

Smart Windows Using Internet of Things in Embedded Systems

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Abstract : Due to the rapid changes in the temperature daily sometimes it is becoming difficult for the people in their house to recognize the changes occurred outside. During the sunrise and sunset the temperature changes will occur. It is a work to open and to close the doors and windows of the house. This paper proposes a framework for opening the windows of the house using sensors in the embedded systems. It also includes the Arduino Uno and the GSM system to send the message to the user in case any gas leakage occurrence. The Gas sensor, Temperature sensor, Light Dependent Resistor sensor and servo motor are used in this approach. The Internet of Things is used to maintain smart windows in the house and to overcome the challenge of opening and closing the door irrespective of any temperature and light changes in the day to day life.

IndexTerms - Sensors, Arduino Uno, embedded system, GSM, Gas sensor, Temperature sensor, Light Dependent Resistor sensor and servo motor.

I. INTRODUCTION

Daily we opening and closing the windows is a work by humans. To avoid this work the Smart Windows is a home based technology which provides the smartness to the home automation. Without any manpower opening and closing of windows can be done automatically by the temperature, light intensity, and weather conditions. It will also provide warning alerts, when any gas leakages are occurred. In this automation of daily tasks through Internet of Things (IOT) [1] leads to opening and closing of windows automatically by using different sensors, GSM module and Arduino Uno. Different sensors which includes the Gas sensor, Temperature sensor, Light Dependent Resistor (LDR) sensor and servo motor. Maintenance of room temperature is done by using different types sensors in the embedded system.

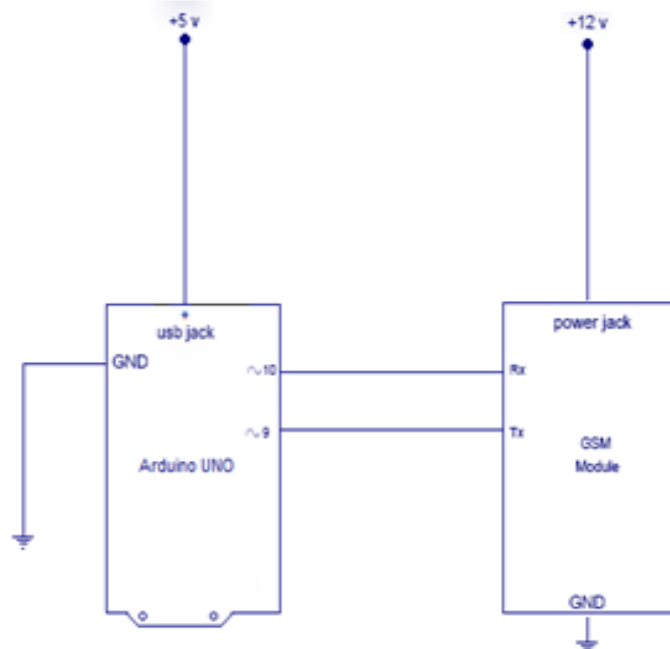


Fig.1: Circuit of GSM

Global System for Mobile Communication (GSM) module is used for generating the message to the user if in case any gas problem occurs in the home which is a digital cellular system used for mobile devices [2]. This module allows the users to send or receive data over General Packet Radio Service (GPRS) [3] and send or receive SMS or voice calls. For using GPRS for internet access and to request or serve web pages, the Access Point Names (APN) which uses a username or password from network operator. Thus, the user can easily know the gas problem.

The Light Dependent Resistor (LDR) sensor [4] detects the light intensity i.e., sunlight to open the window and darkness i.e., night time closes the window [5]. An alarm is used when any gas leakages takes place which creates a buzzer sound. Then a message is generated that a gas leaked in their home. The Graphical User Interface is used to alert the user when any gas leakage problem occurs. The figure 1 shows the Circuit of GSM module.

An Arduino [6] consists of physical programmable circuit board which is referred as a microcontroller and software or an Integrated Development Environment which is used to write and upload computer code to the physical board. The following is the figure 2 of Arduino Uno.

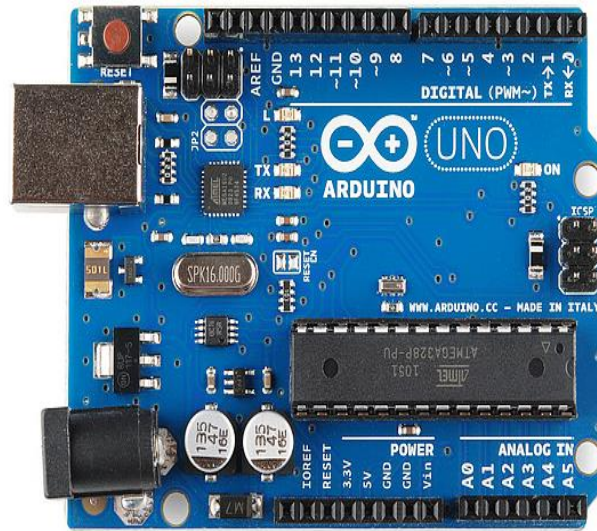


Fig.2: Arduino Uno

II. RELATED WORK

To detect the different types of weather conditions there are different sensors.

2.1 Temperature Sensors

The temperature sensor measures the rise and drop of temperature in the weather condition. Temperature Sensors [7] are directly connected to the microprocessor input which has the capability to have the direct and reliable communication with microprocessors. The sensor unit can communicate effectively and directly with the processor.

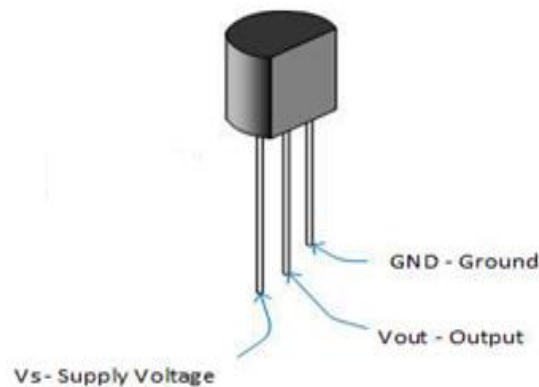


Fig. 3: Temperature Sensor

The above figure 3 shows the temperature sensor which has supply voltage, output and ground connections.

2.2 Servo Motor

An electrical device which is used to push or rotate an object with great precision is a servo motor. The rotation of the object at certain angles is done through the servo motor [8]. If in case the DC current power is used then it is called as DC servo motor and AC current power is used then it is called as AC servo motor. Servo motor consists of the Controlled device, Output Sensor, Feedback system internally. The following figure 4 shows about the servo motor.



Fig. 4: Servo motor

2.2 Servo Motor

Light Dependent Register (LDR) Sensor [9] is basically a photocell that works on the basis of the principle of photoconductivity. The passive component is basically a register in which whose resistant value decreases when the intensity value decreases. This optoelectronic device is mostly used in the light variant sensor circuits like light and dark activated switching circuits. The below figure 5 shows the working of LDR sensor.

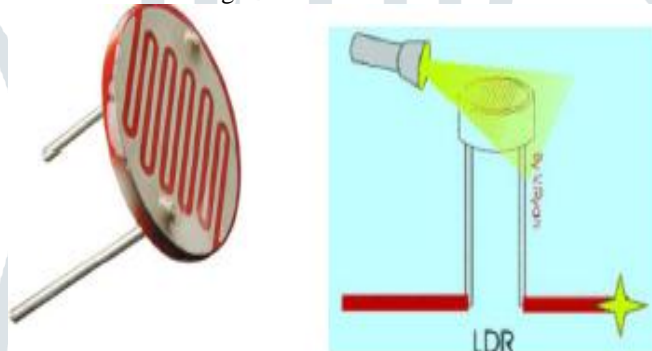


Fig. 5: LDR Sensor

2.3 GSM Module

System for Mobile Communication (GSM) [10] is a mobile communication modem which can be either a mobile phone or a mobile device which can be used to make a computer or any other processor to communicate over a network. GSM modem requires a SIM card for operation over a network range which is subscribed by the network operator. It can be connected to a computer through a serial bus or USB or a Bluetooth connection.

2.4 Gas Sensor

Gas Sensor module [11] is used for finding the gas leakage detection in the house or an industry. It is mostly suitable for detecting H_2 , CH_4 , CO , Alcohol, Smoke or Propane. Due the fast response time and high sensitivity the measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by the servo motor.



Fig. 6: Gas Sensor

The above figure 6 shows the gas sensor. The main features of Gas Sensor are wide detecting scope, suitable and long life time, fast response and high sensitivity. As the concentration of the gas increases the output voltage of the gas increases. The sensitivity can be adjusted by adjusting the servo motor.

2.4 Buzzer

The buzzer shown in the below figure 7 gives a sound alert to the user when there exists a gas leakage. It automatically warns the user to check the gas and opens the window automatically for safety along with buzzer sound [12].

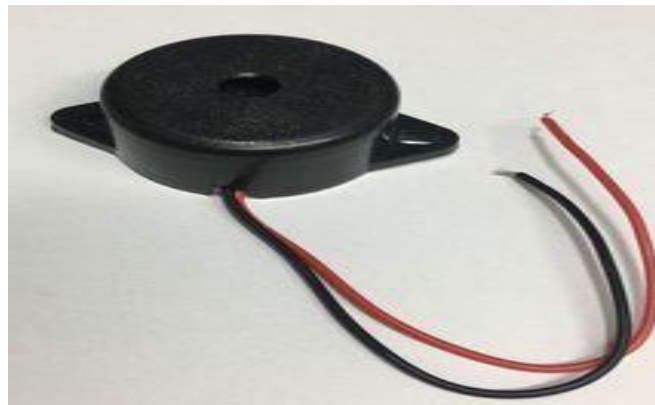


Fig. 7: Buzzer

III. PROPOSED APPROACH

The Aurdino is used to connect to the Servo Motor in which the LDR Sensor and temperature sensor to detect the weather condition such as sunlight and sunset to open or close the window. In case any gas leakage occurred the gas sensor is used for detecting it and the GSM module is used for sending the alert message to the specific person along with Opening the window when the gas is leaked.

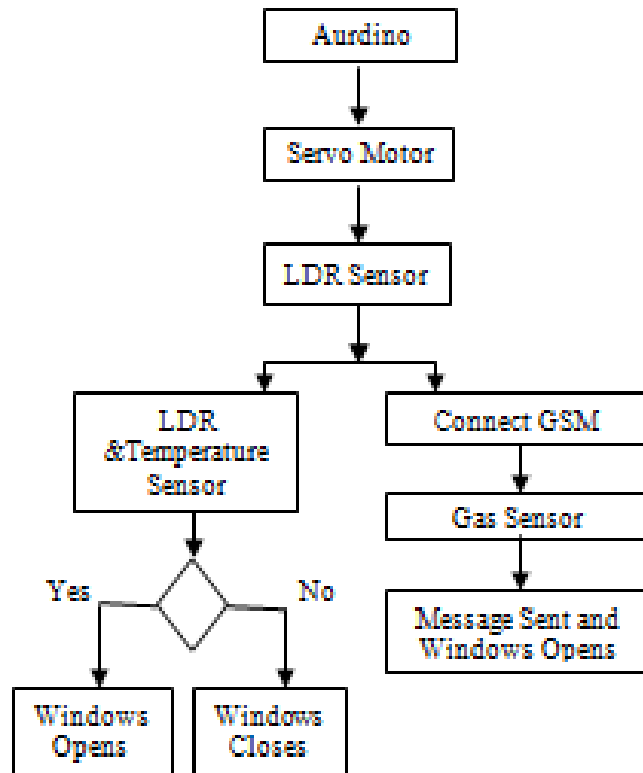


Fig. 8: Proposed approach for smart windows

The above figure 8 shows the proposed approach used in the smart windows. By using Internet of things like sensors detect the temperature changes and gas leakage. This proposed approach controls over the smart windows by opening and closing by the LDR Sensor. The temperature sensor detects the temperature or in case any gas leakages occur it secures by the gas sensor and gives the alarm alert. From the servo motor the window is opened and closed automatically based on the sensor data. In case any gas leakage problem occurred in the home it sends the warning message that the gas leaked to the user and opens the window automatically.

EXPERIMENTAL ANALYSIS

Using embedded system in the smart windows through different sensors the opening and closing of windows is decided by the gas intensity and temperature changes. The normal temperature range increases when the gas intensity in the home increases. When the temperature increases the windows will be automatically open and send the alert message to the user. The following table shows the gas intensity percentage and the room temperature relatively increases. Finally, the windows of the room will be opened if the gas intensity or temperature is high.

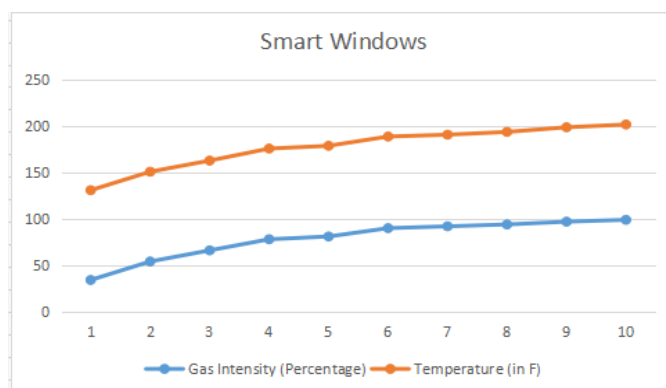


Fig 9: Gas Intensity and Temperature Changes Graph

Using the sensors in the smart windows based on Internet of Things, the embedded system is designed that sunrise and sunset is indicated by the lightning effects. The opening and closing of the windows automatically is done by knowing the light falling on the LDR and Temperature sensors.

IV. CONCLUSION

The sensors are to detect the temperature and gas leakages in the day to day environment. In case any gas leakage occurs it is used for the user to know by sending the alert message by using GSM module and opens the windows. There is another advantage of smart windows is it automatically closes and opens the windows when the sunset and sunrise occurs respectively. Thus, this smart window is used in the day to day life to avoid the closing and opening the windows work..

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