

## Smart Home - An Energy Conservation Initiative

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**Abstract:** The proposed idea is based on remote home automation, one of the efficient methods that not only saves energy and money by providing remote access to your home but also increases reliability and provides security of home thus increasing living standard. This paper describes both the remote and automatic control for home automation. The automatic control, being independent of any signal from user, makes use of Passive Infrared (PIR) sensor and photo resistor that have been integrated together to detect any occupant and darkness and works only when both the conditions are true. On the other hand, remote control gives us the access to control home from any part of the world by sending signal to home server via internet where the controller (Arduino) takes decisions smartly. In order to ensure all 220V appliances work effectively, a relay circuit has been added with the controller

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### I. INTRODUCTION

Pakistan is undergoing acute annual shortage with a general lag of about 5000MW to actual demand leading to frequent power outages. In such scenario, it has become a necessity to utilize energy efficiently. This can be done by shifting to energy efficient methods that are cost effective. Ideas in this field have no bounds as an intelligent system was developed to decide if the blinds are to be opened or closed according to the brightness [1]. Some applications focus on collection of data using sensors thus enabling controlling of home as required by the user [2]. Although this particular approach is efficient but is completely based on sensors i.e., a user has no control and makes no use of internet A similar idea has been implemented that makes use of Android smart phone [3]. However, this idea is limited to smart phone application and if Wi-Fi is not available then 3G/4G required which makes it difficult for normal GPRS users.

The proposed idea gives the user an edge to control as per his requirements at any time from any part of the world by controlling via internet as compared to [2]. In addition the idea is making it independent of the operating system of phone and data internet[3]. Even though it is convenient for smart phone owners, there are still people that do not have access to smart phone. Therefore, our innovation isn't just limited to smart phones. In this regard, the innovation in this paper includes converting your home into digital smart home by controlling it from any part of the world through internet. It has two controllers; automatic and remote. The former focuses on using maximum sunlight instead of conventional electricity. The latter is an added feature to enable users to control their home appliances remotely. The remaining paper is divided as follows: Section II explains the proposed controllers' strategy. Section III makes some useful discussions. Finally, Section IV concludes the paper.

### II. PROPOSED METHOD FOR HOME AUTOMATION

#### A. Automatic Control

In automatic control, switching operations are performed in response to predetermined conditions and is independent of control signal sent by user. The predetermined conditions in this case are presence of any occupant and darkness which are achieved by integrating PIR (occupancy) and photo resistor (darkness) sensor.

PIR senses occupant by detecting infrared rays emitted from human body. At detection, the output of PIR goes high to 3V which is sufficient to activate the darkness sensor ahead. When there is sufficient light, resistance of photo resistor decreases and current travels through the 100K $\Omega$  resistor where it has 2 paths; either to the base of transistor or photo resistor. It follows the least resistance path that is of photo resistor and keeps light off. In case of darkness, resistance goes very high and current flows through transistor which amplifies current and turns on the light.

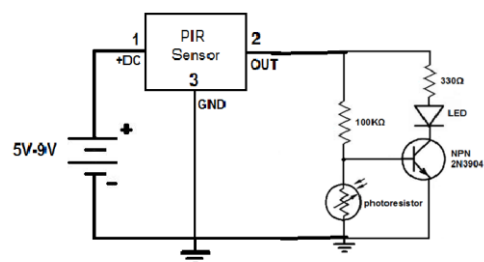


Fig. 1 Integrated PIR and darkness circuit

#### B. Remote Control

The remote control has three main components; client, web server and Arduino. Arduino has been chosen over other controllers due to simplified hardware and software development. The already installed chip in it allows direct serial communication over USB where as other controllers like Micro-controller need a

separate USB to serial converter. Arduino, being the open source has easy debugging as well. In addition, advanced version of Arduino has built-in module that provides IP connectivity. In this idea, web server is a protected website that can be accessed by the respective users only. The website has been made using ASP.net on Microsoft Visual Studio. The website gives the option to select any room of the home. Every room has various modes like night, morning etc. Each mode has a set of lights and fans associated with it.

Client is any internet activated device that serves as a remote control for your home. Any user on logging into the website can see all the modes. Different modes have been programmed to turn on the relevant lights required at that time of day.

### C. Interfacing between ASP.NET and ARDUINO

In order to exchange information between web server and Arduino, serial communication is used. This is achieved by making web application on ASP.net. This web application comprises of event handlers which are functions, programmed to be executed when a particular event takes place. Here, event handlers come into play when a mode is clicked on the website. On clicking any particular mode, request is sent to the serial port control of ASP.net that forwards it to the serial port of the controller. As soon as the Arduino receives input from the web application, it triggers and turns the devices on.

### D. Practical Architecture

Practically, we developed a prototype that comprises of any client, a server, Arduino, appliances/devices and sensors. The idea is illustrated in the figure given.

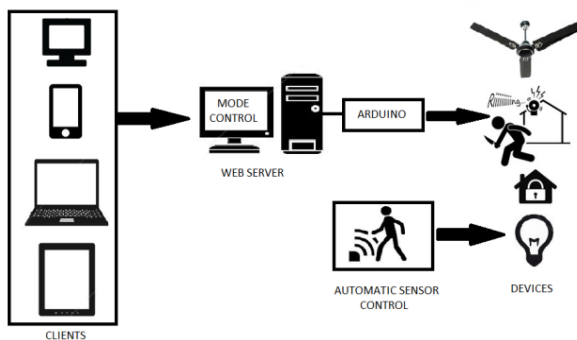


Fig. 2 Work flow of Smart Home

In actual, whenever a user from any internet activated device logs on to the website and selects a particular mode, the request is generated and sent to the server that sends the control signal to the controller.

As we are dealing with lights, fans and other home appliances those have working voltage of 220V so a relay-transistor mechanism has been added. The controller basically triggers the relay which in response turns on the light. Transistor is required for interfacing relay with Arduino because its nominal output voltage is insufficient to energize relay coil; therefore, this arrangement is done i.e. base of Transistor is connected

to output pin of Arduino giving output voltage of 5V that bias the transistor acting as switching device.

### E. Security System

Home security has become a need these days so a home security system has been added to make it an all-purpose choice product. Using Arduino, an inexpensive Intrusion Detection circuit (burglar alarm) has been implemented [4]. An infrared emitter-detector pair has been used to detect any intrusion and turns alarm on. White and black LED's are used as Infrared (IR) light emitter and detector, respectively.

Black LED has been used as the IR detector as black color will absorb almost all the IR radiations falling on it as it has the highest absorption capability. When there is any obstacle between emitter and detector, the amount of IR radiations detected will be less than as compared to no obstacle case. The alarm will trigger in such a situation.

The white LED is being provided 5V. A threshold value has been set for the alarm to set off. If the obstruction is such that the radiations falling on the detector reduce to a high extent, the threshold value, 1005 in this case, will be exceeded. Therefore, for values greater than or equal to 1005, the alarm will trigger.

## III. DISCUSSIONS

This innovation is leading to energy saving and cost is reduced. Besides saving energy, it has great potential in businesses by increasing productivity, reducing wage costing, increasing profit and compensating for labor shortage. Also, this innovation is great for physically disabled people making them independent and not relying on anyone else to do their job. However, this requires that the computer server stays switched on for 24 hours at home which may cause the system to be hanged on. For this, it would be better to use a small computer like Raspberry Pi that can stay on for entire day and consumes less energy too.

## IV. CONCLUSION

The idea gives the user authority to control home from any part of the world and make it smart that is controlling of appliances automatically and remotely. This resource has been especially designed to simplify life i.e. controlling of electrical devices by computer. It has high potential in the market due to usage of cheap components and easy operation. Once it's installed at home then one can control home from any part of the world. In future certain advancements are required which will make it smarter i.e. by having ambient temperature control and smoke protection, controlling via speech and many more. The idea can also be extended for offices and industries.

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