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GSM CONTROL OF ELECTRICAL APPLIANCES

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Abstract- This paper shows an approach for designing a system which implement a microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM (Global system for mobile communication) network. The microcontroller then will carry out the issued commands and then communicate the status of a given appliance or device back to the cellular phone.This device allows a user to remotely control and monitor multiple home/office appliances using a cellular phone. This system will be a powerful and flexible tool that will offer this service at any time, and from anywhere that has network coverage. Due to the fact that the combination and sequential logic circuits have more components soldered together, inflexible, more difficult to the user, and not programmable, the 8951 micro controller was chosen because it can be written to and read from and also has an internal memory which makes it to be versatile in application and user friendly. Apart from the micro controller, other electrical / electronic components used include: resistors, filters, voltage regulator, transformer, rectifiers, capacitors, DTMF (Dual Tone Multi Frequency) Integrated circuit etc.

Keywords: Microcontroller, GSM, Dual-Tone Multi-Frequency (DTMF) Decoder, Assembly Language.

I. INTRODUCTION

GSM based Control System" implements the emerging applications of the GSM technology. Using GSM networks, a control system has been proposed that will act as an embedded system which can monitor and control appliances and other devices locally using built-in input and output peripherals. Remotely, the system allows the user to effectively monitor and control the house/office appliances and equipment via the mobile phone set by sending commands. The main concept behind the project is receiving the sent command and processing it further as required to perform several operations. The type of the operation to be performed depends on the nature of the command sent. The principle in which the project is based is fairly simple. The block diagram of the system is shown in figure 1 below;

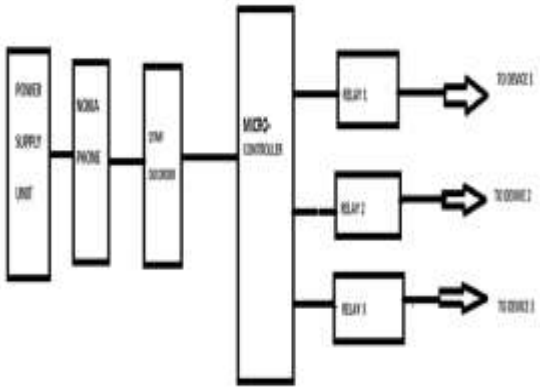

Fig.1. A Block Diagram of GSM Based Micro-Controller System

From the above representation, the first block is used as a supply unit to the circuit. The second mobile station is the GSM phone which is embedded in the casing of the system. The mobile phone as indicated in the block diagram is a Nokia 2300 mobile set. The received command will be decoded by the third block which is the DTMF DECODER and then extracted by the microcontroller and processed accordingly to carry out specific operations. The relay driver is used to drive the relay circuits which switch the different appliances connected to the interface. The input from different sensors are fed to micro-controller and processed to operate respective tasks.

II. SOME OF THE COMPONENTS USED IN THE DESIGN AND APPLICATION

A) Microcontroller

A microcontroller is a chip, which has a computer processor with all its support function (clocking and reset), memory (both program storage and RAM), and I/O (including bus interfaces) built into the device. These built-in functions minimize the need for external circuits and devices to the designed in the final applications. The improvements in micro-controller technology has meant that it is often more cost effective, faster and more efficient to develop an application using a micro-controller rather than discrete logic [1].

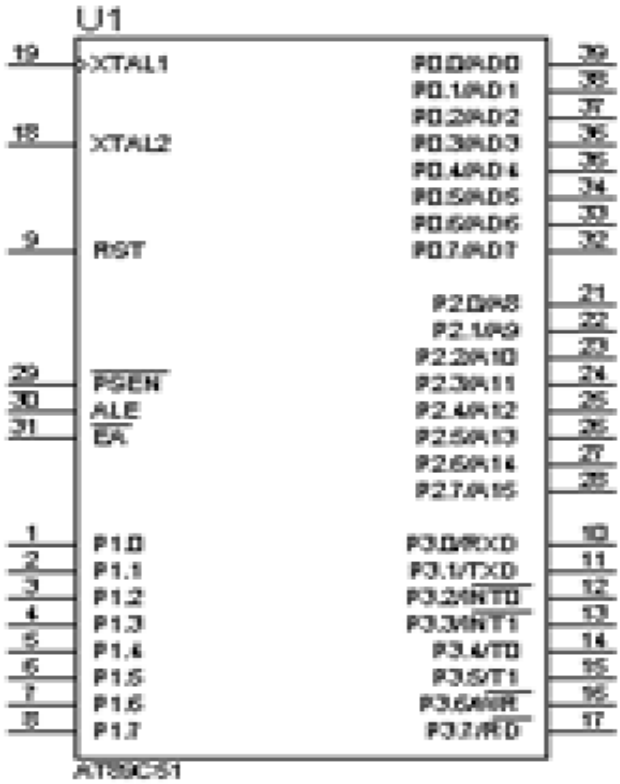

Fig.2. Diagram of a microcontroller.

Table 2.1 Port 3 and Functions

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	WR (external data memory read strobe)
P3.7	RD (external data memory read strobe)

III. DUAL TONE MULTI FREQUENCY (DTMF) DECODER

DTMF is often used in remote control applications that typically use telephones (e.g. accessing your messages from an answering machine, retrieving your account balance info from your bank's database) [2].

In DTMF, there are 16 distinct tones. Each tone is the sum of two frequencies: one from a low and one from a high frequency group. There are four different frequencies in each group. Phone only uses 12 of the possible 16 tones. If you look at a phone, there are only 4 rows (R1, R2, R3 and R4) and 3 columns (C1, C2 and C3). The rows and columns select frequencies from the low and high frequency group respectively.

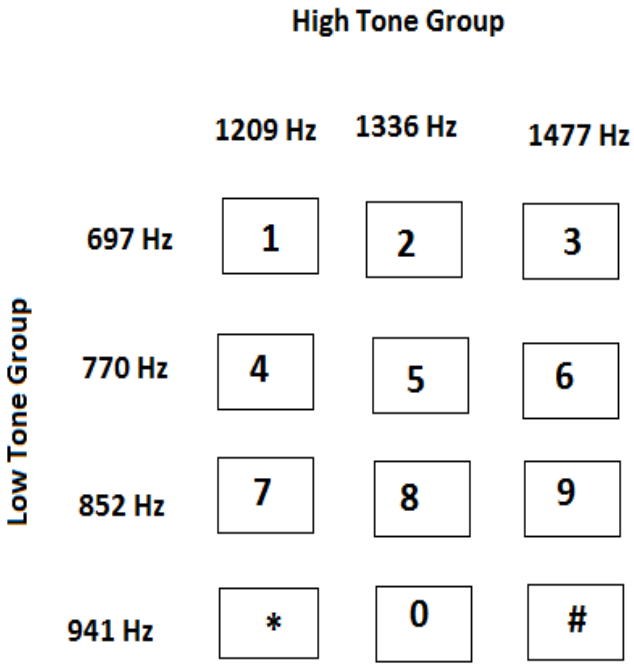

Fig.3. Keyeypad dual tone multi-frequencies

Thus, to decipher what tone frequency is associated with a particular key, look at the phone again. Each key is specified by its row and column locations. For example, the "2" key is row 0 (R1) and column 1 (C2). Thus using the fig.3, "2" has a frequency of 697 + 1336 = 2033 Hz The "9" is row 2 (R3) and column 2 (C3) and has a frequency of 852 + 1477 = 2329 Hz [3] [4].

IV. CIRUIT DIAGRAM AND MODE OF CIRCUIT OPERATIONS

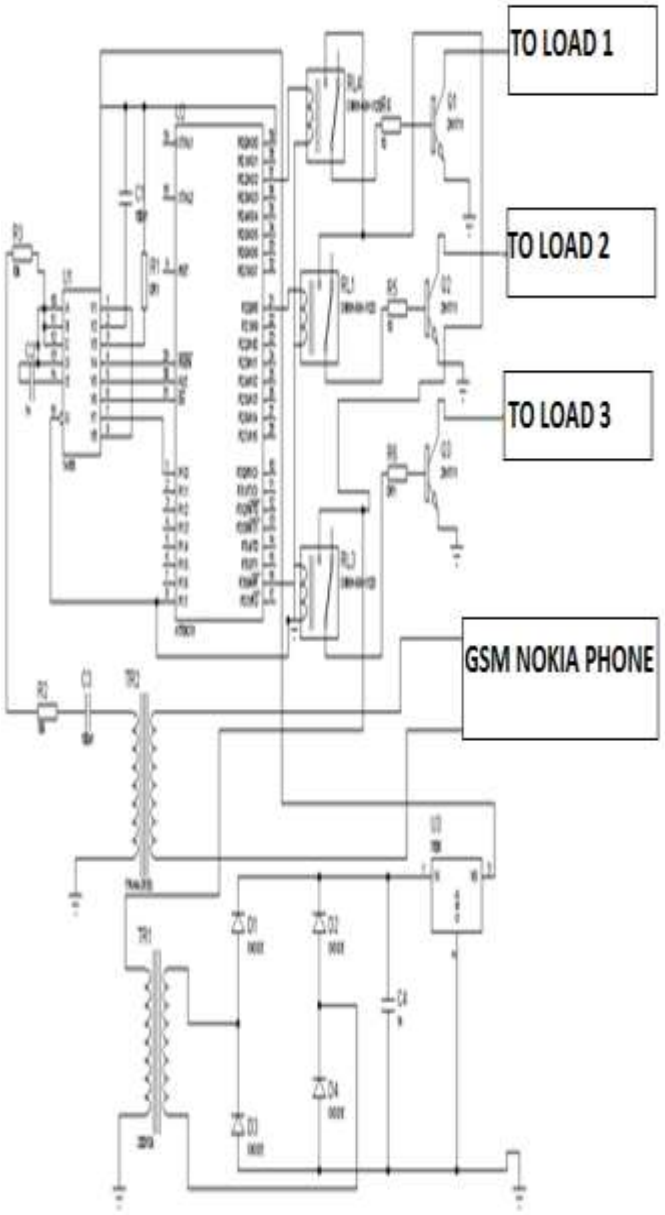

Fig.4. Circuit diagram of gsm based system

A) CIRCUIT ANALYSIS

The complete circuit consists of the power supply unit, the DTMF decoding stage and micro-controlled relay switching sections. The power supply supplies the DTMF decoder. It is seen that the DTMF tones from the mobile phone is coupled through a transformer. This ensures electrical isolation between the phone line and the rest of the circuit. It equally steps up the signal to an appreciable level enough to bias the differential input of the decoder (though the decoder is highly sensitive).

Careful measurements of the DTMF signal output level of different NOKIA phones revealed that the audio output level is relative to the different phone models. Taking NOKIA 2300 as an instance, 5mV was obtained as its audio output level as compared to 2.3mV in NOKIA 2600. Thus, the addition of a

transformer coupling circuit is relevant to step-up the signal to an appreciable level.

B) Principle of Operation

The circuit is powered via 5 volts supplied by IC1, a 78L05 voltage regulator. IC2 is a DTMF receiver chip. The DTMF signals are picked up by a GSM phone interfaced to the DTMF decoder through a handsfree cord connected through a coupling transformer. The transformer provides electrical isolation between the phone and the rest of circuit. The DTMF signal sent from the phone through the transformer is coupled through capacitor C_2 to the inverting input (pin 2) of a differential op amp of the MT8870D decoder. The capacitor couples the AC signal from the GSM phone to the biasing resistor whilst blocking any DC current. Both transformer windings have a nominal impedance of 600 ohms. The op-amp is configured for single-ended operation which means feedback from the output (pin 3) is used to set the gain. The gain is set by R_3/R_2. The non-inverting input (pin 1) is tied to a reference voltage Vref at pin 4. This approximately is 2.5V (half Vcc). Resistor R_4 and capacitor C_3 set the 'guard time', the length of time a tone must be present (or absent) for it to be recognized. For the values shown the guard time is set at 33ms. Once a valid tone has been detected (after 40mS) the STD output (pin 15) goes high and the 4-bit digit data (representing 1-9) is presented on the output pins (pins 11-14). The STD output will remain high whilst the tone is still present and will drop low 40mS after the tone stops. IC_3 is an Atmel AT89C51 microcontroller programmed with software to take the digit data from IC_2 and perform the task of switching the relays. It also monitors the state of the relays. If the DTMF tone level is too low the circuit will not be able to detect them correctly.The sensitivity of the DTMF decoder can be increased by increasing the value of R_f from 100K to 220K.

C) How to Operate the Gsm Control System

Table 2. Operating Codes

CODES	RELAYS	DEVICE CONDITION
1	0001	D1 ON
2	0010	D2 ON
3	0011	D1 and D2 ON
4	0100	D3 ON
5	0101	D1 and D3 ON
6	0110	D2 and D3 ON
7	0111	D1, D2 and D3 ON
8	1000	D1, D2 and D3 OFF
9	1001	D1 ON

The completed circuit works with an algorithm as programmed into the microcontroller chip. In the project, particular command codes for turning on and off the GSM control system were designed. Each relay has been programmed to respond to commands using the keys on the phones.

V. FLOWCHART AND ALGORITHM

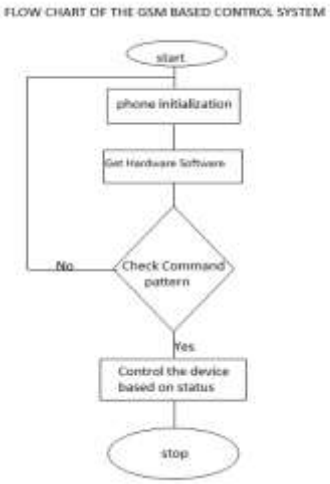

Fig.5. Flowchart of gsm based system

ALGORITHM

Step 1: Start
Step 2: Phone initialization
Step 3: Get Hardware Software
Step 4: Poll command from mobile phone
Step 5: Receive command
Step 6: Check command pattern
Step 7: Control the device based on status
Step 8: Notify end user
Step 9: If new command received goto step1

VI. CONCLUSION

This project is an implication of the concept in automating and monitoring a system. From the convenience of a simple cell phone, a user is able to control and monitor virtually any electrical devices. The practical applications of this project are immense and can have vast level of implementation. This concept can be used in fields such as weather forecasting, remote sensing, robotics, aeronautics, home automation, and many other related fields where continuous monitoring and regulation are needed. So this is not the end of the project but rather is a step towards exploring other possibilities that it brings with it, for example, the outlets can be increased by increasing the number of relays in the work.

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