WIRELESS NURSE CARE CALLING

Karel Bubník

Doctoral Degree Programme (1), FEEC BUT

E-mail: xbubni02@stud.feec.vutbr.cz

Supervised by: Jana Kolářová

E-mail: kolaraj@feec.vutbr.cz

Abstract: This work describes the design, construction a performance of such a complete wireless pager suitable for health care centers, rest homes, home application, for example for calling an attendant. This appliance is designed to be easy to attendance. A wireless transceiver is simplified and is attended only by one button. A wireless receiver also doesn't require a complicated manipulation. The aim is to create pager, which will be an useful assistant thanks to its price and simple construction.

Keywords: wireless nurse, care, calling, pager, Keeloq

1. INTRODUCTION

Many people can get into a situation where they depend on foreign aid. Not only the elderly but also people, who for example, as a result of accident or illness received in the state where either temporarily or permanently require outside assistance. To ensure continued assistance is often impractical. One suitable solution is a wireless pager system, which if necessary will call the caregiver to the patient. It enables the attendant to freely move within range of the receiver and perform other activities (eg preparing a meal or treat other patients.)

Other paragraphs briefly describe the construction of just such a pager. The proposal was put emphasis on design simplicity, small size, reliability and ease of use. In particular, the transmitter can be integrate to subjects that have always patient with them and thus ensure that, when necessary, can summon help immediately.

2. DESIGN SOLUTIONS

For the sake of simplicity, the transmitter has only a single control element, and it is a button that triggers the requirement for the treating physician. The transmitter is also equipped with LED control to the treated be sure it actually works. Thinking is only simplex transmission, so the treated not have any feedback, that the requirement for assistance was recorded. If the button is pressed by the treated, the coded command is send. The signal is be transmitted wirelessly on the legal frequency of 433.92 MHz or 868.95 MHz. Attending have a receiver mounted on the shoulder or a belt and a distress signal from the patient will be notified visually, acoustically, and by vibratins. Furthermore, using different tones and vibrations knows patient summon him. The shape of the transmitter is designed so that it can be build into a plastic tube. It can thus be placed into the handle such as crutches, or ancillary supporting rods, rails tables, beds, etc. The receiver should then be small enough to allow for comfortable nursing wear.

3. METHOD OF COMMUNICATION AND GLOBAL CONNECTION

Communication is carried out at frequencies of 433.92 MHz. If the request is another band, this can be achieved by selecting a different wireless module. 433.05 to 434.79 MHz band is intended for Command facility with a maximum radiated power 10 mW ERP. For devices operating at these

frequencies is a mandatory European standard ETS 300 220, which allows operation without a permit transmitters for applications in industry, research and medicine, not exceeding 10 mW have already mentioned. Total connection string telecommunications pager is in the Figure 1. As the encoder is used HCS301 circuit, which includes all the components out of the modulator. As a modulator can be used any module that meets those standards. In relation to the selected module is necessary to adapt the choice of receiving module (demodulator). The function of the channel decoder and resources is provided by PIC16F636 microcontroller, which also serves peripherals.

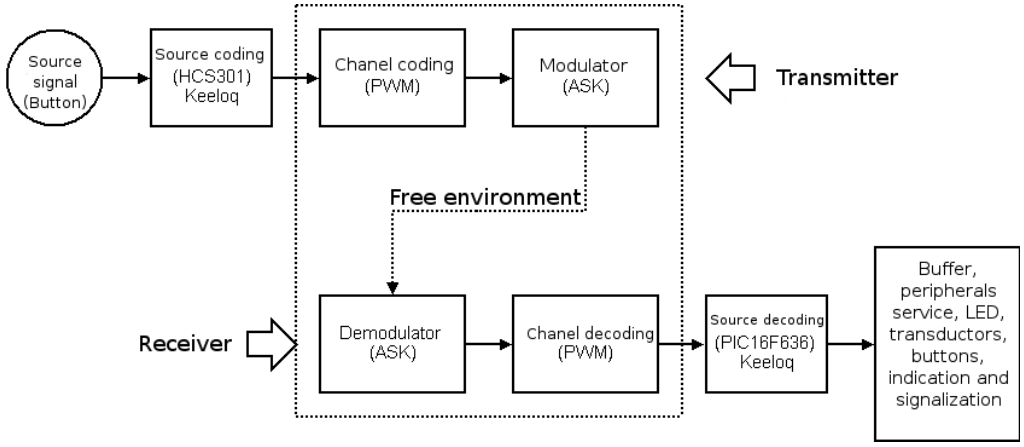

Figure 1**:** Global communication connection

3.1. TRANSMITTER

Total involvement of the transmitter is in Figure 3. Button S1 is directly connected to the input HCS301 encoder, which provides encryption. Circuit HCS301 is a member of the family of coders Keeloq Microchip. They are primarily intended for wireless applications with high security. Each time you press the button, the code changes, it makes each transmission unique. The total code length is 66 bits, of which 32 bits is the variable length. The encoder includes a current limiter LED and internal "PUSH-UP resistors and thus minimized the need for external components. In addition it contains features such as monitoring battery voltage, power saving modes, and more. HCS301 encoder must be initialized, it means program serial number, communication speed, and manufacturer's code or "fetus". Programming algorithm is known, but commercially available programmers do not support, it is necessary to design your own or purchase Keeloq Development Kit. Full documentation can be found under the site DS21143B Microchip. HCS301 encoder use PWM (Pulse-Widht-Modulation) encryption, a pulse width modulation to encode the data stream. The principle is the expression of a constant length bit. The length over which the signal is high level indicates, whether the input is in log 0 or log 1. The advantage of this modulation is that synchronization is contained in each pulse, which can be used at the decoder. This eliminates the need for an accurate crystal oscillators, this saves the cost of construction of the receiver and transmitter. The receiver simply synchronizing by the transmitter.

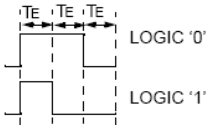

Figure 2: PWM coding [1]

HCS301 encoder and the other coders in the same range structure organize the necessary data to the broadcasting framework. In the time key is pressed complete frame is send. The format and content of the data frame is shown in Figure 4, respectively Table 1.

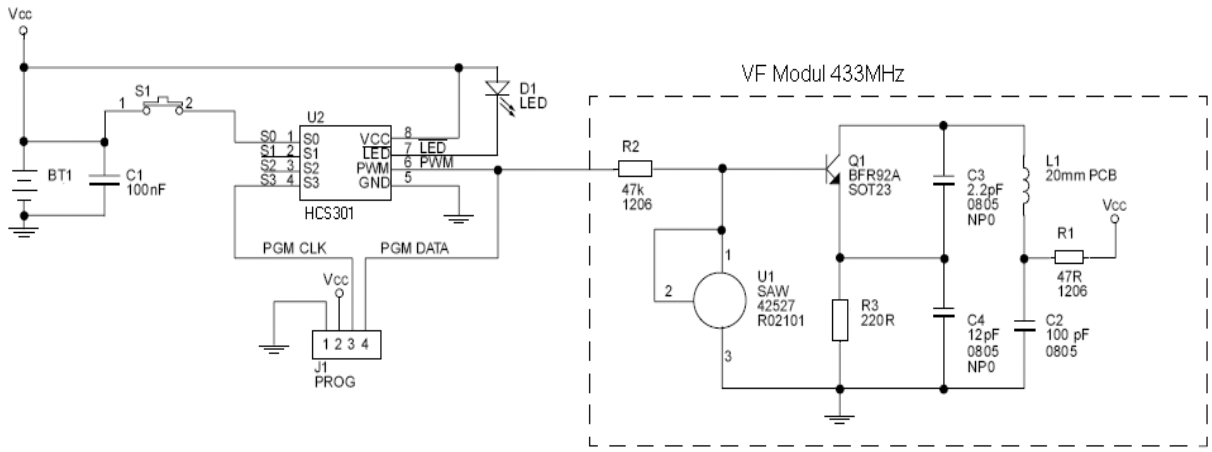

Figure 3 : Total connection of the transmitter (Wireless modul in frame)

The framework begins with a preamble TP, which contains no data, facilitating the synchronization of the receiver and acts as the start bit. Preamble is followed by a header, which the decoder use to verify the function of timing. The header is followed by the LSB (Last Significant Bit) of the encoded THOP, followed by the LSB serial number, code key, low-voltage signaling and finally the MSB (Most Significant Bit) symptom recurrence. The length of each part corresponds to the number of bits. After the airing of all bits is followed by the protective interval of TG, after which the transmitter is idle. If after the expiry of the TG switch was not released, the transmitter sends a new flagged repetition code. The transmitter has four key inputs, by which can be realized up to sixteen states. In this application, we use only two inputs distinguish two patients.

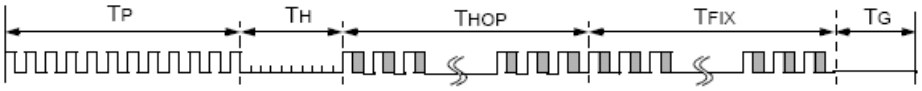

Figure 4: PWM encoding [1]

In figure: TP=Preamble, TH=Header, THOP="Hopping" part, TFIX=Fixed part, TG=toggle

Table 1: Data frame of HCS301 [1]

Repeat (1 bit)	V_{LOW} (1 bit)	Buttons				Serial number (28 bits)	Buttons				OVR (2 bits)	DISC (10 bits)	Counter (16 bits)
		S2	S1	S0	S3		S2	S1	S0	S3			
34 bits fixed part							32 bits of encoded part						

The transmitter is build into a plastic or metal tube with foam handles, which limits the maximum size of the transmitter. The design use as the default size 140x15 mm, which should fit all the components including the battery. Due to the expected "residual" length of tube, can use free space to pull the antenna wire inside. Pipe diameter of 1.5 cm greatly limits the choice of transmitter module. There are not many modules that meet that requirement. Selected module has been offered by FK Technics, the narrowest dimension is 14.5 mm. Parameters of this module see [2]. Insulated wire with length of 17 cm is use as antenna. This length corresponds to ¼ wavelength at 433.92 MHz. Using the whip antenna is appropriate because the tube is pulled out of the possession of the transmitter and there is no of untuning.

To power the transmitter is used miniature alkaline batteries GP 23AE 12V, 55 mAh, 10x28 mm. Standby current is negligible, because the battery is discharged only when the button is pressed.

3.2. RECEIVER

Demands of the receiver are placed slightly different than the transmitter. In particular, it is a device which from principle must be constantly in use. Receiver module accepts and due to the large disturbance on the 433 MHz continuously evaluate if signal is interference or useful signal. Positive detection of the command is indicated acoustically, visually and through vibration. Any signal is differentiated according to the command received (by resolution). In the simpler variant described receiver is not equipped with a display and a number of differentiated transmitter is limited to two (two LEDs). The resolution is also provided by acoustic signal (tone modulation) and vibrations (dashed / long). Required settings and customization is done through the programming connector that is wired to the circuit board inside the box U-KM21B (21x56x72mm).

AUR RX-EL-BC-NBK is selected as signal reception modul. The choice of this module was also adapted to the PCB. Module parameters are listed in the documentation [3]. Choice of module must correspond with the choice of transmission module, especially the broadcast frequency (433.92 MHz) and encoding (ASK). The antenna is wired and twisted inside the box. Length of the whip antenna was reduced by 10% to offset the effect of wear in the vicinity of the body.

Microcontroller PIC16F636 with suitable software is used as the decoder. HCS301 encoder allows the use of floating code. The actual encoding and decoding algorithm of floating code is protected by patent and simplified version was used. The decoder evaluates only static part (serial number). Decoding of floating code can be easily activated, by changing the decoder software, than you need to follow the license agreement. Microprocessor also ensure operating of all peripherals. Thanks to jet contained buffers, output can feed peripherals directly. As the source of the timing signal internal oscillator is used. Microprocessor input MCLR (pin 4) performs two functions now. The first function is the entry key, which is connected via a resistive divider. Divider keeps output in high state and when the button is pressed, then ensures that the output level will be lower than logical zero. The second function is to input the programmer LVP (Low Voltage Programming), which is necessary to bring the MCLR input programming voltage (to activate the programming mode). S1 button is used to control the mode of learning new transmitters. The EEPROM stores the serial number, synchronization counter value of the transmitter. Length of button press distinguishes, whether the receiver is going to learn a new transmitter, or delete old ones.

The receiver power is given to the optimal size used platelet 9V battery. However, you can use any battery the same or smaller sizes with voltages higher than 6.5 V. Because all the circuits required 5V the DC-DC switching mode power supply with an integrated circuit in SMD MC34063 is used, because of the effectiveness of reducing the drive. Calculation of the components of the SMPS follows the manufacturer's recommendations [4].

Average decoder power consumption is 24mW. Used drive efficiency provided by the manufacturer is about 90%. Power of receiver will be about 26.4 mW. Substituting into Equation 1 Determine the approximate time of battery life. This is, when you use rechargeable platelet batteries, about two days.

$$t = (U_{bat} * Cp_{bat}) / P_{p=} (8{,}4*160) / 26{,}4 = 50{,}91 \text{ h} \ (>2 \text{ days}) \quad [(V*mAh)/mVA=h] \quad (1)$$

Calculation of operation for the platelet batteries, *where t [h] is a runtime, UBAT [V] is battery voltage, Cpcap [mAh] is the battery capacity, Pp [mW] power of transmitter and transducer.*

As a vibrating motor, with proven best type, is used in mobile phones Siemens C35, which can be purchased as a spare. It is also possible to use any other vibrating motor, which can withstand higher than rated voltage. The motor is glued to the box at the bottom, as close as possible to arm of nurses.

There are no adjusters on board. All settings are made by changing the microprocessor program through connector, which is freely accessible.

List of parts:

R1 (1206)	2x2Ω
R2 (1206)	1,2kΩ
R3 (1206)	3,6kΩ
R4, R5, R8 (1206)	10kΩ
R6 (1206)	1kΩ
R7, R9, R10 (1206)	150Ω
C1 (1206)	470pF
C2, C3, C8 (1206)	100nF
C4, (radial)	100µF/16V
C5, C6, C7(radial)	100µF/6V
L1	220µH/0,5A
L2	(air coil cca 8curves on 3mm)
IC1 (SOIC)	MC34063
IC2 (miniDip)	16F636
Q1 (SO3)	BS170
D1, D2 (DO3)	MBR0520LT1G
LED1, LED2, LED3	3mm(R,G,G)
BUZ1	piezo-transducter (flat)
VIBRA	vibrator/siemens C35i

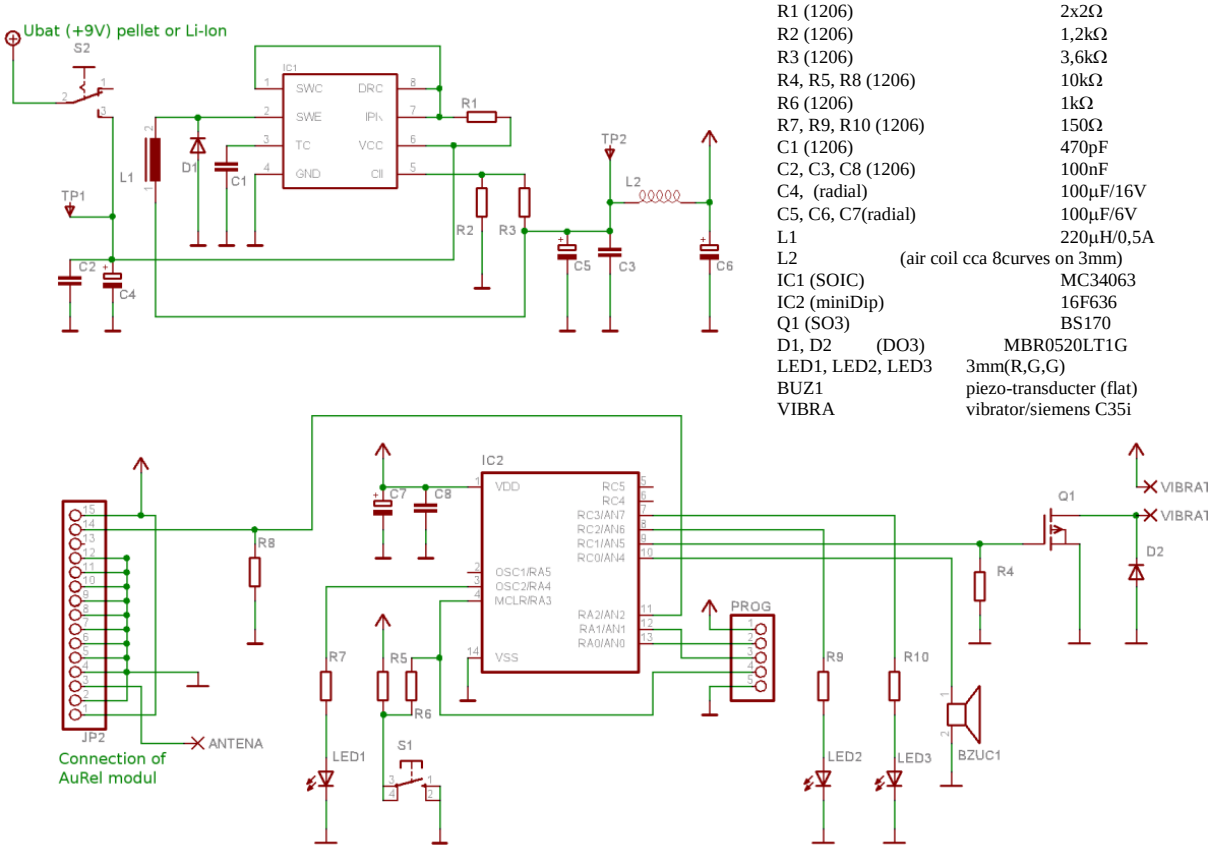

Figure 5: Total connection of the receiver (wireless modul AuRel is connected via JP2)

4. CONCLUSION

The present pager option is simpler working model. The design emphasis was to enable, to be adapted and expanded. The selected processor has enough outlets to connect the display, which can inform nurse about accurate data of patients. Also, the EEPROM is sufficient to learn up to sixteen transmitters.

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