ELECTRICAL LOAD CONTROL USING INTERNET OF THINGS

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Abstract- Electrical Appliances control refers to the branch of automation that deals with the methods dedicated to the reduction of power consumption when it is not required and user forgets to turn it off. The main objective of Electrical appliances control using raspberry pi is to inhibit control of household features activity and loads. This paper deals with the wide range connectivity and energy efficient control of the electrical appliances in a user-friendly manner. These features of connectivity, scalability, power saving can be achieved by the use of Raspberry Pi, which acts as an interface between the hardware and the software of the entire system which can be connected to number of peripherals using USB ports or HDMI port and GPIO, it can be connected to the internet using the Ethernet port or by Wi-Fi connectivity.

Energy is major input sector for economic development of any country. In this paper, it is proposed to develop hardware prototype that will help various organizations, institutions etc., to play an effective role in saving electrical energy. The major area which consumes maximum amount of electricity is observed to be the educational institutions. A simple action of switching OFF the electric consumables when not in use will save lot of energy. In order to conserve energy, we can control the electrical appliances like light, fan etc., and monitor using Raspberry Pi when it is connected to LAN or WI-FI network .

Keywords- Internet of things, Raspberry pi Linux, WI-FI, LAN, WAN, Power consumption, MATLAB.

I. INTRODUCTION

The Internet of Things (IoT) is a new communication paradigm that proposes that the objects of everyday life are equipped with microcontrollers, wireless communication interfaces, and suitable protocols stacks, that will make them able to communicate with one another and with users [1]. Therefore, the IoT concept allows an interconnection of a wide variety of devices (things) to the Internet, promoting the development of new applications in different areas such as home automation, industrial automation, traffic management, assistance to the elderly, smart grids[2].

The possibility to create various intelligent services turned IoT into the key technology for energy management solutions. The control of home devices such as air conditioners, refrigerators, microwave ovens, chains and washing machines allows a better home and energy management. The efficient use of energy resources including energy production, distribution and consumption received a special attention from governments, industry and scientific communities, since in most countries energy production depends on exhaustible natural resources and energy consumption in worldwide is growing, especially in residences [2].

The technology for controlling electrical loads & energy monitoring has seen tremendous evolvement. On the same lines, many devices have come up to provide security for the premises. In this paper a low cost interface for control of electrical loads along with monitoring of electrical loads based on requirement which can be used in building, residential or commercial, to the user in terms of deployment, operation and easy to use interface is presented. The various electrical appliances can be controlled remotely by secure shell protocol which is used in hardware prototype design or via a gateway, which is connected to the internet. Recently the increase of energy consumption has leveraged the development of solutions to save electricity. One of these solutions has been the creation of energy-saving policies based on energy forecasting in smart environments.

The main idea behind this solution is that the residences are instrumented with sensor and actuator networks in order to monitor and manage energy consumption.

II. RASPBERRY PI

The RPi can be used without any additional hardware (except perhaps a power supply of some kind), it won't be much use as a general computer. As with any normal PC, it is likely you will need some additional hardware.

The following are required for designing hardware prototype model:

- Raspberry Pi board
- Prepared Operating System SD Card
- USB keyboard
- Display
- Power Supply
- Cables
- USB mouse
- Internet connectivity - a USB WiFi adaptor (Model A/B) or a LAN cable (Model B)

• Powered USB Hub
• Case

The figure 2.1 shows the raspberry pi2 board. The main advantage of using board is availability of Ethernet. With this facility the device can be accessed from remote location of the same network without availability of internet provided low area network access is enabled.

Figure 2.1 Raspberry pi 2

The connections are given as per following instructions:

- Plug the preloaded SD Card into the Pi.
- Plug the USB keyboard and mouse into the Pi, perhaps via a USB Hub. Connect the Hub to power, if necessary.
- Plug the video cable into the screen (monitor) and into the Pi.
- Plug WiFi, Ethernet cable
- Plug the power source into the main socket.
- With monitor on, plug the other end of the power source into the Pi.
- The Pi should boot up and display messages on the monitor

POWER SUPPLY

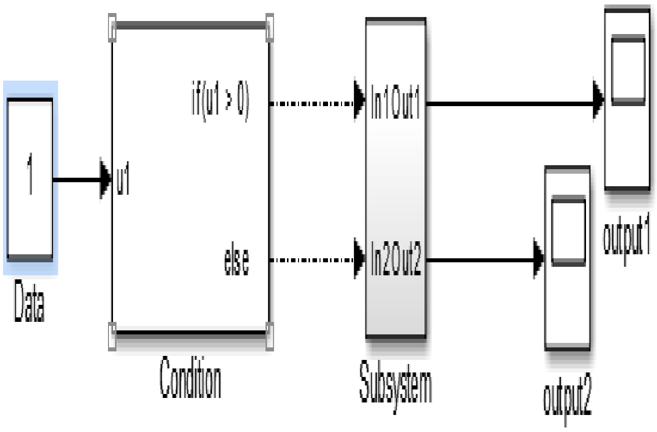
The unit uses a Micro USB connection to power itself (only the power pins are connected - so it will not transfer data over this connection). A standard modern phone charger with a microUSB connector will do, but needs to produce at least 700mA at 5 volts. Check your power supply's ratings carefully. Suitable mains adaptors will be available from the RPi Shop and are recommended if you are unsure what to use. You can use a range of other power sources (assuming they are able to provide enough current ~700mA): • Computer USB Port or powered USB hub (will depend on power output) • Special wall warts with USB ports • Mobile Phone Backup Battery (will depend on power output) (in theory - needs confirmation)

Processor

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first generation smartphones (its CPU is an older ARMv6 architecture),[16] which includes a 700 MHzARM1176JZF-S processor, VideoCore IV graphics processing unit (GPU),[17] and RAM.

It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible.

The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor (as do many current smartphones), with 256 KB shared L2 cache. Raspberry Pi 2 includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. It is described as 4–6 times more powerful than its predecessor.



III. SIMULATION

The simulation is carried out in Matlab software to get basic idea of the logic before implementation of hardware setup. In simulation sensor data is treated as 1 for High and 0 for Low. When the sensor data is high the output is high and when sensor data is low then output should be low which can done manually from computer in hardware setup as per requirement of light at desired location.

The figures 3.1 and 3.2 represents the
Circuit model and its output when the data is in high state .

figure 3.1: simulation model

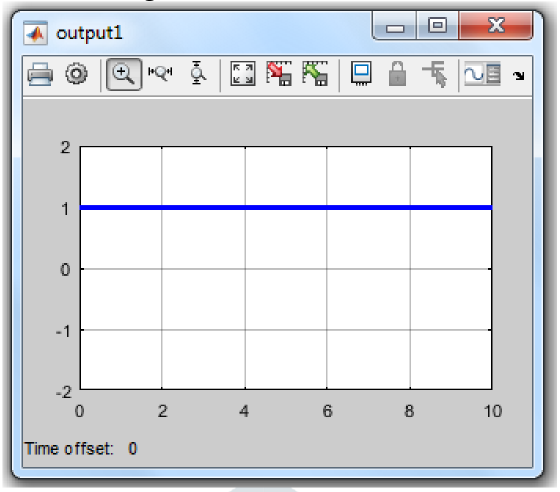


Figure 3.2: Output

The figures 3.3 and 3.4 represents the circuit model and its output when the date is in low state.

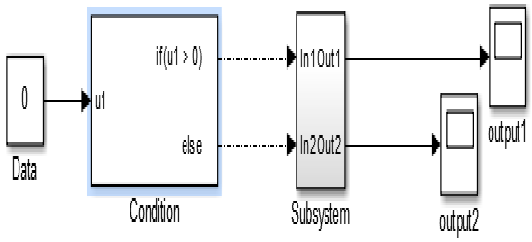


Figure 3.3 simulation model

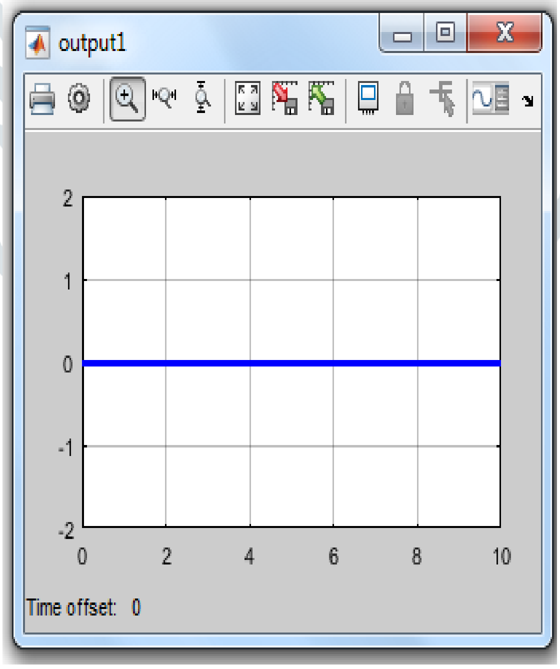


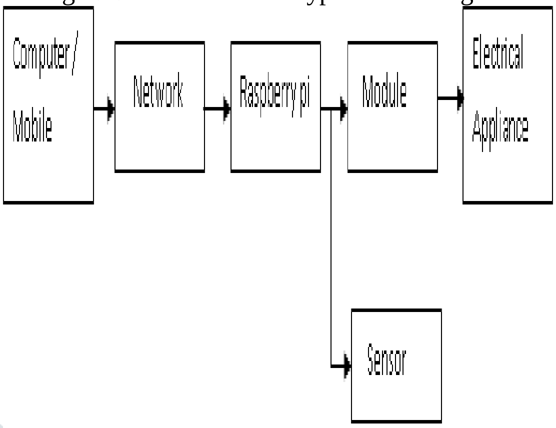
Figure 3.4: Output

IV. HARDWARE IMPLEMENTATION

The figure 4.1 represents the block diagram of hardware circuit. Computer or mobile can be used if either of them are in the network of LAN or WI-FI. When the computer is connected to the network then from computer to raspberry pi which is on same network can be connected using the method known as secure shell (SSH) which is a cryptographic network Protocol for operating network services securely over an unsecured network which uses internet protocol address of devices connected to the same network which is called remote login. In this paper the hardware design is carried out by taking lamp as electrical appliances and pir sensor for motion detector. The code for the light bulb and sensor is written in the python language and saved in Rpi (Raspberry pi). Once it is connected to the network it can be accessed form any of computer or mobile of same network. The

GPIO pins of raspberry pi are connected to the relay module and sensor. The turning on/off relay module and sensor data output can be seen in the output window by executing the respective codes. The logic of the code mentioned in manual flow chart shown in figure 4.2.

Fig 4.1: Hardware Prototype Block Diagram



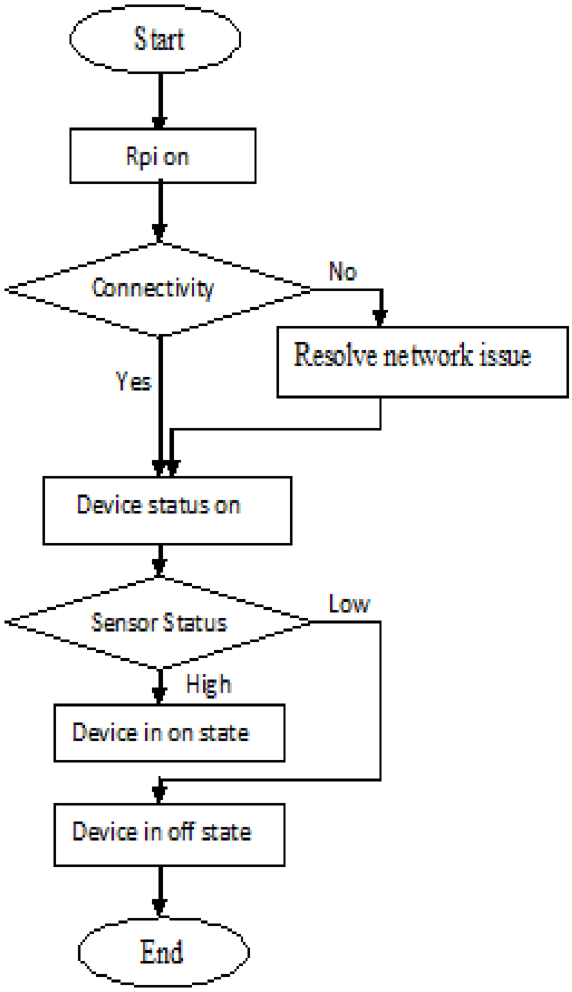


Fig . 4.1 Manual Process Flow Chart

The main power supply is on and raspberry pi (Rpi) is on then network connectivity is carried out if available then execution is carried out to turn on the light

If any network problem then it needs to resolve by checking low area network connections, login credentials.

The light on/off control can be done using the status of sensor. If it is high then light can remain on and if it is low then light can be switched off from remotely even if any user forgot to switch off the light when it is not require. The main supply is switched off when it is not required. With this design the optimum usage of electricity can be achieved which saves electricity during off times.

Figure 4.2 light in off condition

The on/off light is controlled by executing code from computer. The light is in off state as shown in figure 4.2

Figure 4.3 light in on condition

The light is switched on from the computer and based on pir sensor state the light can be remain on or it can be switched of from the computer using secure shell protocol method which results in optimum usage of power.

V. CONCLUSION

The increase of electrical power consumption has leveraged the development of solutions to save electricity. One of these solutions has been the creation of energy-saving policies based on forcasting the requirement of electric power and monitor it . The main idea behind this solution is to save electricity at various organizations, colleges, corridor lightings, residences etc. Most of the users forgets to swtich off the applicances like light, fan etc., when they are not required. In this paper basic simulation and prototype hardware implemnentaion is carried which instrumented with sensor and actuator networks in order to monitor and manage power consumption as per requirements. The advantage of this setup is elctrical administration can be done without internet in local area networks. The electrical appliances can be increased based on home needs can modify the design based on requirement. The appliances can be controlled using internet so that it can be controlled without any distance limits provided internet should be available all the time. If device is off by some means then the output cannot be controlled irrespective of the LAN or WI-FI services availability. Design of a backup supply for LAN or WI-FI and for the module results the continuous power supply under absence of main supply. Incorporation of LDR sensor for indication of status of light at remote centres.

REFERENCES

[1] W. Sousa, E. Souto, T. Rocha, N. Pereira, P. Kool and P. Rosengren, "Prediction of electrical energy consumption for Internet of Things in disaggregated databases," *2016 IEEE Symposium on Computers and Communication (ISCC)*, Messina, 2016

[2] N. Kato, I. Bisio and J. Liu, "Guest Editorial “Things” as Intelligent Sensors and Actuators in the Users’ Context: Processing and Communications Issues," in *IEEE Internet of Things Journal*, vol. 4, no. 2, pp. 297-298, April 2017

[3] IoT for Electric Power: Smart Grid was the Beginning by Jeffrey S. Katz January 10, 2017

[4] https://www.raspberrypi.org/learning/introduction-to-processing/

[5] https://en.wikipedia.org/wiki/Raspberry_Pi

[6] https://www.element14.com/community/docs/DOC-73827/l/raspberry-pi-2-model-b-1gb-technical-specifications.

[7] Liangzhi Li Kaoru Ota Mianxiong Dong “When Weather Matters: IoT-Based Electrical Load Forecasting for Smart Grid”DOI: 10.1109/MCOM.2017.1700168 IEEE Communications Society

[8] Hamed Mortaji Siew Hock Ow Mahmoud Moghavvemi Haider Abbas F. Almurib “Load Shedding and Smart-Direct Load Control Using Internet of Things in Smart Grid Demand Response Management” IEEE Transactions on Industry Applications (Volume: 53, Issue: 6, Nov.-Dec-2017)