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AN ADVANCED AND SOPHISTICATED, RF BASED ANNUNCIATOR SYSTEM FOR FAULT TOLERANT INSTRUMENTATION

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ABSTRACT

This paper presents one method of annunciation in which activation of visual or mechanical indicator (Annunciator) takes place of a remote switch which is activated immediately after the occurring of the faulty condition in any part of the system. An audio alarm is also provided along with the visual sign for better working.

The main part of the system is designed around ATMEL 89S52 microcontroller which is programmed to detect the faulty condition around eight different faulty conditions. To send this faulty data to a remote place within the building, RF medium at 433MHz is used. The faulty condition is fed to the transmitter at 433MHz and is received by the receiver within the building of 30 meters.

Keywords* : *Annunciator, ATMEL 89S52 microcontroller, 433MHz Receiver, 433MHz Transmitter,

I. INTRODUCTION

Nowadays all instrumental system belongs to industrial process, control and domestic applications like elevator control or air conditioning control; involve some automatic fault-finding system. Therefore equipment is needed for close monitoring such complex systems which is effectively done by employing Annunciation System.

"Annunciator" means the device that provides the information on the state or condition of something by indicating which of several electric circuits is activated. The industrial process instrumentation system as well as domestic system like elevator, central a/c, climate control systems require automatic fault-finding facility. This facility normally detects any faulty condition (for example: Any node grounding or connecting to supply) of the system and draws the attention of the operator attending to it towards the faulty conditions, so that suitable remedial action is taken and ensure proper operation of the system. It is basically an audio-visual warning system which detects the faults which are going on. This is very necessary for safety concern in order to avoid unwanted accidents.

II. HARDWARE REQUIREMENTS

Annunciator using embedded system mainly monitors the operator about the faulty condition in the system. Hardware part of the system comprises microcontroller (AT89S52), transmitter (433MHz), receiver (433MHz). Software part of the system is Keil C.

2.1. 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. Due to these built in functions it minimizes the need for external circuits and devices to the designed in the final applications. The improvements in microcontroller has meant that it is often more cost-effective, faster and more efficient to develop an application using a micro-controller rather than discreet logic. Microcontroller has the following responsibilities have to be taken.

- Power distribution
- System clocking
- Interface design and wiring
- System Programming
- Application programming
- Device programming

There are two types of micro-controller real-time applications. Embedded micro-controller and is External memory micro-controller. Embedded micro-controller the microcontroller, which has the entire hardware requirement to run the application, provided on the chip. External memory micro-controller is the micro-controller that allows the connection of external memory when the program memory is insufficient for an application or during the work a separate ROM (or even RAM) will make the work simpler and sophisticated.

2.1.1 Atmel 89s52

Microcontroller has been widely used in embedded systems such as home appliances, robots and toys. The Atmel 89S52 is a low power CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to reprogrammed in-system or by a conventional nonvolatile memory programmer [1]. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

2.2 RF MODULE

There are various methods to find faults in the system. One of the methods is by means of RF communication. The name itself suggests RF module operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. The digital data in this system is represented as variations in the amplitude of carrier wave, which is known as Amplitude Shift Keying

RF Module consists of an RF Transmitter and RF receiver which operate at frequency of 433MHz as shown in the Fig.1. An RF transmitter receives serial data and transmits wirelessly through RF through its antenna connected at pin 4[8]. The transmitted data is received by RF receiver of same frequency as that of transmitter at the rate of 1kbps – 8kbps.

The RF module is used along with encoder/decoder. The HT12E encoder is used to encode the data which is fed to the transmitter while HT12D decoder is used to decode the data at the receiver.

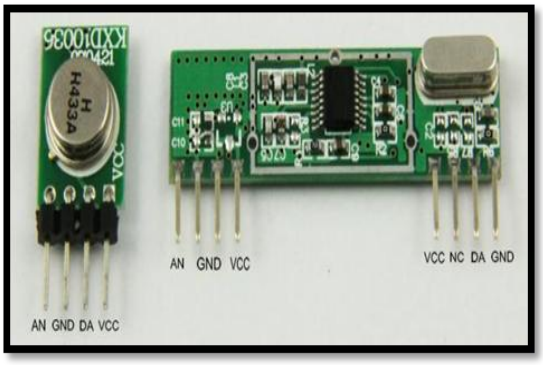


Fig. 1 RF Transmitter and Receiver

The operating voltage of transmitter is 1.5 – 12V and the data rate is up to 8kbps. The receiver operating voltage is 2.4 – 12V. The communication between the transmitter and receiver is shown in the fig.2

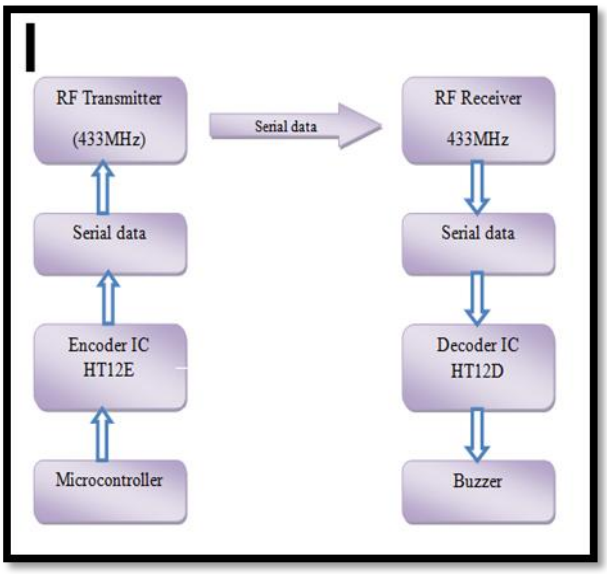


Fig. 2 RF communication

III. SYSTEM HARDWARE STRUCTURE

The system hardware consists of a transmitter and receiver. Transmitter system involves power supply unit. A receiver receives information from a transmitter through an antenna as shown in the fig.3.

Circuit diagram of the annunciator built around an AT89S52 microcontroller. AT89S52 microcontroller has 256 bytes RAM and 8 KB ROM. Since the AT89S52 microcontroller has enough program memory, there is no need

to add additional memory. The annunciator circuit can be employed to scan any input condition from any system that gives 5V [2] and ground for 'ON' and 'OFF' conditions respectively.

The combination of resistor R12 and capacitor C1 provides the necessary slow rising power-on-reset signal to the microcontroller's reset input pin9. The system clock operating frequency is 11.0592MHz and this is provided by the crystal connected across oscillator pins 18 and 19 of the microcontroller. In order to use inbuilt memory resistor R18 is connected between enable pin31 and Vcc pin 40.

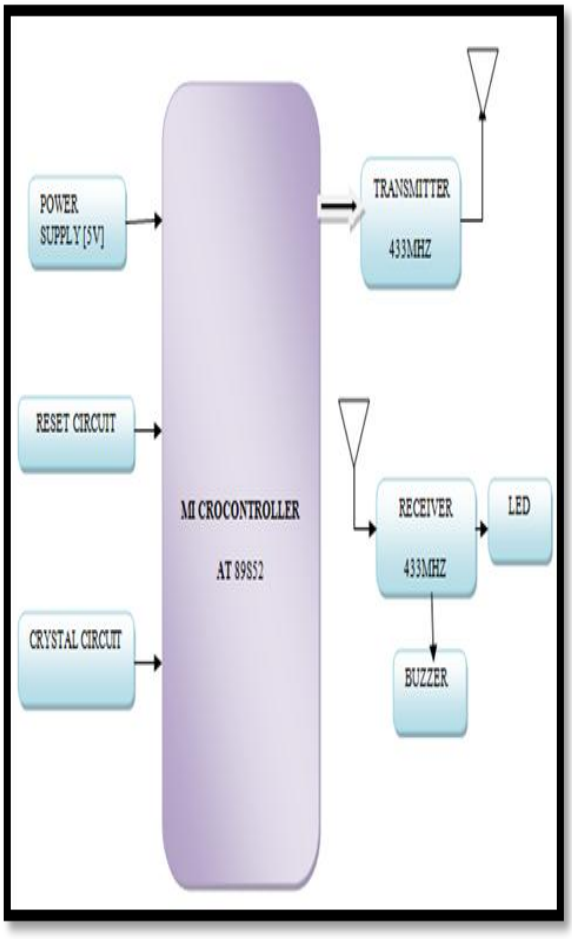


Fig .3 Block Diagram

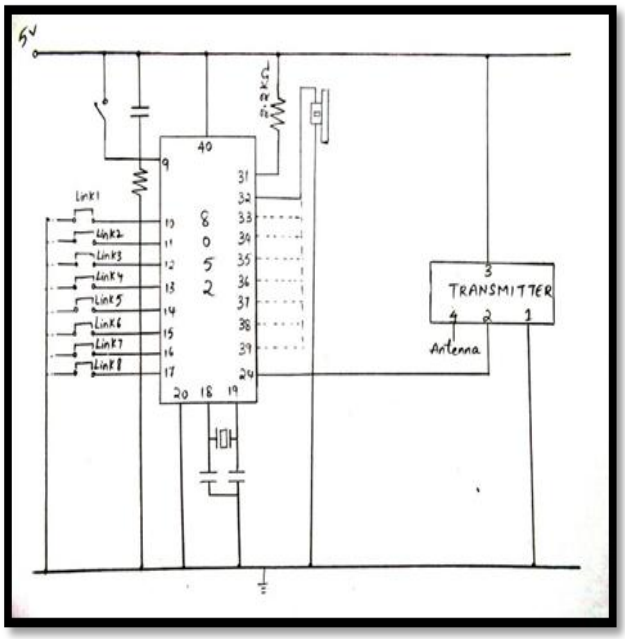


Fig. 4 Circuit diagram of Transmitter (433MHz)

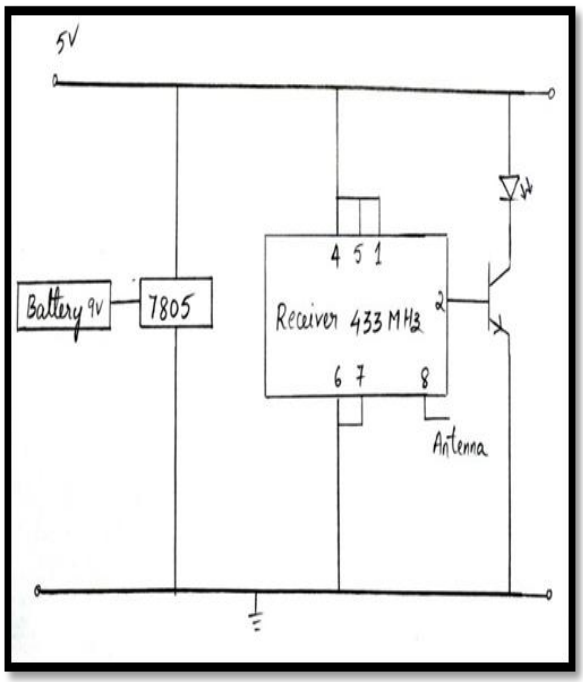


Fig. 5 Circuit diagram for Receiver (433MHz)

The eight inputs are given to the inputs pins (P3.0-P3.7) of port 3 of microcontroller. It is designed in such a way that each faulty condition results after grounding port3 pins and the result reflects on LED depending upon the place of the faulty condition. To send the faulty condition to a remote place within the building RF medium at 433MHz is used.

The address decoding logic for the output was performed by using address signal A11. The transmitter data pin is given to port 2 of pin P2.3 as shown in fig. 4. Whenever there is a faulty condition the transmitter sends data to receiver. The regulator supplies power to the receiver. The receiver data pin

connection is given to base of the transistor and collector terminal of transistor is given to negative terminal of the LED and emitter terminal is grounded.

Whenever a fault occurs in the system, the transmitter sends data to the receiver. An LED will blink for the reported fault and at the same time buzzer will ON. The LED output of a detected fault is not cleared automatically on detection of new fault. LED starts blinking once the fault is detected. Depending on the faulty condition, the LED will blink i.e., if first input is grounded then the first LED will blink and buzzer will ON. If fault occurs at seventh input then the seventh LED will blink and buzzer will ON. In this way we can identify where the fault occurs.

IV. EXPERIMENTAL RESULTS

The snapshot of hardware has been shown in Fig 6.This system detects up to eight different faulty conditions and informs the receiver through transmitter. In order to differentiate subsequent faults the respective LED will glow according to their sequence e.g. there is fault at position 2 then second LED will blink 2 times.

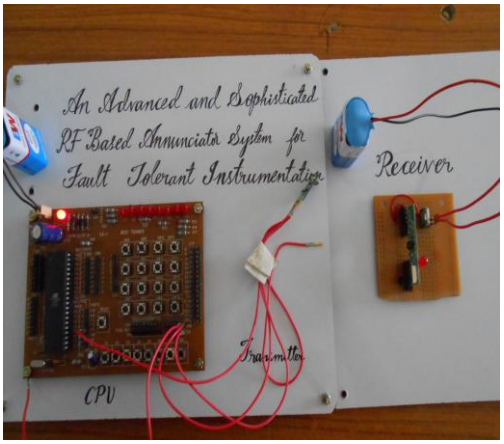
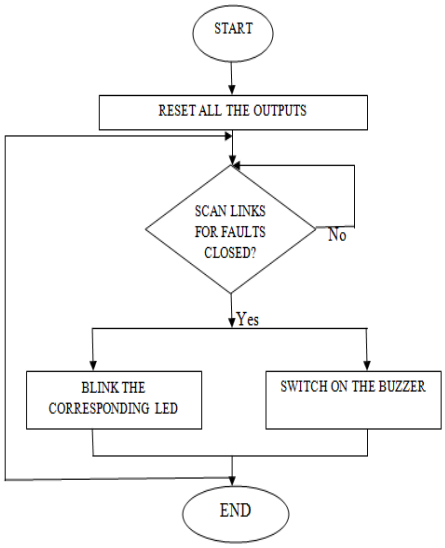


Fig 6.RF Based Annunciation System

V. SOFTWARE MODULE



For software realization, software Keil is used. µvision4 IDE simulation is one powerful environment

VI. CONCLUSION

All complex systems are made fault tolerant for early detection and rectification and down time can be reduced drastically. Systems faults can be detected with this RF based annunciator system and probable rectification matrix can be taken for remote places and quick solution of repair. The system provides visual indication of faults; it is an advanced, highly reliable and compact micro controller based Annunciation System. Dual rate flashing is provided for differentiating the first & subsequent faults. For the convenience LCD can be added at the transmitter section, so that faulty condition can be displayed.

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