HemiSSon

HemUltraSonicSensor

K TEAM

Version 1.2
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Documentation drawn up by:

Alexandre Colot, K-Team S.A.
Ch. de Vuasset, CP 111
1028 Préverenges
Switzerland

E-mail: mailto:info@hemisson.com
Website: http://www.hemisson.com/

Registered Trade Mark:

Hemisson: K-TEAM SA.
SysQuake LE: Calerga SA

Please note:

– The contents of this manual may be changed without prior notification.
– Every effort has been made to ensure the accuracy of this manual.
  However, if you do find an error, we would be grateful if you would inform K-Team S.A.
– Notwithstanding the above, K-Team S.A. cannot be held liable for any consequences
  arising from an error in this manual.

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1 Introduction

The IR sensors fitted to Hemisson have a maximum detection distance of 6 to 7cm depending on the materials in question, and in addition, these sensors are so-called proximity sensors; in other words they do not give information on the exact distance of an obstacle. The HemUltraSonicSensor module enables you not just to considerably extend the detection distance (it can be used from 3cm to 6m), but in addition the information received is in the form of a distance reading (with no fluctuations resulting from type of obstacle). This therefore allows Hemisson to find its bearings in much more complex environments, as well as detecting obstacles a lot earlier.

1.1 How to Use this Manual

This manual is an introduction to the HemUltraSonicSensor designed for the Hemisson robot. If you cannot find any information in this manual relating to a given problem that you encounter, please go to the Hemisson website (http://www.hemisson.com/), and in particular the Forum or the FAQs[1] section.

1.2 Precautionary Measures

Here are a few recommendations for proper use of the HemUltraSonicSensor module:

– **Keep it away from damp areas.**
  Any contact with water might cause it to short circuit.
– **Always make sure it is placed in a stable position.**
  This will avoid any risk of it falling that might lead to its breaking or causing injury to another.
– **Do not plug in the module whilst the robot is switched on.**
  So as to avoid all possibility of damage, all connections should be made should be done when the robot is switched off.
– **Never leave Hemisson switched on when not in use.**
  Once you have finished working with Hemisson, switch it off.

1.3 Recycling

You need to consider what to do with the equipment once it reaches the end of its useful life.
Some parts can be recycled, such as the battery, which should not be thrown in the bin but put in the proper container. If you recycle it you will be contributing to making the environment cleaner and safer for future generations.

[1]Question Forum

For all these reasons, please ensure you deal appropriately with the equipment once it reaches the end of its useful life, for example either by returning it to the manufacturer or your local reseller.

2 Connecting Up

Fitting and removal of the extension module is a delicate operation. Please read carefully the instructions below to prevent damage to it. K-TEAM cannot be held liable for any damage caused by improper handling.

2.1 Fitting

To begin with, make sure the robot is switched off (position O); then insert the HemUltraSonicSensor module keeping it as vertical as possible, but making sure it is positioned as below (the module is in grey):

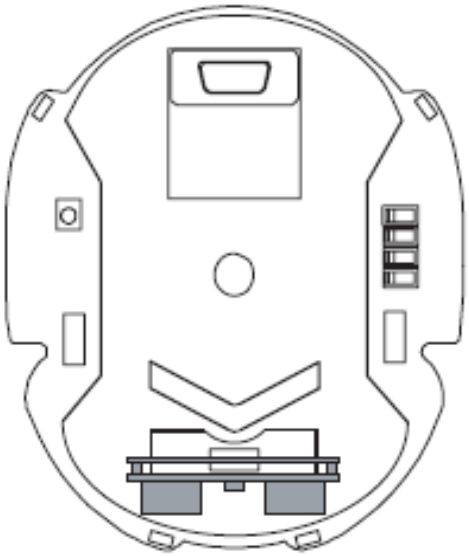

Fig. 2.1 – HemUltraSonicSensor Module on Hemisson – view from above

Under no circumstances try to insert HemUltraSonicSensor in any other way or into any of the other connectors, as this might cause serious damage to your Hemisson robot as well as the extension module.

2.2 Removal

To remove, first make sure that your robot is switched off (position O), then withdraw the HemUltraSonicSensor module vertically with one hand, whilst holding the robot with the other, and making sure not to twist or break the connector pins.

3 The HemUltraSonicSensor Module

3.1 Overall View

The HemUltraSonicSensor module is built up as follows:

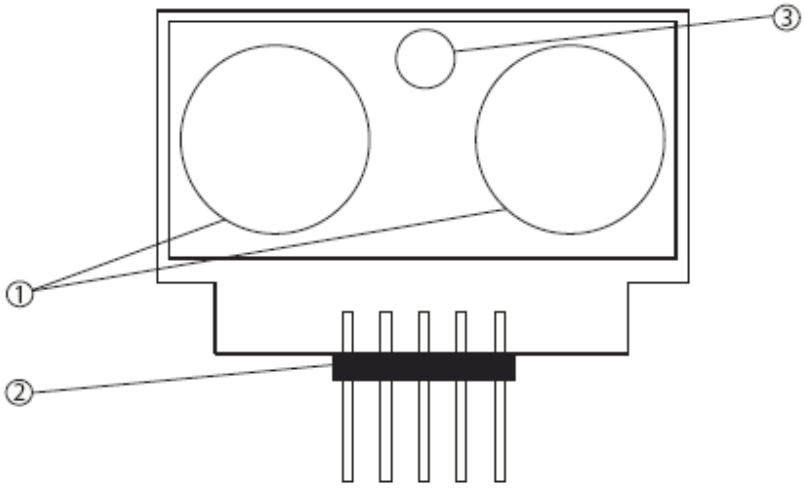

Fig. 3.1 – Detail of the HemUltraSonicSensor Module

1. Ultrasound transmitter and receiver
2. Connector
3. Luminosity sensor

For more information on connector details, please consult the Appendix at the end of this manual.

3.2 I2C Address

The Hemisson robot accesses the HemUltraSonicSensor module via I2C communication. The module has a 7-bit address, plus 1 bit for selecting “read” or “write” mode.

1	1	1	0	0	0	0	R/W

Fig. 3.2 – Module I2C Address

This therefore gives a ”read” mode address of **0xE1**, and a “write” mode address of **0xE0**.

3.3 Physical Phenomenon

Unlike infrared sensors, which are so-called proximity sensors, ultrasound modules enable distance measurements. The principle is to transmit a ”packet” of ultrasound waves and measure the time until the echo is received on the receiver. The distance d to the object producing the echo can be measured, provided we know the speed of sound propagation in an environment c and the elapsed time t.

$$d = \frac{c.t}{2}$$

In the air, at normal atmospheric pressure and 20°C, the speed of sound is about c=343m/s. Ultrasonic waves, typically of between 40 and 180 kHz frequency, are in general produced by a piezzo transducer.

3.4 Register Addresses

Different registers allow configuration of the module or activation of measurements.

ADDRESS	READ	WRITE
0 (0x00)	Firmware version	Main register
1 (0x01)	Luminosity sensor	
2 (0x02)	MSB of 1st echo	Distance control
3 (0x03)	LSB of 1st echo	
…	…	
34 (0x22)	MSB of 17th echo	
35 (0x23)	LSB of 17th echo	

Note:
– MSB = Most Significant Bit
– LSB = Least Significant Bit)

3.4.1 Firmware Version Register

All this register does is send back the firmware version of the ultrasound module.

3.4.2 Main Register

This is the register used to activate a measurement; for this different values can be sent:

VALUE	DESCRIPTION
80 (0x50)	Activate a measurement with a result in inches
81 (0x51)	Activate a measurement with a result in centimetres
82 (0x52)	Activate a measurement with a result in microseconds

So writing 0x51 in the register 0x00 enables activation of a measurement. Once the measurement is activated, the result is available at most 65ms later (this time depends on the settings within the distance register). If you do not want to wait a certain given time, but prefer to check if the measurement is ready, all you need to do is read-access the register 0x00 (Firmware Version); if the module is still taking measurements it will send back the value 0xFF (255).

3.4.3 Luminosity Sensor Register

Reading of this register gives a value proportional to the amount of light present in the environment. The value of this sensor is only refreshed if a measurement is requested on the main register.

3.4.4 Distance Control Register

The module is capable of measuring distances up to 6 metres. If you only want to detect objects at 30cm, there is no point in the module waiting for an echo that might come from an object detected at 6m. So you can specify for it the distance of the obstacles that you want to detect, and the module will carry out the measurement more quickly. The maximum detectable distance is specified by ((value written in the register x 43 mm) + 43mm); so writing the value 24 (0x18) allows you to get a maximum detection distance of (24 x 43mm) + 43mm = 1075mm.

3.4.5 Echo Registers

If you set up Hemisson opposite you and you have a wall behind you, two echoes are sent, one reflecting your presence and another caused by the wall. So the echoes allow detection of the nearest obstacle as well as the ones after that. Since the distance values are 16-bit, you have to read the MSB register and the LSB register to get the distance in your chosen unit.

4 Utilisation

There are two ways of using HemUltraSonicSensor with Hemisson:
– C Programming
– Serial port control (e.g. SysQuake LE)

4.1 C Programming

To program Hemisson in C, you first need to acquire the CCS compiler (available from the software section of the Hemisson website). We first recommend you read the latest version of the HemiOs manual (http ://www.hemisson.com/French/assistance.html); in this document you will find all the information you need on the HemiOs as well as how to install CCS.

– Then download (http ://www.hemisson.com/French/assistance.html) the latest available version of HemiOs, as well as the latest version of HemUltraSonicSensor Lib (containing HemUltraSonicSensor.h).
– Open the project in CCS

The HemUltraSonicSensor.h library includes the following functions:

4.1.1 Void HemUltraSon Init(void)

Purpose: Initialisation of the ultrasound module. This is the first function that needs to be called at the start of your code.
Example:

```
HemUltraSon_Init();
```

4.1.2 Char HemUltraSon Read Version(void)

Purpose: Read the firmware version.
Example:

```
char Version;
Version = HemUltraSon_Read_Version();
```

4.1.3 Char HemUltraSon Read Brightness(void)

Purpose: Read the luminosity sensor.
Example:

```
char Brightness;
Brightness = HemUltraSon_Read_Brightness();
```

4.1.4 Void HemUltraSon Start Measure(void)

Purpose: Activate a distance measurement. This function already includes a waiting time of 65ms
Example:

HemUltraSon_Start_Measure();

4.1.5 Unsigned int16 HemUltraSon Read Values(char Echo)

Purpose: Read the echo obtained; the echo number is parameterised (from 0 to 16)
Example:

unsigned int16 Distance;
Distance = HemUltraSon_Read_Values(0);

4.1.6 Void HemUltraSon Init Range Register(Unsigned char Value)

Purpose: Initialise the maximum detectable distance.
Example:

HemUltraSon_Init_Range_Register(0x10);

NB: To use these functions, you must first prefix an include command for the library at the beginning of your code: #include "HemUltraSonicSensor.h" (Clearly the file needs to be put in the same register.)

4.2 Serial Port Control

Using the 1.30 version of the Hemisson firmware available from the website (http ://www.hemisson.com/French/assistance.html) you can access I2C modules via RS-232 commands. To do this you should consult the latest version of the Hemisson user manual.
Examples:

– W,E0,00,01: Reads the firmware version.

This feature of serial port access is made use of in the case of SysQuake LE, a freeware program distributed by Calerga (http ://www.calerga.com). It allows sending and receiving of ASCII characters via the serial port and also has a graphics interface.
You will find a SysQuake (.sq) interface for this HemUltraSonicSensor module on the Hemisson website (http ://www.hemisson.com/French/assistance.html). It will for example allow you to test your module (for this the module must be plugged into Hemisson and the robot connected to the PC via a serial port). Since the code of this interface is open-source (under GPL licence), you can, for example, use it to develop control interfaces of your own for your robot.

A Technical Specifications

– Weight [g]: Not available
– Voltage [V]: 5
– Minimum detectable distance [cm]: 3
– Maximum detectable distance [m]: 6

Power consumption varies depending on modes of use:

DESCRIPTION	CONSUMPTION	DURATION
The module is in the process of carrying out a measurement	15mA	65ms max.
All other modes	3mA	Undefined

B Connectors

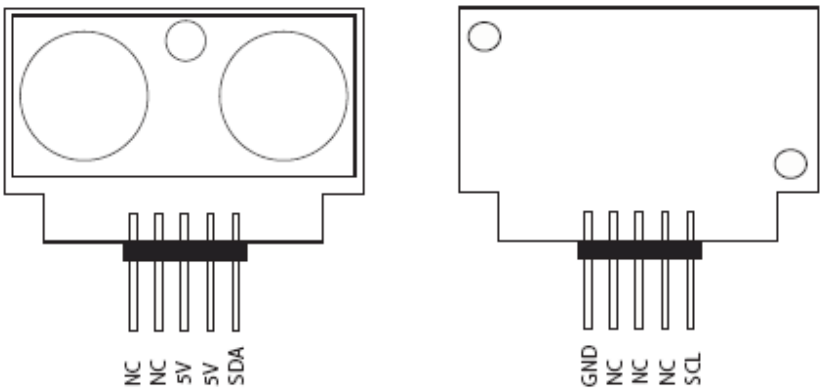

Fig. B.1 – Connector Details

C Signal Aperture

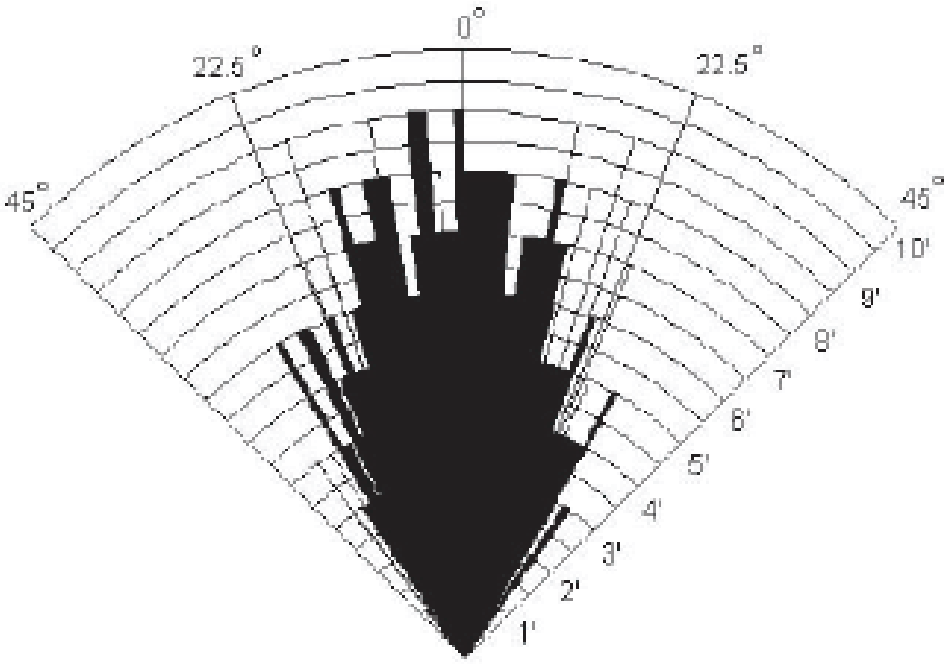

Fig. C.1 – Spatial Distribution of Signal

K-Team SA
Ch de Vuasset, CP 111
1028 Préverenges
Switzerland