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Automated Ambulance Detection and Gate Control with Auto-Traffic Control

S.MANSOOR[1], S.NAGARAJ[2]

[1]Research Scholar, ECE Dept, S.V.C.E.T, Chittoor, AP-INDIA, E-mail: mansoor790@gmail.com.

[2]Assoc Prof, ECE Dept, ECE Dept, S.V.C.E.T, Chittoor, AP-INDIA, E-mail: nagarajsubramanyam@gmail.com.

Abstract: The Automation for Vehicles is the current trend, the project presented here is one such idea in automating the movements of important vehicle like Ambulance & Fire Fighting Vehicle etc., here the idea is to ease the movement of Ambulance by detecting its proximity to the hospital and displaying the arrival of the same on a display device like LCD. The project also serves as an automated parking tool for the staff vehicles like Doctor's car, Ambulance, Hospital van etc., Here whenever a vehicle equipped with its RFID is detected in a range of 5-10 meters, the project automatically identifies the type of the vehicle & depending upon the priority set, activates the automated gate. Here the project also decodes the approaching vehicle's code, and based on the information vehicle transmits, takes decision like displaying an emergency alarm, paging to the concerned doctor, sending message to the required ward etc.,

The project basically aims at 3 following parameters;

1) Detect the approaching Ambulance towards the hospital; if it is activated with Siren & Siren Light, then alert the doctor in charge with a beeper & message on a LCD display.
2) Detect the Hospital Staff vehicle and open the gate for them automatically.
3) Stop all unauthorized vehicles from entering.

To achieve these above said requirements, the project consists of following block elements;

1) RF Code Receiver
2) Code Decoder
3) Buffer & Driver
4) Relay Switching Unit
5) PC/Microcontroller With MONITOR/LCD Display
6) Software
7) Motor Control Unit
8) Power Supply Unit

Keywords: RFID, LCD, RF Code Receiver, PC/Microcontroller.

I. INTRODUCTION

The 'Automated Ambulance Detection & Gate Control' System can be explained by taking the hospital model as follows: The Ambulance Detector stage is having a PC/Microcontroller device with MONITOR/LCD screen, which is connected with the receiver and the software to run Automated Ambulance Detection & Gate Control System. To implement this System every vehicle like hospital's ambulance must be fitted with remote RF ID transmitter, hidden behind the Number Plate of the Vehicle. The job of this RF ID transmitter is to transmit continuously the Number of Vehicle on which it is mounted, in coded form. When any vehicle enters the zone of Ambulance Office, the sensors buried side of the road / hospital gate sends "a vehicle has entered' signal to Ambulance Detector & Receiver Unit. This in turn activates the RF ID Receiver fitted on front end of Ambulance Detector / Gate Office and hence gets the Vehicle ID of the entering vehicle [capturing the signal sent by vehicle's RF ID transmitter]. The PC/Microcontroller Unit with the Receiver & Decoder scans its database and displays the details of that vehicle with the current message like Pediatrician, Ortho-Specialist, Heart Surgeon etc based on the type of the patient the ambulance is carrying. The details are then can be used for various requirement like arranging the emergency operation theater, arranging the respective doctor, arrangement of blood type required, etc,:

For all the hospital vehicles including ambulance, If the vehicle records show its Current Status is Set to open the gate, then the gate will be opened automatically whenever the hospital vehicle / staff vehicle is identified. Otherwise, the gate will not open and the vehicle owner will be called for redirection to “General Public Parking Lot”. But the presented project is not so sophisticated to deliver all the features explained above. The actual working explanation of this Automation of Ambulance model is as follows: The main requirement to implement this system is need of a RF ID transmitter which can transmit vehicle’s registration number. This requirement is fulfilled by fitting wireless RF ID transmitters besides the Number Plate of the vehicle. These RF ID transmitters represent different numbered vehicles which are going to cross the Hospital gate.

The RF ID receiver detects the vehicle number and sends the message to PC/Microcontroller Unit which is located inside the Hospital through buffer & driver. The computer/MICROCONTROLLER detects the number and displays the details of the Ambulance with its Current Status. Simultaneously the receiver switches ON the motor to open the gate, and let the vehicle pass without any interruption.

Main Features of the Project:

1. Effective in implementation.

2. Low power consumption, and compact size,

3. High reliability, due to the usage of power semiconductor devices,

4. Greater control range due the usage of Frequency Modulation.

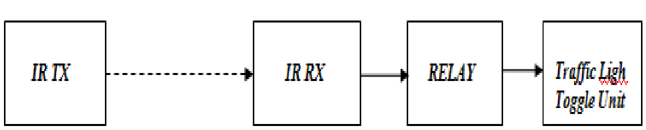
5. Vehicles monitored from a remote area (no need of 'line-of-sight’ arrangement).

II. BLOCK DIAGRAM DESCRIPTION

RF RECEIVER: The VHF signal [which contains each message about the required treatment for the patient] transmitted by the moving vehicle is received by this RF Receiver.

8 CHANNEL AMPLIFIER: This stage provides the amplification to the 8 CHANNEL received RF signal. The signal must be elevated to sufficient level, such that it can be fed to next section without any load effect.

AUTO AMBULANCE – Traffic Junction Section AUTOMATIC Traffic Light



RECEIVING END:

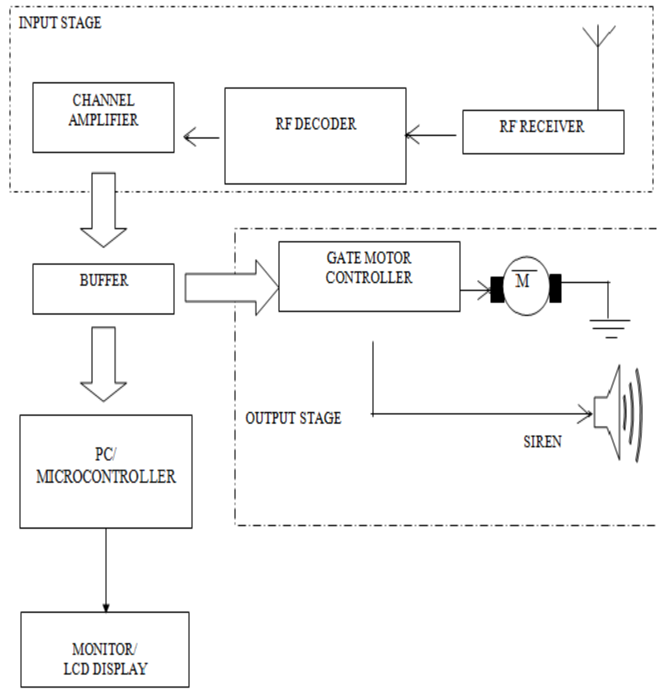


Fig.1 Block Diagram of Automated Ambulance Detection & Gate Control.

BUFFER: This is to provide the stronger current path to the decoded signal and also to isolate the driver section & PC/MICROCONTROLLER from the rest of the circuit. Because the driver section deals with the mains operated motor and needs the strong signal to drive its switch to saturation region. A PC/MICROCONTROLLER can accept or transmit TTL compatible voltage levels and so needs the isolation from any load driving circuit. Output of this Buffer is divided into two paths, one is fed to PC/MICROCONTROLLER through interfacing circuit, and second path leads towards the AMBULANCE DETECTION WITH GATE CONTROL Motor Controller section.

Ambulance Detection with Gate Control motor Controller: This driver section acts as an electronic switch and drives the Gate Open/Shut Motor. When it senses the OK signal from the PC [after confirming that vehicle has Current Status: Clear], driver section switches the motor and thus Ambulance Detection with Gate Control opens.

PC/Microcontroller with Software & Database (Optional): The output of Buffer has enhanced decoded vehicle registration number, which is fed to PC/Microcontroller’s port through interface circuit. The software recognizes the decoded signal and starts scanning its database for the details. After fetching the details, it shows it in standard fashion on the screen/LCD for operator’s knowledge. And also checks ‘Current Status of the vehicle: if the vehicle is black listed by any authority then marked as ‘dirty’; otherwise marked as ‘Clear’.

The Conventional Automated Ambulance Detection & Gate Control's block diagram and its explanation are as follows: Here this system is designed to automatically open the AMBULANCE DETECTION WITH GATE CONTROL whenever there is a registered vehicle on the road, and within the AMBULANCE DETECTION WITH GATE CONTROL zone.

Auto-Traffic Sensing for Ambulance: This section of the project deals with the remote sensing of an ambulance at traffic junctions and automatically toggle / flip the traffic signals from Red to Green. This done so as to enable the ambulance move faster in the traffic crowd and block all other vehicles moving from other directions. As seen from the following block diagram, the arrival of an ambulance is detected at the Traffic Junction with the aid of an IR Transmitter & Receiver set.

If the Current Status: Dirty, then System immediately alerts the concerned authority by siren and shuts the door, if it is opened. If the Current Status: Clear, then order the AMBULANCE DETECTION WITH GATE CONTROL Motor Controller section to open the door. All these interaction are carried out through interface circuit, which sits next to the PC/Microcontroller's port.

A. TRANSMITTING END:

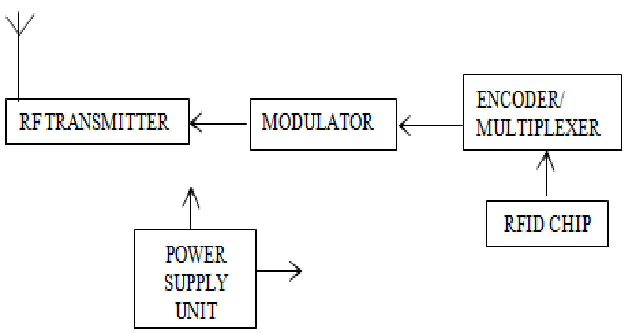


Fig2.

RFID CHIP: This is heart of the RF Transmitter, as it contains the Vehicle's registration number. Every RF transmitter fitted besides the Number Plate, is implanted with one RFID Chip which stores that vehicle's registration number.

ENCODER/MULTIPLEXER: The output of the RFID Chip, that is the vehicle's registration number, is further encoded for the security reason. After the encoding, this encoded signal is fed to multiplexer, which in result sends the encoded signal to the modulator.

MODULATOR: Here the encoded signals undergo the frequency modulation and prepare the signal for transmission. Frequency modulation means, the coded weak signals are mixed with another frequency signal, called carrier frequency, such that the signal can travel the sufficient distance.

RF TRANSMITTER: Every vehicle which moves on the road must have this RF Transmitter besides its Number Plate, and then only this system works as it has to. This transmitter continuously transmits the radio frequency signal [which is encoded with Vehicle's Registration Number in code] towards its moving direction through the antenna.

POWER SUPPLY UNIT: As the whole RF Transmitter Unit goes with the vehicle, its power supply must be kept compact and compatible with all kinds of vehicles and its power generators. This is very sophisticated system which is used to trace multiple vehicles [using multiplexers] at-a-time on the same road. And also uses the crack free, software generated codes to transmit the register number of the vehicle with wide area coverage.

RF communication: This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs.

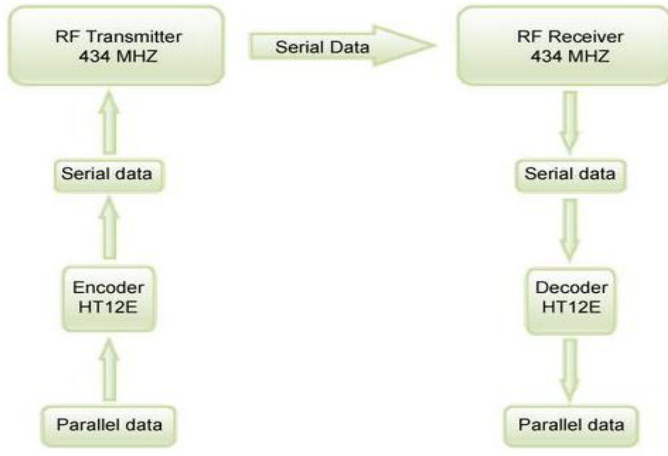


Fig3.Block Diagram for RF communication

Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins

10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E. Transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver. The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data.

HT12D DECODER:

HT12D IC comes from HolTek Company. HT12D is a decoder integrated circuit that belongs to 212 series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 212 series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format. In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin. HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

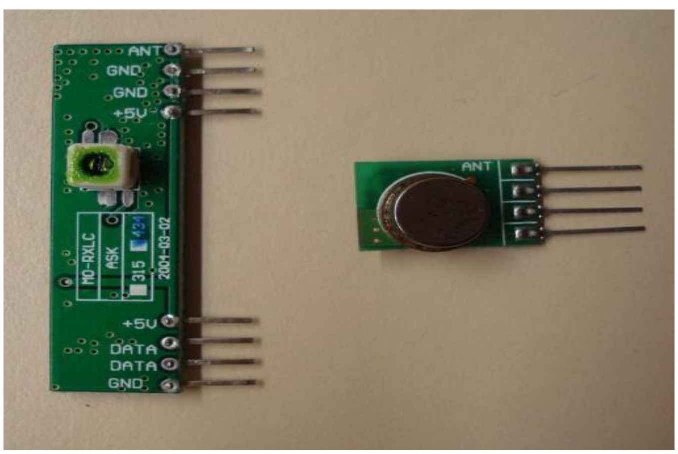


Fig4. RF Modules

HT12E ENCODER:

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

LPC2148 (ARM7 CONTROLLER):

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

The LPC2141/2/4/6/8 consists of an ARM7TDMI-S CPU with emulation support, the ARM7 Local Bus for interface to on-chip memory controllers, the AMBA Advanced High-performance Bus (AHB) for interface to the interrupt controller, and the ARM Peripheral Bus (APB, a compatible superset of ARM's AMBA Advanced Peripheral Bus) for connection to on-chip peripheral functions. The LPC2141/24/6/8 configures the ARM7TDMI-S processor in little-endian byte order. AHB peripherals are allocated a 2 megabyte range of addresses at the very top of the 4 gigabyte ARM memory space. Each AHB peripheral is allocated a 16 kB address space within the AHB address space. LPC2141/2/4/6/8 peripheral functions (other than the interrupt controller) are connected to the APB bus. The AHB to APB bridge interfaces the APB bus to the AHB bus. APB peripherals are also allocated a 2 megabyte range of addresses, beginning at the 3.5 gigabyte address point. Each APB peripheral is allocated a 16 kB address space within the APB address space. The connection of on-chip peripherals to device pins is controlled by a Pin Connect Block (see chapter "Pin Connect Block" on page 58). This must be configured by software to fit specific application requirements for the use of peripheral functions and pins. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on

Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of microprogrammed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind THUMB is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

• The standard 32-bit ARM instruction set.

• A 16-bit THUMB instruction set.

The THUMB set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because THUMB code operates on the same 32-bit register set as ARM code. THUMB code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system.

Key Features: 16-bit/32-bit ARM7TDMI-S microcontroller in a tinyLQFP64 package.

■ 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.128-bit wide interface/ accelerator enables high-speed 60 MHz operation.

■ In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1 ms.

■ Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.

■ USB 2.0 Full-speed compliant device controller with 2 kB of endpoint RAMS. In addition, the LPC2146/48 provides 8 kB of on-chip RAM accessible to USB by DMA.

■ CPU operating voltage range of 3.0 V to 3.6 V (3.3 V± 10 %) with 5 V tolerant I/O pads.

Applications:

1. The project is used to secure and avoid the road accidents.
2. This system is used to trace the culprit vehicles by police persons.
3. This project can also be used by Cargo Companies to intimate their on-road vehicles about the next delivery spot or assignment.
4. This system can be used to 'time keeping' purpose in public transportation, such as departure & arrival timings, number of rotations each vehicle turned etc.

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