The Study of Home based Control Systems

Nitin Kumar
Lovely Professional University,
Jalandhar, India

Ritika Singal
Lovely Professional University,
Jalandhar, India

Greesh Kumar Singh
Lovely Professional University,
Jalandhar, India

ABSTRACT

Nowadays the intelligent homes are quite common; these homes gather information through certain sensors to monitor the environment, control the appliances and helps in communing with the outer world. The use of this technology brings more précised work environment although it would make our system more composite. These technologies coalesce to share information among them so that the system becomes more efficacious. The owner can control the devices by sending the command through a network or through telephone. This paper describes the feasibility to control home appliances in much simpler way based on the certain parameters such as Motion detection of humans, illumination, humidity, Temperature, fire, leakage of gases and smoke etc. The system configuration will assure reliability and complete protection to the user.

Keywords

Tele control, LAN, MCU, CCD, LUX.

1. INTRODUCTION

Today as the world is modernizing, the life of common man becomes more comfortable with the use of advanced technologies. Intelligent home systems are using most of these technologies. These intelligent systems comprises of different subsystems for lighting control, sound control, telegraphed (wired) systems, radio (wireless) systems, temperature control, timing control, security control and certain other systems .This Paper has carried out with a design to build an intelligent home which could be governed in different ways. The key control of these systems is through microcontroller ATmega6490 which is capable enough to process the received sensory data.

The system ought to be such that it would make user life much simpler from dawn to dusk providing security, reliability and energy saving. These home control systems integrate whole of the Sensory information with security systems [1] and connect all the modules of these systems with either telephone connection or through LAN [2]. These systems can be employed even with SMS based modules [3]. To enhance the living standard, the operation of smart homes should be completely based on human thought process [5]. This in turn also helps meliorate resource utilization and minimizes energy loss [4]. The system ought to be user friendly and efficient [6].

2. PROPOSED DESIGN OF A SYSTEM

The proposed design of home based intelligent control system comprises of ATmega6490 µC along with several inputs like temperature, light, motion detector, humidity, fire and gas sensor along with some inputs as keyboard etc. It also comprises of several actuators based devices like fountain pumps, vacuum cleaners, lights, fans, air conditioners, grinders etc.

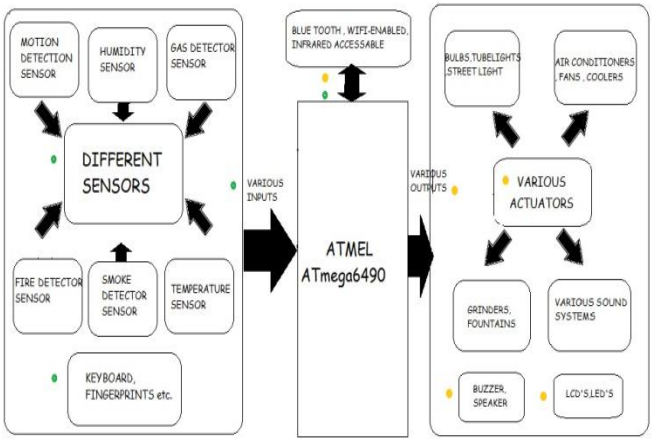
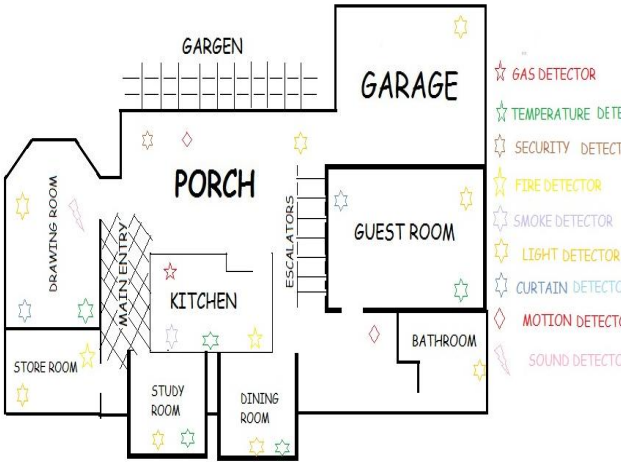


Figure.1 depicts the sensory inputs and the various outputs

The microcontroller used is ATmega6490 formulated by ATMEL. ATmega6490 is low power 8 bit MCU having 64 K bytes of Programmable Flash Memory, 2K (4K) of SRAM and 1K (2K) of EEPROM which allow IC to store data as well as to execute read-while-write operation, with 64 general Purpose registers, 10 bit ADC, a watchdog timer and five software power selecting modes which can save power even though the whole system is in sleep mode. It has on chip LCD controller (to vary the contrast) and an ADC noise reduction module (helpful in acquiring noise free signals). The ATmega6490 supported by development tools include C compilers, micro Assemblers, program simulator, Emulators and several other kits.

3. METHODOLOGY USED IN PROPOSED SUB-SYSTEMS



3.1 Temperature Control Subsystem

Temperature control Subsystem uses DS1822 sensor formulated by MAXIM. This sensor requires only one pin for communicating data from the microprocessor. The operating range of this sensor is –55 ^{0}C to +125 ^{0}C.The unique characteristic of such sensor is that it can derive the power from the data line making the external power supply as backup and its 64 bit serial code, which permits multiple DS1822s to function on a single bus. The output of the sensor is digital and is visualized on the LCD with a default resolution of 12 bit.

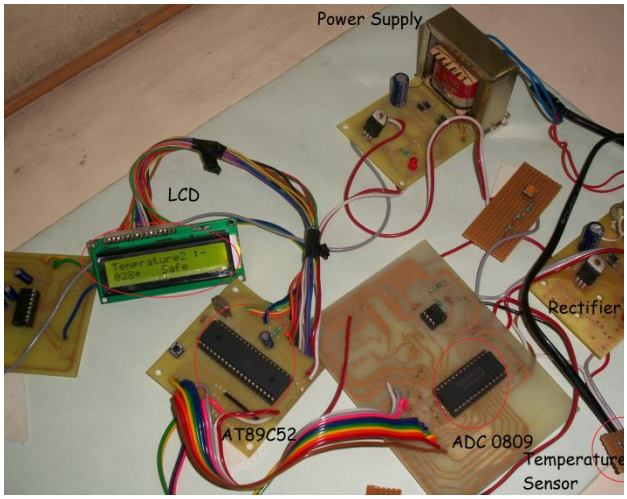


Figure. 3 Temperature sensor with connected peripherals.

3.2 Security Control Subsystem

The door security is characterized by door lock and through the webcams. The security through doors can be entertained by either magnetic door lock, by biometric recognition, facial signature, voice signature or through a simple password based door lock. The magnetic door locking includes the use of a controller (Microchip PIC16F84) which have 64 bit EEPROM to store the desired information of the card and a timer to detect the duration of the process, magnetic card reader (LCC LM300) and the strips (ISO 2) are adapted to ISO 7810,7811,7812 applications.

Biometric recognition uses several sensors for fingerprints those sensors includes optical, ultrasonic and solid state sensor. We have used LM 100/ LM 200 a laser based optical sensor which has high immunity to roughness, reflectivity and color changes. The LED on this sensor illuminate the finger from one of the side while the other side carries the image to the CMOS camera or to CCD (charge coupled device) and then converts the analog signal it into digital signal and process it to the controller to process.

3.3 Automatic Lightening Control System

The lighting control system controls the automatic switching of lights depending on the number of persons present in the room and the incident sunlight. Depending on the situation the light of the room will be switched ON and OFF. The possible situations are explained as in a table 1 shown below. When the incident sunlight decreases to the threshold value, then the power supply is made available to the light switches automatically. The luminosity can be either by remote control or by manual control. The focus is to create an energy saving environment by dimming control, shading or by color management.

Table 1 Shows the possibility of the lights switched ON and OFF.

Human Presence	Incident Sunlight (on LDR sensor)	Action Performed (Lights ON/OFF)
✓	✓	Few Lights ON
✓	✗	All Lights ON
✗	✓	All lights OFF
✗	✗	All lights OFF

3.4 Curtain Control Subsystem

Curtains can be remotely controlled as well as through the manual central control. The mechanism involved in this is based on the DC motors which may run in clockwise and/or in anticlockwise direction to draw the curtains and thus, in a certain way, controls the lighting of the room. Opening and/or closing of the curtains would take nearly 15 -25 sec for simultaneous operation of 5 dc motors of 100 rpm each.

3.5 Scene Control Subsystem

Scene Control refers to the controlling of the surrounding of a particular place through some manual central control for example changing bedroom to study, dining room to drawing room, etc. The control will be through servo motors which help in getting required scenarios. In changing one scene to another the cost, comfort, safety and demand of a person are highly considered. Some scenarios are as proposed below.

Bedchamber to the study room: For converting a bedchamber to a study or vice versa, we first have to categorize the accessories that need to be available to both of them. One such arrangement can be thought of by using a rotating wall arrangement. This wall can be partitioned off in such a way that one side can contain a standard wall bed and the other side of the wall could have a bookshelf at a certain height and a drop-open study table just below it. Certain side tables, closet, etc. can be kept as it is.

Dining to Drawing room: Dining room will have dining tables and chairs around it while a drawing room is expected to have a sofa-set with a center table. To facilitate this, we can have wall sofa sets. The dining table can be lowered in height to act as a center table. The chairs around the tables can have the option to be lowered into the floor.

Garage to Gaming area: When the garage is unoccupied, the garage floor can be parted to bring out a gaming table. This table can be pool, snooker, etc. As and when the garage door is opened to bring in the car, the table will automatically be lowered into the garage floor.

3.6 Humidity Control Subsystem

Humidity control system senses the humidity present in the room through the sensor HCH-1000 formulated by Honeywell. This polymer sensor senses the humidity and converts it into a capacitive value that can be measured. It supports few timers which continuously issue a train of pulses in order to trigger the other timers being operated in PWM (Pulse Width Modulation) mode.

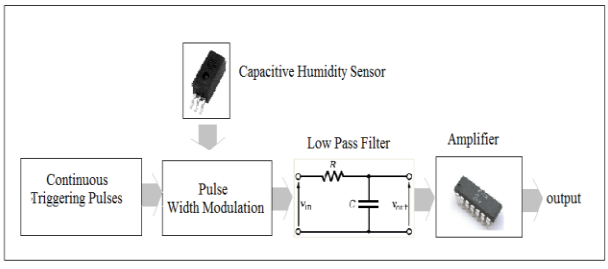


Figure. 4 Block diagram for measuring humidity

The sensor shows the linear characteristics for capacitance value against the humidity present in the room. The sensor characteristics are determined by the formula

$$C_{mc}(\%RH) = C_{st} + S * [\%RH(C_{rh}) - \%RH(C_{srh})]\,pF$$

Where,

$C_{mc}(\%RH)$ = Calculated capacitance at measured relative humidity.

C_{st} = Standard Capacitance value at 55%RH

S=Sensitivity (pF% RH)

$\%RH(C_{rh})$ = Measured relative humidity value

$\%RH(C_{srh})$ = Standard relative humidity value at 55%RH.

3.7 Central Control Subsystem

The central control system is the heart of all these systems. It comprises of manual control of all the above systems namely temperature, automatic lighting, security, scene, humidity, gas and fire/smoke control systems. If any of the above sensors does not respond automatically then the option for manually control is also available. This system has all the sensory information embedded in one control panel. This panel can be controlled either by on-wall switch board or with remote. The panel has a color LCD with touch screen facility driven through ADS7843 A/D converter which allows a user friendly interface. The Panel is thus a portable and easily handled device which can be operated using internet as well (using standard Ethernet cables). This device runs on AC power source of 220V and can be inserted in a docking station.

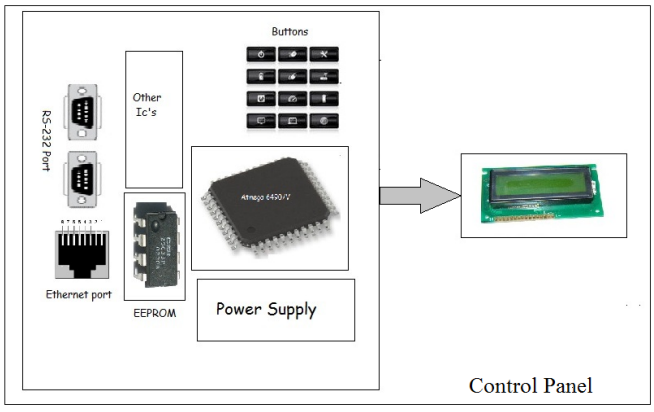


Figure. 5 Block diagram of the central Control Panel

3.8 Gas and Smoke Control Subsystem

Gas control Subsystem: This uses a Sensor MQ 6 formulated by RhydoLABZ. It is simple to use and mainly used for sensing LPG (liquefied Petroleum Gas) and natural (Propane and Butane). The sensor has high Sensitivity and a quick response. The sensor has sensitive semiconductor material SNO_2 which lowers the conductivity in the clean air. Whenever there is a gas leakage of about 200-1000 ppm (parts per million), the sensor senses and produces a HIGH output to the 555 timer which works as an Astable Multivibrator the output of the timer will go to the LED's present in the circuit and they will began to flash. A buzzer can also be activated using the same output.

Smoke sensor: This uses RE46C190 as Sensor formulated by Microchip. The sensor uses a pair of infrared emitters with a photo amplifier. To minimize the standby current to a minimum, the oscillator pumps power to the circuit in every 10 seconds. The sensor accumulates smoke to a threshold till certain a level, but when this value is crossed, the sensor output becomes HIGH and buzzer begins to buzz.

3.9 Motion Detection Control Subsystem

Motion detection is possible through the PIR (Passive Infrared) sensor. It senses the heat radiation emitted by bodies which include living beings and physical objects. The typical construction of PIR includes Fresnel lenses which focus the radiation emitted by the source, pyroelectric passive infrared sensor amplify the difference between the radiation (ranging from 8-14μm) received by the two elements to activate the relays, Photoelectric cells records the LUX of the surrounding light and compares with the preset value, any increment in load will reduce the possibilities of switching the load, control potentiometers are used to ascertain the time and various other parameters. The rapid change in the infrared energy helps in detecting the person.

3.10 Wireless GSM connectivity Module

Wireless module contains GSM modem that has a PC /PCMCIA card over which we send and receive SMS's. It is very compact over GPRS channel. User can control the switching of devices by sending an SMS. We can use any Programming languages such as C/C++/Java. To perform these task a GSM modem should support an extended AT command set for sending receiving messages as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications and Programmable and can be connected either serially, USB or through Bluetooth. The module transfer informatory messages over GPRS channel. User can control the switching of devices by sending an SMS. We can use any Programming languages such as C/C++/Java. To perform these task a GSM modem should support an extended AT command set for sending receiving messages as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications.

4. CONCLUSION

The real time control of home is affordable at low cost and achievable by the use of sensors and actuators. The manual and automatic modes make the total system much simpler and easily controllable. The combined use internet intelligent control and management brings a new living experience. The entire system takes modular design and facilitates the user to select a different combination of modules to meet the needs of individual users. The wireless module will be helpful in monitoring any of the devices remotely even over long distances

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