Design and Development of an Intelligent Adjustable Automatic Timer System

Amol R. Sutar
Department of Electronics
FAMT, Ratnagiri
Affiliated to Mumbai University

Abstract-*Time management is a very important factor not only in person's life but also in every system or organization. The Electronic Timers are used in industries, street light control, household appliances and many other applications to control the operation at specified time interval of repetitive nature. The available timer systems have limited timer modes, also they require continuous power supply for their operation, and also they are suitable only for specific applications. This paper focuses on the design and development of an Intelligent Adjustable Automatic Alarm System which will be useful in schools, colleges, offices, and industries to sound a siren at preset time. The proposed system is very advantageous for time management, and it helps making more systematic and disciplined environment. The alarm system presented here uses microcontroller, real time clock ic, memory ic as main programmable devices. Also it consists of matrix keypad and LCD for user interface with the system. The complete system is designed and implemented to achieve desired result.*

Keywords:electronics, timer, microcontroller, relay, alarm

I. INTRODUCTION

This paper presents design and development of an intelligent timer system using microcontroller. In schools and colleges lectures, practical and exams are being conducted at preplanned time. After each hour or at desired time the peon has to ring the bell. Whatever the work the peon is doing at the bell time, he has to run to ring the bell. This may affect the office work the peon is dealing with. Sometimes peon may forget to ring the bell. In such a case the lectures and practical may get delayed by some time may be by five to fifteen minutes. This is undesirable in schools and colleges.Instead if we use electronic timer and alarm system in schools and colleges, definitely reduce burden of peon and he can focus on office work. The electronic timer will automatically ring the bell at programmed time. Nowadays Electronic and mechanical timer are available in the market, but there function suits for specific applications e.g. street light control, induction heating etc. and not for the schools and college alarm systems [1],[2]. In addition in these timers the delay time setting is in minutes not in seconds. In school and colleges the bell should ring for 5 to 10 seconds only at stipulated times, otherwise it will create disturbance. Electronic timers manufactured today are available with limited timer modes that may be 8/16/20 maximum [2]. Also it requires continuous power supply or battery backup otherwise time and timer setting flushed off after power removal and needs to set timer again after power resume[2],[3].

In this work we are going to develop a microcontroller based an Intelligent Adjustable Automatic timer System which will be useful to ring the bell used in school, colleges, office and even in industries. The timer system is highly recommended for all schools and colleges where lectures, practical and written examinations are being conducted. It serves as time manager and reminder during academic teaching period and examination time. It also helps maintain disciplinary culture as far as time is concerned. All lecture and practical will be conducted at right time. It will also help students during examination time to write their paper in allotted time.Siren sounds perfectly at preset time every day. The system proposed here designed to support following features:

a. We can change date and time at any time.
b. We can change alarm time at any time.
c. More than 25 alarm time can be set.
d. We can set alarm time of whole year.
e. Once set no frequent date/time/alarm time adjustment required.
f. No battery back up required.
g. Simple and user friendly. Even peon can make time setting of the system. Reduce work overhead of peon and will be free to do other work.

Next section covers detailed timer system and its implementation using microcontroller.

II. SYSTEM OVERVIEW

Proposed Timer System

The timer system consists of microcontroller, real time clock IC, EEPROM memory, lcd display and 4*3 keypad matrix for user interaction with the system. The electrical bell

or alarm is interfaced with microcontroller through relay and driver circuit. The block diagram of the proposed system is shown in the figure 1.

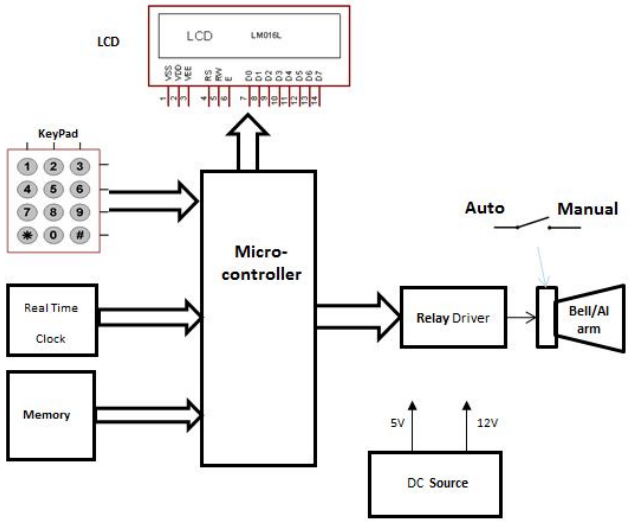

Fig. 1. Block diagram of the proposed timer system

In this work 89c52 microcontroller is used because it has all necessary features those are required in this project. It has four I/O ports for peripheral component connection, Timers, UART, internal RAM and code memory. It can work up to 20MHz clock frequency. Matrix keypad is connected to port 1, LCD data pins are connected to port 0 and LCD control pins are connected to the P2.6 and P2.7. In this circuit real time clock IC DS1307 is used to provide time and date information. Real time clock IC consist of small amount of RAM memory (64 byte) where we can store: time information i.e. hours, minutes, seconds, date information: date, month, year and day Monday to Sunday in BCD format. In addition it has one control byte to configure RTC function. Remaining 56byte ram memory can be used to store temporary data e.g. alarm time. RTC has two oscillator pins where a standard 32.768 kHz crystal is connected. It has one battery pin where we can connect 3v battery. This battery provides power to RTC in case of mains power fail condition and can long last for more than ten years. Memory 24c08 is used to store alarm time. It has 8 kilobit or (1024*8) 1 kilo byte capacity which is more than sufficient storage capacity for this system. Memory start address is 000 and end address is 3FF(H). If alarm system is using on time only in hours and minutes only, it will require two bytes to store this alarm time. Thus we can store 512 alarm times in memory ic. If the alarm system is using alarm on time and off time (e.g. street light control) we can store 256 alarm time in memory ic. Even by increasing memory size we can store large number of alarm modes. But this much number of alarm count is not required in practical alarm system. In figure 1 shown single relay driver, we can connect multiple relays to operate multiple bells connected in different sections of building.

Working of System

After power on reset initially it displays welcome message on lcd. Then Controller reads current date and time from rtcic. Then it displays date, time and day on lcd. Then it compares current time with the alarm times stored in memory ic. If both the time match controller gives a signal to turns on relay driver to ring the bell. Algorithm of the system looks very simple but very difficult to implement practically. RTC and memory are i2c based ics. It has two pins for communication with controller called SDA and SCL. Two port pins of microcontroller connected to the SDA and SCL pins of time ic and memory ic. SDA pin is serial data pin and SCL pin is serial clock pin. Serial bit by bit data is send through SDA pin and clock signal is used for data synchronization between controller and i2c chips. RTC and memory has unique device addresses.

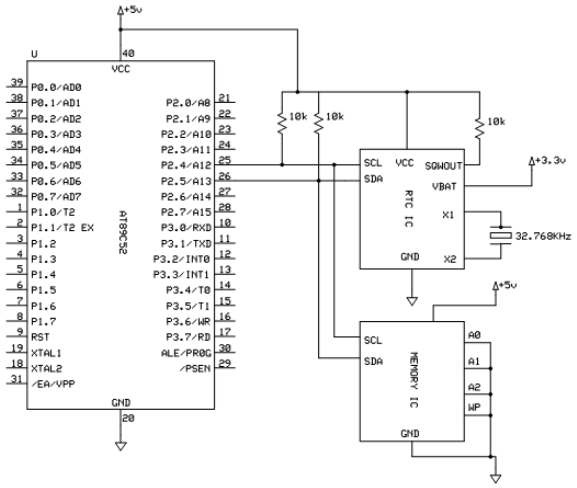

Fig.2. Memory and RTC interfacing with uC

RTC has device address 0xa0 while memory has 0xd0. Hence we can connect SDA pin of rtcic with SDA pin of memory and it is connected to single port pin of microcontroller ic. Similarly SCL pins of both ics connected together and then it is connected single port pin of microcontroller as shown in fig.2. Memory ic allows single byte write as well as page write operation. When we want to set the current date and time a key * on keypad is used. If this key is pressed microcontroller goes in time setting mode. In this mode controller takes date and time data from keypad and displays on lcd at the same time controller writes to the rtc ram at respective ram address. In case of mistake during time or date setting we can recorrect it using # key. Pressing # key controller remains in the same mode. If entered time or date information is correct * key used to set it and exit. When we

want to set the alarm time a key # on keypad is used. If this key is pressed microcontroller goes in alarm time setting mode. In this mode controller takes alarm time data from keypad and displays on lcd at the same time it writes to the memory chip at respective memory address. In case of mistake during this setting alarm time we can recorrect it using # key. Pressing # key controller remains in the same mode. If entered alarm time information is correct * key used to set it and exit. Controller executes whole code within few milliseconds and refreshes lcd hundreds of times in a seconds. Due to this time and date information correctly displayed on lcd.

III. HARDWARE AND RESULTS

This project involves development of hardware part as well as software part. Initially complete hardware is designed. After designing hardware, it is implemented on well-designed PCB. Required code is written using appropriate software and tested on hardware. For the proposed work requires following tools:keil software for writing and debugging the program code and Express PCB Software for PCB design. Hardware tools: PC or Laptop, PCB Lab, Multimeter, Circuit components and tools. The detailed hardware and its results presented in this section. Figure 3 shows complete hardware system fixed in a plastic box. The input voltage 5V is given to the system using step down transformer rectifier, filter and 5v regulator ic. While 12V is generated for relay operation using same transformer and rectifier-filter circuit and 12V regulator. Data lines of lcd are connected to port 0 and control lines are connected to port 2 of controller. Initially it displays welcome message on lcd as shown in fig. 4.

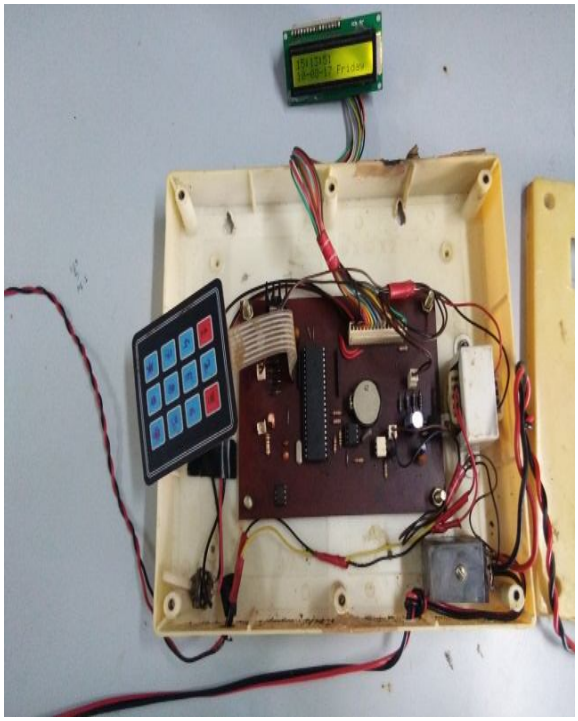

Fig. 3. Complete Hardware of Timer System

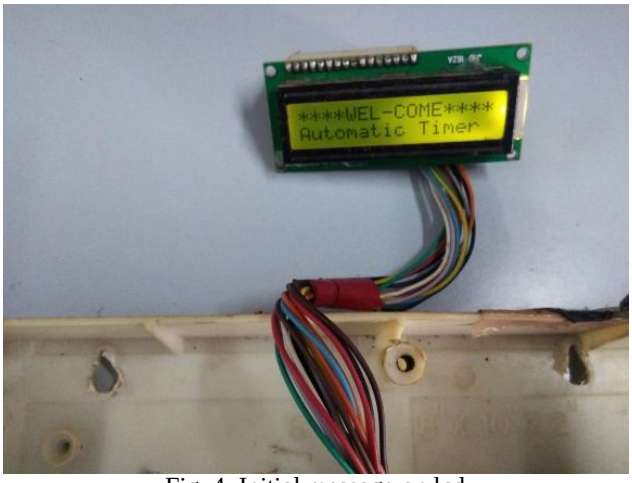

Fig. 4. Initial message on lcd

Controller reads total alarm count from memory ic and display it on lcd as shown in fig. 4.

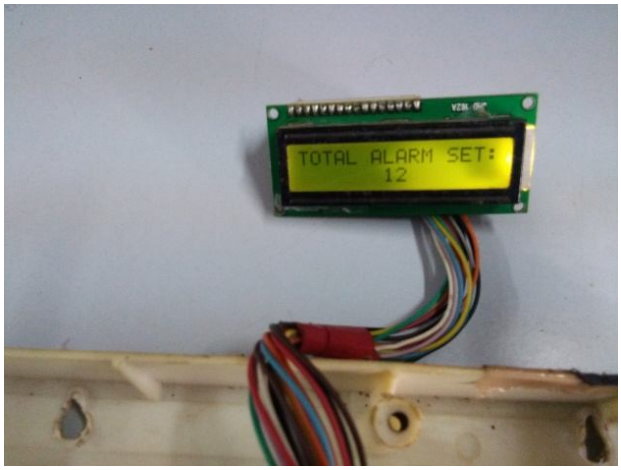

Fig. 4. Displaying total alarm count

After displaying total alarm count, controller reads current date and time information from rtcic and display it on lcd as shown in fig. 5.

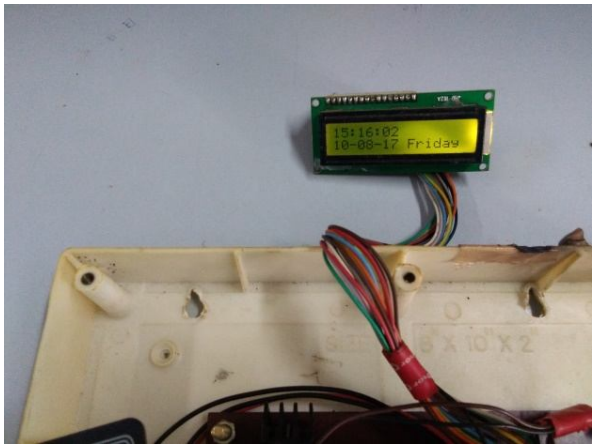

Fig. 5. Displaying current time, date, day

User can set current day, date and time information by pressing # key on keypad. After pressing # key controller goes in to time set mode and displays set date-time message on lcd as shown in the figure 6.

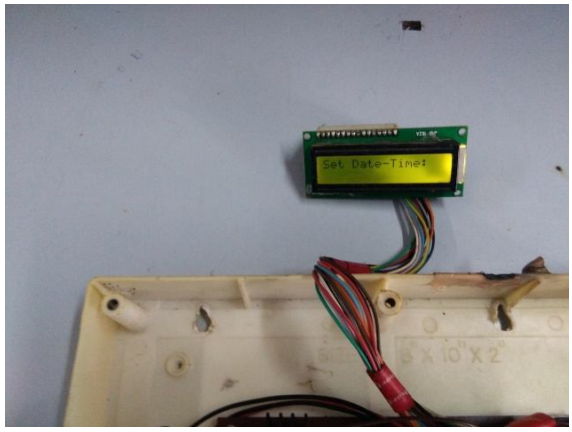

Fig. 6. Display message: set current time and date

Time information is set in hr:mn:sec form as shown in the fig.7. Time information should be set in 24hour format. Once current time information is given user can press # key to that time. After pressing this key controller stores time information in rtc ram memory at predefined locations. If the user enterswrong time information by mistake, he can re-set it by pressing * key. Pressing * key keeps controller execution in the same mode/loop.

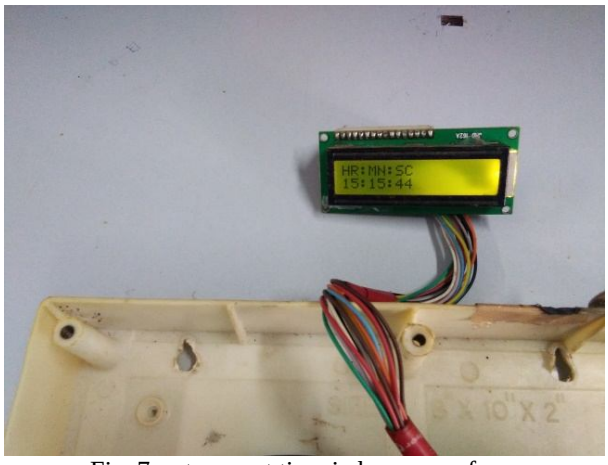

Fig. 7. set current time in hr:mn:sec form

After entering time information and pressing # key controller waits for date information to be set. Date information is entered in dd:mm:yy form. After setting date, controller waits for day information. Day information is entered in terms of numbers 1 to 7, where number 1 implies Monday.

Controller goes in alarm time set mode whenever user presses * key. Since this system is developed for school/college alarm, it takes only alarm on times. This system rings the bell for only 5 to 10 seconds so off time setting doesn't require.As shown in the fig.8., it displays alarm time and its respective count.

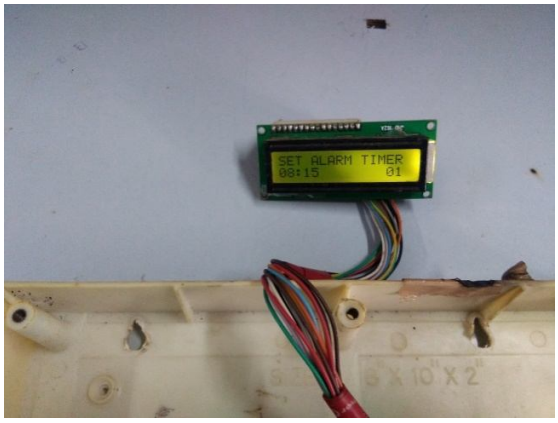

Fig. 8. Set alarm time

The complete timer system after housing in plastic box is as shown in the fig.9. A manual/auto switch is also provided to set the timer system in automatic mode or manual mode. This switch is useful when alarm system fails or fault condition occurs. The user can ring the bell by pressing this switch manually.

Fig. 9. Timer system

IV. CONCLUSION

The alarm system discussed in this paper will be very useful in schools, colleges and offices ring the bell at preprogrammed time. It provides better user interface using keypad and lcd display unit. The current date and time and alarm time can be easily adjusted even by peon. Instruction manual for setting current time and date, and alarm time can be provided for user guidance. Once current date, time and alarm time is set it does not require setting it again even after power fails. This system does not require any battery backup for saving date, time and timer setting and thus very useful. Same system can be also applicable in street light control, timely appliances control (lights, motor etc.) at remote locations.

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