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DEVELOPMENT OF ULTRASONIC RANGEFINDER WITH IMPROVED MEASUREMENT ACCURACY

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ABSTRACT

In the paper, the ultrasonic rangefinder with improved measurement accuracy has been developed. The developed digital device makes it possible to quickly obtain information about the distance to an obstacle with minimal error and can operate as an obstacle detector. The flexible menu allows a user to set the device operation modes, distance output format, provision of sound and visual messages (discharged battery and detected obstacles), to set the critical distance to the obstacle and save the settings in EEPROM.

KEYWORDS: **ultrasonic rangefinder, obstacle detector, distance measurement methods, ultrasonic measurement accuracy improvement, AVR ATmega128 MCU, HC-SR04 ultrasonic sensor, DS18B20 temperature sensor, LCD 16*2 HD44780 (WH1602B).**

I. INTRODUCTION

With the advent of microcontrollers, it is possible to create cheap intelligent distance measurement systems. Such rangefinder systems can be used for accurate distance measurement, firefighters working in smoky rooms, speleologists, security alarms, robotics (drones), advertising, toys [1,2]. The distance measurement accuracy can be significantly improved if the speed of sound propagation from the environment temperature is taken into account [3,4].

As known, the distance to the object can be calculated using the formula:

$$d=v*t/2 \quad (1)$$

where d is the distance to the object, v is the speed of the sound wave propagation in a given environment, t – the time needed for the wave to cover the distance to the object and back.

The speed of ultrasound propagation in air depends on the ambient temperature and is calculated by the formula:

$$v(\Theta)=331.3+0.59*\Theta \quad (2)$$

where $v(\Theta)$ is the speed of sound in air (m/s), Θ is the ambient temperature (°C).

II. DEVELOPMENT OF ULTRASONIC RANGEFINDER WITH IMPROVED MEASUREMENT ACCURACY

In Fig.1, hardware of the ultrasonic rangefinder with improved measurement accuracy is shown.

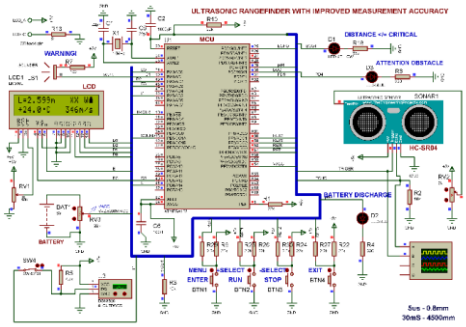

Fig.1. Hardware of the ultrasonic rangefinder with improved measurement accuracy

The rangefinder hardware consists of the ATmega128 MCU, HC-SR04 ultrasonic module, DS18B20 temperature sensor, LCD, sound and LED indicators, menu buttons (BTN1, BTN2, BTN3, BTN4) for setting up the rangefinder.

III. CONCLUSIONS

The hardware and software for the ultrasonic rangefinder with improved measurement accuracy have been developed. The developed device detects obstacles, measures the distance to them, taking into account the speed of wave propagation in the environment, notifies about approaching an obstacle closer than the configured critical distances by turning on sound and visual warnings, has a flexible menu for setting the rangefinder operation modes and input parameters (critical distance to the obstacle, distance measurement units), saves settings in non-volatile memory, and monitors the battery charge. The ultrasonic rangefinder with improved measurement accuracy is cheaper compared to existing products and has wider capabilities.

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