International Journal of Engineering & Technology, 7 (2.9) (2018) 106-108

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Long range wireless communication by using arduino and HC-12 Wireless Serial Module

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Abstract

Smart control systems are developing these days; it's become a demand for companies and, factories, and homes to control their appliances and reduce the consumption electric power. HC-12 is a Half-duplex wireless serial Communication unit has a capability of creating wireless link between two end devices. In this work, HC-12 is presented and used for controlling any electrical devices inside the company, to establish the smart control system for company appliances. HC-12 incorporate with Arduino provide a transmitter receiving system, which used for sending commands from user to the appliances via personal computer, these commands enable an controller to turn OFF or turn ON an appliance. Assembly language obtained from the Arduino IDE software to establish the integration between the microcontroller and HC-12 for proposed system. The system activated by sending the command from the end user, personal computer, to the controller, after receiving the command by microcontroller unit and carried out the proper order by switching OFF or switching ON automatically the electrical appliances inside the home or factory. The prototype system was implemented and applied to factory and had been working successfully; besides, it provides an effective mechanism for utilization the energy efficiently.

Keywords: *Smart Control System, HC-12, Arduino-IDE, microcontroller.*

Introduction

Digital transmissions for information provide a significant and rapid evolution in human life style. Electricity represents an important and essential item in human life and it's very important to preserve the use of electric energy to get comfortable life. Several techniques and mechanisms are used to control and reduce the consumption electric energy by clients [1].Consequently, a prototype based on an Arduino device using HC-12 and some switching relays and some other easily available electronic components can be provide automatically control to any electrical device at factory remotely using personal computer. The most advantage in this a prototype an effective communication can be established between a sender and the receiver without using any internet or mobile network data; hence the electrical energy saving in daily can be made more efficient and effective. Using HC-12 wireless serial port communication unit is due to capability of creating a multi-channel wireless data transmission with coverage of 1 km with mammal cost. Thus using of HC-12 enables the controlling of electrical devices at factory with long distance location of personal computer, with physical geographical boundaries independent. Most of the previous research works published in the field of controlling is using GSM system to control and turn ON/OFF any device, such as [1], [2], and [3], or using the services supplied by internet as the work of [6]. In this work, new technique is used for controlling with a significant coverage range of remote control without requiring to the mention services of GSM and internet, in spite of that the previous works more practical for long distance remote control, but for short distance application for instance 1 kilometer, this work is more efficient and best choice.

1. SYSTEM DEVELOPMENT

2.1. Arduino controller

Arduino is open source platform and easy to use software and hardware, the platform contains two main constituents. The first part is a circuit board which programmed as microcontroller, and second part is available software named Arduino Integrated Development Environment (IDE), sometimes called Arduino software IDE. Arduino IDE has a text editor for writing code via computer and uploads the code to the circuit board; besides, it has a toolbar with buttons for common functions and a series of menus. The main purpose for choosing Adriano Uno is that controller board based ATmega328 consists of "14 digital i/o pins (with 6 pins can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button and Flash Memory 32 KB of which 0.5 KB used by boot loader SRAM 2 KB EEPROM 1 KB Clock Speed 16 MHz" [5], Figure (1) shows the mention device.

Fig. 1: Arduino Uno

1.2. H C–12 (Wireless Serial Module/ Radio Frequency Module)

The HC-12 wireless serial module plays a vital role in the implementation of this project, which is shown in figure (2). It makes it possible for the communication to take place within a maximum range of 1.8 kilo meter. This particular module has a working frequency range of 433.4 to 473.0MHz and it provides up to a 100 communication channels at a time. The frequency range of the HC -12 actually comes in the ISM band, ISM is industrial, scientific, and medical radio band frequency reserved for the use of radio frequency (RF) energy for industrial, scientific and medical uses for other purposes other than telecommunications . Hence, it is easy and costless to make use of this band. One of the main disadvantages of using this band is that, we must be setting the proper channel and also we must provide adequate amount of security for a hassle free communication [6].

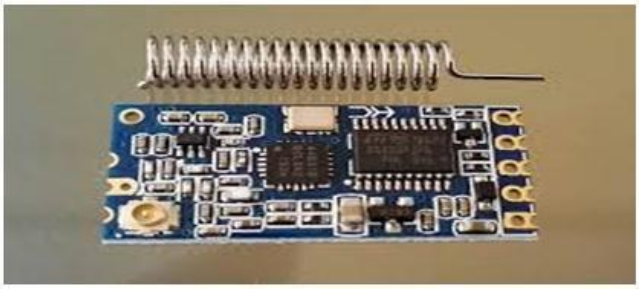

Fig. 2: HC-12 SI4463 Wireless Serial Port Module

The conventional antenna of HC-12 is spring antenna, but with this work the mentioned antenna was replaced with SMA antenna, to provide long distance of coverage. The coverage area provided by the HC-12 in this work was measured and it's shown by the table 1.

Table 1: Baud rate and coverage area by HC-12

Baud rate	Distance	Partitioned	Open air
9600	30	√	√
115200		X	√
9600	200	√	√
115200		X	√
9600	500	X	√
115200		X	√
9600	800	X	√
115200		X	√

Relay

Relay is an electromechanical device operates as electromagnetic switch by relatively small current, its mean it has two of movable contacts which can be turn ON or OFF another large electric circuit. The main part of a relay is an electromagnet "a coil of wire that becomes a temporary magnet when electricity flows through it". The advantage of relays is start working with a relatively small power to operate the relay coil as mention above, but the relay itself can be used to control a large circuit or appliance such as motors, heaters, lamps or AC circuits which themselves can consumption a lot more electrical power [7]. The relay used with this work is shown in figure (3)

Fig. 3: Relay for switching

2. Working mechanism of the transmitter unit

The transmitter circuit is depicted with figure (4) and (5), the input order start with pressing push button, then an command will be moved to the arduino to generates and transmit a specific code, which represent a specific order or condition, to the receiver unit using HC-12 kit. The process of transmitting and receiving is carried out according to the program, which is built-in to the used Arduino Kit. A response is received by Arduino kit after a period of time from the receiving unit confirm execute of the transmitted specific code and the device to be operated.

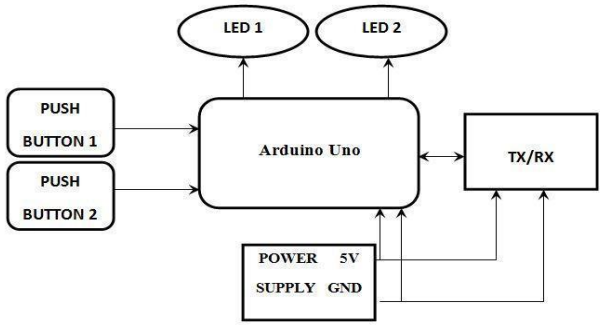

Fig. 4: Block diagram of the transmitter

Fig. 5: Sender unit

3. Working mechanism of the receiver unit

After sending the order from the transmitter unit, the order is received by HC-12 and sends the information to the Arduino, which analyzes the information and gives the results by open or close one of the two devices to be controlled during the open or cutting the current using the relay through a program previously carried in the receiver .The receiver block diagram is shown in Figure (6) and (7).

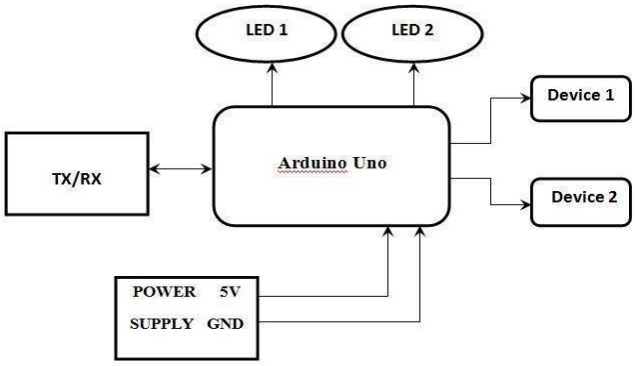

Fig. 6: Block diagram of the receiver

Fig. 5: Receiver unit

5.Result and Conclusion of the work

Industry appliances are selected to be controlled by the prototype system of this work, with a significant preserve consumption of power at the transmitter unit and receiver unit, and easy of using and handling. An experiment were carried out by this prototype work to control a device located at distance of 300 meter, and the results show a remarkable controlling on the used device by sending the order of turn ON and reception the order and execution. Figure (8) show the final form of system's units. This wireless control system is comfortable and good choice for the customers who are interested to control their industry appliances, regardless if the devices are AC or DC type, consume high power or low.

Fig. 5: Transmitter and Receiver units

Acknowledgement

We would like to thanks our colleagues and the head of the department of Electronic, for their advices and encouragement to carried out this work.

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