

УДК 007.52:004.896/621

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ULTRASONIC INTERNAL POSITIONING SYSTEM FOR MOBILE ROBOTS

This article discusses our proposal positioning system for mobile robotics in interiors. The article outlined the initial draft arrangement of essential elements in the system. It also addresses the functional linkages of individual elements. The connection is also reflected in the block diagram.

The arrangement of elements in the system

The system is composed of three basic elements:

- Transmitter clock,
- Ultrasonic transmitter (2pcs),
- Ultrasonic receiver.

The arrangement of ultrasonic transmitter and receiver is in figure 1.

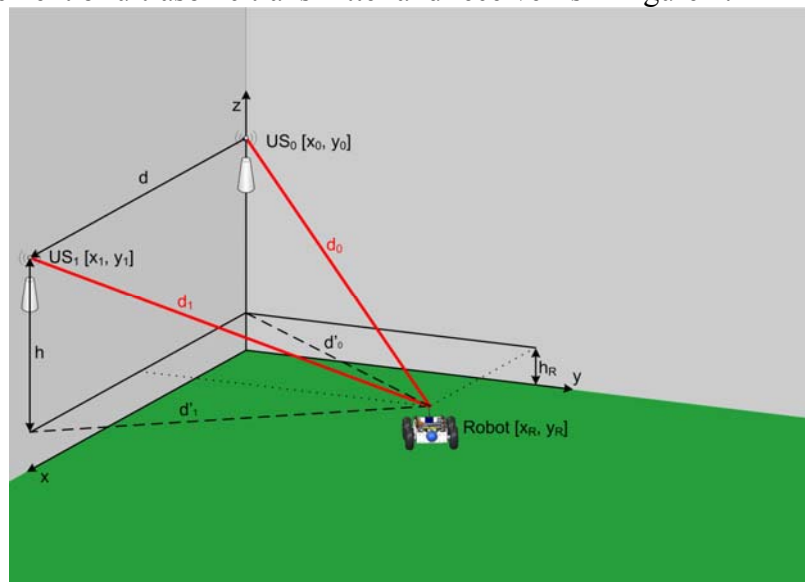


Fig. 1 Layout of the elements

Module ultrasonic receiver knows which transmitter sends the right. Accordingly, may determine the distance d_0 and d_1 . Using the formulas:

$$x_R = \frac{d_0'^2 + d^2 + d_1'^2}{2 \times d} \quad (1)$$

$$y_R = \sqrt{d_0'^2 - x_R^2} \quad (2)$$

it can determine its position in two-dimensional space.

Transmitter clock

This member is responsible for the transmission cycle of ultrasonic transmitters. It consists of a microcontroller and RF transmitter signal. As transmitter circuit is used Nordic 24L01 who hang with frequency 2.4GHz. The module can transmit 96 channels at data 2MBit/s. Microcontroller provides precise timing for ultrasonic transducers. Clock module determines which ultrasonic transmitter has just broadcast. This signal also receives ultrasonic receiver. According to this knows that US transmitter sends and what time he began his broadcast. The block diagram is on the figure 2.

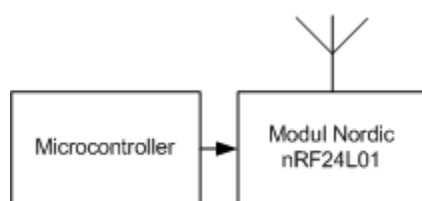


Fig. 2 Clock transmitter block diagram

The flow chart of the cycle time algorithm of the clock transmitter is on the figure 3.

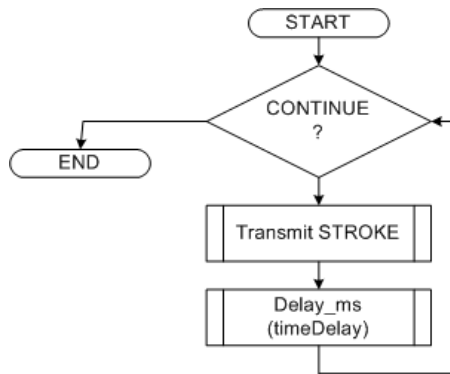


Fig. 3 Cycle time algorithm of the clock transmitter

Ultrasonic transmitter

Our first proposal for such a system has two ultrasonic transducers. It may also be more but then you need to solve the timing and the resulting calculation of position. These ultrasonic transducers must be capable of receiving RF signal from the clock. They must then send the ultrasonic signal. The block diagram is shown in Figure 4, and the algorithm of the job is on Figure 5.

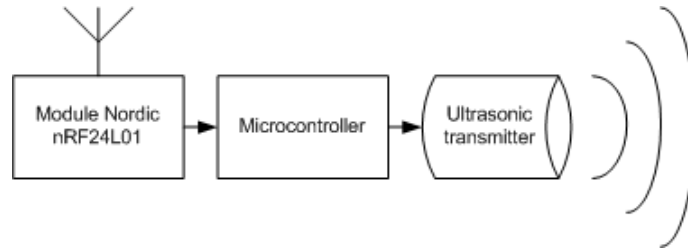


Fig. 4 Ultrasonic transmitter block diagram

Ultrasonic receiver

Module ultrasonic receiver has a similar involvement of the transmitter. The difference is the use of ultrasonic transmitter receiver instead. The receiver also intercepted transmission of the clock.

The microcontroller is implemented formulas for calculating the position. Microcontroller can be connected to the bus USART, SPI, IIC, or TWI control system of a mobile robot. Use this link can be traced coordinates transmitted to the control system of the robot. Signal processing procedure is outlined in the flow chart in figure 7.

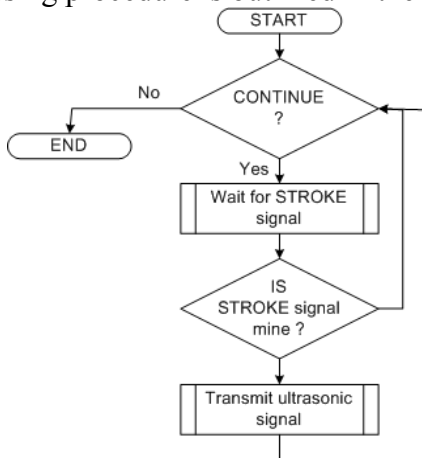


Fig. 5 Ultrasonic transmitter algorithm

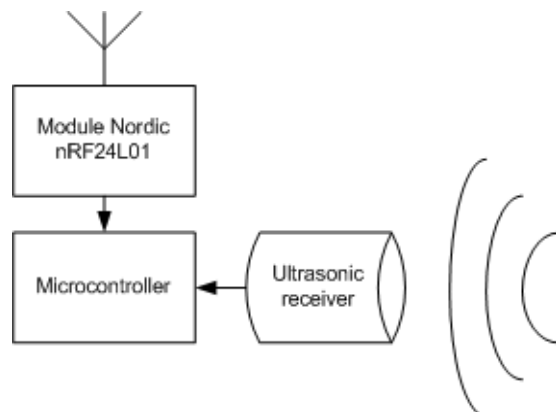


Fig. 6 Ultrasonic receiver block diagram

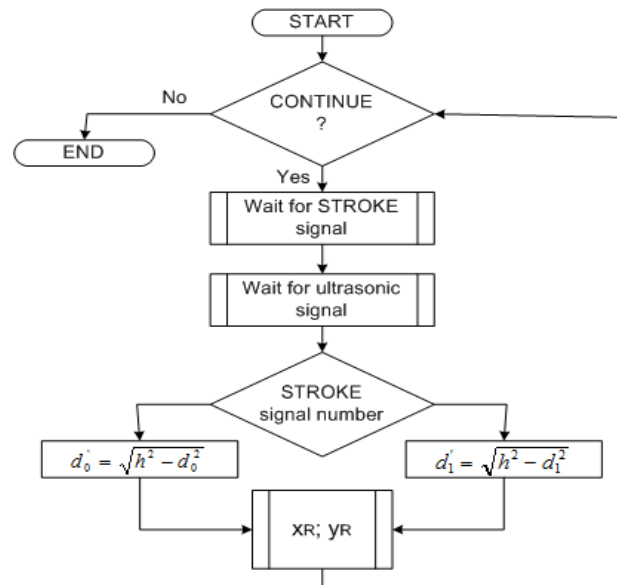


Fig. 7 Ultrasonic receiver algorithm

Conclusions

After the development of such internal positioning system we expect that we will be able to use the placed ambient temperature sensor on the receiver module. This is to eliminate the uncertainty of the measurement positions depending on the ambient temperature. We would also like to extend the scheme further ultrasound transmitters. You will be optimized position calculation and optimization of system operation to avoid long response.

List of sources used

- [1] MacArthur D.K.: Design and implementation of an ultrasonic position system for multiple vehicle control. University of Florida. 2003. http://cimar.mae.ufl.edu/CIMAR/pages/thesis/macarthur_d.pdf
- [2] Do-Eun Kim, et.al.: A Simple Ultrasonic GPS System for Indoor Mobile Robot System using Kalman Filtering. <http://robogames.net/symposium/2007/07-125-Kim-SungKyunKwanUniv-UltrasonicGPSIndoorMobileRobotSystem.pdf>
- [3] Saeed ShiryGhidary, et.al.: A new Home Robot Positioning System (HRPS) using IR switched multi ultrasonic sensors. http://www.cs.cmu.edu/~motionplanning/papers/sbp_papers/integrated2/ghidary_ir_beacon.pdf
- [4] Soo-Yeong Yi, Byoung-Wook Choi: Autonomous Navigation of Indoor Mobile Robot Using Global Ultrasonic System. Seoul. Korea. <http://cdn.intechopen.com/pdfs-wm/145.pdf>

This contribution is the result of the project implementation: Research modules for intelligent robotic systems (ITMS: 26220220141), activity 2.2, supported by the Research & Development operational Program funded by the ERDF.