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Smart Home Automation Using Arduino, Passive Infrared Sensor and LCD Display

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ABSTRACT: In the field of consumer electronics, in the past decade, significant advancement has been seen. To realize the concept of smartphone various intelligent utilization appliances are available in the market such as cellular phones, air-conditioners, home safety devices, home cinemas, etc. are set to comprehend the perception of a smart home. They have given growth to a Personal Area Network in home atmosphere, where all these appliances can be interrelated and supervised using a single controller. Busy families and individuals with physical limitation represent a striking market for home automation and networking. A wireless home network that does not sustain additional costs of wiring would be looked-for. The fame of home automation has been growing enormously in recent years due to much higher affordability and effortlessness. Being able to control facets of our houses, and for having the feature to respond automatically to events, it is becoming more and more popular and necessary due to security and cost purposes. We propose to device a unified home automation and safekeeping system. Passive Infrared Sensor, which has emerged in late 1980s, is an ideal solution for this purpose.

KEYWORDS: Smart Home, Intelligent Utilizations, Single Controller, Home Automation, Passive Infrared Sensor.

I. INTRODUCTION

The Internet of things (IoT) defines the web of material objects that are entrenched with sensors, software, and other technologies for the purpose of linking and swapping data with further devices and systems over the Internet without necessitating human-to-human or human-to-computer communication. An entity can be an individual with a cardiac monitor implant, a farm animal with a biochip transponder, a vehicle that has in-built sensors to make the driver cautious when tire pressure is low or any other natural or manufactured object that can be allotted an Internet Protocol (IP) address and is able to transfer data over a network.

In our project, we have used the Arduino Uno which is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc, a passive infrared sensor which is an automated sensor to measure infrared (IR) light radiating from objects in its field of view. Mostly, PIR-based motion detectors is used. Also, we have used LCD display which is a flat-panel display that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly.

II. LITERATURE SURVEY

Home automation or smart homes can be labeled as overview of technology within the home environment to offer suitability, well-being, safety and energy efficiency to its occupants. There are numerous projects completed on home automation in different countries. They are all dissimilar to each other in designs; features, devices, elements and algorithm. They were designed rendering for precise needs and accessibility of components in the particular areas. Some of them are inexpensive; some of them are very expensive hence of both hardware and software is necessary to work. After an extensive searching, we have found a lot of articles. We also found some projects done for garage security



after searching for security purpose articles. These are mainly done in western countries. Several projects are done only for security purpose while others for controlling home appliances with Arduino or Raspberry Pi.

Idea of home automation system is a significant issue for researchers and home appliances' companies [1]. Automation system not only aids in reducing the human labor nevertheless it saves time and energy. Earlier, home automation systems were used in labor saving machines but now its main objective is to provide facilities to elderly and handicapped people to perform their daily routine tasks and control the home appliances[2]. Home automation systems are rapidly evolving and becoming prevalent nowadays in the world and its end users are specifically the disabled and elderly but due to their complication and cost it is not always accepted. Demographic ageing is taking place in nearly all the countries of the world. Ageing consequences from declining impermanence, and most importantly, deteriorating lushness. This process primes to a comparative decrease in the number of children and to a rise in the share of people in the main working ages and of older persons in the population. The worldwide share of aged people (aged 60 years or over) amplified from 9.2 per cent in 1990 to 11.7 per cent in 2013 and will carry on as a proportion of the world population, reaching 21.1 per cent by 2050 [3].

Its foremost benefits range from improved luxury and better safety and security, to an additional balanced use of energy and other resources, allowing for important investments. It similarly offers powerful means for serving and supporting the unusual desires of people with disabilities and, in particular, the elderly. This application domain is very important and will progressively surge in the forthcoming [4].

The main objective of this paper is to develop home automation using Passive Infrared Sensor which are used in some security systems to detect motion of an infrared emitting source, usually a human body. As technology is progressing, so houses are also getting smarter. Modern houses are slowly moving from standard switches to centralized control system. The sensors will be controlled with the help of Arduino, which is an open-source prototyping platform that provides easy-to-use hardware and programming environments. It is comparatively low-cost compared to other microcontroller-based platforms. Consequently, forming an economic and energy efficient system development.

III. HARDWARE PLATFORM

The software part consists of Arduino IDE v1.01 The hardware part mainly consists of a digital computer, an Arduino Uno board, Liquid Crystal Display, GasDetector (MQ2), Passive Infrared Sensor, Light Dependent Resistors and Ultrasonic Sensor, which are being discussed along with their specific functions.

A. ARDUINO UNO R3

Arduino Uno R3 [5] shown in Fig.1 is a microcontroller based open source electronic prototyping board which can be programmed with an easy to use Arduino IDE. It contains 20 digital input/output pins where 6 pins can be used as analog inputs and 6 pins can be used as PWM outputs. Programs can be overloaded on to it from the easy-to-use Arduino computer program.

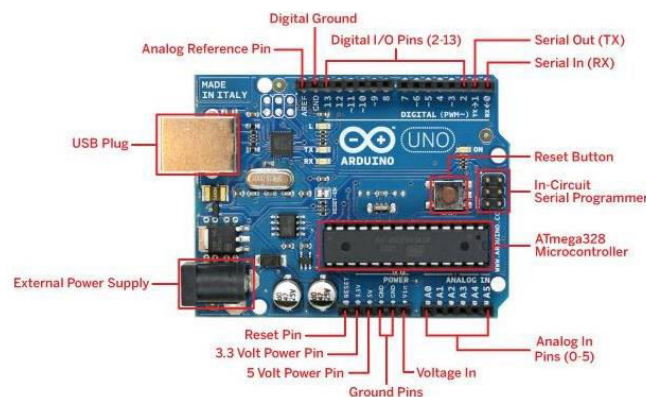


Fig.1 Arduino Uno R3



B. 16x2 LCD Display

A 16x2 LCD [6] display is commonly used in various devices and circuits i.e., it can display 16 characters per line and 2 such lines. Each character is displayed in 5x7 pixel matrix in the display.

C. GAS SENSOR

A gas sensor [7] is a device which detects the presence of gases in the atmosphere. The gas sensor produces an equivalent potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage based on the concentration.

D. PIR SENSOR

A passive infrared sensor (PIR sensor) [8] is a sensor that is used to measure infrared (IR) light generating from objects in its field of view and are often used in PIR-based motion detectors which are commonly used in safety and security alarms and automatic lighting applications.

E. LIGHT DEPENDENT RESISTOR (LDR)

Light Dependent resistance (LDR) [9] is additionally referred to as a photo resistor or a sulphide (CDS) cell. It's conjointly referred to as a photoconductor. It's a passive resistance and a sensor that works on the principle of photoconduction. Once the intensity of sunshine decreases, resistance worth decreases. This optoelectronic device is usually employed in lightweight varied device circuit, and light-weight and dark activated switch circuits. A number of its applications embody camera lightweight meters, street lights, clock radios, ray of light alarms, reflective smoke alarms, and outside clocks.

F. ULTRASONIC SENSOR

An ultrasonic sensor [10] is a device that measures the distance of a target object by releasing ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel quicker than the speed of hearable sound (i.e. the sound that humans can hear).

IV. PROPOSED SYSTEM ARCHITECTURE

In this paper our main aim is to propose model for Smart Home Automation. Proposed System Architecture is shown in the Figure 2.

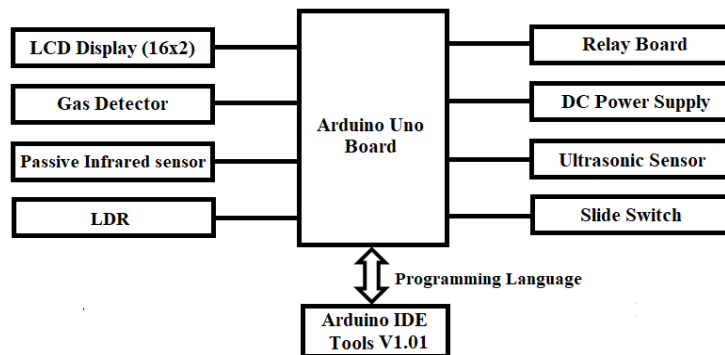


Fig. 2. System Architecture



In this project, we have connected 16*2 LCD Display to show informative message. The gas sensor will detect the level of leakage gas and show message according to that display e.g., LOW, MED, HIGH and if the intensity is very high then it shows the exit message on display. The LDR / PHOTORESISTOR works on intensity of light at night bulb is automatically turned ON and at the day bulb is turned OFF. The main thing is that the fan and light circuit is active only when someone is inside the room or someone is in front of PIR sensor.

V. RESULTS

In order to demonstrate and implement the system developed, we created a prototype which represents different home appliances. Thus, the whole system that has been developed is shown in Fig No.3.

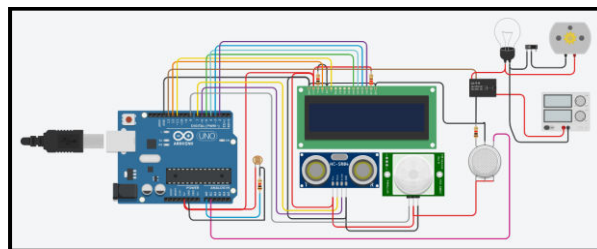


Fig. 3. Complete Circuit

The light and the fan are activated only when someone is inside the room shown in Fig. 4.

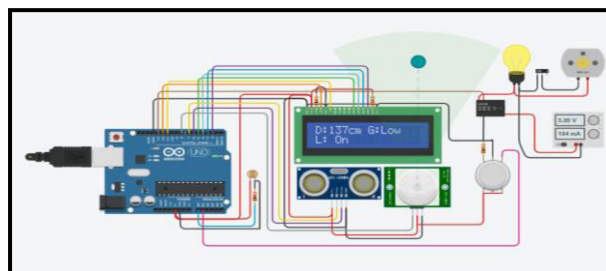


Fig. 4. Light and the fan are activated

Light is automatically turned on and off according to light intensity shown in Fig.5.

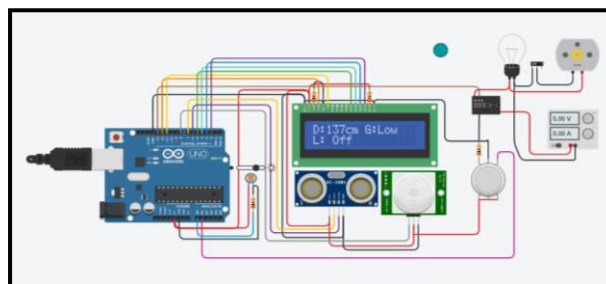


Fig. 5. Light is automatically turned on and off

Smoke Sensor detects the level of gas intensity and displays message according to that shown in Fig.6.

The Gas sensor detects the level of smoke. Currently, the level of smoke is low, so it shows LOW message on the LCD Display.

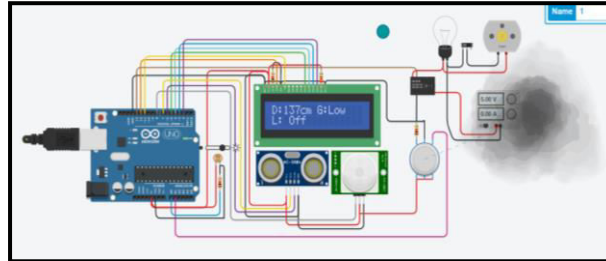


Fig. 6 LOW message is displayed on the screen

The level of smoke is medium now, so it shows MED message on the LCD Display shown in Fig.7

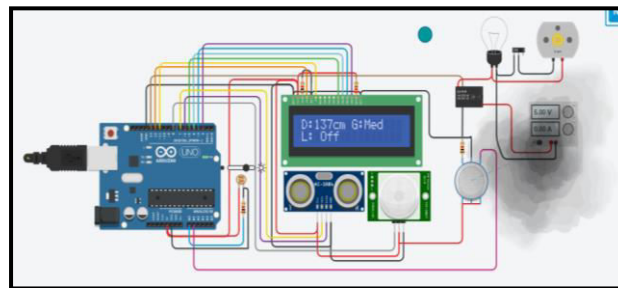


Fig. 7 MED message is displayed on the screen

The level of smoke is medium now, so it shows HIGH message on the LCD Display shown in Fig.8

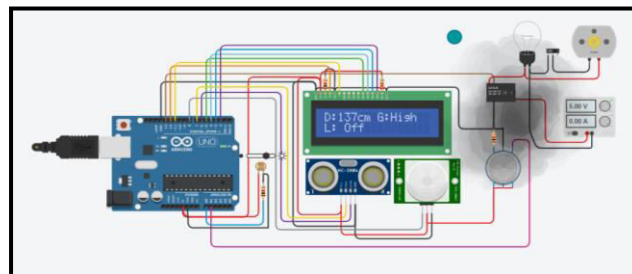


Fig. 8. HIGH message is displayed on the screen

If the intensity is extreme, then display shows EXIT message shown in Fig. 9

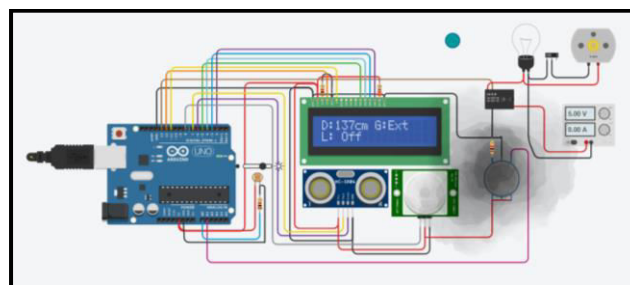


Fig. 9 EXIT message is displayed on the screen

We can place Ultrasonic Sensor in front of the door, to know the distance of person from it. Also, we can use Passive Infrared Sensor with Ultrasonic Sensor as shown in Fig.10 and 11.

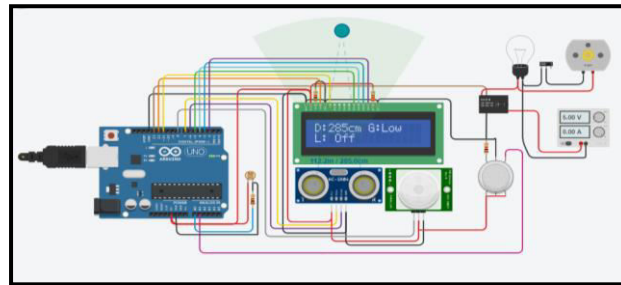


Fig. 10. LCD shows the distance of person from the door

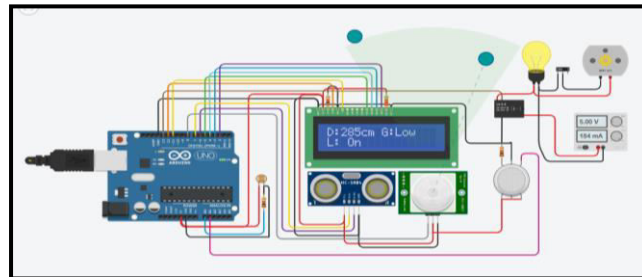


Fig. 11 PIR and ultrasonic sensor being used together

Slide Switch is also used to control the DC Fan manually as shown in Fig.12.

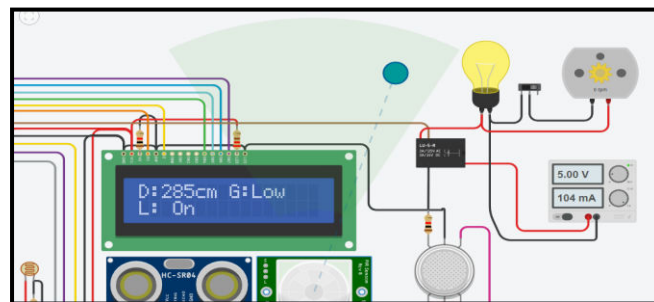


Fig. 12. Slide Switch is being used manually

VI. CONCLUSION

Smart Home Automation is done in IoT Domain. A novel architecture for an economic smart home system is proposed and implemented in this paper. It gives basic idea of how to control various home appliances and provide a security using Arduino Uno. The paper has proposed the idea of smart homes that can support a lot of home automation systems. A smart home comprises a linking between wireless communication, sensors, monitoring and security. For future work, some recommendation can be made like adding wireless connectivity and schedulers can be added for controlling home appliances. The whole system can be made-up as economic commercial hardware package.



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