Wireless Water-Level Indicator

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Using this system, you can remotely monitor the water level of an overhead tank that is placed up to 30 metres away. The system features an RF transmitter-receiver pair, doing away with the need to run wires from the roof to ground. The transmitter is placed near the tank with sensors inside the tank to monitor the level of water. The sensed level is streamed wirelessly through the RF transmitter. This is received by the receiver unit placed remotely and decoded to indicate the water level on an LCD. It also has a buzzer that beeps when the water level drops below one-fourth level or when the tank is about to overflow.

When the tank is quarter-, half- or three-quarters-full, the percentage of the water level is flashed on the LCD. The system is developed using an EFY-KnS 8051 development board which is available from EFY associates Kits'n'Spares (KnS) for Rs 500.

EFY-KnS' 8051 development board

Fig. 1 shows the block diagram of EFY-KnS 8051 development board. It consists of a 40-pin IC socket, four 8-pin berg-strip male connectors, 9-pin serial COM port connector, MAX232 driver, 16-pin connector for the LCD and 5V regulator. Some other features of the board include:

1. Power LED with an on/off switch

2. Reset LED with a reset switch. This LED is also used as a programming-status indicator.

3. A 5-pin male connector (not shown here) for 5V DC supply. The voltage is regulated to 5V using voltage regulator IC 7805.

4. Eleven jumper wires (16cm each) for connecting the LCD

Data and control pins of the LCD are not permanently connected to the microcontroller. So you can use any of the controller ports to connect the LCD using jumper wires.

Circuit description

Fig. 2 shows the circuit of the transmitter. It operates off 5V DC and consists of a sensor assembly, encoder HT12E (IC1) and RF transmitter module (TX1). The sensor assembly consists of four BC547 npn transistors (T1 through T4), each connected to a water-level-sensor metal strip corresponding to one of the

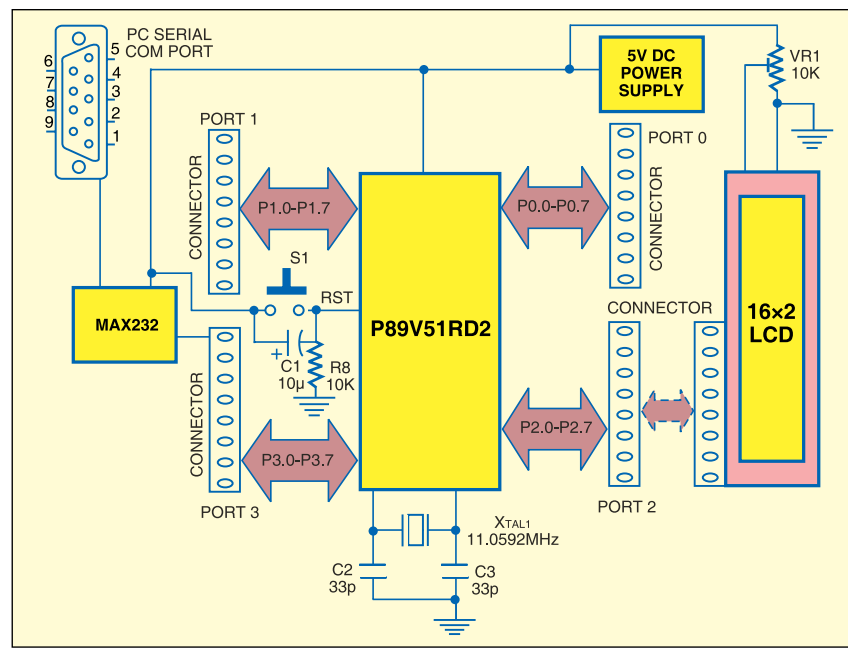

Fig. 1: Block diagram of EFY-KnS 8051 development board

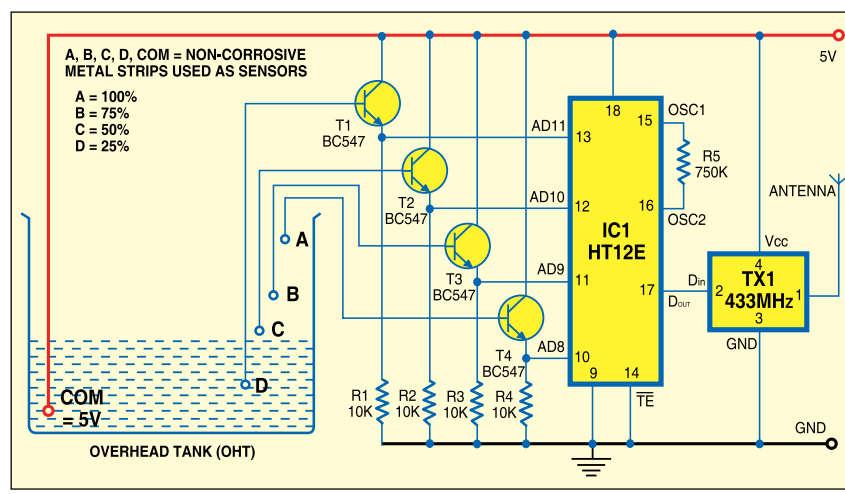

Fig. 2: Transmitter circuit

PARTS LIST

Semiconductors:
IC1 - HT12E encoder
IC2 - HT12D decoder
T1-T5 - BC547 npn transistor
LED1 - 5mm light-emitting diode
LCD1 - 16×2 line LCD module
TX1, RX1 - 433MHz RF module

Resistors (all ¼-watt, ±5 per cent carbon):
R1-R4, R8 - 10-kilo-ohm
R5 - 750-kilo-ohm
R6 - 33-kilo-ohm
R7 - 330-ohm
R9 - 1-kilo-ohm
VR1 - 10-kilo-ohm preset

Capacitors:
C1 - 10nF ceramic disk
C2, C3 - 33pF ceramic disk

Miscellaneous:
X_{TAL1} - 11.0592MHz crystal
S1 - Push-to-on switch
PZ1 - Piezobuzzer
Board - EFY-KnS 8051 development board

four water levels—25 per cent, 50 per cent, 75 per cent and 100 per cent. The sensors are non-corrosive stainless-steel metal strips.

The receiver circuit too operates off 5V DC. It is assembled and tested on EFY-KnS 8051 development board as shown in Fig. 3. Mount the buzzer (PZ1), HT12D and RX1 on a general-purpose PCB or breadboard. Connect decoder HT12D (IC2), piezobuzzer (PZ1) and LCD1 to the development board. The output of the RF receiver (RX1) is fed to data input D_{in} (pin 14) of decoder HT12D. A red LED (LED1) is connected to VT pin (pin 17) of the decoder through R7.

Data is processed by P89V51RD2 microcontroller mounted on the development board. The program is written in Assembly language and assembled using ASM51 cross-assembler. Burn the code into the microcontroller using the on-board RS-232 serial COM port.

How it works?

The water level in the tank is sensed by the sensor assembly, which is connected to 4-bit data lines (AD8 through AD11) of encoder HT12E (IC1) through transistors. Depending on the water level in the tank, BC547 transistors (T1 through T4) conduct to generate a 4-bit code (refer the table). The 4-bit code so generated is encoded by encoder HT12E. The encoded data is fed to pin 2 of RF transmitter TX1, which transmits it serially at 433 MHz through the antenna connected to its pin 1. The transmission range of TX1 module is about 30 metres.

The 4-bit signal from the transmitter is received by the antenna of the RF receiver (RX1). LED1 glows to indicate that a valid signal is received. The 4-bit output from decoder HT12D is processed by the microcontroller to generate an 8-bit code. The microcontroller's output is fed to data input lines of LCD1, which, in turn, shows the water level in percentage.

At an intermediate water level, say, 25 per cent of the tank capacity, LCD1 shows the message "Water level 25 per cent. When the tank is full, the buzzer rings for two minutes, while LCD1 shows "Water level 100 per cent. The 4-bit code, message and buzzer status for different water levels are shown in the table.

4-bit Code, Message and Buzzer Status for Different Water Levels

Water level	4-bit code (DCBA)	Message displayed on the LCD	Buzzer status
Less than 25 per cent	0000	Water level low	Buzzer rings for two minutes
25 per cent	1000	Water level 25 per cent	—
50 per cent	1100	Water level 50 per cent	—
75 per cent	1110	Water level 75 per cent	—
100 per cent	1111	Water level 100 per cent	Buzzer rings for two minutes

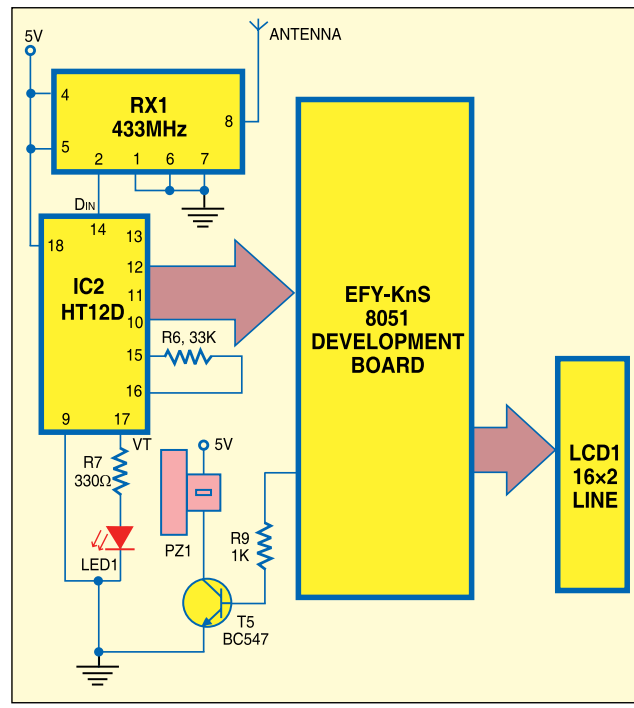

Fig. 3: Testing of receiver circuit using development board

Software

In the program, first LCD1 and buzzer are initialised followed by the reset, read-write and enable pins of LCD1. Then LCD1 shows 'EFY' in the first line and 'Water Level' in the second line. The program further enters a loop to check which of the five values is true—less than 25 per cent, 25 per cent, 50 per cent, 75 per cent or 100 per cent. The percentage is displayed in the second line after 'Water Level.' The piezobuzzer is timed to sound for two minutes for the 100 per cent full condition and less than 25 per cent full condition.

This circuit can also be modified to work as a water-level controller system. When the water level is low, the microcontroller can be programmed to start the motor pump. When the tank is full, the same can be made to stop the motor.

EFY note. The source code of this article is available on www.efymag.com website.