WAVE

Subject: Digital Logic Circuit
Course Code: EL101

REPORT INFO

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1.Introduction

Home Automation is the new trend in a consumer market. There are many home automation systems with different features and facilities. All the home automation systems are used to control home appliances through a remote control. The remote control can be a stationary unit or a wireless remote. The remote used for controlling appliances usually have keys or touch-based sensors. In this project, a home automation system is designed which can be controlled by gestures.

The prototype designed in this project controls two appliances which are taken 15 milli watt bulbs for demonstration. The user can select the appliance to be controlled through a display which shows the list of appliances in a drag-able fashion. The user can swipe through the devices by moving a finger in left or right direction and switch the appliance ON or OFF by moving a finger in an upward or downward direction.

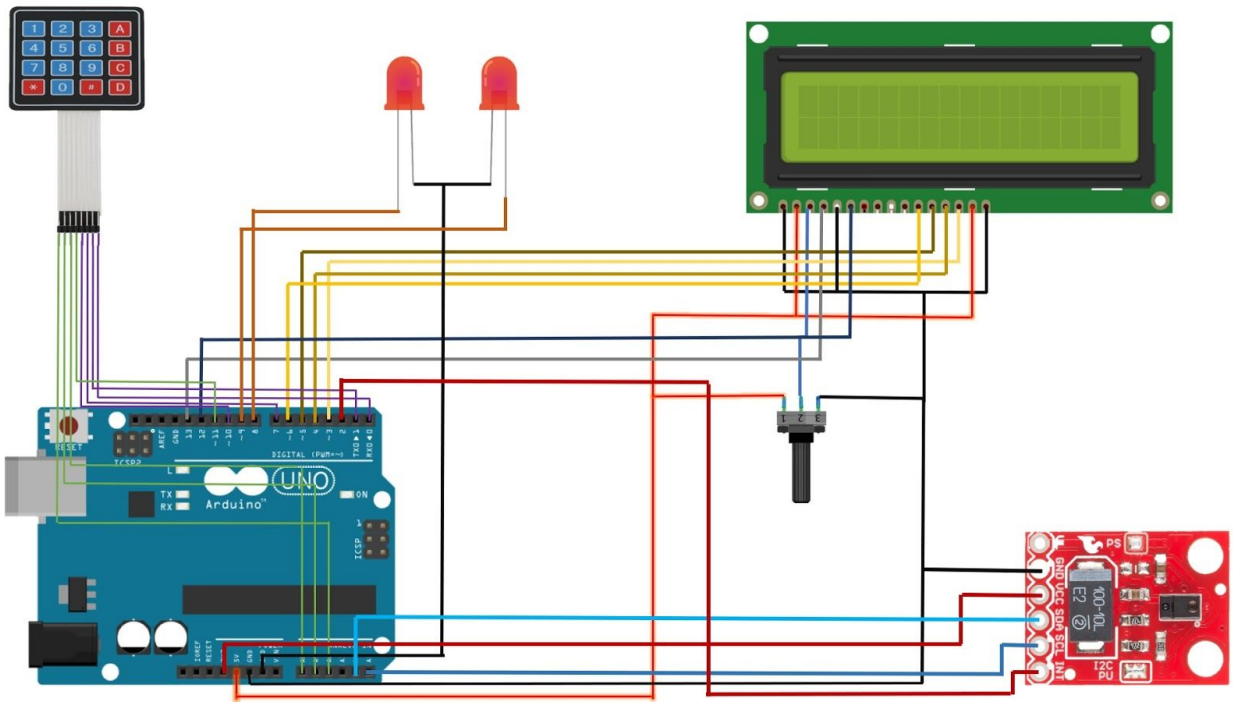
For gesture recognition, APDS-9960 gesture sensor is used. This is the same sensor which is used in Samsung Galaxy S5. The module used in the project has a small breakout board sensor with built in APDS-9960 sensor. The sensor has ambient light detection, color measuring, proximity detection and gesture sensing features. The sensor has on-chip UV and IR blocking filters, four separate diodes sensitive to different directions and I2C compatible interface for communicating with embedded controllers.

The project is built on Arduino UNO and has LCD module for the user interface, APDS-9960 gesture sensor for user input and a relay circuit to drive appliances ON or OFF, interfaced to it. An open-source library for interfacing APDS-9960 gesture sensor with the Arduino is utilized in the project. The Arduino code is written on the Arduino IDE and burnt to the board using AVR Dude. The relay circuit controlling the appliances is hard wired with the Arduino based remote control.

2.Components

- Arduino UNO
- 5mm LED
- 10K ohm PRESET
- Transistor (BC547)
- APDS-9960 gesture sensor
- LCD 16x2 Display
- Jumper wires
- 9V Battery
- Keypad

3.Circuit Connections



The gesture sensor, and the LCD module are interfaced with the Arduino board. The Arduino UNO controls and operates the different interfaced sensors, and modules. The circuit connections are as follows –

Power Supply – In the circuit, Arduino board and LCD module need a 5V regulated DC. A 9V battery is used as a primary source of power in this prototype.

16X2 LCD: The 16X2 LCD display is used to display the drag-able list of devices. It is connected to the Arduino board by connecting its data pins to pins 3 to 6 of the Arduino board. The RS and E pins of the LCD are connected to pins 13 and 12 of the Arduino UNO respectively. The RW pin of the LCD is grounded.

LCD	Arduino UNO
RS	13
RW	GRND
E	12
D7, D6, D5, D4	3, 4, 5, 6 respectively

APDS-9960 gesture sensor – The APDS-9960 sensor module has six pins – VL, Ground, VCC, SDA, SCL and Interrupt. The VL pin is provided to supply power to the IR LEDs if PS jumper is disconnected. If IR LEDs are provided power through VL pin, it should be 3 to 4.5 V. In the project, PS jumper is used so the VL pin is disconnected. The Ground and VCC pins are used to supply power to the module itself. SDA is I2C data and SCL is I2C clock pin. The interrupt pin is an external interrupt pin which is active LOW on interrupt event.

There are two solder jumpers on the module – PS which connects the power supplies of the sensor and IR LED together so that IR LEDs need not provided power separately and I2C PU which is used to connect and disconnect the I2C pull-up resistors.

In the circuit, the VL pin is not connected. The VCC and Ground pins of the module are connected to the common VCC and Ground. The SCL, SDA and INT pins of the module are connected to SCL, SDA and pin 2 of the Arduino board. The pull-up resistors of 4.7 K ohms are used at the SDA and SCL pins of the module. If the module is not working properly, first connecting pull-up resistors should be tried. For programming the module, the SparkFun APDS-9960 gesture sensor library is used. The SparkFun APDS-9960 gesture sensor library is used because it is compatible with other vendors also and can be easily tested with GestureTest example. Within the library, there is file SparkFun_APDS9960.cpp in which a function bool SparkFun_APDS9960::setGestureGain(uint8_t gain) is provided to set the gain factor of the sensor. In this function, the sensitivity level can be changed by modifying the following statement – gain = gain << 3; The gain factor can be set to 3, 2, 1 or 0 depending upon the desired sensitivity of the sensor. During the project development, this was set to 3.

Keypad - The pins of the keypad are connected to the digital and analog pins of the arduino UNO which is used for user recognition using a predefined password which can be changed in the code.

4.Working

Once the circuit is powered using the battery, the Arduino board loads the required libraries. The Sparkfun library handles the operation of gesture sensor. Initial messages are passed to the LCD module and the module starts displaying the horizontal list of appliances. The user can swipe through the appliances by hovering finger left or right over the gesture module. On hovering the finger upwards, the selected appliance is switched OFF by sending LOW logic at the respective Arduino pin connecting the respective appliance. On hovering the finger downwards, the selected appliance is switched ON by sending HIGH logic at the respective Arduino pin that controls the respective appliance.

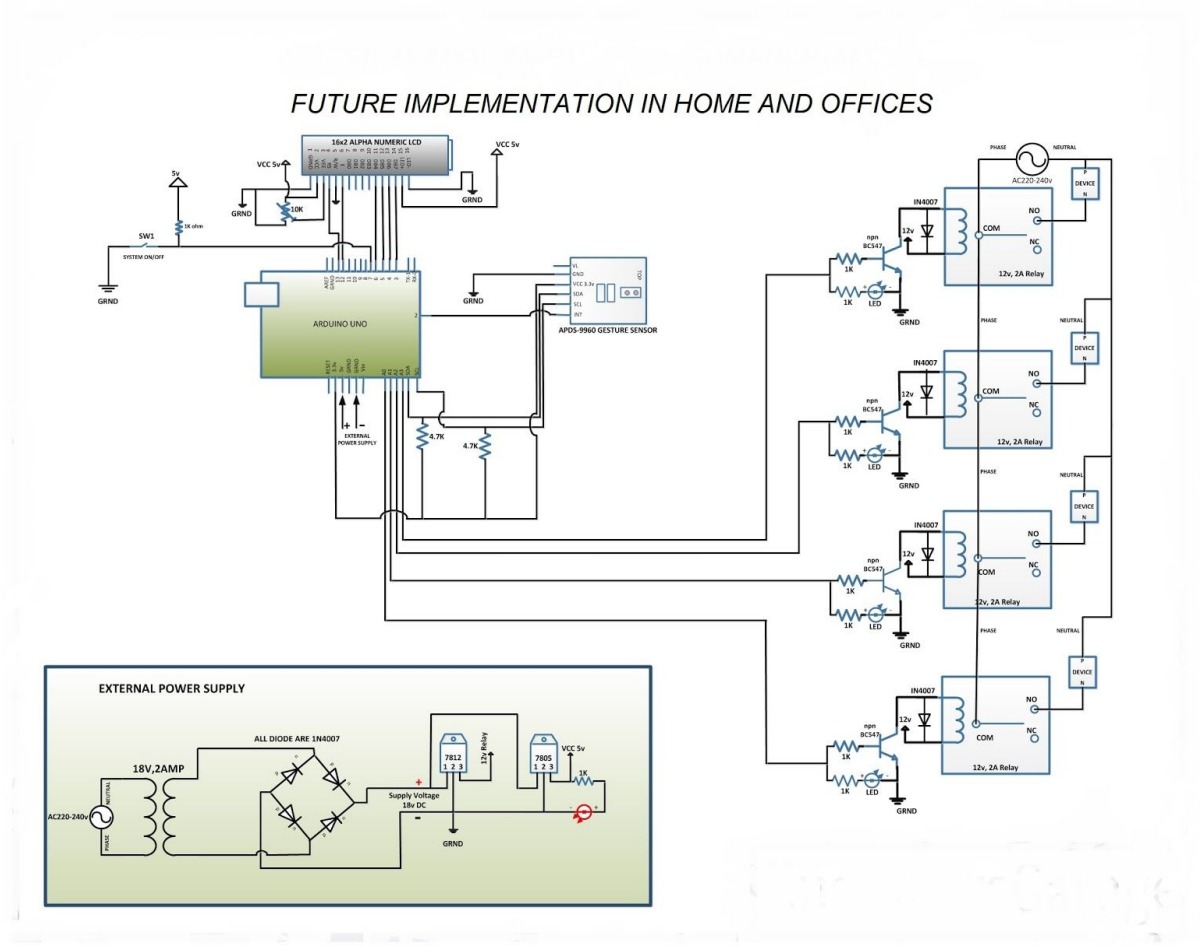
The gestures of moving finger upward, downward, left, right, far and near are detected by using the Sparkfun library's readGesture() method and accordingly, the value of certain variables is changed in the code. The status of these variables is traced to determine the selected appliance and changing the ON/OFF status of the current appliance on the list.

The proximity detection feature of the module is used to control all the appliances together. If the finger is brought near the sensor module, all the appliances are switched ON and if the finger is taken away from the sensor module, all the appliances are switched OFF.

4.Conclusion

The above circuit is just a prototype of the actual product to be implemented in alternating current circuit. We can connect each and every appliance to this device and start running each and every device simultaneously. The circuit for future implementation is shown

below.


FUTURE IMPLEMENTATION IN HOME AND OFFICES
16x2 ALPHA NUMERIC LCD
VCC 5v
GRND
10K
SW1
SYSTEM ON/OFF
ARDUINO UNO
APDS-9960 GESTURE SENSOR
EXTERNAL POWER SUPPLY
4.7K
4.7K
AC220-240v
IN4007
12v
npn BC547
1K
LED
COM
NO
NC
12v, 2A Relay
PHASE
NEUTRAL
DEVICE
EXTERNAL POWER SUPPLY
ALL DIODE ARE 1N4007
18V,2AMP
AC220-240v
Supply Voltage 18v DC
7812
7805
12V Relay
VCC 5v
1K