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A PROPOSAL OF SMART HOME AUTOMATION SYSTEM BASED ON RENEWABLE ENERGY

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Abstract

The object of this paper is to develop a home automation system based on environmental monitoring system, which can be monitored from all over the world. Besides the system will have an individual sun tracking solar panel based power supply technology. On the other hand, this system will run all the appliances without any internal wifi technology. The system employs an embedded web server based on Arduino Mega 2560 microcontroller, with internet protocol connectivity for accessing and controlling electronic appliances remotely. Additionally, the proposed system does not require a dedicated server PC like other available systems and offers a specific communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility, devices such as light switches, temperature sensor, gas sensor, water flow and level sensor and motion sensors, smart touch-pad control door security have been integrated.

Keywords*: sun tracking solar system, home automation, Arduino mega, wifi, security system.*

1. Introduction

With the development of new electronic technologies and their integration with older, traditional building technologies, smart home is at last becoming a real possibility. At first "home computer" was an experimental system in 1966, then in the early 1980's the smart home automation was initiated as a project of the National Research Center of the National Association of Home Builders (NAHB) with the cooperation of a collection of major industrial partners (1). Even though smart home is not a new term for science society but it's still far more away from people's vision and audition. Because recently various work is done with the design and general overview of the possible remote access approaches for controlling devices, or in cases of simulating the smart home itself. The design and implementation of an off-the-shelf Smart Home remote control application has been limited to simply the computer applications and just in cases mobile and web applications development. The "smart home" technology is one realization of home automation ideals using a specific set of technologies. It's a home that has highly advanced automatic systems for lighting, temperature control, security, appliances and own power generation system using sun tracking solar panel. The smart house gets two parallel power sources. As a result, it makes smart house more reliable and less power consumable nowadays.

The conversion of solar light to electricity is known by PV (Photo-Voltaic) conversion. A PV panel consists of numerous p-n junctions are placed on a flat surface and electrically conducting strips are used for connecting junctions. Position of a PV panel and sensors output are processed by the help of microprocessor code. 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 home (2). 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 home technology can interface basically using computer interface of everything.

Smart home 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. The goal of the smart home with sun tracking solar panel project is to integrate lighting, temperature, media, and security systems into a central interface. This will give the users the ability to control light and

temperature levels throughout the home while streaming audio to multiple zones and monitoring their house's security system. The following aspects were considered in the choice of our aims:

Firstly, we will include Wi-Fi connectivity for worldwide access.

Then, a security camera with features like spy protector will be installed to provide automatic security system.

Next, to turn on the security floodlights and cameras, motion sensors are planned to be used in the security system.

Later, a user-friendly interface, Automatic control and Command control system will be placed.

Finally, distinct energy supply frameworks toward utilizing sun oriented board require to design, which will need the sun following framework will turn along the sun.

2. Existing Technologies

In most wireless systems, a designer has two overriding constraints: it must operate over a certain distance (range) and transfer a certain amount of information within a time frame (data rate) (4). Then the overall costs of the system must work out (price) along with acquiring government agency approvals (regulations and licensing). Considering existing technologies, zigbee is one of the most used wireless systems, which is an open standardized system. Basically, zigbee is for designing network architecture like point to point, star and mesh networks in a building block within minimum cost per node. To design a home automation system zigbee is used mostly for Ad Hoc On-demand Distance Vector (AODV) routing. Information storing capability and for routing failure node can also work as replacement route (3). Wi-Fi is the best for a area. It uses radio wave to provide high speed internet for a three-bedroom wall block radio waves.

That is why to achieve connection for many square kilometers it uses multiple overlapping access point (7). By using multiple overlapping access point users can easily control a system based on big area (8). Omni directional radio wave can travel through walls or nonmetal barrier. Bluetooth technology is the best and widely used wireless technology for that special character. Short range radio transmitter is built for Bluetooth communication. It has several applications to setup communication among devices. The new base in home automation is an android smart phone. Home automation equipment recently use existing home Wi-Fi networks (9). However, very soon there will be some gadgets like Google glass. Google Glass is a very exceptional device which could be worn like glass, but it will provide a screen over the right eye.

That screen is controlled by voice command and by touching an intelligent touch-pad on the right side. It will connect via Bluetooth or connect to Wi-Fi to a smart phone device and plays Google Glass applications. There is another project is coming in the Home Automation department is named ivee, which looks like an alarm clock (6). This alarm clock can talk with the operator, it can take order, and it can control some home appliance. As example, if anyone asks about the weather to ivee and if ivee relates to Wi-Fi then it can tell and show you the total forecast.

TABLE 1. Comparison & rating of existing systems (5)

	Wi-Fi	**Bluetooth**	**ZigBee**
Network Architecture	Star	Star	Mesh
Network Size	32	7	20-250
Application Focus	Web, email and video	Cable replacement	Monitoring & control
Optimized for	Speed	Low cost, convenience	Reliability, low power, low cost & scalability

3. Proposed System

The overall system works in three steps; First, we use a wi-fi network to control the entire system without any need of external wiring system. Secondly with Bluetooth technology which must be installed for controlling the system with the aid of portable android devices. Lastly, we need a sun tracking solar system which will do the job of an individual power supply system (10). The following image shows the design of the planned design on first two objectives.

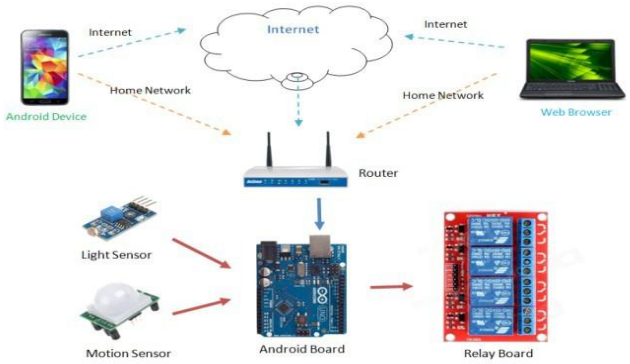

Figure 1 Basic design of the proposed system

Different kinds of sensors are needed to obtain physical condition, temperature sensor detects the temperature value, gas sensor detect smoke and for avoiding fire outbreak cooking gas have been used. This information is gained by using micro-controller (11). To judge the intensity of light LDRs are used, with this property of LDR it allows automatic switching on/off the light control by determining the day light intensity. Passive infrared Sensor (PIR) is added to motion detector to detect any movement in the house when the security system is turned on. CC camera also activates its night vision mode by determining the light intensity. A relay switch is used to send control signals from the micro-controller to the electronic device used to achieve the switching on and off action (12). A web portal is designed with verification system to verify the user by username and password. It can perform the function of both input and output devices. Input device to control home appliances and output device to read the physical condition's value.

In mobile application same procedure, it followed to be an input and output device. A new feature is combined with national grid that is the smart sun tracking system. In each panel of the solar system 4 LDRs are used. The more the number of panel the more power will be supplied, it depends on the amount of power needed for a specific house. These LDRs task is to help with the detection of the sun's direction and move the solar panel according to that. It increases the efficiency of the solar power. There is another way to increase its efficiency by setting a time which will automatically clean the dust on the panel at a regular interval of time. By using Arduino board sun tracking solar panel can be controlled (13). Solar panel is connecting through charge controller to battery. An inverter is used for the AC devices. Purpose of installing sun tracking solar panel system is to reduce the use of national power supply by consuming minimum energy from it.

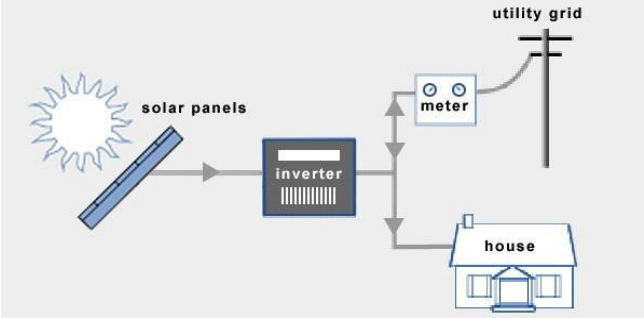

Figure 2: The preliminary design of the sun tracking solar panel system

An application is developed for the system using the Android and Arduino Ethernet based micro web server. Arduino micro-controller is responsible for hosting the micro web server and it activates the action that needs to

be carried out (14). The sensors and actuators/relays are directly interfaced to the main controller. With the help of the home application smart home environment can be controlled and monitored from a remote location. The home application will communicate with the micro web-server through the internet (15). Internet connection like Wi-Fi or 3G/4G network can be used on the user device.

4. Expected Outcome

The expected outcome of the system can be discussed in few different ways (16). Its mandatory for the system to have an authentication process to enter the smart home system, to avoid any kind of unauthorized access. When an invalid password is entered a message will come at the display saying, 'wrong password'. If the password is correct a message comes out notifying 'login success' then it proceeds to display the home page of the app where controls option is given. Voice activation function is used to give commands, if no command is received a message is displayed prompting. Even we can add reminder into the app which will remind us about when to activate a certain home appliance, also set a timer for that specific device (17). The system is run by using browsing website and mobile application, which will control the home appliances through wi-fi/cellular data technology. Besides, we can view and check the security system by using wi-fi.

Figure 3 & 4: Screenshot of the app and web control system respectively

Sun tracking solar system gives us a huge advantage of using individual power supply rather than national power grid system. Especially when the power is cut off from national power grid or damaged for some reason, we can still operate with the power saved in sun tracking solar system without any disturbance. Below this, there is a flow chart which shows the design and steps of the application.

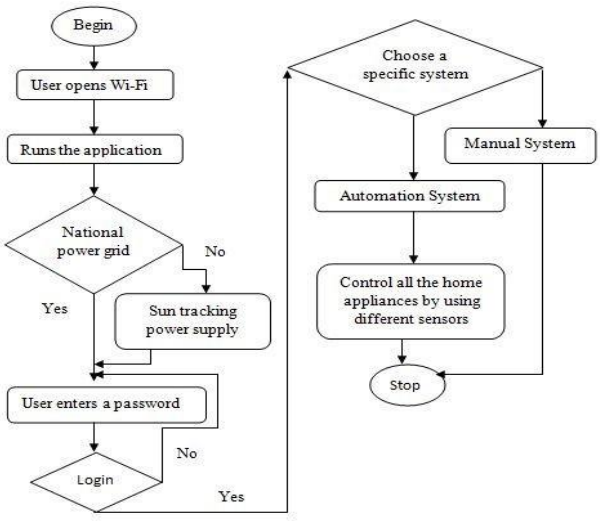

Figure 5: Flow chart for working procedure of the design

5. Discussion & Limitations

The purpose to design the overall system is to run and control all the home appliances by environmental monitoring system with the help of sensors. The user can control those appliances from all over the world through a dedicated website. The main purpose of this project is to design a sun tracking solar panel system, which in practical is a success (18). In developing countries like Bangladesh where the people are suffering from load shedding issues because of too much dependency on the national power supply system, this can be a relief for the backup power when they are facing load shedding. During the shedding time, people usually depends on IPS, which is also depended upon National Power Grid System. However, with this in hand, the overall dependency will fall drastically and as it is more efficient, reliability for the user will be much higher than the traditional solar panel. In this paper, we designed a system, which will help to develop an individual power supply system for each house, and it will reduce the overall pressure from the national power grid, thus reduce the overall load shedding. The basic price of the overall system is around BDT 3000, which is quite reasonable. Lastly, to improve on the effectiveness and efficiency of the system the following recommendations can also be put into considerations as to use relay modules instead of normal relays with breadboard and connect it directly, then trying to find a specific way to amplify the Bluetooth module signal to work from a greater distance. This can be a great way to reach the solar renewable energy system for the users.

6. Conclusion

In this time of computers, advanced mobile home innovation organization need to be turned inescapable. It's an advanced mobile innovation organization that provides us an alternative level for existing standard (19). We would completely be dependent in an arrangement where the place will fully be programmed. We need aid utilizing the sun following engineering organization thereabouts we could get the most effectiveness from claiming sun powered force. We need two different client functions; case will be regulated manually, what's more different naturally. Security is a secret key or biometrically ensured also sensing capability provides for this home quality on protecting itself. There will be no energy disappointment along these lines that framework might worth of effort under at whatever circumstance alternately whatever crisis state. Utilization from claiming low control makes it cost effective and that's only the tip of the iceberg easy to understand acknowledging the economy from claiming Bangladesh. Toward last, it will be a finished framework raised for a renewable vitality along mechanization engineering organization which serves detract the new era of a new dream for both averages and urban users.

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