

Automated Control System: Using Lab VIEW, Android and Arduino

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Abstract: Today in modern and technical era, where most of the time we spend with technologies operating with our finger tips, I felt the need that a technology should exist which has ability to control the home as well as other electrical appliances either automatically or through an Android device or a desktop/laptop. My project has a dwelling incorporation of a communication network that connects electrical appliances making it possible to control them remotely over local area network. It has several objectives to meet the day-to-day requirement such as comfort for handicapped and elderly people, remote monitoring, environmental monitoring (humidity, temperature etc.), safety and security. The system has been designed using Lab VIEW as main communicating tool, Arduino for processing Input/output of various active and passive sensors and a Wi-Fi system for networking and communication. This paper shows the purpose met by the system, implementation with details about hardware and software technology used and that too in very little investment. The result shows that it can be applied in various areas such as homes, offices, institutes etc. meeting the requirement of comfort, security, safety in easy and affordable way.

Keywords-Home Automation, Lab VIEW Automation, Security, Android Home, Arduino Automation

I. Introduction

With each and every day passing-by the existing technology becomes much better and efficient, but this efficiency comes up with a deep technical research and analysis done over long period of time. In condition of energy (read here as Electrical Power) crisis in developing and under-developing countries other options and procedures have to be carried out in order to utilize the produced energy at its best and save the rest and

also involving minimal losses. These were the main concern that lead me to investigate and develop some efficient means and finally come up with suitable technology to fight out the problems that could arise in future due to energy crisis. Thus, the main objective of my project was to conserve the energy at possible level best, along with providing the other means of modern technology involving comfort, security, control and constant monitoring.

Recent other successful attempts had been made to meet the same purpose differently but this project serves all purpose under one roof, and the best part of it is that it comes in cheap budget and also has a very short duration pay-back period. This automated system has been successfully tested and worked out for all the kind of home appliances. Usually, the available automated system are not only too costly but are also quiet far away from reach of common man, but this project has eliminated these problems and comes up with the best and easily available tools and hardware which has a lesser complex design and operational features.

This automated system comes up with continuous monitoring of connected load status, remote operation and control of the connected respective loads, automated control of lighting and fan loads depending upon the intensity of natural light falling in the room, and presence of the human at a particular place. The system also comes with automatically operated sprinklers of the garden which operate according to moisture content of the soil, and also had command feature to instruct the centralized air conditioner to control humidity, and the temperature of the covered space.

Apart from these means of comfort it also has safety and security feature involving water-pumping units installed for fire safety in case of any fire, operate and control the speed of ventilators in case of smoke etc. The security part involves tracking of human and track unnecessary movements using cameras, and also involving door break warnings and status of the doors of the building.

II. TECHNOLOGICAL OVERVIEW

Automated control System is designed and programmed in such a manner that it brings together the electrical loads control and their monitoring to our finger tips i.e. either on android device or to a Laptop/Desktop. In order to carry out this remote operation we make use of networking devices such as Wi-Fi router. Fig. 1 depicts the various sub-systems of automation system which uses active and passive sensors to detect the condition such as humidity content, light detecting resistor (LDR) for natural light intensity detection, thermistors for temperature detection, moisture detectors to detect the moisture content of the soil, smoke detectors to detect the presence of smoke or fire in space and passive infrared sensor to detect the movements made by human. Data and signals received from these sensors are collected and manipulated at the brain of the complete system known as Arduino, to send appropriate respective signals to switching relay so that they can control the respective load connected.

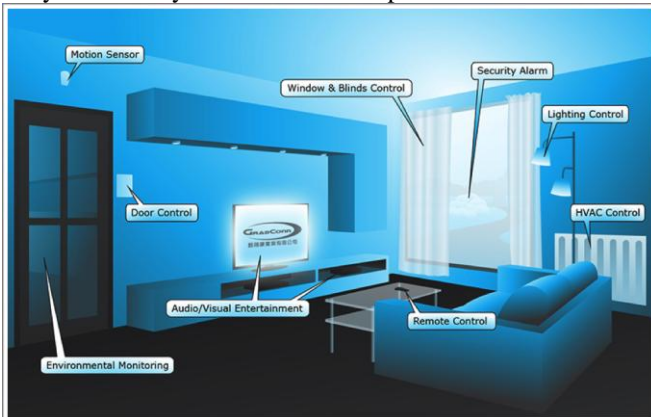


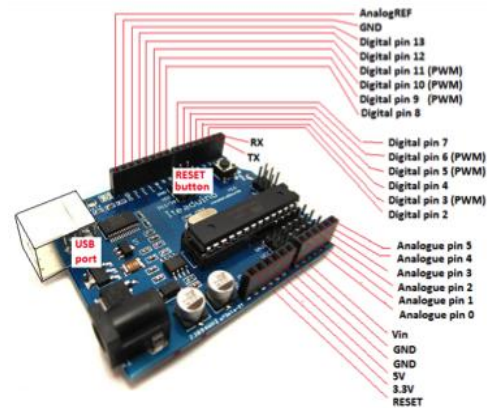
Fig. 1. Various sub-control systems of an Automated Control System

In addition to this, the system make use of the several software's and one of them being Lab VIEW. Lab VIEW is used to control and monitor various connected loads. Lab VIEW not only provides the graphical interface but also facilitates to program up the Arduino according to the requirement and the sensors connected to it. Due to which Arduino could be regarded as the heart of the system. In addition to that, Automated System Module is equipped with an additional feature i.e. Android control, which makes its operation much easier and advanced. This technology has a key feature to obtain all the rights of controlling all electrical appliances connected to the Desktop module over Android application being the condition that both Android device and the master machine (on which main processing is taking place) should be on Local Area Network.

A. Arduino Board:

Arduino is a device, which handles all the processing of input as well as output signals. It can also be regarded to as brain of the system, as the main decision making takes places here in, i.e. handling received signals and processing it out to give the respective signals to the relays which can drive loads

according to the programming in LabVIEW. It helps to sense the physical world.



Arduino is basically an open source physical computing platform based on a simple micro-controller board and a

development environment for writing software for the board. Arduino, here is used to interact with physical world situation and take various decision according to the data received from various sensors. Various tasks that are realized using it in this project are controlling of light—according to the natural light intensity falling in the room, controlling of remotely located load such as in upper floors or in the basement etc. by receiving the signals from the desktop or android device as per user requirement and like this much more. There are several other micro controller that can help to carry out physical computing, but the reason to choose the Arduino is that it reduces complexity, it's easy and quick to installation, easy and readily available support and interface with other platforms such as Lab VIEW. The best and the most attractive feature is its reliability and cheap price which makes it a better option than any other micro-controller available in market. Arduino Uno is a micro-controller board having 14 digital I/O pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16-MHz ceramic resonator, an ICSP header and a reset button.

B. LabVIEW:

LabVIEW (an acronym for Laboratory Virtual Instrument Engineering Workbench) is a system design platform and development environment for a visual programming language from National Instruments. Programming in this development tool is different from other traditional programming languages like C, C++, as it utilizes the graphical notions to (connecting functional nodes via wire through which data flows) carry out the process. Much more than programming, it is a tool used by scientists and experts to carry out simulation and designing process. Due to features such as ease in programming, fast execution, direct interaction with hardware makes it very convenient to be utilized in this project. LabVIEW provides an easy interface, third party software which can be downloaded to interact with Arduino and further programmed to carry out the process efficiently and effectively. All the basic data handling and G-programming is done here with-in it such as interacting with Arduino, collecting the status of sensors and processing the data. All these raw data received are converted to valuable result in form of signal which is then

transferred back to Arduino using serial cable which can further drive relays and other output loads connected to it. LabVIEW not only help to manipulate the data but also creates the G.I. (Graphical Interface) for interaction of user with the machine. It also provides the capability of driving any selected load using software or in other words, just a single mouse click away and one can check the load status. LabVIEW can also be regarded as the tool having 'Supervisory Control and Data Acquisition'.

C. Android:

A smart phone is mobile phone with operation system, having advanced computing capability, controllability and connectivity than any ordinary phone. Android is a software stack for mobile devices that includes an operating system, middle-ware and key applications. Android, by simple definition, is an operating system for many mobile phones. Android is a customizable platform that can look and feel very different on every different handsets. Android gives us tools for creating apps that looks great and take more advantage of the hardware capabilities available on each device. Android is mainly based on Linux operating system which uses java like languages for running applications. The main purpose of using android is to send the control signals from smart phone over Wi-Fi connectivity over Local Area Network (LAN).

D. Local Area Network (Wi-Fi):

A local area network (LAN) is an electronic device network that sets up communication medium between two or more devices using a wireless distribution method. LAN can be used within a limited area such as a homes and apartments, schools, computer laboratories or office buildings. It enables user to remain connected on the go within the boundaries of local coverage area to the network, and can realize a communication link to the wider Internet. This wireless linking network is termed as WLAN. Currently available networks are based on IEEE 802.11 standard protocols and are commercialized with the name Wi-Fi.

We employed this technology in our project in order to give comfort controllability of appliances with Android devices, which is connected on wireless network to the main machine as host. The wireless connectivity also provide ability to connect multiple devices over wireless network and with which every user in the area connected to network could have their own individual control of appliances. The device connected should have android platform and should have application installed in it to carry out the operation.

III. AUTOMATED CONTROL FUNCTIONS

A. Control System of Most Commonly Used Appliances at Home/Office:

The feature, automated control, allows user comfort in operating various most commonly used loads such as fans, tube-lights/bulbs/CFLs, TVs and audio systems etc. There are

basically 2 modes for controlling the respective appliances/loads. First is the Auto Mode, which operates on the signal generated by the sensors installed on various respective positions such as PIR's (Passive Infrared Sensors) for detection of any human presence in a particular space or room, and LDR's (Light Dependent Resistor) for detection of natural light intensity falling in the room.

As for PIR, which remains always in active state and operating on 5V supply from Arduino continuously monitors the movement in the room. As soon as any movement is detected, it send a data high signal to Arduino Digital Read pin which is further passed to LabVIEW for comparing the received information to the programmed information and directs the Arduino to generate a high signal out from another pin that further directs a Relay Driver I.C. for amplification of signal and finally, relay is excited and the load connected corresponding to it goes high. Whereas in case there is no sign of any movement in the room the relay remains to OFF state. In order to update the load status continuously, PIR can be reset to OFF state after interval of specified time.

On other hand, LDR works on a slightly different concept, but has somewhat similar operation characteristics. The LDR also remains always in high state in order to continuously monitor the natural light intensity that falls on its surface. The LDR installed here is programmed in such a way that it continuously monitors and shows the intensity of light fallen on its surface (value in the range 0-100) on the screen of desktop having the application installed on it. Now the most attractive feature here is that user can manually initialize the threshold according to his own comfort and requirement. As soon as the threshold value is entered, the program starts to work accordingly and operate the load as per the value entered. Suppose user enters a threshold value as 40, so the program is designed in such a manner that the load will remain in ON state only upto the values less than or equal to 40, as soon as the value of natural light intensity goes above 40 the load connected to it (i.e. tube-light, bulb) will switch to OFF state indicating that the natural light is enough and there is no requirement of artificial lighting load.

B. Temperature/Humidity Control for Centralized Air Conditioning System:

In order to maintain the level best comfort living situation Automated control system is equipped with the Thermistor (LM-35) and Humidity detector, which always remain to high state and continuously monitors the variable temperature and humidity.

On detection of any sign of humidity content more than 75%, analog signal is read by Arduino coming from Humidity sensor and accordingly a signal is send from Arduino to relay which changes the mode of operation of Centralized Air Conditioner to Dry mode, and as soon as the normal operating condition are achieve the relay trips of bring in back the centralized Air Conditioner to normal operation mode.

On other hand a thermistor also remains always in high state and monitors the temperature of the room. It has output voltage is proportional to Celsius temperature, and these

variable value according are continuously monitored to the existing situation, always displaying the status on the Desktop. It has operating voltage of 5v being fed by Arduino itself and its analog values are recorded at analog pins of Arduino. It also has low cost due to wafer level timing, and low impedance. As soon as the temperature of outside environment falls below 15 degree Celsius a signal is send from Arduino to micro-controller of the centralized airconditioner to switch on the heating mode and maintain the comfort level in the space provided, as on other case if the temperature of outside environment goes above 30 degree Celsius a signal is send to micro-controller of the centralized air conditioner to switch on the cooling mode.

This automated system is also equipped with an additional feature of controlling the temperature remotely either with your android device or through a Desktop on which application is installed.

C. Control System for Gardening, Garden Lights and Main-Door Lamps:

One of the most attractive feature with which this Automated Control Module is that, it comes equipped with worry free control of the operation of water sprinklers installed in the garden. This feature enables user to avoid the operation of water sprinklers manually, as the complete process is modified and made to run on auto mode. This happens because of a soil moisture detector installed in the soil, which continuously monitors the moisture content of the soil and provides a feedback signal to the Arduino. Arduino is capable of processing this and appropriate relay could be switched in order to control the operation of water pump, feeding water to sprinkler system. The basic construction of the soil moisture detector consist of two simple high conducting, non-rusting electrodes separated few centimeters apart and a continuous supply is fed to them to track the resistance between the electrodes. As soon as the moisture content increases the resistance value decreases and on other hand if the resistance value is high a signal is send to Arduino to operate relay connected to water pumping machine so that sprinkler can spray water to soil.

Second feature with which this system is equipped with is automatic timing based control of the lights of garden or door lamps. Operating garden and main-door lamps manually makes it difficult and also leads to discomfort in switching it off back. Now this module help the user to enter the timing for which he want to keep the load ON and these lights will operate automatically. In addition to it, has feature of switching the main-door lamp ON/OFF manually with android device or Desktop.

D. Advanced Safety Features:

Automated control system is equipped with a feature of controlling the equipments such as ventilators and fire extinguishing units in emergency situations such as fire breakout or smoke. For their efficient operation they are to be operated continuously and track the record of the ongoing

situation persisting in the house. In case of any emergency such as any sign of detection of smoke or a fire in a space, a high data signal is send to Arduino which takes decision according to designed algorithm by switching ON the ventilators and water pumping units as per requirement to fight the cause and reduce the loss. In order to detect smoke/fire smoke detectors and fire detectors are installed at various locations. In addition to it, a siren also goes ON indicating that there is an emergency situation in the house.

E. Camera Based Advanced Security System:

This system not only provides the comfort level but also has the security feature for avoiding any theft and other mishappenings. This task is performed by the security cameras installed at various location and corners of the house which have the feature of continuously tracking the situation of the area. The live video footage of the area covered by camera can be viewed on a desktop. The video can also be recorded for future reference. It has also an additional feature of movement of camera about an angle of 360 degrees, but this depends on the type of camera installed.

IV. CONCLUSION

This paper gives the basic features, design, and implementation of an automated control system. The implementation and installation of this automated control system is easy and environment friendly. It has additional features such as better and fast control, assured safety & security. It comes with the most remarkable feature of the energy saving design, which makes it a better option for fighting the energy crises situation existing in our country. This system is designed to not only provide comfort living but is most useful for disabled and elderly people who have big houses.

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