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Wireless Home Automation Control Using Voice Recognition Based on HM2007

Ansam S. Jabbar , Dr. Eyad I. Abbas , Mohammed E. Safi
Email: 30173@uotechnology.edu.iq
Email: 30165@uotechnology.edu.iq
Email: 30013@uotechnology.edu.iq
Department of Electrical Engineering
University of Technology, Baghdad, Iraq

Abstract

This paper introduced design and implementation of wireless home automation system (WHAM), which is developed using an Arduino microcontroller, Bluetooth wireless communication technology, and voice recognition based on HM2007. Software Development Kit HM2007 is embedded system to detect and recognize human voice commands and it converts into binary format and send respective digital representations to the microcontroller. The microcontroller then interprets these data signals, compares them with a database and thus identifies the referred load and its desired state. A Bluetooth module was added to microcontroller, so as to control lights and electrical appliances in the home. This system is most suitable for the elderly and the disabled persons, especially those who live alone and since recognize voice so it is secure. The response time is 1.2 sec which is efficient in these applications.

نظام تحكم لاسلكي لاتمتة المنزل باستخدام التمييز الصوتي المستند على HM2007

انسام صبحي جبار د. اياد ابراهيم عباس محمد احسان صافي
الجامعة التكنولوجية – قسم الهندسة الكهربائية
العراق - بغداد

الخلاصة:

هذا البحث يقدم تصميم وتنفيذ الأتمتة المنزلية اللاسلكية المعروف (WHAM) التي تم تطويرها باستخدام المتحكم الدقيق اردوينو، وتكنولوجيا الاتصالات اللاسلكية البلوتوث، ونظام

التمييز الصوتيمن خلال أدوات تطوير HM2007 للكشف والتعرف على الأوامر الصوتية للانسان. تقوم ادوات التطوير HM2007 بعد تدريبها على الاوامرالصوتية بتحويل هذه الاوامر الى تنسيق ثنائي وإرسال التمثيل الرقمية منها إلى متحكم دقيق . يقوم المتحكم الدقيق بتفسير هذه البيانات، بمقارنتها مع قاعدة بيانات لتحديد الأشارة المطلوبة لتشغيل الجهاز المنزلي. تم تعزيز أضافة وحدة البلوتوث إلى المتحكم الدقيق وذلك لتحقيق التحكم عن بعد لأنوار والأجهزة الكهربائية في المنزل. ان هذا النظام هو الافضل والانسب لكبار السن والمعوقين وخاصة أولئك الذين يعيشون بمفردهم وكون التمييز الصوتي يعتبر وسيلة آمنة لهم.زمن الاستجابة للنظام 1.2 ثانية والذي يعتبر فعالا في هكذا تطبيقات.

1. Introduction

Home automation is control home appliances remotely or automatically to reduce the effort that human being act in daily routine. The automation development, witness a great revolution with the development of embedded system.Wireless is one of the most feature that used in the automation to enhance the systems by making control more easy and reliable [1]. Speech is the oldest way for the human being used to communicate after sign language so that the speech recognition tends designer to use it to communicate with the machine, robotics and other application. The system introduced in this paper proposed a speech recognition control using hm2007 and Bluetooth as wireless technology to control the home appliances [2]. The system is used to provide an easy way to manage the house especially for those who have disabilities or Elderly people.

2. Proposed system Design

The proposed system is shown in figure (1), consist of the speech recognition part that recognize the command after turning it based on Hm2007 IC for speech recognition, which communicate with the Arduino Microcontroller to interface with Bluetooth technology using the HC-05 master module [3]. The command code transmitted through Bluetooth domain to the receiver using the HC-05 slave module. The second Arduino microcontroller task is to interface with the Bluetooth module and translate the command to the driver of the appliance as signal output

voltage of the appliance sequence that work according to the speech recognition. The driver of appliance consists of ULN2803 IC which composed of Darlington high current driver circuits that drive the relays to provide the suitable power that appliances need [4].

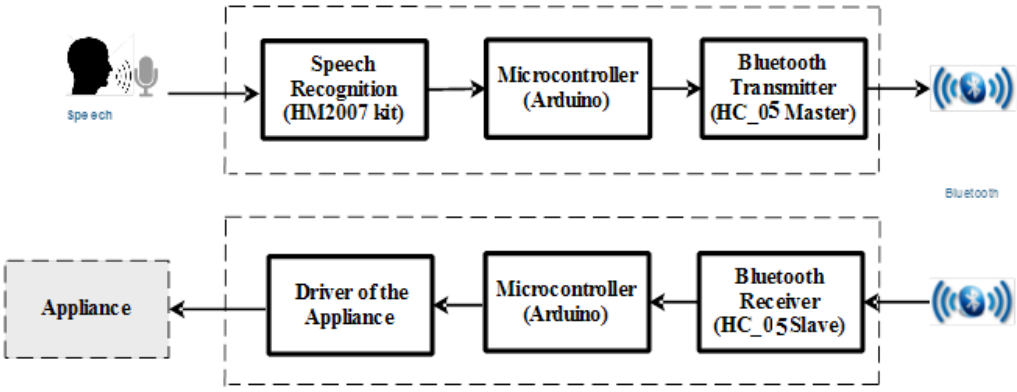

Figure (1): Block Diagram of proposed system

2.1 Speech Recognition with HM2007 board

The Speech recognition board is based on the HM2007 IC. The IC is specialized microcontroller for speech recognition; it can recognize 20 words, each word of length 1.92 seconds, or 40 words of length 0.96 seconds for each word. The on-board 3V battery is used to store the RAM content, even after the power is off so if you store the training words it remains after power off. Else its need to train board again after each power up. The board is feeding from external voltage to power the board as shown in figure (2) [5].

2.1.1 Training Words for Recognition

Press "1" (display will show "01" and the LED will turn off) on the keypad shown in figure (2), then press the TRAIN key (the LED will turn on) to place circuit in training mode, for word accepted one, then say the target word into the onboard microphone (near LED) clearly. The

circuit signals acceptance of the voice input by blinking the LED off then on. The word (or utterance) is now identified as the "01" word. If the LED did not flash, start over by pressing "1" and then "TRAIN" key again.

It may continue training new words in the circuit. Press "2" then TRN to train the second word and so on. The circuit will accept and recognize up to 20 words (numbers 1 through 20). It is not necessary to train all word spaces. If you only require 10 target words that are all you need to train [6].

2.1.2 Testing Recognition

Repeat a trained word into the microphone. The number of the word should be displayed on the digital display. For instance, if the word is "directory" was trained as word number 20, saying the word "directory" into the microphone will cause the number 20 to be displayed.

2.1.3 Error Codes:

The chip provides the following error codes.

55 = word to long
66 = word to short
77 = no match

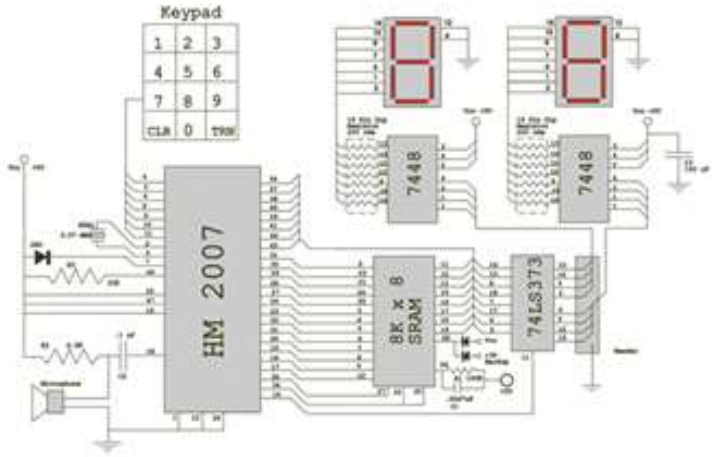

Figure (2): HM2007 Board Schematic

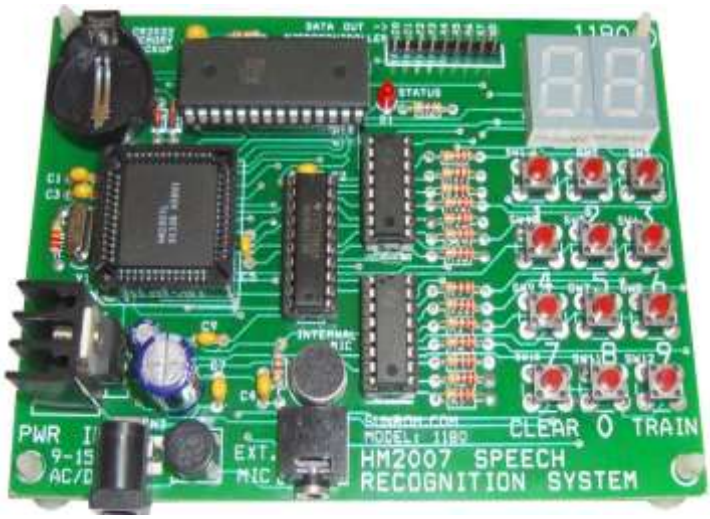

Figure (3): HM2007 Board

2.2 Arduino Uno microcontroller board

The Arduino Uno is a microcontroller board, as shown in figure(4) based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button [7].

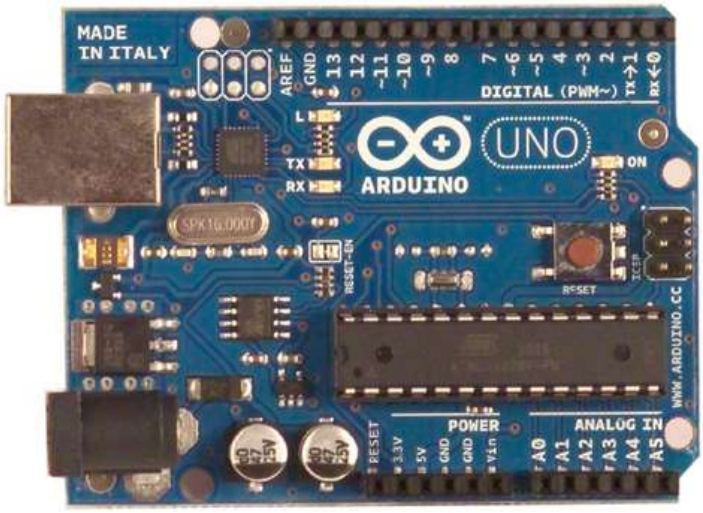

Figure (4): Arduino Uno microcontroller board

2.3 Bluetooth module HC-05

The Bluetooth (HC-05) module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature) [8]. Bluetooth serial module is used for converting serial port to Bluetooth. These modules have two modes: master and slaver devices. Figure (5) shows this type.

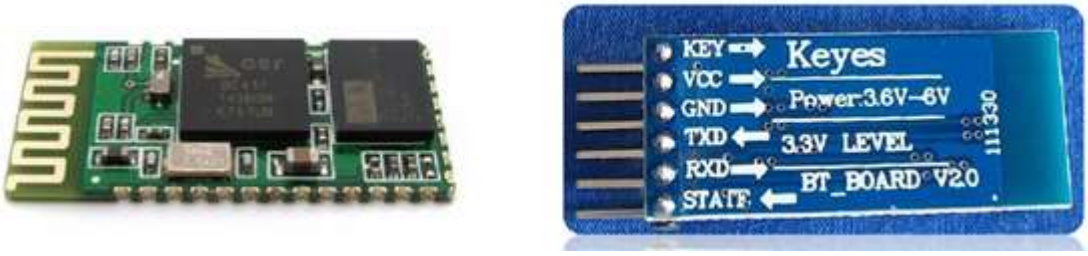

Figure (5): Bluetooth HC-05

2.4 Relay Board – 8 Channels:

The board has eight relays driven by ULN2803 IC. The board works on 12V but the input signal can come directly from microcontroller output working at 3V or 5V to control relays. Each relay can switch variety of AC or DC high voltage, high current loads working at 110V or 220V AC mains like lights, fans, motors and such. The status of relay is indicated by individual LEDs as shown in figure (6)[9].

Figure (6): Relay Board – 8 Channels

3. System Implementation and Results

The proposed system is a completely assembled and implemented as shown in figure(7), which is consists of recognition and transmitter section, and received command voice code and relays as second section . The voice command input is taking from internal microphone in the HM 2007 board for training and testing. The output data of the training voice command will be stored in Arduino microcontroller as database. The number of voice command for training is eight as FON for fan on; FOF for fan off, LON for light on, LOF for light off, etc Otherwise is error in recognition. The HM2007 output data D_0 to D_7 is represented the state of command word. This output data will received from microcontroller and send appropriate signal to Bluetooth HC-05 to transmit. This Bluetooth in the first section is operated as a master. The appropriate signal will received by slave Bluetooth in the second section from design. The

received signal is analysis by microcontroller in the second section to control the relays state for appliances operation. The flow chart in the figure (11) is illustrating the software algorithm for the system. The experimental test was achieved for different cases:

- Case 1: The wrong voice command led to all relay OFF and stays in initial state as shown in figure (8).
- Case 2: The voice command is LOF led to change light relay state to ON as shown in the figure (9).
- Case 3: The multi voice commands are FON, LON, TON, and MON led to change all four relays state to ON as shown in the figure (10).

The Table (1) illustrates all cases above.

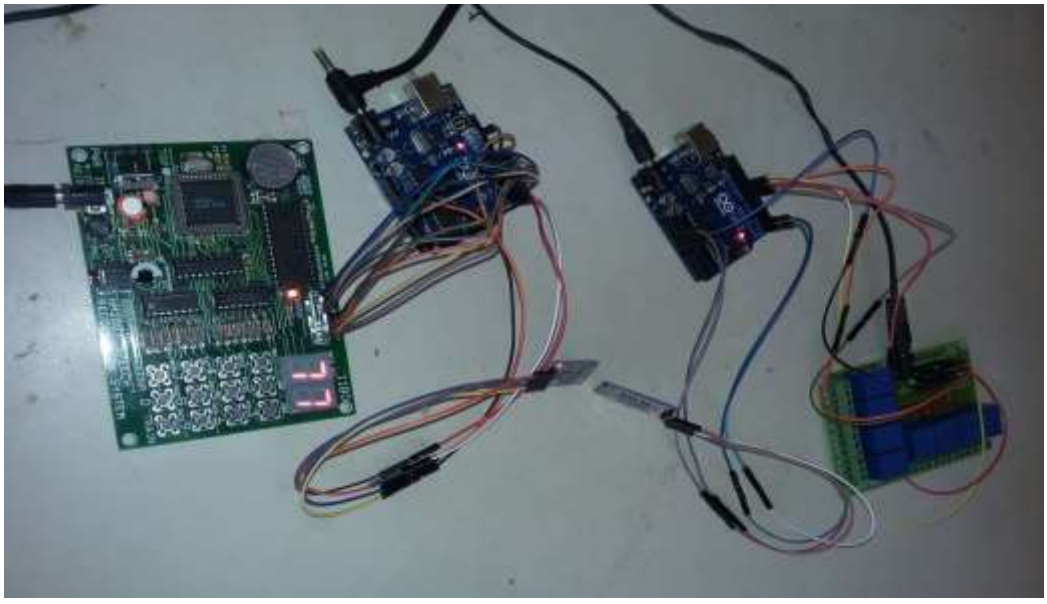

Figure (7): proposed system implementation

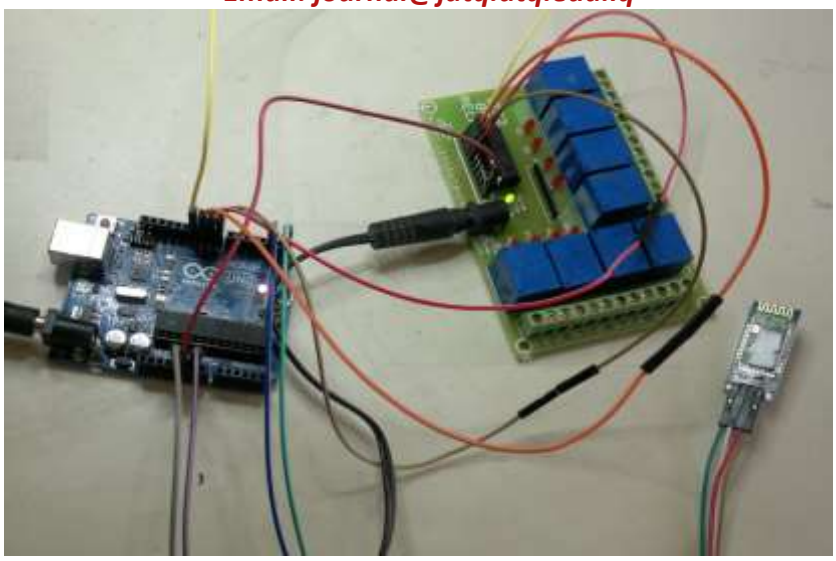

Figure (8): The Case 1 all relays OFF

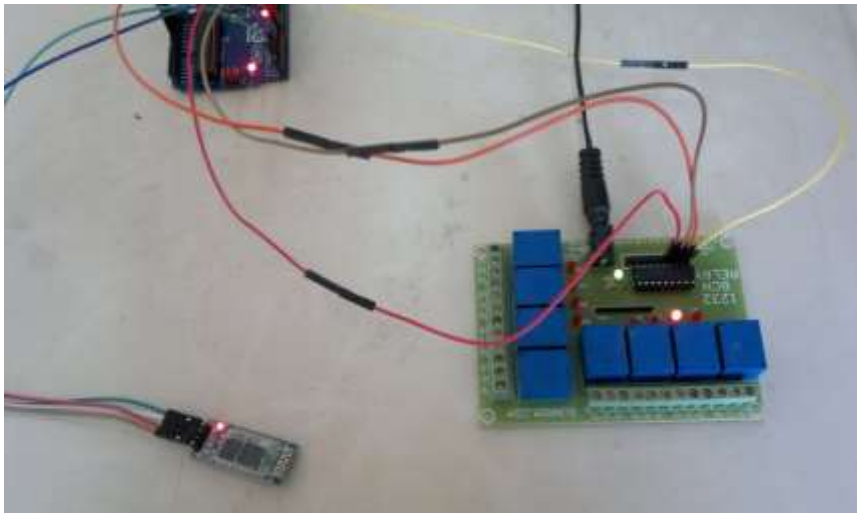

Figure (9): The Case 2 relay two ON

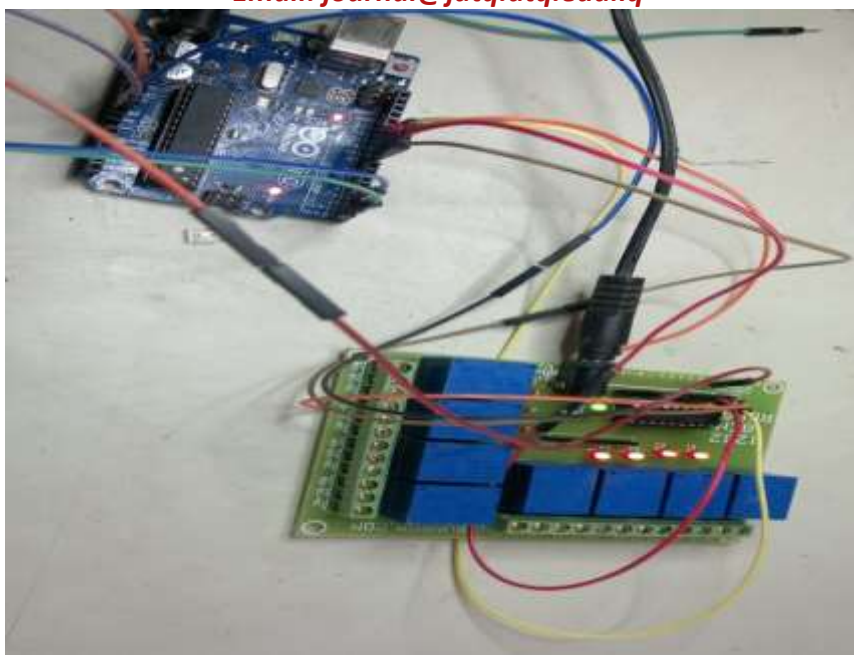

Figure (10): The Case 3all relays ON

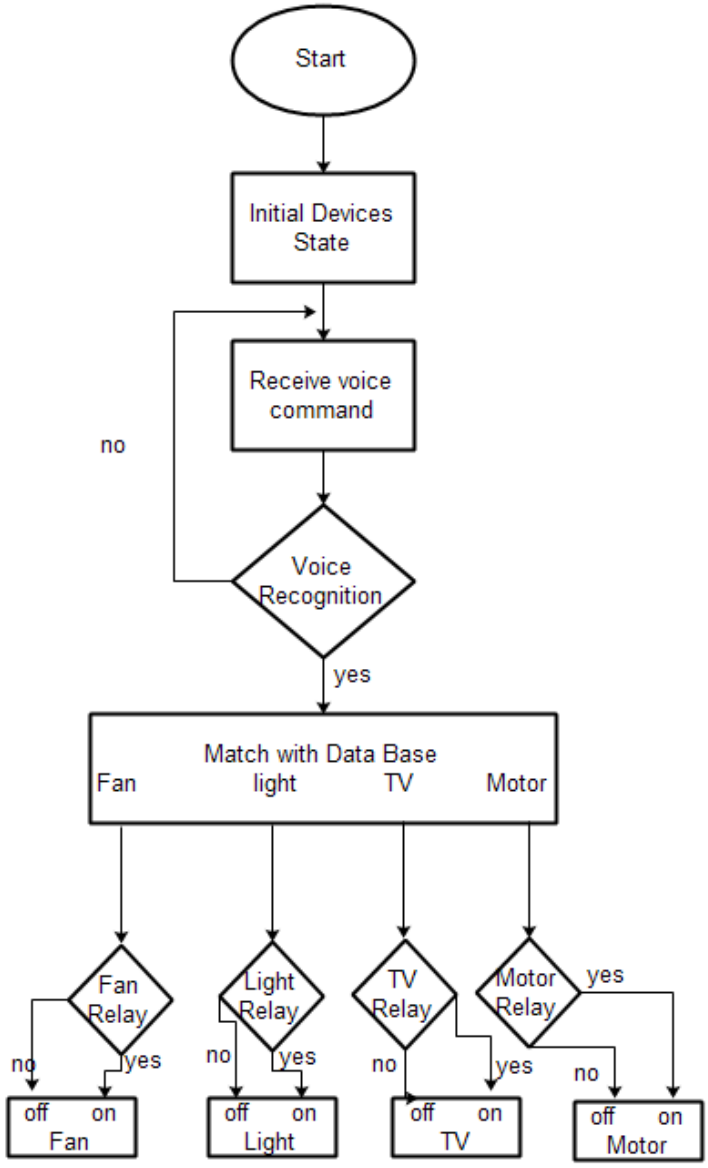

Figure (11): Flowchart for system algorithm

Table (1): Appliance and Voice for All Cases Result

Appliances	Voice Command	Recognize State	Data out from HM2007 Board	Relays State			
				1	2	3	4
Fan	FON	Match	0000 0001	ON	*	*	*
	FOF	Match	0000 0010	OFF	*	*	*
Light	LON	Match	0000 0011	*	ON	*	*
	LOF	Match	0000 0100	*	OFF	*	*
TV	TON	Match	0000 0101	*	*	ON	*
	TOF	Match	0000 0110	*	*	OFF	*
Motor	MON	Match	0000 0111	*	*	*	ON
	MOF	Match	0000 1000	*	*	*	OFF
Error	Others	Mismatch	Others	NO Change			

4. CONCLUSION

A home automation system was built and implemented based on HM2007 voice recognition with Arduino microcontroller, Bluetooth, and

relays board. The system also implements the wireless network using Bluetooth modules for their efficiency and low power consumption. This system was applied in electrical appliances fan, light, TV, and motor. The system is most suitable, efficient and focused for the elderly and the disabled persons, especially those who live alone and since recognize voice so it is secure. The system uses one word for each state because of the ability of HM2007 that recognizes on word in one test. The response time is 1.2 sec which is efficient in these applications.

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