Testing software for ultrasonic sensors

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Abstract: - Robotic systems used many types of sensors for distance measurement. System which is developed in this project is supported by laser scanner and ultrasonic sensors. The ultrasonic sensors are used on robotic platform for solving problem with distance anomaly. This anomaly is created by Laser scanner SICK LMS 400 between period 0 m to 0.7 m. Ultrasonic sensors had minimal and maximal measured range begins from 0.17 m to 6 m. These sensors with their measurement range could be used for covering the distance anomaly and for normal distance processing.

Key-Words: - ultrasonic, sensor, distance, I2C interface, communications, time checking

1 Ultrasonic definition

Ultrasonic is sound pressure with a frequency greater than 20 kHz. The characteristic of ultrasonic waves can be influenced by intensity, amplitude and frequency of oscillation. The other part of influence is an environment part which ultrasound used for transmission [1].

Ultrasonic energy can be sorted by the intensity on:

- Active ultrasound – is created by the high-intensity ($0.5\ 10^4$ W/m²). It can be used for cleaning components, welding materials or medical therapy.

- Passive ultrasound – is created by the lower intensity than active ultrasound. The specification for this type of energy is noninvasive characters in environment.

For autonomic mobile robotic system can be used the ultrasonic sensors with passive ultrasound energy.

2 Ultrasonic measure principle

Ultrasonic measuring is provided by non-contact measurement. Principle of distance measuring is based on the propagation time between the wave sent and the wave received. The difference between these times is used for determination distance. Ultrasonic measuring used two construction types [2]:

- source and sensor are separate

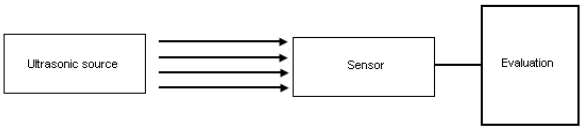

Fig. 1 Ultrasonic measure with separated source and sensor

- source and sensor are connected into the one device

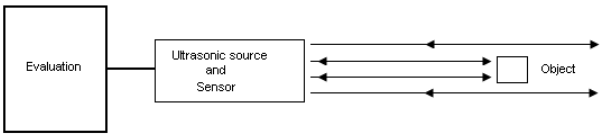

Fig. 2 Ultrasonic measure with source and sensor in one device

3 I2C interface

I2C is multi-master data bus for connection low-speed devices. I2C bus was developed by Philips Semiconductors, originally designed to be a battery control interface [3].

The I2C bus uses a bi-directional Serial Clock Line (SCL) and Serial Data Lines (SDA). Both the

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SCL and SDA lines are pulled high via pull-up resistors (4,7kΩ). The link may have multiple masters and slaves on the bus, but only one master may be active at one time. I2C slaves may receive or transmit data to the master. I2C bus can communicate only half-duplex. The maximum bus capacitance is 400pF, which sets the maximum number of devices on the I2C bus and the maximum line length.

4 SRF02 sensor

SRF02 is ultrasonic sensor with two standard types for communications RS232 and I2C. Standard RS232 have specific communication form called TTL UART (Universal Asynchronous Receiver/Transmitter) which have to be set up on 9600 bauds, 1 start bit, 2 stop bit and without parity. Internal functions allow sending ultrasonic impulse without confirmation from master device and without waiting on reflected signal. The minimal measure range can be set up from 17 to 18 cm in warm environment. The minimal distance value in cooler environment is between 15 and 16 cm. Sensor SRF02 has a possibility to sending distance in milliseconds, centimeters or inches [4].

Fig. 3 Sensor SRF02 [4]

5 USB-I2C communications module

The USB-I2C module uses the FTDI FT232R USB chip to handle all the USB protocols. Module USB-I2C is used for transferring data from PC to sensors and from sensors to PC. Communications module is every time master device because sensors didn't have possibilities for retranslate information to other sensor [5].

0V Gnd – pin with this description have to be connected to the same pin on sensor side or to the 0V ground on I2C bus.

Input 1 – is used for CPU factory reset. But it can be used for income data too.

SCL a SDA – these pins are main part of I2C bus. They have to be connected with same pins on sensors sides. SDA and SCL pins are used for communications between sensors and USB-I2C module.

+5V – is voltage pin for power connection.

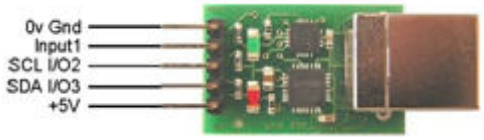

Fig. 4 USB-I2C module [5]

6 Commands for USB-I2C module

This type of communication interface provides all data transferring. The necessary commands didn't apply starts, stop or restart bits. Commands have form focused on addresses, specification of measure, number of connect sensors and which type of firmware is used.

7 Software for testing ultrasonic sensors

Testing software was created for finding typical sensors characteristic. But before any action was required reallocation all sensors. This condition is required by I2C data bus. Because each packet contained data only for one sensor, using two sensors with same address will cause a data collision. When the sensors have different address they can be connected on I2C bus.

The software for the ultrasonic sensors is made in the C# and the entire communication is incorporated to the software solution. In the start-up menu, by selecting the RS232 port a link between the computer and the USB-I2C with a handshake is created. Received values from the sensors are displayed in the text box. Values are stored in hexadecimal distance values, followed by the computational algorithms processing. Filtered values are converted into the boxes for displaying distance from sensors (Sensor 1, Sensor 2, etc.). Testing was provided by time checking between send a received the ultrasonic impulse. Short time period causes that one sensor can receive the impulse from other sensor, due to quick changing sensor address and decaying ultrasonic wave. The correct time change after testing was established on

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413 ms for right processing without double effect (2 times receiving same ultrasonic wave).

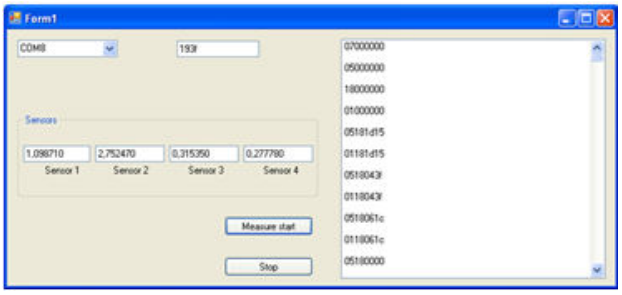

Fig. 5 Software for testing ultrasonic sensors

8 Conclusion

Knowledge and values from this testing software will be used for developing software which can be used for autonomic mobile robotic system. The main purpose for creation testing software was defined time period between send and received ultrasonic wave in the active environment because the sensors will be on same robotic platform where can be possible to receiving ultrasonic wave from other ultrasonic sensor.

9 Acknowledgment

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