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Design of a smart home automation Using Virtual Instrumentation

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Abstract: Smart home is a house that uses computerized technology to monitor the environment, control the electric appliance and communicates with the outer world. Smart home is a complex technology, at the same time it is flourish. A smart home automation system has been establish to automatically achieve some activities performed frequently in daily life to obtain more comfortable and easier life environment. A sample house environment monitor and control system that is one route of the Smart home is addressed in this project. The structure is act as a security guard for the home. This system can monitor the temperature, humidity, lighting, fire & burglar alarm, gas density of the house and have infrared sensor to guarantees the family security. The system also has internet connection to monitor and control the house equipment's from anywhere in the world.

Index Terms- Smart House, LabVIEW, Arduino, Data Acquisition Card, Remote Control
.

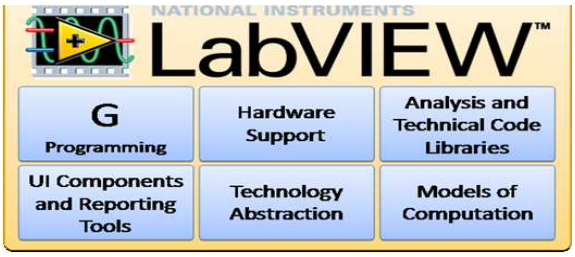
1. INTRODUCTION

With the development of new electronic technologies and their integration with older, traditional building technologies, smart house is at last becoming a real possibility. Possibly the first "home computer" was an experimental system in 1966.The Smart House Project was initiated in the early 1980's as a project of the National Research Center of the National Association of Home Builders (NAHB) with the co operation of a collection of major industrial partners . Smart House is not a new term for science society but is still far more away from people's vision and audition. This is because although recent various works has been done in designing the general overview of the possible remote access approaches for controlling devices, or in cases simulating the Smart house itself, and designing the main server, the design and implementation of an off-the-shelf Smart House remote control application has been limited to simply the computer applications and just in cases mobile and web applications development. The "smart house" technology is on realization of home automation ideals using a specific set of technologies. It's a house that has highly advanced automatic systems for lighting, temperature control, security, appliances, and many other functions. Coded signals are sent through the home's wiring to switches and outlets that are programmed to operate appliances and electronic devices in every part of the house. A smart home appears "intelligent" because its computer systems can monitor many aspects of daily living .As the number of controllable appliances in the home rises, the ability of these devices to interconnect and communicate with each other digitally becomes a useful and desirable feature. The consolidation of control or monitoring signals from appliances, fittings or basic services is an aim of home automation. Smart house technology can interface basically using computer interface. Smart house can also provide a remote interface to home appliances or the automation system itself, via telephone line, wireless transmission or the internet, to provide control and monitoring via a smart phone or web browser. This work presents smart house controlled by LabVIEW that controls main system. The main system consists of five parts; these five parts are connected to LabVIEW software as the main controller for these systems.

2. LABVIEW

NI LabVIEW software is used for a wide variety of applications and industries. LabVIEW is a highly productive development environment for creating custom applications that interact with real-world data or signals in fields such as science and engineering. The net result of using a tool such as LabVIEW is that higher quality projects can be completed in less time with fewer people involved. So productivity is the key benefit, but that is a broad and general statement. LabVIEW is unique because it makes this

wide variety of tools available in a single environment, ensuring that compatibility is as simple as drawing wires between functions. LabVIEW itself is a software development environment that contains numerous components, as shown in



***G Programming Language**:*

The G programming language is central to LabVIEW; so much so that it is often called "LabVIEW programming."Using it, you can quickly tie together data acquisition, analysis, and logical operations and understand how data is being modified. From a technical standpoint, G is a graphical dataflow language in which nodes (operations or functions) operates on data as soon as it becomes available, rather than in the sequential line-by-line manner that most programming languages employ. You lay out the "flow" of data through the application graphically with wires connecting the output of one node to the input of another. LabVIEW contains a powerful optimizing compiler that examines your block diagram and directly generates efficient machine code, voiding the performance penalty associated with interpreted or cross-compiled languages. The compiler can also identify segments of code with no data dependencies(that is, no wires connecting them) and automatically split your application into multiple threads that can run in parallel on multi core processors, yielding significantly faster analysis and more responsive control compared to a single-threaded ,sequential application

Examine the following considerations:

▪ Graphical data flow is the default model of computation for LabVIEW

.▪ State charts provide a higher level of abstraction for state-based

▪ Simulation diagrams are a familiar way of modeling and analyzing dynamic systems

. ▪ Formula No deputes Simple mathematical formulas in line with your G code.

▪LabVIEW Math Script is math-oriented, textual programming for LabVIEW that you can use to call m files without the need for extra software.

▪ CLIP and IP integration nodes import FPGA intellectual property so you can use VHDL. These flexible models of computation allow picking the right tool for the particular problem you are trying to solve. In any given application you will likely want to use more than one approach, and LabVIEW is the perfect tool to quickly tie everything together.

3. EXISTING METHOTOLOGY

Transmitter remote control implementation Both RF Module and IR systems are used to implement the remote control system. PIC16F877A is used as a controller and a processing unit in remote control Unit. PIC16F877A is programmed to have eleven input port and six output port to implement the remote control. All of the inputs are connected with button switch to send a signal to PIC16F877A for the difference operation in the system. For output port, four are used to send a parallel code to the RF Module encoder. Then transfer it to serial code and send it to RF module transmitter unit. Also one port is used to send data to IR transmitter, and finally another port is used to connect it with led to make indicator for sending data from PIC16F877A. In the same time of switching the different load, PIC16F84A will send output signal to buzzer to make a sound as indicator about the change in the loads condition; that means that every buzzer sound give us a sense that the load is on or off. IR receiver output signal is connected with one pin of coding pins of RF module decoder. This pin will be activated when the IR signal reach the room receiver unit, and in the same time the same pin in RF module encoder in remote control unit is originally connected as same way in the decoder IC. Using this way enables us to connect the two side of RF module only when the remote control unit is guided to room receiver unit, and this system give us the ability to install room receiver unit in any room inside the house.

4. PROPOSED METHODOLOGY

Arduino

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers.

These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages.The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be manufactured by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands. To replace the DAQ card, this Arduino methodology is proposed.

Features:

- + 5V power supply (Also available for + 3V)
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED) ,Optional for + 3V power supply
- Intelligent, with built-in Hitachi HD44780 compatible LCD controller and RAM providing simple interfacing
- 6.61 x 15.8 mm viewing area
- 7.5 x 7 dot matrix format for 2.96 x 5.56 mm characters, plus cursor line
- Can display 224 different symbols
- Low power consumption (1 mA typical)

5. BLOCK DIAGRAM DESCRIPTION

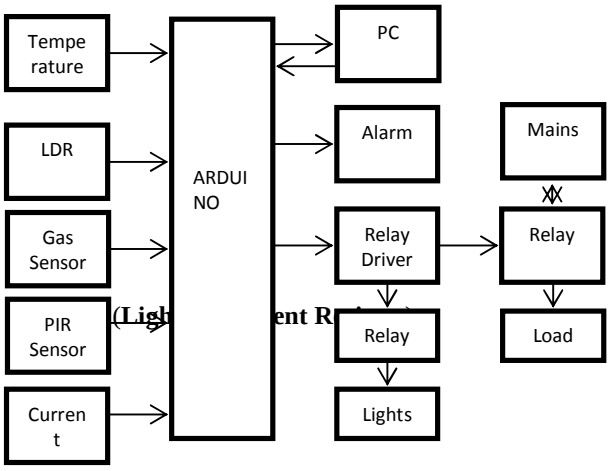


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Figure5.2 LDR

An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient Light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS).

An LDR has a zigzag cadmium sulphide track. It is a bilateral device, *i.e.*, conducts in both directions in same fashion.

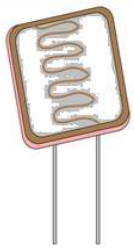
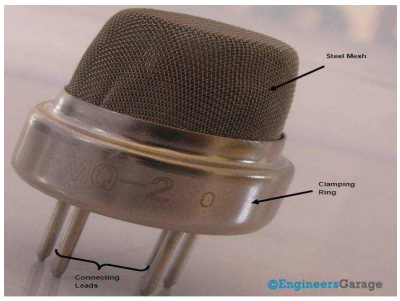


Photo resistor or **light-dependent resistor** (**LDR**) or **photocell** is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as a few mega ohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the

semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands. A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called do pants, and added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

GAS SENSORS

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a **methane gas sensor** that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current. The **gas sensor module** consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.



External of gas sensor

Image shows externals of a standard gas sensor module: a steel mesh, copper clamping ring and connecting leads. The top part is a stainless steel mesh which takes care of the following:

- Filtering out the suspended particles so that only gaseous elements are able to pass to insides of the sensor.
- Protecting the insides of the sensor.
- Exhibits an anti explosion network that keeps the sensor module intact at high temperatures and gas pressures.
- In order to manage above listed functions efficiently, the steel mesh is made into two layers. The mesh is bound to rest of the body via a copper plated clamping ring. The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part.

PASSIVE INFRARED SENSOR

A Passive Infrared sensor (PIR sensor) is an electronic device that measures infrared (IR) light radiating from objects in its field of view. PIR sensors are often used in the construction of *PIR*-based motion detectors. A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. Apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall.It is usually infrared radiation that is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term passive in this instance means that the PIR device does not emit an infrared beam but merely passively accepts incoming infrared radiation.Every

object that has a temperature above perfect zero emits thermal energy (heat) in form of radiation. The PIR sensors are tuned to detect this IR wavelength which only emanates when a human being arrives in their proximity. The term "pyro electricity" means: heat that generates electricity (here, an electric signal of small amplitude). Since these sensors do not have an infrared source of their own, they are also termed as passive.

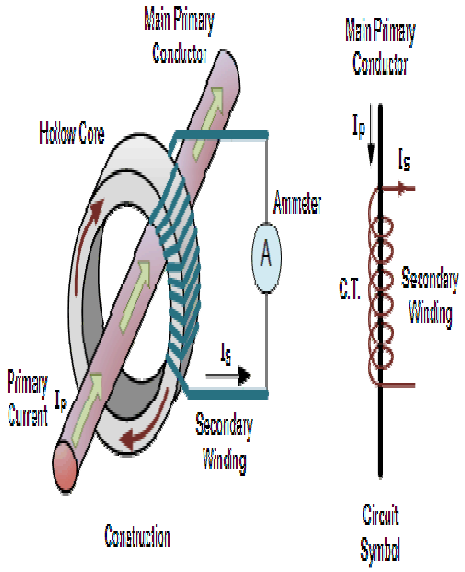
CONSTRUCTION

On closely observing the top region of the sensor, the beehive structure, curved segments are seen. These curved segments are Fresnel lenses which constitute an array that increases the detection zone of the sensor. Fresnel lens array is known to capture more infrared radiation and focus it to a relatively smaller point. Detection is more stable and maximum distance for detection is also increased. Fresnel lens has been crafted to be translucent so that it can capture only infrared radiation without getting unwanted radiations from visible spectrum of light.

At the top of the sensor is the infrared filter. Looking more like a square shaped glass, this filter selects the desired wavelength at which sensor is desired to respond. Since this sensor is designed to detect human presence, the wavelength chosen is 8micrometer to 14 micrometer which is the range within which human body radiates electromagnetic rays.

CURRENT TRANSFORMER

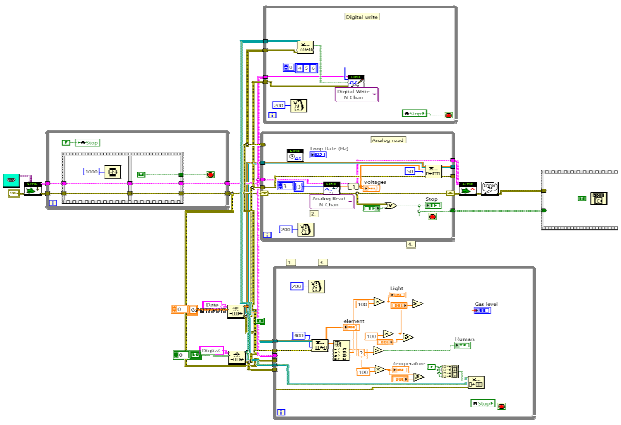
The Current Transformer (CT) is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers are generally used to measure currents of high magnitude.Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current flowing in an AC transmission line using a standard ammeter. The principal of operation of a current transformer is no different from that of an ordinary transformer.



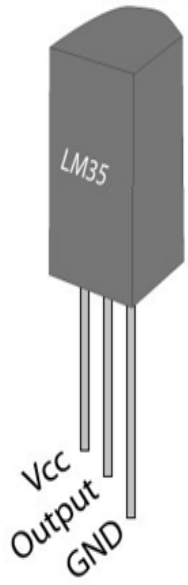
A current transformer (CT) is used for measurement of alternating electric currents. When current in a circuit is too high to apply directly to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. A current transformer isolates the measuring instruments from what may be very high voltage in the monitored

circuit. Current transformers are commonly used in metering and protective relays in the electrical power industry.

TEMPERATURE SENSOR LM35 is a IC **temperature sensor** with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1^{o}C temperature rise in precision still air.
The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C rise/fal



l in ambient temperature, *i.e.*, its scale factor is 0.01V/^{o}C.



With technological advances, the control in smart house systems evolve and include new and sophisticated methods based on different control programs and systems. In this paper we use LabVIEW program, and remote control to control the different systems in the smart house model. The control of the smart house is divided into two different types of control as shown in Figure 3.

Figure 1

OUTPUT DISPLAY

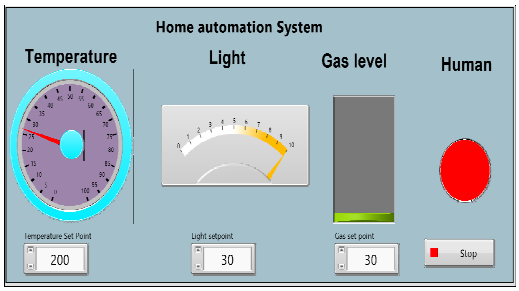


Figure **2**

6 CONCLUSION

This project **"**SMART HOME AUTOMATION THROUGH LABVIEW**"** has been completed successfully and the output results are verified. The results are in line with the expected output. This project has been checked with both software and hardware testing tools. In this work "LCD, Temperature Sensor, Relay and Gas sensor," are chosen are proved to be more appropriate for the intended application. The project is having enough Avenues for future enhancement. The project is a prototype model that fulfills all the logical requirements. The project with minimal improvements can be directly applicable for real time applications. Thus the project contributes a significant step forward in the "AUTOMATION SYSTEM"**,** and further paves a road path towards faster developments in the same field. The project is further adaptive towards continuous performance and

peripheral up gradations. This work can also be applied to variety of commercial applications.

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FUTURE WORK

This project is automated by single room, if we automate the whole house or organization, the number of sensors are increases, to automate the above process, and for this purpose usage of DAQ (data acquisition system) is used to know the current rating and gives accurate result.