Pulse Monitor 2 Sensor
for the LogIT Microsense® system

Introduction
Pulse Monitor 2 incorporates improved electronics and software from the original unit which makes most results a great deal more stable.

Whilst the ear/finger clip method of measuring pulse rate is the preferred method for schools (because of child safety issues concerning chest skin types) it has always been necessary to keep the clip quite still whilst measuring. With advances in electronic technology and software techniques the waveform from the clip is now filtered and analysed by the Pulse Monitor 2's internal microprocessor to provide much more consistent and intelligent readings.

In Use
The advantage with this system of measuring heart rate over our wireless Heart Receiver system is that nothing needs to be attached to the chest area of the body, which can be difficult or impractical to fit, especially with students. However unlike our wireless system it is not suitable for logging during vigorous exercise without careful setting up which can produce good results.

How it works
The dual purpose Ear/Finger clip supplied has a small infrared light source on one side and an infrared sensor on the other, with the sensor measuring minute alterations in infrared level due to the small changes in the size and volume of the artery as blood is pumped by the heart.

Calculating the pulse rate reliably is quite difficult, not least because the beats per minute value needs to be assessed in periods of much less than a minute, so that averaging and filtering heart rates of say 60 -70 beats per minute within a few seconds is complex because of the relatively few sets of real data received during this time.

Pulse Monitor 2 works by processing, storing and comparing several sets of readings and ignoring any really obscure ones which do not fit in with the trends from most of the readings.

Applying microprocessor 'intelligence' before the data logger sees the data reduces the number of spurious readings and measurements so that logging even in fast changing environments where the person is moving is possible, though it is worth taking some time to set it up carefully and prevent the ear/finger clip and plug moving as shown in these instructions.

Instructions & Resources

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Setting up
Plug the Pulse module into a LogIT data logger. Connect the ear/finger clip into the module's pulse sensor socket. Clip onto a finger or the ear lobe (as shown on previous page). The Monitor has a small LED (light) indicator next to the pulse sensor socket and this will flash in time with your pulse when the system and sensor is setup correctly - the LED works the same way in either switch position. When using with exercise, keeping the ear/finger clip and the plug going into the module secure will produce much more reliable results. An elastic band around the module holding the ear/finger clip cable is a good method.

Use the LED to set up the sensor in the best position. Stay still (preferably seated) and try different positions on the ear lobe or different fingers. It takes a few seconds for readings to stabilise after fitting or moving the clip.

Once the LED is flashing at a constant rate, the pulse monitor will display the heart rate.

This can be in the form of the 'Pulse Waveform' or the 'Pulse Rate'. To select either, use the switch on the side of the adaptor.

Pulse Waveform (mV)
This mode works with all LogIT data loggers and provides a real time 'analogue' waveform trace of pulse activity on the computer screen. Any standard LogIT compatible software will work with this mode but it is only suitable for live real time / As It Happens logging (not remote).

After the switch is set to the Pulse Waveform position and the LED is flashing start the computer logging - you will see a trace on the screen representing the pulse waveform detected by the sensor - you can manually count 'beats per minute' by referring to the time axis and the peaks on the graph. Calibration units will be V volts or mV millivolts; the measurement unit is irrelevant as it is the shape of the trace waveform that is important.

Pulse Rate (per min)
This mode provides a calculated pulse rate (per min) and can be used for 'LIVE' logging using a computer or 'Remote' logging using a remote logger such as Voyager or DataVision.

You can use most standard LogIT compatible software with this monitor including LogIT Lab, DataSweet, iLog and Insight.

Because the monitor works by measuring minute changes of light through skin and arteries, changes of light surrounding the sensor, including movement, will also vary the incident light and this will affect readings. We have incorporated electronic and software techniques to improve the sensors immunity to changes in ambient light but for best results readings should be taken with the subject as still as possible, ideally seated.

However, for measurement whilst exercising or moving you may wish to experiment by covering the sensor clip when mounted on a finger. In trials we obtained quite good results by covering the finger and sensor clip with some black elasticated material, so holding the clip in position and blocking out ambient light.

Restraining the sensor cable from moving by clipping it to clothing will also help stabilise results.

Troubleshooting

Q. I get erratic readings.
A. Check that the finger/ear clip is not pushed too far onto the finger as the cuticle's of the nail can prevent the IR passing through the finger. If using the ear lobe, make sure the clip sits flat. Please note that in some cases the finger is a better option than the ear lobe. Also, check the small jack plug from the ear/finger clip is pushed fully into the socket of the module and cannot move or drop out.

Q. I still get erratic readings.
A. Make sure that the clip is not exposed to bright lights as this can flood the tiny receiver and cause false readings. You can lightly grip the edge of a desk with the clip underneath to prevent this happening or make a shroud out of black card or cloth to cover the clip. This is how it is done in hospitals.

Q. I get no pulse for the first few seconds when using pulse rate mode.
A. The sensor monitors the output from the clip and will not start calculating pulse rate until a suitable strong signal has been obtained and locked onto.

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Care
Care must be taken not to attach the sensor clip too tightly as this could cause injury if the cable is caught.

Only use the monitor and sensor supplied together - never with other products. This product is intended for education and research only and must not be used for medical or life support purposes.

Quick example experiments
With the finger clip connected, try raising your other arm and keep an eye on the pulse rate.
Try eating different types of food whilst monitoring your pulse. Are the results a surprise?
Try altering your breathing and see what happens to the pulse rate.
Connect the clip to your ear, clip the lead to a hat or headband as shown below and go for a walk.

For best results.....

• Initially adjust clip for maximum changes in waveform (mV) reading.

• Ears normally give better results because there is no bone to block the signal.

• Restrain wire from moving the ear/finger clip by tucking it under a wristband or sweatband whilst ensuring it cannot move (see photo).

• When exercising vigorously, ensure that the plugs from ear/finger clip and LogIT are restrained using elastic bands or tape etc.

• Try and avoid areas of dramatically changing light.
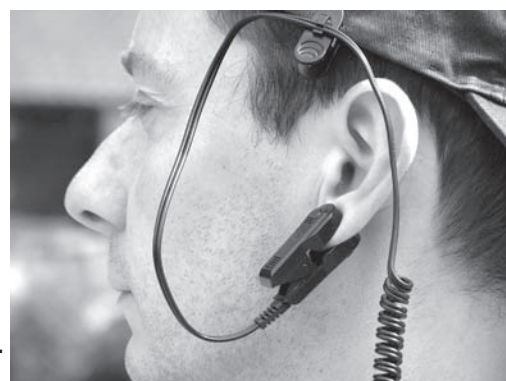
• When connecting to the finger, ensure that the clip is not pushed too far onto the finger.

• Nail polish can sometimes cause poor readings.

• Whilst the monitor will cope with occasional loss of signal, try to avoid a lot of movement when using with the fingers.

Risk assessment.
Any student undertaking exercise should be supervised at all times.
Make sure that the activity is suitable for the students and is performed in a suitable location.
Ensure the datalogger cannot come into contact with water or be exposed to damp.
It is the responsibility of the user or teacher to have made suitable risk assessments before carrying out any student led experimentation. A teacher has a duty of care towards their students to ensure experiments are carried out within a safe environment. The instructions and experiment ideas contained within this manual highlight particular hazards but are not exhaustive and are not a substitute for your own assessment. Refer to your science departments risk assessment criteria and apply accordingly.

Exercise and Pulse Rate

Subject: Biology

Overview:
This simple experiment is to measure what happens to the pulse rate during exercise. The circulatory or vascular system is a network of tubes filled with blood. Blood is kept flowing in one direction by the pumping of the heart. The heart is a muscular organ and with blood vessels forms part of the cardiovascular system. The cardiac cycle is a series of events which make up a complete pumping action of the heart and can be heard as a heart beat.

Equipment required: LogIT Datalogger
LogIT Pulse Monitor
Computer and data logging software
Form of exercise ie. skipping rope,
exercise bike, step ups etc.

Hazards:
Students should be supervised at all times.
Ensure the datalogger, ear/finger clip cannot come into contact with water or be exposed to damp.
Make sure that the activity is suitable for the pupils involved and is performed in a suitable location.
Always check your local regulations or a school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material or activity/exercise.

Suggested Setup:
1. Connect the pulse monitor as described in the instructions overleaf.
2. Connect the pulse monitor to the LogIT datalogger and set the monitor to record Pulse Rate.
3. Connect the datalogger to a computer if required.
4. Record the Pulse and note this as the resting pulse rate.

Suggested Method:
1. Begin the exercise.
2. Stop exercising and connect the pulse monitor.
3. Start either the datalogger (if remote logging) or datalogging software.
4. Stop logging once the pulse rate has returned to the initial pulse rate prior to exercise.
5. If remote logging, connect to a computer and download the results to a graph.

Results:
What do the results show?
Are the results a surprise?

Going further:
Why might this be a good method of showing fitness levels?
What factor could you vary in the experiment? For example, if using an exercise bike, what effect on the pulse rate might increasing the resistance of the bike have (ie. simulate cycling up hill).
What other piece of data might you like to record in addition to the pulse rate?

Biology