Design and Implementation of an Arduino based Wireless Home Appliances Control System

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ABSTRACT

This paper presents design and implementation concepts for a wireless real-time home appliance control system based on Arduino Uno microcontroller as central controller for the automation of appliances. To automate these appliances, we can use the different communication media like Infrared, Bluetooth, Radio frequency, RFID, GSM, DTMF and MATLAB GUI. Keeping all these facts in mind, this paper propose a system which is based on Radio frequency module (transmitter –receiver pair) in which the user can monitor and control the home appliances remotely with the help of the Radio frequency transmitter –receiver pair with arduino (ATmega328) as the main processing unit.

Keyword: *Home Appliance control, Radio Frequency, Arduino, wireless real-time*

1.0 INTRODUCTION

There are many electrical devices in the home that their statuses are unknown (ON or OFF), which can be left ON inadvertently or by mistake and they use up power energy when not in use. Any device or equipment that can be controlled wirelessly is more easily manipulated and it responds very fast comparing to the manual operation of the equipment. So, there is need to control the electrical devices remotely to prevent the risk of any accidents, as well as to decrease electricity usage (saving the power) [2-6]. The electrical devices such as; television (TV), air-conditioners, electric showers and lights can be controlled remotely using the RF module and Arduino (ATmega 328). All home electrical appliances (devices) are been powered by 230 V AC mains, while the Arduino-nano (with ATMEGA328P-PU microcontroller), can only use 5 Vdc. Relays are used between the Arduino board and the home appliances. Relay is powered by 5 Vdc and work as a switch to trigger ON or OFF the home appliance which are connected to 230V AC mains. The relay can be controlled by the input and Output pins of the Arduino which in turn controls the appliances through the transistors [5-7].
This paper designs and implements the concept for a wireless real-time home appliance control system based on Arduino Uno microcontroller as central controller for the automation of appliances.

2.0 METHODOLOGY

The proposed home appliance system uses; the push buttons, arduino, relays and RF module (transmitter-receiver pair). The purpose of the designed application is to interface the control signal to the MCU at the transmitting unit so that MCU at the receiving unit can compare the received data and transfer the control signal to relay section to turn ON and OFF controlled devices. On pressing of ON push button at the transmitting side, a logic HIGH is detected at that particular I/O pin as a result the Arduino transmits a suitable message corresponding to the switch pressed. The switch pressed represents each of the appliances the system is intended to control.

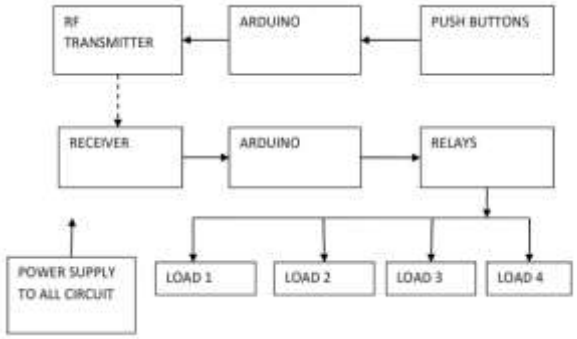

Fig.1.0: Block Diagram of the Home Automation System

From fig.1.0 there are five fundamental stages of interconnected electrical and electronic components/circuits including power supply, transmitting unit; receiving unit, logic control unit (Arduino Uno Board), switching unit and the controlled devices or loads, as well as software components. The home automation system circuit design comprises five major components – a Microcontroller, Relays, RF transmitter receiver pair, and an LCD. Here ATMEGA328 microcontroller is used and it is an 8-bit controller. This controller requires a supply voltage of +5V DC.

Below are the flow charts of the user defined instructions coded into the two controllers for execution of the desired function.

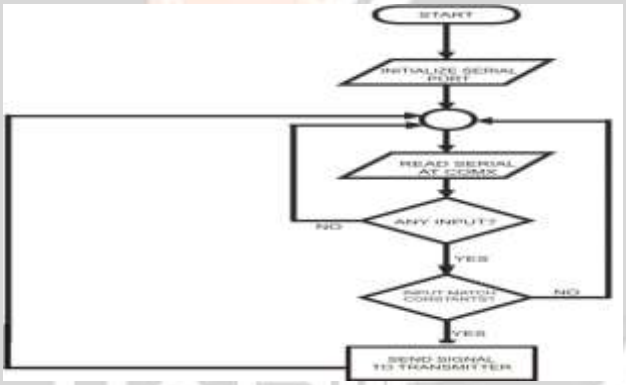

Fig. 2.0: Flow chart of the C code running on the arduino board in the Transmitter

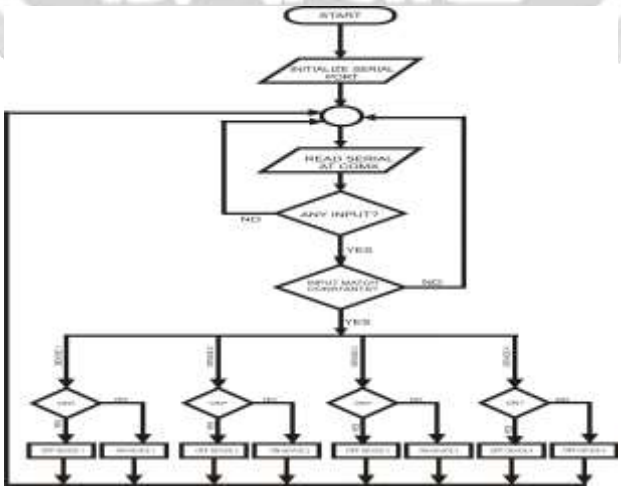

Fig.3.0: Flow chart of the C code running on the arduino board in the Receiver

All the sub-circuits analyzed in the above sections are put together in the complete circuit diagram shown in fig 3.4.

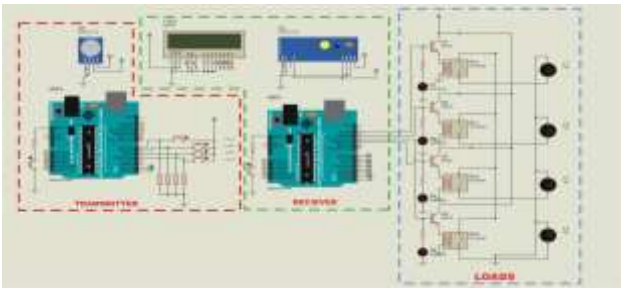

Fig. 4.0: Circuit diagram of the system

Once the circuit is powered, the control command(s) is/are entered using the push buttons. At the transmitter section, the Arduino continuously monitors the status of the buttons. Whenever a button is pressed, logic HIGH is detected at that particular I/O pin. As a result, the Arduino transmits a suitable message corresponding to the button pressed through the transmitter module in form of radio frequencies. For example if LOAD1-ON button which is connected to pin 6, is pressed Arduino detects logic HIGH at pin 6 and sends a message via the RF transmitter. At the receiver end, the RF receiver receives the RF signals radiated by the transmitter and feeds them to the decoding arduino. When the Arduino decodes the signal, it then writes a HIGH signal on the digital I/O PIN. As a result, the relay connected the particular load is activated and the load is turned ON or OFF. In this way, a simple home automation system can be implemented wirelessly.

3.0 RESULT

The simulation was carried out using advanced circuit design software, PROTEUS 8.4 professional. The circuit development from the most essential (Arduino board) to the common components (resistors, capacitors), all found in the components library under different subdivisions and classes according to the models and chip makers. The interconnections and circuits' links are all available minor circuit accessories in the CAD software.

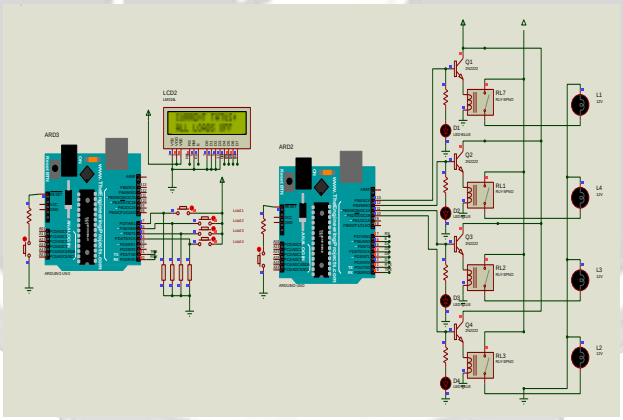

Fig. 5.0: When all loads are OFF

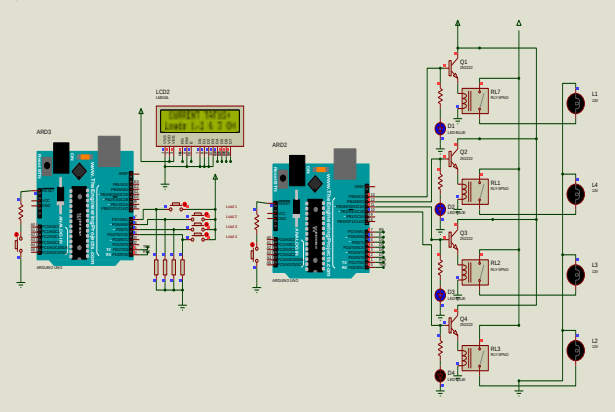

Fig. 6.0: When all loads are ON

3.1 Implementation

Fig. 7.0 shows the implementation of the Arduino Based Wireless Home Appliances Control System when all the necessary connections and soldering were done permanently before encasing. It involves transferring the construction on the bread board to the Vero board where it is permanently soldered, tested and encased. However, some of the components used (RF module, and the Arduino relay shield) came with their respective boards.

Fig. 7.0: construction stage

3.2 Testing

Testing entails verifying that at all stage, the implementation conformed to the objectives of the research work. Every component was tested before and after soldering using the relevant test instruments in the laboratory. At every stage, continuity test was carried out with the aid of the multi-meter and all lapses were cleared before proceeding to the next stage. Finally the prototype was test-ran and confirmed to be working.

Fig. 8.0: Testing Stage

4.0 CONCLUSION

It is worthwhile to state here that the aim and objectives of this research has been achieved. The circuit was designed and implemented, its feedback was observed to be highly efficient as a result of standard criteria employed during design and construction. This high efficiency of the circuit has proven the reliability of the system for sustainable human life in any kind of environment. This paper has presented a means of switching appliances without necessarily being present. This system is very marketable because of its simplicity, affordability, portability and low power consumption.

5.0 REFERENCES

[1] Fatima Jinnah "SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security" May 2009.
[2] I. Attiah, Hamdy A., "Energy Saving Through Smart Home", The Online Journal on Power and Energy Engineering (OJPEE), Vol.(2)-No.(3), pp.223-227, 2011.
[3]Conte, G., and Scaradozzi, D. (2003). Viewing home as multiple agent's systems.RoiboCUP2003, Padova, Italy.
[4] Potamitis, I., Georgila, K., Fakotalis, N., and Kokkinakis, G. (2003). An Integrated System for Smart-Home Control of Appliances Based on Remote Speech Interaction. *EUROSPEECH 2003, 8th European Conference on Speech Communication and Technology*, pp.2197-2200, Geneva, Switzerland, Sept.1-4, 2003.
[5] Alkar, A. Z., and Buhur, U. (2005). An Internet Home Wireless Automation System for Multifunctional Devices. IEEE Consumer Electronics, 51(4), 1169-1174.
[6] Delgado, A. R., Picking, R., and Grout, V. (2006). Remote-Controlled Home Automation System with different network technologies. *Proceedings of the 6th International Network Conference (INC 2006),* University of Plymouth, 11-14 July 2006, pp. 357-366.
[7] Ciubotaru-Petrescu, B., Chiciudean, D., Coiarga, R., and Stanescu, D. (2006). Wireless Solutions for Telemetry in Civil Equipment and Infrastructure Monitoring.*3rd Romanian-Hungarian Joint Symposium on Applied Computational Intelligence(SACI)* May25-26, 2006.