

Supplemental Material

DIY Automated Feeding and Motion Recording System for the Analysis of Fish Behavior

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Bill of Materials

Component	Quantity
Data acquisition device: Measurement Computing USB-1024HLS	1
Infrared photocell sensor: Omron E3S-AD62	6-12
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Diode: 1N4148	12
Reed Relais: Meder Electronic SIL05-1A72-BV669, 5VDC / 1A	12
Resistor: 68 k Ω , ¼ W	12
Resistor: 100 k Ω , ¼ W	12
PCB terminal: Phoenix Contact MKDS 1/2-3,81	2
PCB terminal: Phoenix Contact MKDS 1/3-3,81	1
PCB terminal: Phoenix Contact MKDS 1/5-3,81	1
PCB terminal: Phoenix Contact MKDS 1/8-3,81	2
Socket for the 12V DC power supply unit (PSU)	1
Food dispenser: Eheim 3581	6
Enclosure, Bopla # 63239000, ABS, 250 x 160 x 57 mm	1
power supply unit (PSU) 12V DC	1

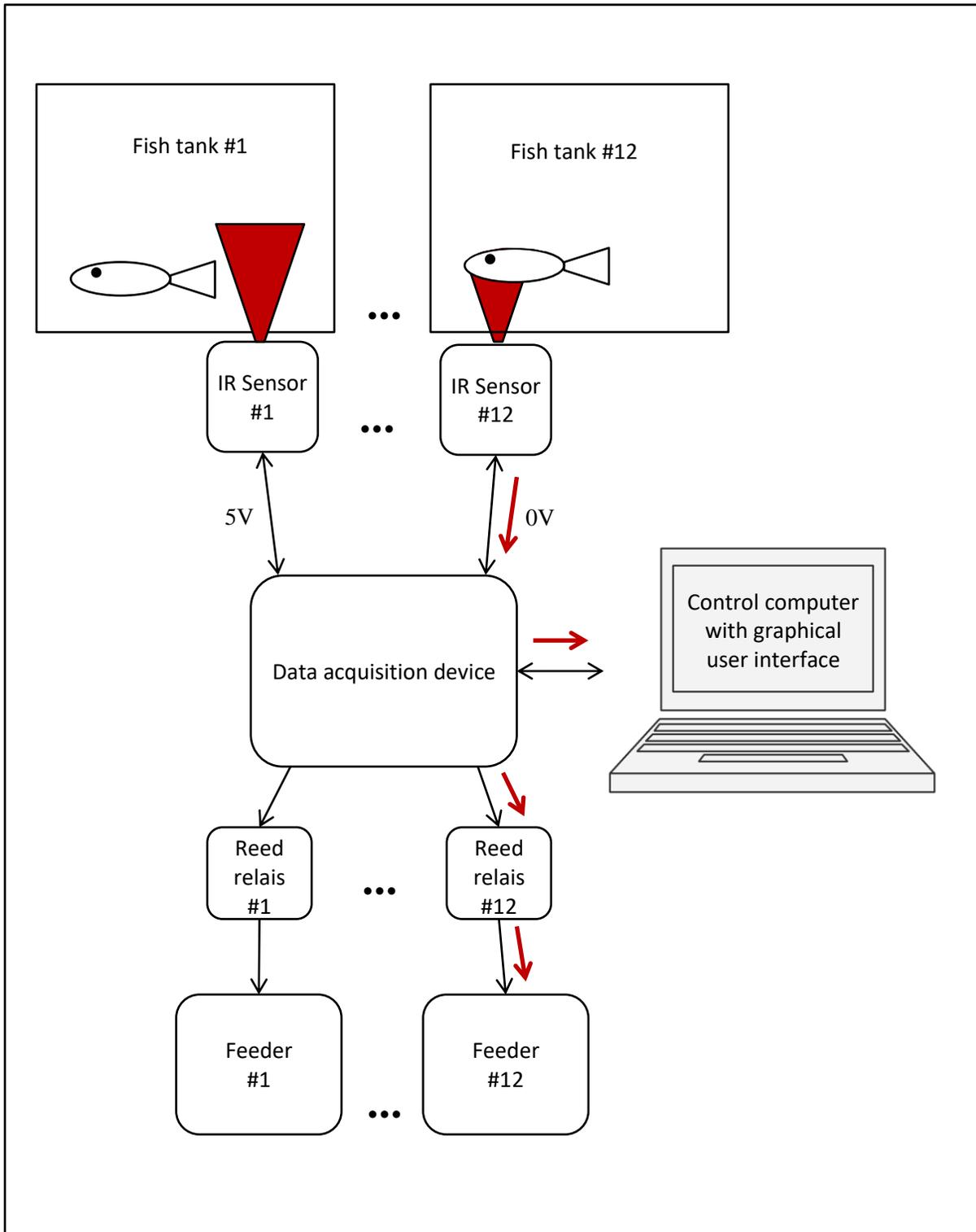


Figure1: Sequential diagram for the automated feeding system.

Each sensor emits infrared light. If an object (fish) enters the sensors' cone of light, the light is reflected and detected by the sensor, as shown for sensor #12. The sensors' output signal is connected to a data acquisition device (DAQ) and drops from 5V to 0V. In case of sensors that control feeders, the DAQ output controls the corresponding feeder via reed relays. The DAQ is also connected to a computer to choose the number of sensors for an experiment and to register the signals from the sensors.

Build Instructions

1. Connect the data acquisition device with screws to the PCB (Fig. 2).
2. Solder all electronic components onto the PCB and connect the data acquisition device with wires.

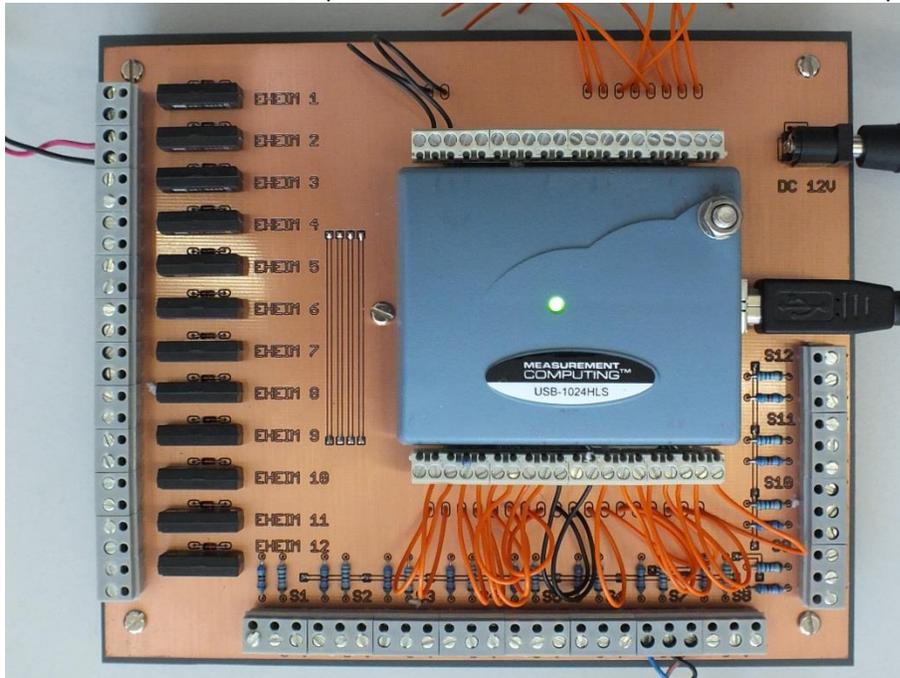


Figure 2: PCB with data acquisition device.

3. Drill holes in the enclosure for all connectors.
4. Connect the PCB with wires to connectors inside an enclosure (Fig. 3) to protect it from water.
5. Connect all infrared sensors, feeders, USB, power supply with connectors of the enclosure.

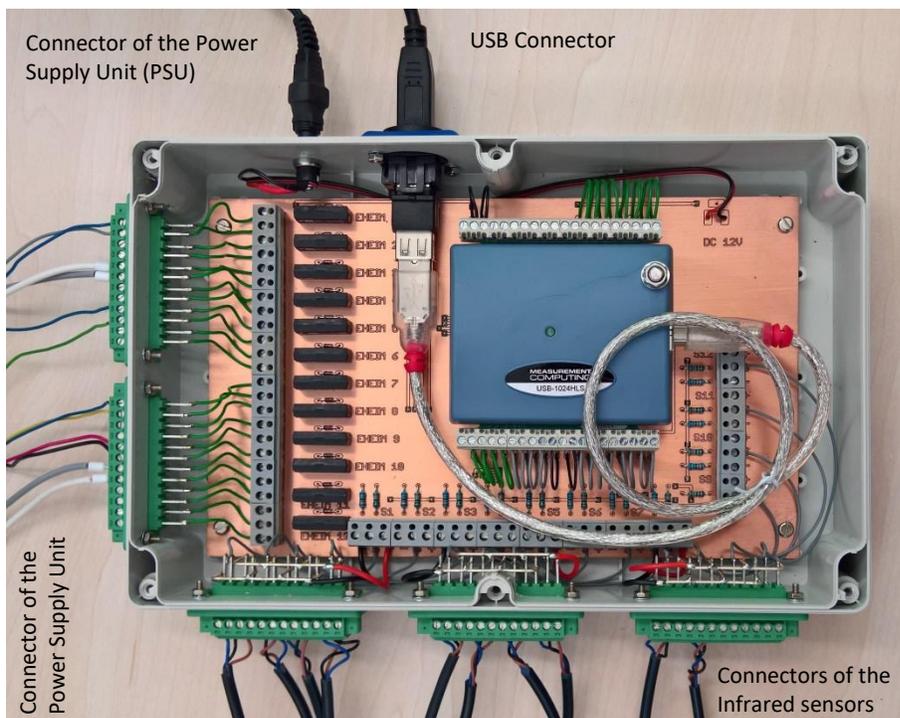


Figure 3: opened Housing connected with PCB, PSU and USB

Software installation

The control software of the photocell sensors and of the food dispensors via data acquisition device was developed in the programming language LabView (National Instruments Inc., Austin, TX). The software files are freely available and can be downloaded from the approved online repository <https://osf.io/ndb65/>.

Installation steps:

1. Download and install the latest firmware version "mccdaq.exe" for data acquisition device (USB-1024HLS) from the manufacturers homepage: <https://www.mccdaq.com/Software-Downloads.aspx>.
2. Start the 'InstaCal' program. With its help, you will be able to establish communication with the USB-1024HLS, register current device in the operating system of your computer, and test the device.
3. Download the .zip file of setup software: 'Setup USB-1024HLS V1.0 64-Bit.zip' for a 64-bit MS Win7-10 OS or the 'Setup USB-1024HLS V1.0 32-Bit.zip' for a 32-bit MS Win XP or Win 7-10 OS. Unzip the folder and run the "setup.exe" file.

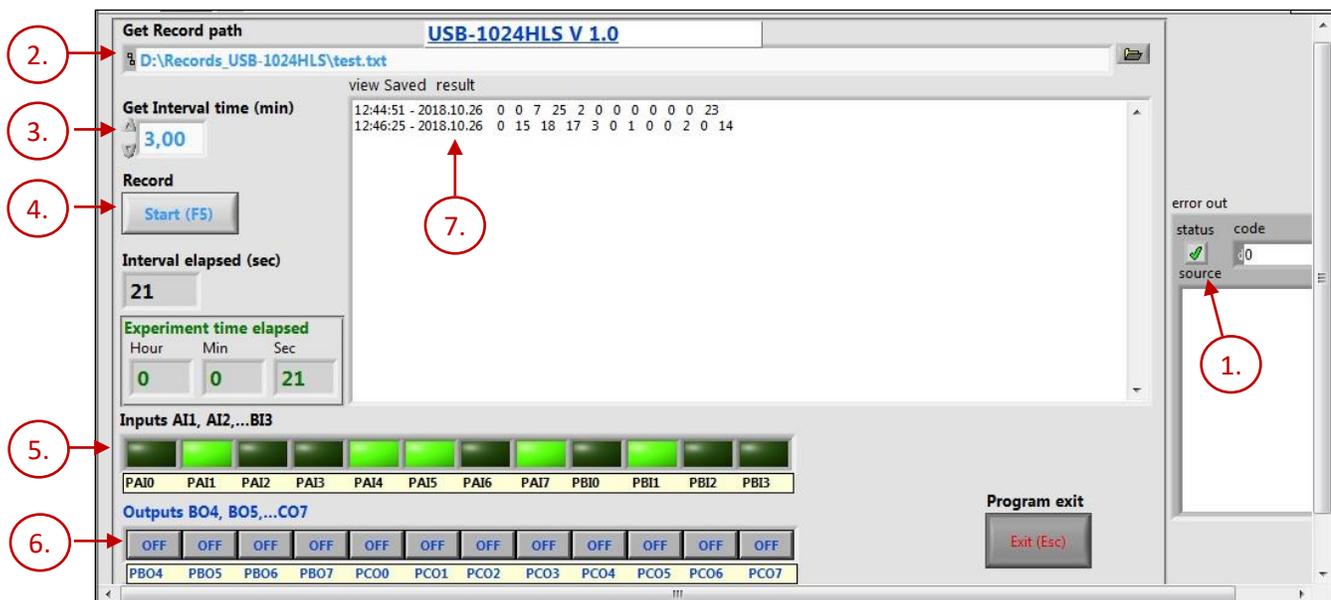
The control program of photocell sensors is 'USB-1024HLS Read All Dig Ports V 1.0 64-Bit.exe' or 'USB-1024HLS Read All Dig Ports V 1.0.exe'.

We have tested the control software successfully with different computers and low-cost notebooks such as Acer Travelmate B117 M with Microsoft Windows 10 (64-bit) operating system, Asus Eee PC 1015BX with Microsoft Windows 7 (32-bit) operating system and a desktop computer with Intel Core i7-2600K CPU with Microsoft Windows 7 (64-bit) operating system.

Operation Instructions

Start the control software by double clicking on the 'USB-1024HLS Read All Dig Ports V 1.0 64-Bit.exe' file or the '~32-Bit.exe' file, respectively. A new window with the Graphical User Interface (GUI) will pop up.

1. The software is ready for use, when a green tick appears in the status box.
2. Chose a folder and name for the dataset.
3. Chose a time for the interval between two measurements.
4. Click the button to start recording.
5. Each time a sensor measures a signal it will turn from dark green to a light green color.
6. Here you can switch on a feeder that is activated when a corresponding sensor detects motion
7. The number of measured activities for each sensor is displayed and saved together with a time stamp into a text file.



Graphical User Interface of the software.