4.8 Flowchart of NEWCODE.

Flowchart of VOICE subprogram is shown in Figure 4.9. Firstly, message number is read. Address of message is calculated. Keypad is read. Voice message is recorded or played according to pushed button.

After, software goes to READN subprogram. Flowchart of READN is shown in Figure 4.10. Menu messages are written to LCD. Concerned subprograms are started according to pushed button on keypad.

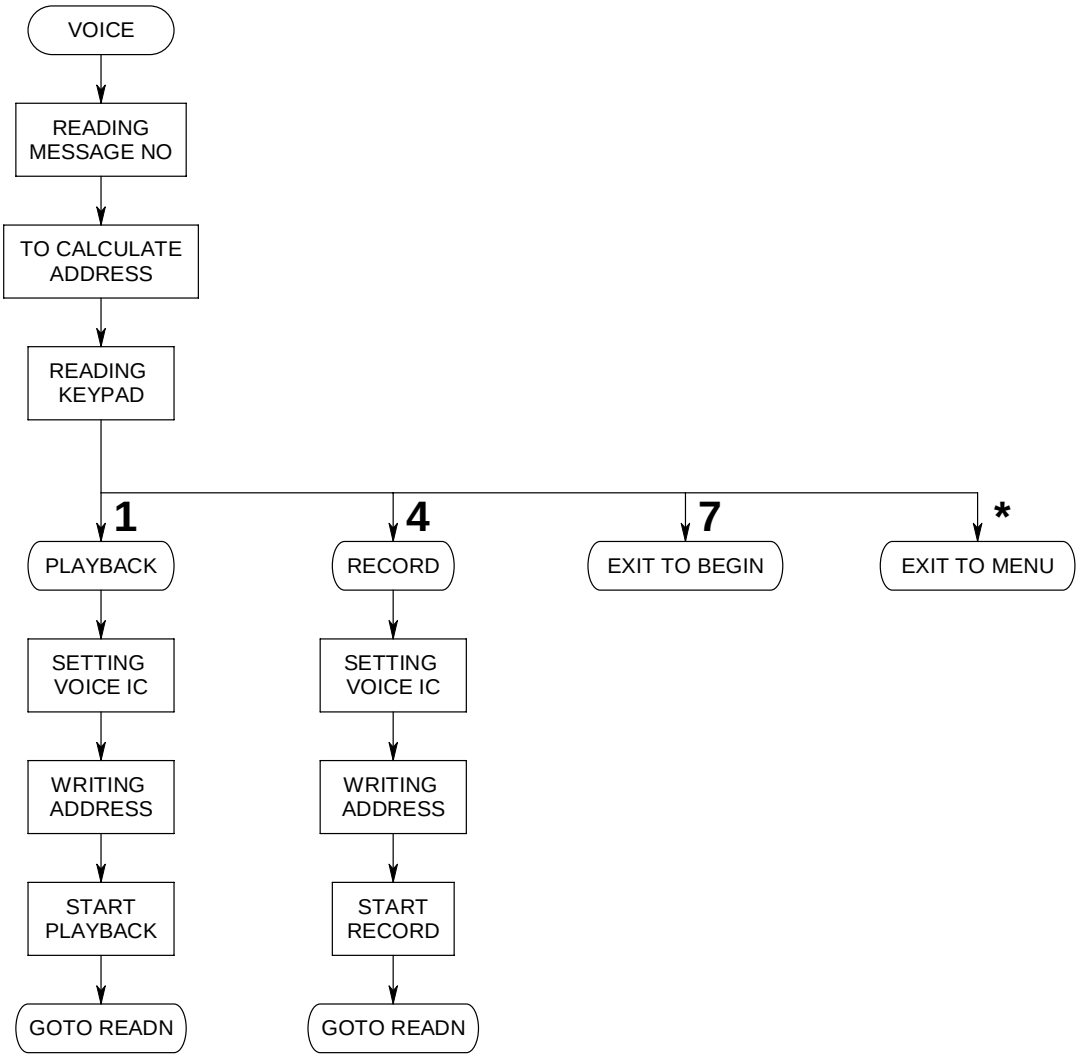


Figure 4.9 Flowchart of VOICE.

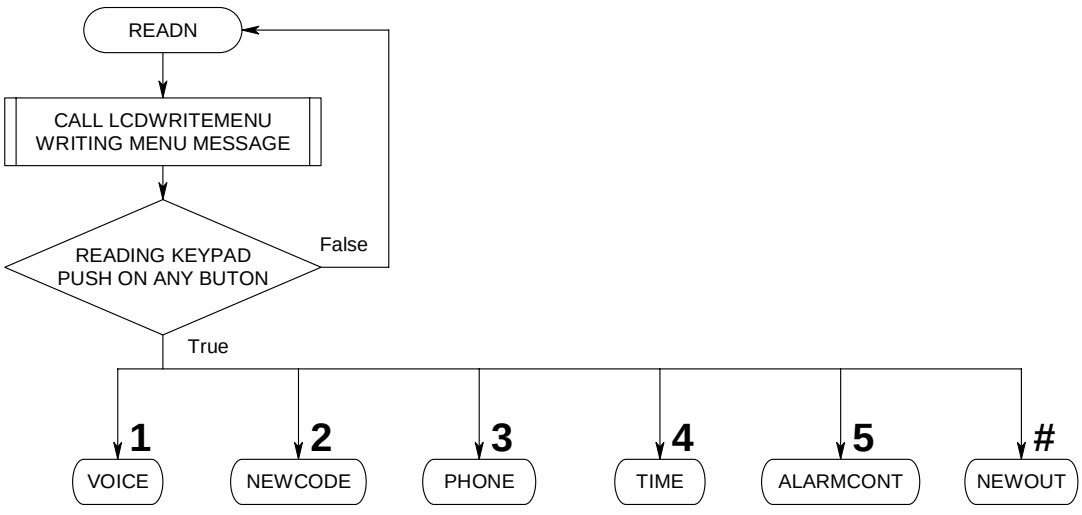


Figure 4.10 Flowchart of READN.

Port B and D are set in READT subprogram which is shown in Figure 4.11. When ‘*’ button was pushed, software goes to menu. LCDWRITECODE and READE subprograms are called. Password is read from keypad and, it is compared with code in EEPROM. If it is true, software goes to menu.

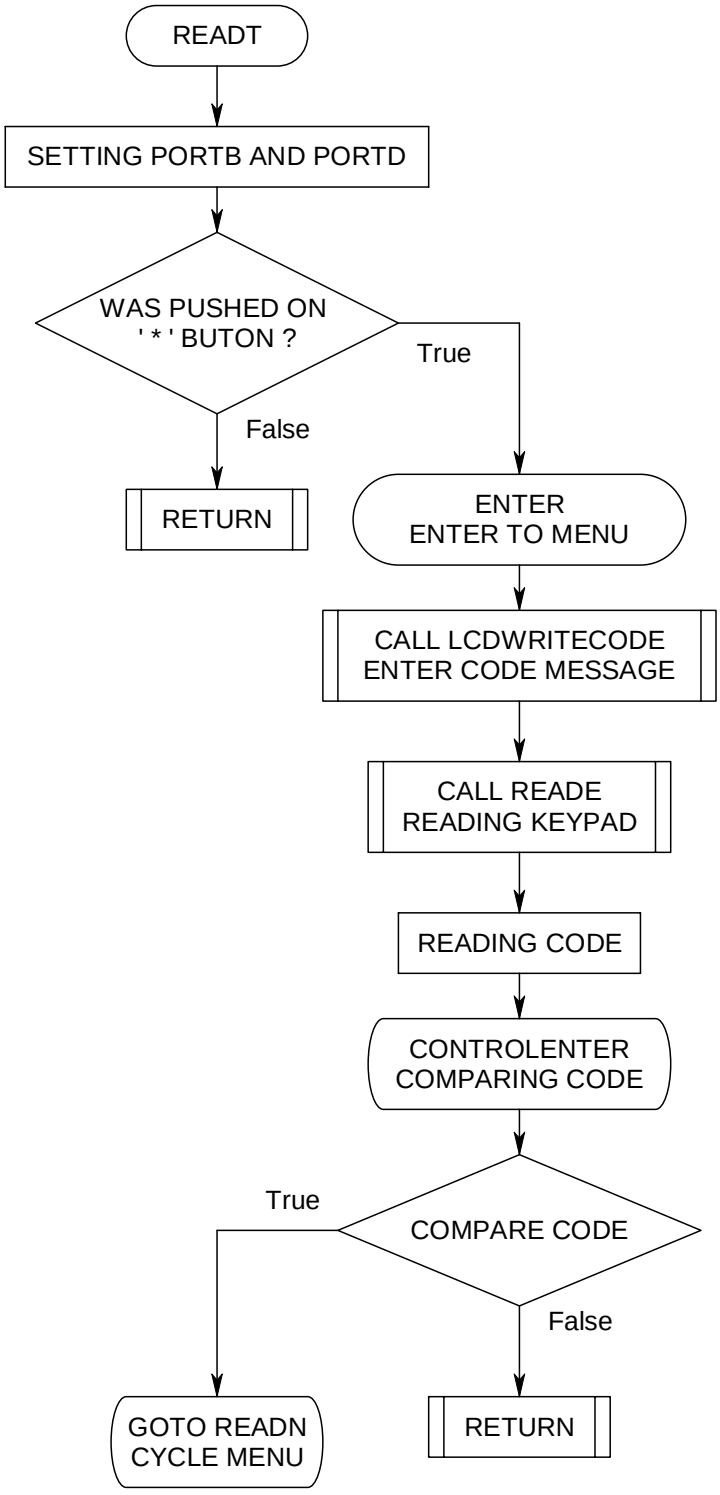


Figure 4.11 Flowchart of READT.

Ports are set in READD subprogram. “Şifreyi giriniz” message is played. Entered password is solved by DTMF. Software goes to CONTROLOPEN subprogram. Entered password is compared with code in EEPROM. If it is false, line is closed. If it is true, “cihazı çalıştırınız” message is played. After, concerned device is opened or closed according to pushed button. Flowchart of READD subprogram is shown in Figure 4.12.

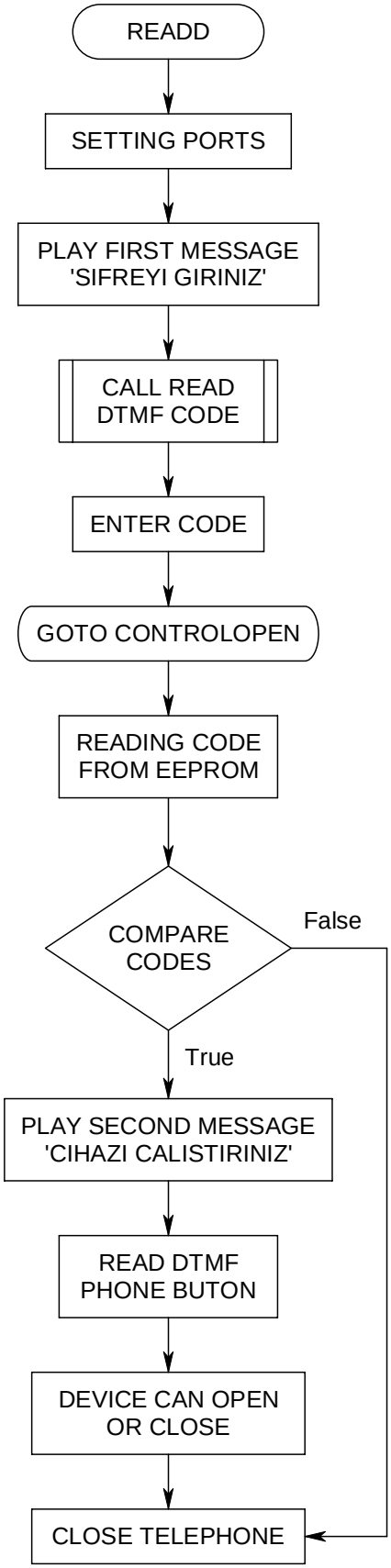


Figure 4.12 Flowchart of READD.

4.2 Operational Manual of System

When this system was started first, image in the following will be produced on the LCD. Keypad is used to see menu and to go forward. Temperature of environment, time and date are produced as an image on LCD. Entry menu is shown in Figure 4.13.

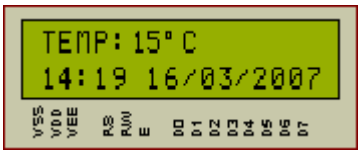
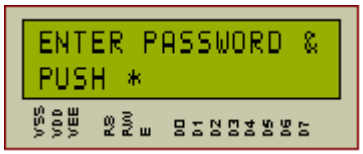


Figure 4.13 Entry menu.

When '*' was pushed, password is entered and '*' is pushed in the following Figure 4.14. Password has four numbers which its default value is '1234'. If password is entered wrong, screen has returned to entry menu.



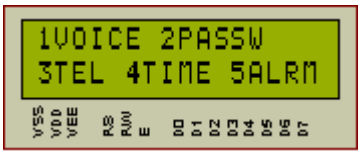


Figure 4.14 Enter to main menu.

If password is entered right, main menu is come on screen. Numeral and '*' are pushed to enter required menu.

When '1' and '*' are pushed, message number must be entered and '*' is pushed to enter in voice menu relevant message.

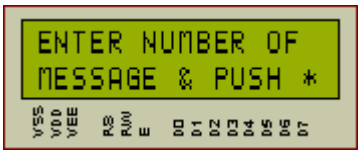


Figure 4.15 Enter to voice menu.

Right screen of Figure 4.15 is come. '1' should be pushed to play message. '4' should be pressed to record message until two seconds. '7' should be pushed to exit to entry menu. '*' should be pushed to return to main menu.

If ‘2’ is pushed in main menu, password menu is entered. Four numbers and ‘*’ are pushed to enter new password. Then new password should be entered again to verify as shown in Figure 4.16. If new password has not been confirmed, screen is gone to entry menu.

Figure 4.16 Enter to password.

When ‘3’ was dialled, phone menu comes to screen. Three phone numbers can be loaded to software. Phone menu is shown in Figure 4.17. ‘1’ is pushed to enter new phone number. ‘2’ is pushed to clear required phone number.

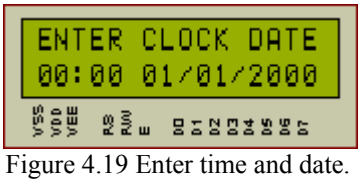
Figure 4.17 Enter to phone menu.

When ‘1’ was pushed, queue of phone number should be selected and ‘*’ is pushed. Then phone numbers are dialled and ‘*’ is pushed as shown in 4.18.

Figure 4.18 Enter phone number.

When ‘2’ was pushed to clear required phone number, queue of phone number should be selected and ‘*’ is pushed.

‘4’ and ‘*’ should be pushed to enter to time menu at the main menu. Hour, minute, day, month and year are entered in rows. Then ‘*’ should be pushed. Time and date menu is shown in Figure 4.19.



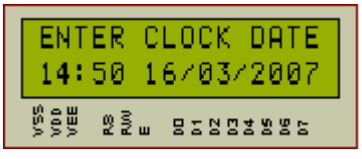


Figure 4.19 Enter time and date.

‘5’ should be pushed to enter alarm menu is shown in Figure 4.20. ‘1’ should be pushed to enable alarm. ‘4’ should be pushed to disable alarm. ‘*’ should be pushed to return to main menu. ‘7’ should be pushed to exit to entry menu.

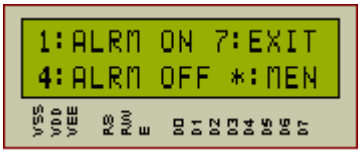


Figure 4.20 Enter to alarm menu.

CHAPTER FIVE

CONCLUSION AND DISCUSSION

The main advantage of the realized system over various security and control systems is that it is a bidirectional control system. It contains both control circuit to turn on/off electrical devices from remote locations and warning system to inform dangerous situations such as fire, flood, etc. These are all realized using the simple phone line which can be reached from everywhere. Besides this system has sound feedback from devices and it can send voice messages in case of any danger.

Moreover, this system has been working as a smart home automation system. Namely, it enables the user to control several home security and electricity devices by the concept of smart life system. This concept means the routines about house have done automatically, the ideal comfort conditions, and probable malfunctions and danger warnings in your living area have been managed by the system.

As a result, the system is constructed according to this concept of use. In the model that is constructed over the internal phone lines, DTMF decoder is used to connect the control panel. Electrical devices can be turned on/off through the telephone line. Besides, situations of motion sensors, steam detectors, electricity and water malfunctions and floods can be informed to phone nembers which are saved previously by using the same phone substructure. The integrated heat sensor also warns the related person via phone when the temperature reaches the level that is determined by us.

The set up and adjustments of the system were realized via phone key set that exists on the phone of the house automation system. For forming an easy use of interface, an LCD panel was added on the phone. The main control circuit was realized by programming a PIC16F877 microcontroller in the Assembly language. This provides more flexible control and more reliable system.

By separating system into zones, program scenarios will be provided inside the environment units. Besides, steam detector and glass breakdown sensor can be added to fulfill the construction of the complete automation system. The internet connection can be done effectively by adapting the system substructure into the TCP/IP protocols.

According to the improvements of today's automation technologies, the need of secure and more comfortable life emerges designing and using so called smart living system. The subject matter of the study focuses on the growing need of the building and security applications in the field of their interactive and remote controls, and presents possible solutions therein.

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APPENDIX A: PIC ASSEMBLY CODES

```
        LIST    P=16F877
        INCLUDE"P16F877.INC"
;*****************************
;       __CONFIG _CP_OFF & _WDT_OFF & _BODEN_OFF & _PWRTE_ON & _XT_OSC & _WRT_ENABLE_ON
& _LVP_OFF & _DEBUG_OFF & _CPD_OFF
;*****************************
;***** VARIABLE DEFINITIONS
TEMP            EQU     21H             ;GECİKME DÖNGÜSÜ İÇİN
TEMP1           EQU     22H             ;GECİKME DÖNGÜSÜ İÇİN
TEMP2           EQU     23H             ;GECİKME DÖNGÜSÜ İÇİN
NUM             EQU     24H             ;OKUNAN DEĞER
NUM1            EQU     25H             ;GİRİLEN ŞİFRE 1. DEĞERİ
NUM2            EQU     26H             ;GİRİLEN ŞİFRE 2. DEĞERİ
NUM3            EQU     27H             ;GİRİLEN ŞİFRE 3. DEĞERİ
NUM4            EQU     28H             ;GİRİLEN ŞİFRE 4. DEĞERİ
REG1            EQU     29H             ;KAYITLI ŞİFRE 1. DEĞERİ
REG2            EQU     2AH             ;KAYITLI ŞİFRE 2. DEĞERİ
REG3            EQU     2BH             ;KAYITLI ŞİFRE 3. DEĞERİ
REG4            EQU     2CH             ;KAYITLI ŞİFRE 4. DEĞERİ
ADDR            EQU     2DH             ;EEPROM ADRES BİLGİSİ
TEMPR           EQU     2EH             ;EEPROM İÇERİĞİ BİLGİSİ
CONT            EQU     2FH             ;İLK DEFAMI ÇALIŞTIRILIYOR
CONT1           EQU     30H             ;OPEN YADA NEWCODE
CONTR           EQU     31H             ;TELEFONUN ÇALMA SAYISI
CONTW           EQU     32H             ;TELEFONUN KAPANMA SURESI
CONT2           EQU     33H             ;TELEFONUN KAPANMA SURESI
CONT3           EQU     34H             ;TELEFONUN ÇALMA SAYISI
PHONES          EQU     35H             ;KAÇINCI ARAMA
ADRESX          EQU     36H             ;ADRESBUL İÇİN ADRES BİLGİSİ
TEMPD           EQU     37H             ;CIHAZ CALISTIRMA DURUMU
TEMPA           EQU     38H             ;SES ENTEGRESI ADRES BILGISI
SAYAC           EQU     39H             ;SANIYE GECIKME BILGISI
TELX            EQU     3AH             ;ÇEVİRİLECEK TELEFON NUMARASI
REG01           EQU     3BH             ;TEKRAR GİRİLEN ŞİFRE 1. DEĞERİ
REG02           EQU     3CH             ;TEKRAR GİRİLEN ŞİFRE 2. DEĞERİ
REG03           EQU     3DH             ;TEKRAR GİRİLEN ŞİFRE 3. DEĞERİ
REG04           EQU     3EH             ;TEKRAR GİRİLEN ŞİFRE 4. DEĞERİ
REG5            EQU     3FH             ;GİRİLEN 5. DEĞER * MI # Mİ
ADDRX           EQU     40H             ;ADRES BİLGİSİ SAKLAMA
TELS            EQU     41H             ;TELEFON ARAMA DURUMU
                                        ;0. BİTİ AÇILIP 1 E BASILDI MI
                                        ;1. BİTİ OKUMAYA NEREDEN GELDİK
                                        ;2.     BİTİ TELEFON NUMARASI BİTTİ Mİ
                                        ;3. BİTİ TELEFON AÇILSIN MI
                                        ;4. BİTİ TELEFON KAPAMA SURESİ SAYSIN MI
HEAT            EQU     42H             ;OKUNAN SICAKLIK DEĞERİ
YUZ             EQU     43H             ;SICAKLIK DEĞERİ YUZLER
ON              EQU     44H             ;SICAKLIK DEĞERİ ONLAR
BIR             EQU     45H             ;SICAKLIK DEĞERİ BİRLER
COUNT           EQU     46H             ;LCD MEŞGUL OKUMA PORTD SAKLAMA
WLCDTEMP        EQU     47H             ;LCD İÇİNDEKİ W SAKLAMA
TELX1           EQU     48H             ;TELEFON NUMARASI VE SANİYE ONLAR
TELX2           EQU     49H             ;TELEFON NUMARASI VE SANİYE     BİRLER
TELX3           EQU     4AH             ;TELEFON NUMARASI VE DAKİKA ONLAR
TELX4           EQU     4BH             ;TELEFON NUMARASI VE DAKİKA BİRLER
TELX5           EQU     4CH             ;TELEFON NUMARASI VE SAAT ONLAR
TELX6           EQU     4DH             ;TELEFON NUMARASI VE SAAT BİRLER
TELX7           EQU     4EH             ;TELEFON NUMARASI VE GUN ONLAR
TELX8           EQU     4FH             ;TELEFON NUMARASI VE GUN BİRLER
TELX9           EQU     50H             ;TELEFON NUMARASI VE AY ONLAR
TELX10          EQU     51H             ;TELEFON NUMARASI VE AY BİRLER
TELX11          EQU     52H             ;TELEFON NUMARASI VE YIL1 ONLAR
TELX12          EQU     53H             ;TELEFON NUMARASI VE YIL1 BİRLER
TELX13          EQU     54H             ;TELEFON NUMARASI VE YIL2 ONLAR
TELX14          EQU     55H             ;TELEFON NUMARASI VE YIL2 BİRLER
TELX15          EQU     56H             ;TELEFON NUMARASI VE BCDD BİRLER
```

```
TELX16          EQU     57H             ;TELEFON NUMARASI VE BCDD ONLAR
ADDRL           EQU     58H             ;EEPROM İÇİNDEKİ ADDR SAKLAMA
SANIYE          EQU     59H             ;SANİYE DEĞERİ
DAKIKA          EQU     5AH             ;DAKİKA DEĞERİ
SAAT            EQU     5BH             ;SAAT DEĞERİ
GUN                     EQU     5CH             ;GUN DEĞERİ
AY                      EQU     5DH             ;AY DEĞERİ
YIL1            EQU     5EH             ;YIL1 DEĞERİ BİRLER VE ONLAR
YIL2            EQU     5FH             ;YIL2 DEĞERİ YÜZLER VE BİNLER
GUNC            EQU     60H             ;GUN MAX DEĞERİ
SAYAC2          EQU     61H             ;SANİYE GECİKME DONGÜSÜ
TEMPS           EQU     62H             ;SENSOR OKUMA
TEMPC           EQU     63H             ;SENSOR ALARM DURUMU
TEMPH           EQU     64H             ;SICAKLIK HESAPLAMA
ALRM            EQU     65H             ;ALARM ACMA KAPAMA
TEMPAH          EQU     66H             ;SICAKLIK DONGUSU
PCLATHTEMP      EQU     6FH             ;İNTERRUPT PCLATH KAYDI
WTEMP           EQU     70H             ;İNTERRUPT W KAYDI
STATUSTEMP      EQU     71H             ;İNTERRUPT STATUS KAYDI
;*****************************
                ORG     0X0000
                GOTO    INIT            ;AYARLAR DÖNGÜSÜ

                ORG     0X0004
        MOVWF   WTEMP
        SWAPF   STATUS,W
        CLRF    STATUS
        MOVWF   STATUSTEMP
        MOVF    PCLATH,W
        MOVWF   PCLATHTEMP
        CLRF    PCLATH
        GOTO    INTERRUPT       ;İNTERRUPT DÖNGÜSÜ
;*****************************
INTERRUPT
        BTFSC   INTCON,1
        GOTO    RING
        BTFSC   INTCON,2
        GOTO    CLOCK
        GOTO    RET
;*****************************
CLOCK
        DECFSZ  SAYAC2,F
        GOTO    $-1
        MOVLW   .58
        MOVWF   SAYAC2
        MOVLW   .6
        MOVWF   TMR0
        BCF             INTCON,2
        DECFSZ  SAYAC,F
        GOTO    RET
        MOVLW   .238
        MOVWF   SAYAC
        BCF             PCLATH,3
        BSF             PCLATH,4
        GOTO    ARTIR
;*****************************
RING                            ;TELEFON ZİLİ İNTERRUPT DÖNGÜSÜ
        BCF             INTCON,1
        CALL    BOUNCE
        BTFSS   PORTB,0
        GOTO    RET
        CALL    RDELAY
        CALL    RDELAY
        DECFSZ  CONTR,F
        GOTO    RET
        MOVF    CONT3,W
        MOVWF   CONTR
        BSF             TELS,3
        BCF             TELS,4
        GOTO    RET
RET
        MOVF    PCLATHTEMP,W
        MOVWF   PCLATH
```

```
        SWAPF   STATUSTEMP,W
        MOVWF   STATUS
        SWAPF   WTEMP,F
        SWAPF   WTEMP,W
        RETFIE
;*****************************
INIT                                    ;AYAR DÖNGÜSÜ
        CLRF    CONT1
        CLRF    TELS
        CLRF    TEMPS
        CLRF    TEMPC
        CLRF    ALRM
        MOVLW   .5
        MOVWF   TEMPAH
        MOVLW   .58
        MOVWF   SAYAC2
        MOVLW   .6
        MOVWF   TMR0
        MOVLW   .238
        MOVWF   SAYAC
        MOVLW   .60
        MOVWF   SANIYE
        MOVWF   DAKIKA
        MOVLW   .24
        MOVWF   SAAT
        MOVLW   .31
        MOVWF   GUN
        MOVWF   GUNC
        MOVLW   .12
        MOVWF   AY
        MOVLW   .100
        MOVWF   YIL1
        MOVLW   .80
        MOVWF   YIL2
        MOVLW   B'11111111'
        MOVWF   CONT
        MOVLW   .6
        MOVWF   CONT3
        MOVWF   CONTR           ;TELEFON ÇALMA SAYISI
        MOVLW   .18
        MOVWF   CONT2
        MOVWF   CONTW           ;BEKLEME KATSAYISI

        CLRF    INTCON
        BSF             INTCON,4
        BSF             INTCON,5
        BSF             INTCON,7

        BANKSEL         TRISA

        MOVLW   B'11010011'
        MOVWF   OPTION_REG      ;
        MOVLW   B'101011'
        MOVWF   TRISA           ;
        MOVLW   B'11110001'
        MOVWF   TRISB           ;
        MOVLW   B'00000000'
        MOVWF   TRISC           ;
        MOVLW   B'00000000'
        MOVWF   TRISD           ;
        MOVLW   B'00000000'
        MOVWF   TRISE           ;
        MOVLW   B'10000100'
        MOVWF   ADCON1          ;

        BANKSEL         PORTA
        BSF             PORTC,0         ;CE
        BSF             PORTC,1         ;PLAYBACK
        BSF             PORTC,2         ;PD
        BSF             PORTC,4         ;TELEFON PALS ÇIKIŞI
        BSF             PORTA,4         ;SENSOR ENTEGRESİ AÇMA
        BCF             PORTE,0         ;TELEFON HATTI AÇMA
        BCF             PORTE,1         ;SES ENTEGRESİ ADRES LATCH
```

```
        BCF     PORTE,2         ;CİHAZ LATCH

        CALL    RDELAY

        CLRF    TEMPD
        MOVF    TEMPD,W
        MOVWF   PORTD
        CALL    BOUNCE
        BSF     PORTE,2
        CALL    DELAY
        BCF     PORTE,2

        BSF     PCLATH,3
        BCF     PCLATH,4
        CALL    LCDINITBEGIN

        CLRF    PORTD

        MOVLW   .1
        MOVWF   REG1            ;STANDART 1. ŞİFRE DEĞERİ
        MOVLW   .2
        MOVWF   REG2            ;STANDART 1. ŞİFRE DEĞERİ
        MOVLW   .3
        MOVWF   REG3            ;STANDART 1. ŞİFRE DEĞERİ
        MOVLW   .4
        MOVWF   REG4            ;STANDART 1. ŞİFRE DEĞERİ

        CALL    FIRST           ;ILK DEFAMI CALISTIRILIYOR
        NOP
        BTFSC   CONT,0
        CALL    SETTING         ;DEGERLER EEPROM A YAZILIYOR
        NOP

        GOTO    BEGIN           ;ANA PROGRAMA GİT
;*************************
BEGIN                           ;ESAS PROGRAM BURADAN BASLIYOR
        BSF     INTCON,4
        BSF     INTCON,5
        BSF     INTCON,7
        NOP
        CALL    WRITECLOCK1             ;YAZILACAK SAATİ HESAPLA
        NOP
        CALL    LCDWRITEOPEN1   ;İLK EKRANI YAZ
        NOP
        DECFSZ  TEMPAH,F
        GOTO    $+2
        CALL    READH           ;SICAKLIK DEĞERİNİ OKU
        NOP
        CALL    READT           ;TUS TAKIMI OKUMA
        NOP
        CALL    READS           ;SENSOR OKUMA
        NOP
        CALL    RESET           ;ŞİFRE RESETİNE BASILMIŞ MI
        NOP
        BTFSS   TELS,3          ;HAT AÇIK MI
        GOTO    BEGIN
        GOTO    READD
;*************************
READT                                   ;İLK BAŞTA YILDIZA BASILDI MI
        BTFSC   TELS,3
        RETURN

        BANKSEL         TRISA           ;INPUT/OUTPUT SETTING

        MOVLW   B'11110001'
        MOVWF   TRISB
        MOVLW   B'11111111'
        MOVWF   TRISD           ;

        BANKSEL         PORTA

        CALL    BOUNCE
```

```
        BTFSC   TELS,3
        RETURN

        MOVLW   B'11110011'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,7
        GOTO    ENTER           ;YILDIZA BASILDI ŞİFRE SOR

        RETURN

READN                                   ;MENU TUS TAKIMI OKUMA
        BTFSC   TELS,3
        RETURN

        BANKSEL         TRISA           ;INPUT/OUTPUT SETTING

        MOVLW   B'11110001'
        MOVWF   TRISB
        MOVLW   B'00000000'
        MOVWF   TRISD           ;

        BANKSEL         PORTA

        BSF             PORTE,1
        CALL    BOUNCE
        BSF             PCLATH,3
        BCF             PCLATH,4
        CALL    LCDWRITEMENU
        BSF             PORTA,4

        MOVLW   B'11110011'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    VOICE           ;SES MENUSU
        BTFSC   PORTB,5
        GOTO    TIME            ;SAAT MENUSU
        BTFSC   PORTB,6
        NOP
        BTFSC   PORTB,7
        NOP

        MOVLW   B'11110101'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    NEWCODE                 ;YENİ ŞİFRE MENUSU
        BTFSC   PORTB,5
        GOTO    ALARMCONT       ;ALARM MENUSU
        BTFSC   PORTB,6
        NOP
        BTFSC   PORTB,7
        NOP

        MOVLW   B'11111001'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    PHONE           ;YENİ TELEFON MENUSU
        BTFSC   PORTB,5
        NOP
        BTFSC   PORTB,6
        NOP
        BTFSC   PORTB,7
        GOTO    NEWOUT          ;MENUDEN ÇIKIŞ

        GOTO    READN
;***************************
READH
        BTFSC   TELS,3
        RETURN
        BCF             PCLATH,3
```

```
        BSF     PCLATH,4
        GOTO    HESAP
;*************************
READE                                   ;TUS TAKIMI OKUMA
        BTFSC   TELS,3
        RETURN

        BANKSEL         TRISA           ;INPUT/OUTPUT SETTING

        MOVLW   B'11110001'
        MOVWF   TRISB
        MOVLW   B'00000000'
        MOVWF   TRISD           ;

        BANKSEL         PORTA
        BSF             PORTE,1
        CALL    BOUNCE

        MOVLW   B'11110011'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    NUMBER1
        BTFSC   PORTB,5
        GOTO    NUMBER4
        BTFSC   PORTB,6
        GOTO    NUMBER7
        BTFSC   PORTB,7
        GOTO    NUMBERY

        MOVLW   B'11110101'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    NUMBER2
        BTFSC   PORTB,5
        GOTO    NUMBER5
        BTFSC   PORTB,6
        GOTO    NUMBER8
        BTFSC   PORTB,7
        GOTO    NUMBER0

        MOVLW   B'11111001'
        MOVWF   PORTB
        CALL    SDELAY
        BTFSC   PORTB,4
        GOTO    NUMBER3
        BTFSC   PORTB,5
        GOTO    NUMBER6
        BTFSC   PORTB,6
        GOTO    NUMBER9
        BTFSC   PORTB,7
        GOTO    NUMBERK

        GOTO    READE
;*************************
READS                                   ;SENSOR OKUMA
        BTFSC   TELS,3
        RETURN
        BTFSS   ALRM,0
        RETURN
        CLRF    PORTD

        BANKSEL         TRISA           ;INPUT/OUTPUT SETTING

        MOVLW   B'11110001'
        MOVWF   TRISB
        MOVLW   B'11111111'
        MOVWF   TRISD           ;

        BANKSEL         PORTA

        BCF             PORTE,1
```

```
        BCF             PORTE,2
        BCF             PORTA,4
        CALL    BOUNCE
        CALL    BOUNCE
        CALL    BOUNCE

        BTFSC   PORTD,0
        CALL    ELGEL
        NOP
        BTFSS   PORTD,0
        CALL    ELKES
        NOP
        BTFSC   PORTD,1
        CALL    SUGEL
        NOP
        BTFSS   PORTD,1
        CALL    SUKES
        NOP
        BTFSC   PORTD,2
        CALL    SUBAS
        NOP
        BTFSS   PORTD,2
        CALL    SUBASMA
        NOP
        BTFSC   PORTD,3
        CALL    HIRVAR
        NOP
        BTFSS   PORTD,3
        CALL    HIRYOK
        NOP
        BTFSS   PORTD,4
        CALL    YANVAR
        NOP
        BTFSC   PORTD,4
        CALL    YANYOK
        NOP
        BTFSC   PORTD,5
        CALL    GARAJACIK
        NOP
        BTFSS   PORTD,5
        CALL    GARAJKAPALI
        NOP
        BTFSS   TEMPC,0
        GOTO    SICAKNOR
        NOP
        BTFSC   TEMPC,1
        CALL    SICAKYUK
        NOP
        BTFSC   TEMPC,2
        GOTO    SICAKDUS
        NOP
        RETURN
;*****************************
ALARMCONT
        CALL    BOUNCE
        BTFSS   PORTB,5
        GOTO    READN
        CALL    EDELAY
        BTFSC   PORTB,5
        GOTO    $-2
        BCF             PCLATH,3
        BSF             PCLATH,4
        GOTO    ALARM1
;*****************************
READD                                   ;DTMF KOD OKUMA
        BTFSS   TELS,3
        GOTO    BEGIN

        BCF             INTCON,7

        BANKSEL         TRISA

        MOVLW   B'11111111'
```

```
        MOVWF   TRISB           ;
        MOVLW   B'00000000'
        MOVWF   TRISD           ;

        BANKSEL         PORTA

        CALL    BOUNCE
        BSF             PORTE,0
        CALL    DELAY
        BSF             TELS,4
        BCF             TELS,1
        MOVLW   .20
        MOVWF   TEMPA
        CALL    PLAYBACK1
        CLRF    PORTD
        MOVF    CONT2,W
        MOVWF   CONTW

RPUSHCLOSE                      ;TELEFON HATTINI KAPAT
        CLRF    PORTD
        CALL    DELAY
        BCF             PORTE,0
        BCF             PORTE,1
        BCF             PORTE,2
        BSF             PORTA,4
        BCF             TELS,3
        BCF             TELS,4
        GOTO    BEGIN

CONTROLOPEN                             ;ŞİFRE KONTROL DÖNGÜSÜ
        CALL    REFRESH
        MOVF    NUM1,W
        SUBWF   REG1,W
        BTFSS   STATUS,Z
        GOTO    RPUSHCLOSE

        MOVF    NUM2,W
        SUBWF   REG2,W
        BTFSS   STATUS,Z
        GOTO    RPUSHCLOSE

        MOVF    NUM3,W
        SUBWF   REG3,W
        BTFSS   STATUS,Z
        GOTO    RPUSHCLOSE

        MOVF    NUM4,W
        SUBWF   REG4,W
        BTFSS   STATUS,Z
        GOTO    RPUSHCLOSE

        MOVLW   .40
        MOVWF   TEMPA
        CALL    PLAYBACK1
        CLRF    PORTD

        BSF             PCLATH,3
        BCF             PCLATH,4
        GOTO    OPEN

READ                            ;TUŞ OKUMA DÖNGÜSÜ
        CLRF    NUM
        BTFSS   TELS,3
        GOTO    TELRET
        BSF             INTCON,7
        BTFSS   PORTB,3
        GOTO    READ
        CALL    BOUNCE
        BTFSS   PORTB,3
        GOTO    READ
        CALL    EDELAY
        SWAPF   PORTB,W
        ANDLW   B'00001111'
```

```
        MOVWF   NUM
        BTFSC   PORTB,3
        GOTO    $-1
        CALL    BOUNCE
        BTFSC   PORTB,3
        GOTO    $-4

        MOVF    CONT2,W
        MOVWF   CONTW

EEPROMREAD                      ;EEPROMDAN BILGI OKUMA
        MOVF    ADDR,W
        BANKSEL         EEADR
        MOVWF   EEADR
        BANKSEL         EECON1
        BSF             EECON1,RD
        BANKSEL         EEDATA
        MOVF    EEDATA,W
        BANKSEL         PORTA
        RETURN
;*************************
EEPROMWRITE                     ;EEPROM A BILGI YAZMA
        MOVWF   TEMPR
        BANKSEL         EECON1
        BTFSC   EECON1,WR
        GOTO    $-1
        BANKSEL         ADDR
        MOVF    ADDR,W
        MOVWF   ADDRL
        MOVF    ADDR,W
        BANKSEL         EEADR
        MOVWF   EEADR
        BANKSEL         TEMPR
        MOVF    TEMPR,W
        BANKSEL         EEDATA
        MOVWF   EEDATA
        BANKSEL         EECON1
        BSF             EECON1,WREN
        BCF             INTCON,GIE
        MOVLW   0X55
        MOVWF   EECON2
        MOVLW   0XAA
        MOVWF   EECON2
        BSF             EECON1,WR
        BSF             INTCON,GIE
        BCF             EECON1,WREN
        BANKSEL         PORTA
        MOVF    ADDRL,W
        MOVWF   ADDR
        RETURN
;*************************
OPEN                            ;CİHAZLARI AÇMA DÖNGÜSÜ
        BTFSS   TELS,3
        GOTO    PBEGIN
        BSF             TELS,1
        BCF             PCLATH,3
        BCF             PCLATH,4
        CALL    READ

        MOVLW   .10
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    CLOSE

        MOVLW   .1
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSH1

        MOVLW   .2
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSH2
```

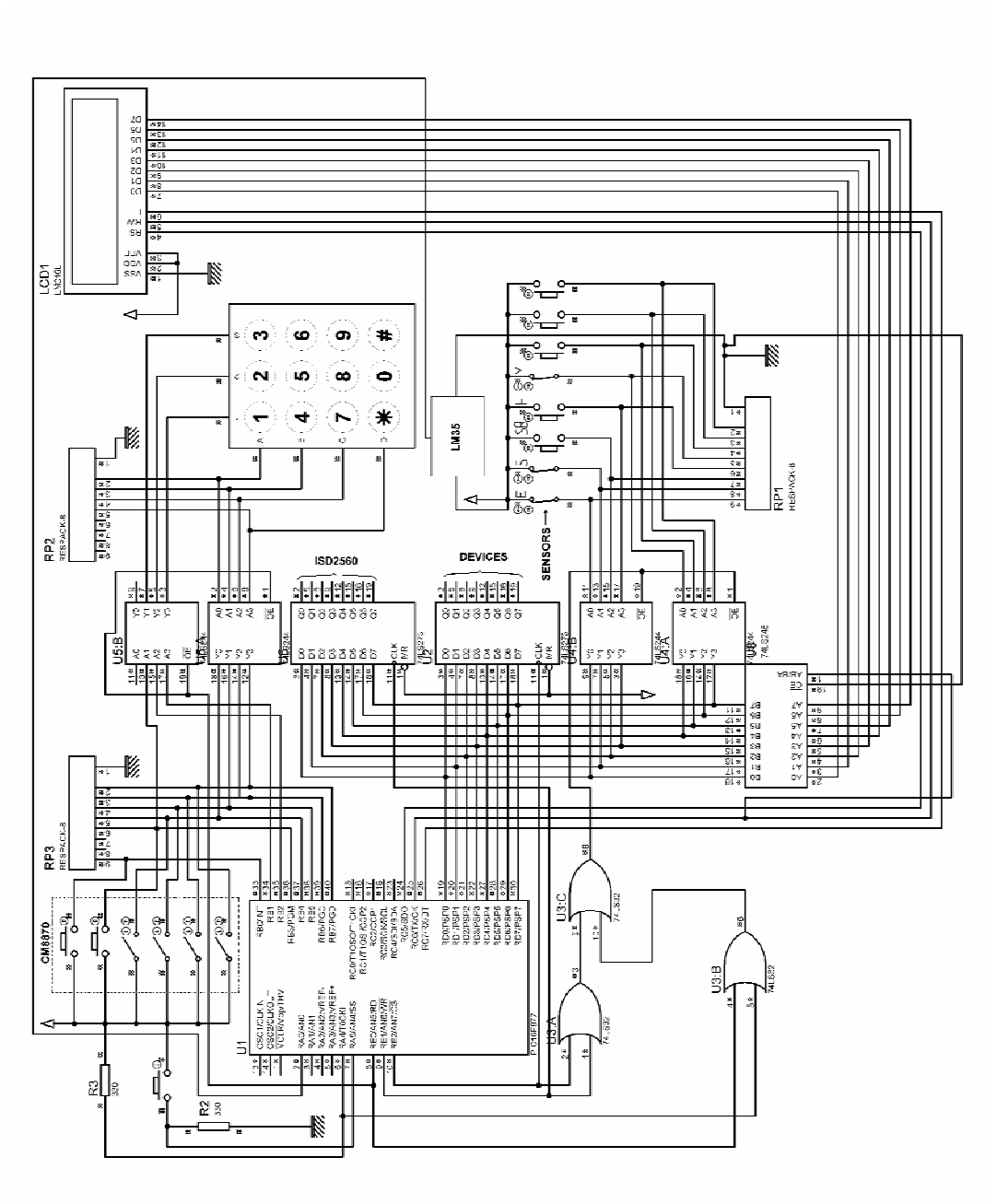
```
        MOVLW  .3
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH3

        MOVLW  .4
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH4

        MOVLW  .5
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH5

        MOVLW  .6
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH6

        MOVLW  .7
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH7

        MOVLW  .8
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH8

        MOVLW  .12                  ;#
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSHCLOSE
        GOTO   OPEN
;*****************************
CLOSE                               ;CİHAZLARI KAPAMA DÖNGÜSÜ
        BTFSS  TELS,3
        GOTO   PBEGIN
        BSF            TELS,1
        BCF            PCLATH,3
        BCF            PCLATH,4
        CALL   READ

        MOVLW  .10
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH00

        MOVLW  .1
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH01

        MOVLW  .2
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH02

        MOVLW  .3
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH03

        MOVLW  .4
        SUBWF  NUM,W
        BTFSC  STATUS,Z
        GOTO   PUSH04

        MOVLW  .5
        SUBWF  NUM,W
        BTFSC  STATUS,Z
```

```
        GOTO    PUSH05

        MOVLW   .6
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSH06

        MOVLW   .7
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSH07

        MOVLW   .8
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSH08

        MOVLW   .12                 ;#
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    PUSHCLOSE

        MOVLW   .11                 ;*
        SUBWF   NUM,W
        BTFSC   STATUS,Z
        GOTO    OPEN
        GOTO    CLOSE
;*****************************
PBEGIN
        BCF             PCLATH,3
        BCF             PCLATH,4
        GOTO    BEGIN
;*****************************
PUSHCLOSE                           ;TELEFON HATTINI KAPAT
        CLRF    PORTD
        CALL    PDELAY
        BCF             PORTE,0
        BCF             PORTE,1
        BCF             PORTE,2
        BSF             PORTA,4
        BCF             TELS,3
        BCF             TELS,4
        GOTO    PBEGIN
;*****************************
PUSHOPEN
        CLRF    PORTD
        MOVF    TEMPD,W
        MOVWF   PORTD
        CALL    PBOUNCE
        BSF             PORTE,2
        CALL    CDELAY
        BCF             PORTE,2
        GOTO    OPEN
;*****************************
PUSH00                              ;TÜM CİHAZLARI KAPAT
        CLRF    TEMPD
        GOTO    PUSHOPEN
;*****************************
PUSH1                               ;1. CİHAZI AÇ
        BSF             TEMPD,0
        GOTO    PUSHOPEN
;*****************************
PUSH2                               ;2. CİHAZI AÇ
        BSF             TEMPD,1
        GOTO    PUSHOPEN
;*****************************
PUSH3                               ;3. CİHAZI AÇ
        BSF             TEMPD,2
        GOTO    PUSHOPEN
;*****************************
PUSH4                               ;4. CİHAZI AÇ
        BSF             TEMPD,3
        GOTO    PUSHOPEN
```

```
;*****************************
PUSH5                                   ;5. CİHAZI AÇ
        BSF             TEMPD,4
        GOTO    PUSHOPEN
;*****************************
PUSH6                                   ;6. CİHAZI AÇ
        BSF             TEMPD,5
        GOTO    PUSHOPEN
;*****************************
PUSH7                                   ;7. CİHAZI AÇ
        BSF             TEMPD,6
        GOTO    PUSHOPEN
;*****************************
PUSH8                                   ;8. CİHAZI AÇ
        BSF             TEMPD,7
        GOTO    PUSHOPEN
;*****************************
PUSH01                                  ;1. CİHAZI KAPAT
        BCF             TEMPD,0
        GOTO    PUSHOPEN
;*****************************
PUSH02                                  ;2. CİHAZI KAPAT
        BCF             TEMPD,1
        GOTO    PUSHOPEN
;*****************************
PUSH03                                  ;3. CİHAZI KAPAT
        BCF             TEMPD,2
        GOTO    PUSHOPEN
;*****************************
PUSH04                                  ;4. CİHAZI KAPAT
        BCF             TEMPD,3
        GOTO    PUSHOPEN
;*****************************
PUSH05                                  ;5. CİHAZI KAPAT
        BCF             TEMPD,4
        GOTO    PUSHOPEN
;*****************************
PUSH06                                  ;6. CİHAZI KAPAT
        BCF             TEMPD,5
        GOTO    PUSHOPEN
;*****************************
PUSH07                                  ;7. CİHAZI KAPAT
        BCF             TEMPD,6
        GOTO    PUSHOPEN
;*****************************
PUSH08                                  ;8. CİHAZI KAPAT
        BCF             TEMPD,7
        GOTO    PUSHOPEN
;*****************************
ALARM1
        BSF             PCLATH,3
        BCF             PCLATH,4
        CALL    LCDWRITEALARMCONT
        MOVLW   B'00000010'
        MOVWF   PORTB
        CALL    AEDELAY
ALARM2
        BTFSC   PORTB,4
        GOTO    ALARMON
        BTFSC   PORTB,5
        GOTO    ALARMOFF
        BTFSC   PORTB,6
        GOTO    READAT
        BTFSC   PORTB,7
        GOTO    READAN
        GOTO    ALARM2
;*****************************
ALARMON
        BSF             ALRM,0
        GOTO    READAN
ALARMOFF
        BCF             ALRM,0
        GOTO    READAN
```

```
READAT
        BCF             PCLATH,3
        BCF             PCLATH,4
        GOTO    READT
READAN
        BCF             PCLATH,3
        BCF             PCLATH,4
        GOTO    READN
;*************************
        END
```

APPENDIX B: DETAILED SCHEMA OF MAIN CIRCUIT



APPENDIX C: PRINTED CIRCUIT BOARD OF MAIN CIRCUIT