RTOS Based Home Automation System Using ATMEGA

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ABSTRACT: This paper represents the design and implementation of a low cost yet compact and secure RTOS based home automation system using ATMEGA. This design is based on the ATmega328 controller board where the sensors and electrical appliances are connected to the input/output ports of the board. In order to enhance the system performance to make it more dynamic, an open source RTOS has been integrated, which has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply. Devices like light switches, power plugs, temperature sensors, have been integrated in the system to demonstrate the effectiveness and feasibility of the proposed smart home system.

KEYWORDS: Android; ATMEGA328; Bluetooth

I. INTRODUCTION

Wireless technologies have become more popular around the world which gives consumers relive of the well-known "cable chaos" that tends to grow under their desk. The system operates on Bluetooth technology which operates over unlicensed, globally available frequency of 2.4GHz that can link digital devices within a range of 10m to 100m at the speed of up to 3Mbps depending on the Bluetooth device class. With this capability; we propose a home automation system based on Bluetooth technology.

Automation implicates introducing a degree of automatic or computerized control to certain electronic and electrical systems. These include temperature, lighting, control on basis of Real time Operating System. Various intelligent appliances such as smart phone, home security devices like smoke detection, human presence; home theaters and many more are set to realize the concept of a smart home. All these appliances can be interconnected and monitored using a single micro-controller. This paper demonstrates an automation system inclusive of remote mobile host controller and several client modules .The client modules communicate with the host controller through a wireless device such as a Bluetooth operated smart phone. Although automation today is not a new thing but most advanced home automation systems in existence today require a big and expensive change of infrastructure. We have designed an automation system that can control appliances like TVs, Fan, Tube lights from an android smart phone using Bluetooth. In this a low cost secure smart phone based flexible automation system is introduced.

The communication between the smart phone and the ATmega controller is done wirelessly. Additional devices with more features can be connected into the system with inclusive modifications. ATmega microcontroller controls the electronics devices like fans and lights etc. ATmega328 is an 8-bit microcontroller that supports wireless serial communication over Bluetooth. This board has 32 digital I/O ports. Different home or office appliances are connected to the digital output ports of the ATmega controller board via relays to provide sufficiently voltage compatibility and high currents. 25W, 240V lamps are used for test purposes.

II. RELATED WORK

Smart home is not a recent term for science society but still far more away from people's audition and vision. As electronic technologies are approaching the field of home automation is elaborating. Manifold smart systems have been proposed where the control is done via, internet, short message service (SMS) base, Bluetooth etc. Bluetooth capabilities are better and almost all current laptop/notebook, cell phones and tablets have built-in adaptor that will indirectly

diminished the cost of the system. However it restricts the control within the Bluetooth range of the environment while most other systems are not too feasible to implement as low cost solution.

Existing system is based on Arduino Ethernet, which is used to eliminate the use of a personal computer (PC) keeping the cost of the overall system to a minimum although voice activation is incorporated for switching functionalities [1].

This paper presents the automated approach of controlling the devices in a household that would ease the tasks to use the traditional method of the switch. Bluetooth, which is the most efficient and famous technology for short range wireless communication is used here to automate the system.[2]

Pattern based password protection is implemented for allowing only authorized users to control the appliances. Another inclusive integration of Google's voice recognition feature is used to recognize users' voice commands for controlling appliances. [3]

In this modern era, everybody uses smart phones which are a part of our day-to-day life. They use all their daily uses like daily updates, social networking, newspaper reading and all the apps like vehicle security, home automation control, health maintenance, human body anatomy etc. has been designed in the form of applications that can be easily installed in their hand held smart phones. This project approaches a robotic movement control through the smart phone[4]
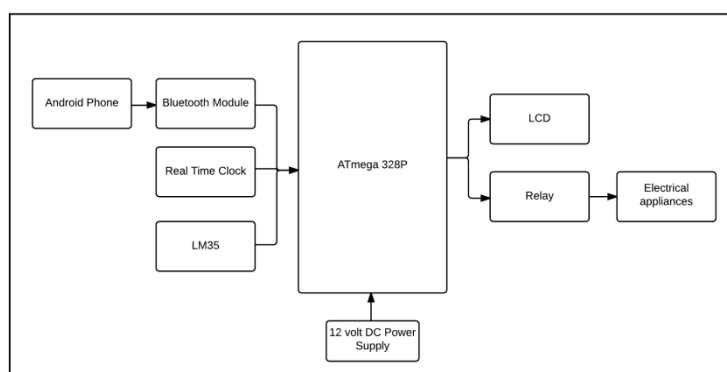
III. BLOCK DIAGRAM

Fig.1. Block diagram of proposed system

It consists of following blocks

- Blue-tooth module-JY MCU BT HC-06
- Micro-Controller -ATMEGA 328
- LM35 Temperature Sensor
- Liquid Crystal Display
- Real Time Clock DS1307
- Relay Board

The hardware components that make up our home automation system are Smart Phone, the ATmega328 Micro-controller Board, the Bluetooth module connected to the Microcontroller board and relay boards that will drive the electrical appliances. The other components inclusive are a 16x2 char LCD display and Temperature sensor (LM35).

IV. IMPLEMENTATION

The circuit is built around an ATmega328 controller, ultrasonic transceiver module HC-SR04, Bluetooth module JY MCU BT,LM35 Temperature Sensor , Relay Board and LCD Display On burning the program in micro-controller of ATMega328, the output decision of ATMEGA328 is sent to drive the relays to operate the required electrical appliances very easily and precisely. A real time clock is basically just like a watch - it runs on a battery and keeps time

for us even whenever there is a power outage. Using an RTC, a track of long time lines can be kept, even if microcontroller is reprogrammed or disconnected from USB or a power plug. The RTC chip is a specialized chip that just keeps track of time. It can count leap years and number of days in a month, but it doesn't take care of Daylight Savings Time. LCD is interfaced to display the temperature of the LM35 sensor.

1. Controller - ATmega328P
2. Bluetooth Module (JY MCU BT HC-06)
3. Relay Board (ULN2003)
4. Temperature Sensor (LM35)
5. RTC (DS1307)
7. LCD Display
8. Android Mobile

A. *ATmega328*

ATmega328 micro-controller is intended for artists, designers, hobbyists and anyone interested in creating interactive objects or environments.

It consists of following specifications

- Open-Source single-board microcontroller,
- 32KB flash memory and 2KB SRAM
- A USB connection for programming
- 14 Digital, 6 Analog I/O pins
- An ISCP header and a reset button

B. *Blue-tooth module (JY MCU BT HC-06)*

The module provides a method to connect wirelessly with a PC or Bluetooth phone to transmit/receive embedded data such as GPS data, ADC voltage reading and other parameters. Bluetooth module JY MCU BT used in the project can be connected to any device, via built in UART interface to communicate with other Bluetooth -enabled devices such as mobile phones, handheld computers and laptops. The module runs on a 3.6V to 6V supply.

It consists of following specifications

- Supply voltage can be between 3.6 to 6V DC. I/Os are 5V tolerant.
- Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps
- Bluetooth SPP (Serial Port Protocol)
- Easy to connect this module with any standard Bluetooth device, just search and key "1234" passcode.
- Baud rate: 38400 bps.
- Module requires no setup.
- Dimensions: 1.73 in x 0.63 in x 0.28 in (4.4 cm x 1.6 cm x 0.7 cm)

C. *Relay Board (ULN2003)*

The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA.

It consists of following specifications

- 3 Relays (Load up to 6A)
- 7 NPN High voltage, High current Darlington array IC
- 2.7 Kilo ohm Resistor

- TTL or 5v CMOS Devices
- Open Collector o/p

D. *Temperature Sensor (LM35)*

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.

It consists of following specifications

- Operating temp -55C to 150C
- Low cost
- Calibrated in Celsius
- Linear + 10.0mV/C scale factor
- Current drain ¡ 60uA
- Low impedance o/p
- Low self-heating

E. *RTC (DS1307)*

The DS1307 serial real-time clock (RTC) is a lowpower, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information.. The clock operates in either the 24-hour or 12hour format with AM/PM indicator.

It consists of following specifications

- I2C serial interface
- 2 Automatic switch circuitry and power fail detect
- Programmable square wave output signal
- Serial real time clock
- Low power
- Full binary coded decimal
- Industrial temp range -40 to 85

F. *LCD Display*

16*2 Liquid Crystal Display has features like 16 Character, 2 Line, View Angle 12H or 6H ,TN or STN Fluid, Extended Temperature Range available ,Several Character Types available ,LED or EL Backlight available

It consists of following specifications

- Declining prices of LCD
- Ability to display numbers, graphics and character
- 16*2 LCD
- Ease of programming for graphics and character

The proposed module RTOS based home automation system using ATMEGA of is shown below.
The android application consists of values that operate the robot accordingly. In this application, if '1' is pressed, "Appliance 1 is on''; if '2' is pressed, "Appliance 1 is off"; if '3' is pressed, "Appliance 2 is on"; if '4' is pressed, "Appliance 2 is off" ;if '5' is pressed, "Appliance 3 is on";if '6' is pressed, "Appliance 3 is off";if '7' is pressed,

"Appliance 4 is on"; and if '8' is pressed ,"Appliance 4 is off" .The proposed module ofRTOS based home automation system using ATMEGAis shown below.
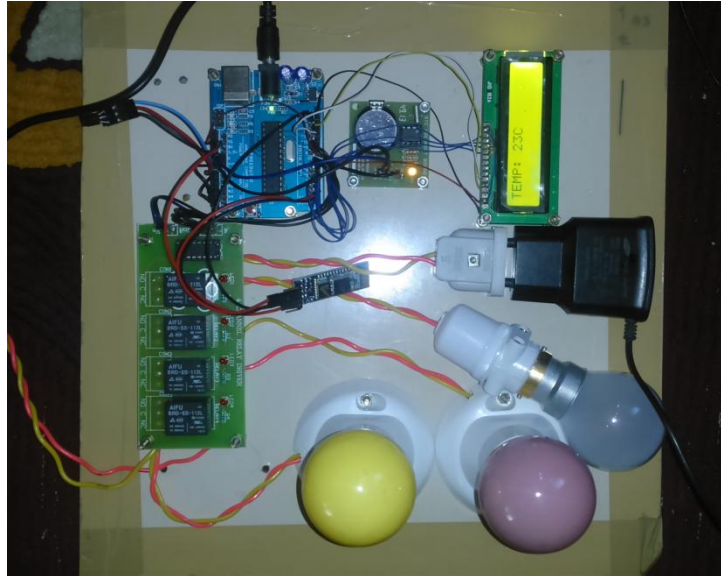

Fig.2RTOS based home automation system

V. ALGORITHM

- Scan for other Bluetooth devices.
- Establishes a connection.
- Send data to Bluetooth enabled ATmega board.
- Send command from smartphone to the ATmega controller board.
- The microcontroller will decide which appliances to switch ON/OFF.

VI. APPLICATION & ADVANTAGE

- For central locking of all circumference doors and windows.
- Medical alert / tele assistance.
- Precise and safe blind control.
- In terms of lighting control, it is possible to save energy when hours of wasted energy
- Security cameras can be controlled.
- Security systems inclusive of motion sensors
- An intercom system allows communication via a loud speaker and microphone between multiple rooms.
- Overall performance cost is very cheap.
- No complicating wiring is required.

VII. FUTURE SCOPE

Further improvements can be executed on the system such as the integration of an intelligent controller for controlling the various home devices based on various factors like humidity,LDR, gas detection, human detection using PIR, counting living things using IR sensoretc. Also, we can easily Google Cloud Messaging for controlling our home systems from the Internet, hence making it possible to monitor our home appliances anywhere in the world.

VIII.   CONCLUSION

The design and implementation of a low cost RTOS based home automation system. This system can be manufactured on a large scale for mass adoption owing to its ease of design and simplicity. Another advantage of is that the application software is based on Android, which has the largest smartphone base in the present era. With improvements in technology and the fact that Android is open source and free, cheap Smart Phones can be used in overall system to make it cost effective for mass adoption.

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