

## Smart Home Automation Using ATMEGA328

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**ABSTRACT.** Automation is one of the applications of control systems and information technologies to cut back the necessary works for human in the assembly of products and services. In the field of industrialization, automation could be a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular necessities of work. In addition, automation greatly decreases the necessity for human sensory and mental requirements. The use of automation is increasing day by day in daily experiences and in the world economy. The idea of home automation has been a crucial issue in several publications and residential appliances corporations. Home automation could be a house or living setting that contains the technology to permit devices and systems to be controlled mechanically. Remote and native management is helpful to stay home snug and to support either older or disabled individuals. Hereby, the most effective and easiest method to automate the home appliances are discussed in this work. Among many ways and things to be automated, this paper mainly comprises of three things; Bluetooth based home automation using Arduino UNO, sensing the brightness through photo-resistor and actuating accordingly and the last one is water level indicator. Both hardware and software implementations are discussed serially. The experimental and observation analysis is also given for all three systems, simulation-based circuits are also being introduced and some techniques and tools related to the algorithm that works on a microcontroller are also discussed.

**Keywords:** Microcontroller; Arduino; Sensor; Actuator; Integrated Development Environment (IDE); Algorithm.

### INTRODUCTION

Technology is a never ending process. To be able to design a product using the current technology that will

be beneficial to the lives of others is a huge contribution to the community.<sup>1</sup> The idea of "Home Automation" has been existed for several years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house.<sup>2</sup> Thus the concept of smart home has focused the attention of researchers, lifestyle practitioners, and the consumers to be directed forward the usage of the recent technology. Significant endeavors have been made to the advancement of remote control frameworks for home computerization. The prior work of such frameworks are essentially founded on the utilization of phone line, for example, a telephone based framework for home computerization utilizing an equipment based remote controller dependent on a PC approach.<sup>3-5</sup> These kinds of systems which make use of the telephone as the remote control input device have no way to be connected through any user interface.<sup>6</sup> Concept of Bluetooth wireless technology has also been introduced which gave the idea to control different appliances that are connected over a Bluetooth network based on a mobile host controller.<sup>7, 8</sup> Internet based wireless home automated system for multifunctional devices has also been proposed.<sup>9</sup> Although the system features a low price and versatile wireless answer to the house automation, there are still some limitations associated with the wireless communication range and power failure. Home automation system supported Programmable Logic Controller (PLC) has also been introduced that uses household electric wire for communication and internet control with logging facilities.<sup>10</sup> Despite the fact that this framework method conquers the deficiencies of

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correspondences strategies, yet at the same time require some enhancement. System that uses a GSM-Bluetooth based controller and remote monitoring system is proposed.<sup>11</sup> A cost effective and flexible automation system has also been implemented through FPGA (Field-Programmable Gate Array) controller and mobile phone Bluetooth network.<sup>12</sup> This technique provides a parallel implementation of hardware results utilizing quick algorithmic rule execution. Moreover, A WiFi based automation system is implemented where a microcontroller and WiFi technology for remote control have been used.<sup>13</sup> Based on all the preceding materials, a design concept for smart home automation system using Arduino Uno microcontroller are proposed in this work. This paper presented the straight forward Arduino Uno implementation at the system. This system has two operational modes; Hardware based and software based. Both approaches have been provided in this paper.

## MATERIALS AND METHODS

Arduino is an open-source platform dependent on simple to-utilize equipment and programming. Arduino boards are able to scan inputs - and turn it into an output - activating a motor, turning on an LED, publishing something online.<sup>14</sup> Arduino board has 14 digital pins of input/output (from which 6 pins can be used as PWM outputs), 6 can be used as analog inputs, a 16 MHz crystal oscillator, a USB affiliation, a power jack, an ICSP (In-Circuit Serial Programming) header, and a reset button. This board has been packaged with all the things that microcontroller needs; so whether connect it to the computer via USB port or power it with an AC-to-DC adapter or use a battery to power up the board. The Uno doesn't use the Future Technology Device International (FTDI) USB-to-serial driver chip as compared to all the preceding boards. Instead, it provides the facility that Atmega8U2 programmed as a USB-to-serial convertor.

## RESULTS AND DISCUSSION

### Hardware Implementation

Hardware implementation mainly comprises of home automation, sensing of brightness through LDR and turn the lights on and the water level detector. The main components used in the entire project are listed below

- Arduino Uno Kit
- Relay Module

- Photo-Resistor
- BC547 transistor
- Light Emitting Diodes
- Arduino IDE
- Android apk
- Power supply

### Home Automation

A low cost and flexible design and implementation of a cell phone-based home automation is being presented in this paper. The design is based on a standalone Arduino UNO board and the home appliances are connected to the input/ output ports of this board via relays. The communication between the cell phone and the Arduino Bluetooth board is wireless. This system is intended to be low price and scalable permitting type of devices to be controlled with minimum changes to its core. The simple circuit diagram of home automation is shown in Fig. 1.

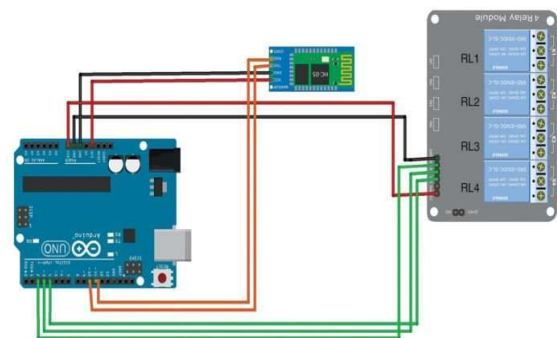


Fig. 1: Circuit diagram of home automation.

The Circuit Diagram in Fig. 1 has been implemented in a prototype house in Fig. 2. In order to automate the home relay module, Bluetooth module HC05 need to be interfaced with Arduino. It is clear from the Fig. 1 that the input pins of each relay are connected to the digital pins of Arduino, Vcc (Source pin) is connected to +5 V and GND (Ground) is connected to GND of Arduino. Similarly, four pins of the Bluetooth module have been used. Among them, Tx (Transmitter) and Rx (Receiver) of Bluetooth module are connected to Rx and Tx of Arduino respectively and Vcc and Gnd of Hc05 are connected to +5 V and Gnd of Arduino. The other side of Relay is connected to the appliances of 220 V such that normally closed NO pin is left empty while Common and normally open NO is connected such that common is connected through an appliance and NO is connected directly to 220 V. The principle of the circuit in Fig. 1 is such that microcontroller receives a signal from any Android app and the program uploaded on the

microcontroller directed it to ON and OFF when it receives a signal from android app. When Arduino receives signal then relay which is electromagnetic switch behaves accordingly that is it turns the appliances ON and OFF. The description of the android app and the program to be uploaded on Arduino is discussed later in this paper.



Fig. 2: Prototype for home automation.

*Sensing of Brightness through LDR*

Light Sensors are photoelectric devices that convert light energy (photons) whether infra-red or visible light, into an electrical signal (electrons). In order to detect the intensity of light or darkness, a sensor is used called an LDR (light dependent resistor). The LDR could be a special form of resistance that permits higher voltages to undergo it (low resistance) whenever there's a high intensity of sunshine, and passes a low voltage (high resistance) whenever it is dark. The simple schematic and circuit diagram of LDR is shown in Fig 3.



Fig. 3: Block diagram of LDR sensor.

Fig. 3 shows the block diagram of LDR sensor through which the working of sensor can be easily understood. It is clear that LDR or photo resistor sense the brightness

of light and change the voltage across it accordingly which is the signal for Arduino. Arduino transmits that signal to relay through which 220 V appliance can be easily turned on and off when LDR sense low brightness and high brightness. Fig. 4 shows the complete schematic of the LDR interfacing with microcontroller. It can be seen that the one leg of LDR is directly connected to the +5 V of Arduino and the other leg is connected to ground through 10 K resistor and the same leg is connected to the analog pin of Arduino which transmits the sensed signal.

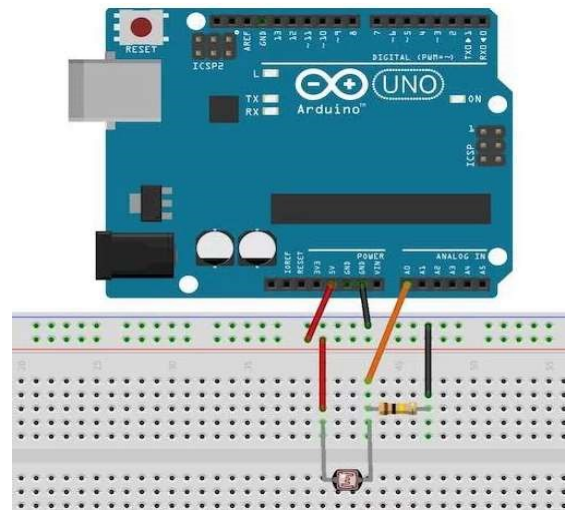


Fig. 4: Circuit diagram of LDR interfacing with Arduino.

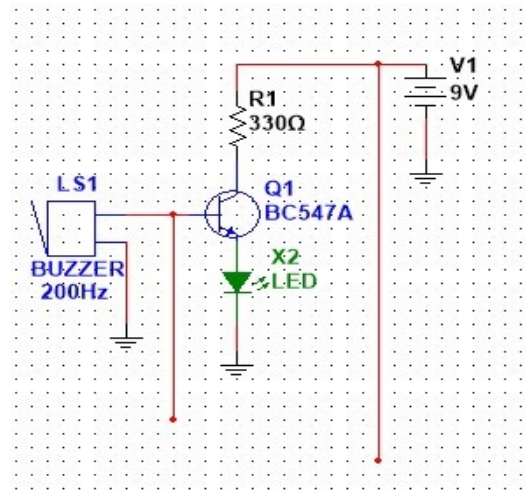


Fig. 5: Schematic of water level indicator.

*Water Level Indicator*

Generally, water hold on in overhead tank is wasted because of over flow, once the tank is full. Water level alarm using transistors like BC547 is shown in this paper. Fig. 5 shows the complete circuit diagram of water level indicator. Base of transistor is connected to the buzzer and the other end of buzzer is grounded, emitter is also grounded through an LED while collector

is connected to 9 V DC through 330 ohm resistor, the two wires in the air shown in Fig. 5 is going to be dipped in water tank. When there is no water in the tank, the LED is OFF indicating that tank is empty and when water reaches to the desired level two wires got shorted through water (as electricity conductor) and the buzzer and LED start blowing to show the tank is full.

### Software Implementation

In order to direct the Arduino what to actuate, a program written in C/C++ has need to be uploaded in a microcontroller. Arduino provided its own integrated development environment (IDE) on which sketch is written and then uploaded into the microcontroller. The syntax is somewhat similar to the C/C++ but Arduino also contains its own built-in functions and classes.

In Fig. 6, basic initialization is given. In line#14 analogRead function is used to read the sensed brightness through LDR in terms of signal voltages and the value is going to be stored in sensorValue variable. Then this value is compared with the limit (below which, light will turn on) and giving commands with the help of digitalWrite functions according to the brightness of light. In line#22 Serial.available functions check that if there is any byte available in the buffer and then this byte is read out through Serial.read and stored in variable c. However, line#28 checks if there is a value stored in value variable and printed out that value on serial monitor of Arduino.

```

13 void loop() {
14   int sensorValue = analogRead(sensorPin);
15
16   if (sensorValue<=limit){
17     digitalWrite(ldr,HIGH);
18   }
19   else {
20     digitalWrite(ldr,LOW);
21   }
22   while(Serial.available()){
23     delay(3);
24     char c = Serial.read();
25     value +=c;
26
27   }
28   if(value.length(>0){
29     Serial.println(value);
30   }

```

Fig. 6: Coding of basic initialization.

In Fig. 7, it is shown that the ON and OFF command will be sent through an android app. This app sends the command of ON and OFF in terms of unique strings and these strings are then understood by microcontroller through coding given in Fig. 8. Line#31 to onwards compared the input strings and then commanded the Arduino through digitalWrite Function to actuate accordingly. In this manner for the automation of every home appliance two IF blocks are required in coding, one for comparing the ON command String and other for Comparing the OFF command string. In this case "1", "2" is used for ON and "A" and "B" is used for OFF.

```

31 if (value=="1")
32 {
33   digitalWrite(pin1,HIGH);
34 }
35 if (value=="A") {
36   digitalWrite (pin1,LOW);
37
38 }
39 if (value=="2")
40 {
41   digitalWrite (pin2,HIGH);
42 }
43 if (value=="B") {
44   digitalWrite (pin2,LOW);
45 }

```

Fig. 7: Comparison of strings sent by an Android app.

## CONCLUSION

In this paper, a design, concept, and implementation of a wireless smart home automation system based on Arduino Uno microcontroller (ATMEGA328) as central controller have been obtained. The design and implementation of this system are of low cost, secure, ubiquitously accessible and auto-configurable as compared to the other approaches presented previously in the literature. The approach mentioned in the paper has achieved the target to manage home appliances. This system is often simply factory-made on an oversized scale for mass adoption as a result of its simplicity and easy style. Another advantage is that fact that application software is based on Android, which today has the largest smartphone base. Moreover, implementation of wireless Bluetooth affiliation along with microcontroller permits the system installation in additional straightforward means. However, for

disabled and old aged peoples it has become very easy to control their home appliances by just sitting at one place. In contradiction, this technology is not limited to

just homes and factories but with this, in mind, one can also automate approximately all the things related to life.

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