Infrared Sensor

for the LogIT Microsense® system

Instructions & Resources

Overview

The IR sensor is used to measure Infrared radiation emitted from an object.

Ideas for use

Can be used with a Leslie cube to show that a matt black surface emits more heat radiation than a polished silver surface. Used with a temperature sensor you can demonstrate the Stefan-Boltzman law.

Heat patterns can also be traced. For example, the pattern left from a hot drink or a hand on the table can produce some interesting patterns that require students to think about heat transfer. Finding hot water bottles buried in sand can also be used to demonstrate how survivors are located after an earthquake disaster.

The IR sensor can also be used for non-contact thermometry when the temperature scale is selected in the logging software.

The field of view is 60^{O}. As a result, to trace heat patterns and surface temperature's, it is best to place the sensor about 2cm from the object.

Specifications

Standard Range:	0 – 1820 W/m^2 (resolution 1 W/m^2)
Alternative Range (via software):	-20 to $150^{O}C$ (resolution $0.1^{O}C$)
Alternative Range (via software):	250K to 420K (resolution 0.1K)
Field of view:	60^{O}
Window material:	Silicon 0.5mm, 5.5um cut on filter
Encapsulating gas:	Dry Nitrogen

Care

Do not use the sensor in excessive damp conditions or extremes of temperature as permanent damage will result.

Do not disassemble this sensor, no user serviceable parts inside.

Trouble shooting

If the sensor is not recognised by your software or datalogger, see www.logitworld.com

To upgrade the software click on the 'Downloads' tab followed by 'Software Updates'. The installation instructions are available from the same page.

To upgrade the datalogger, select the logger from the list on the left of the page followed by the 'Support' tab and then select 'Logger Updates'. Follow the on screen instructions.

Note: Sensorlink, LogIT SL and LIVE only require a software update and so do not have an 'update' option on their respective pages.

Note the Infrared sensor is not compatible with CheckIT.

The resources shown overleaf are available along with others for download in PDF format at www.logitworld.com

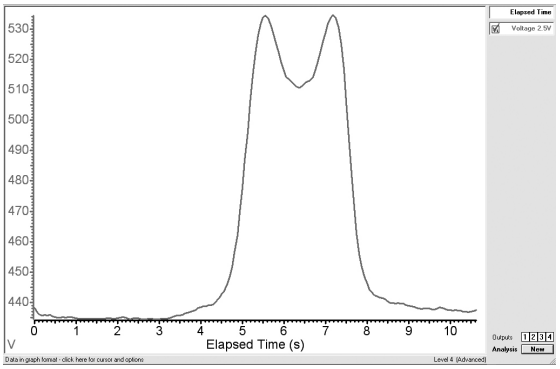
www.logitworld.com

Tel: 01827 488008
email: support@logitworld.com

Ideas for other experiments (continued)

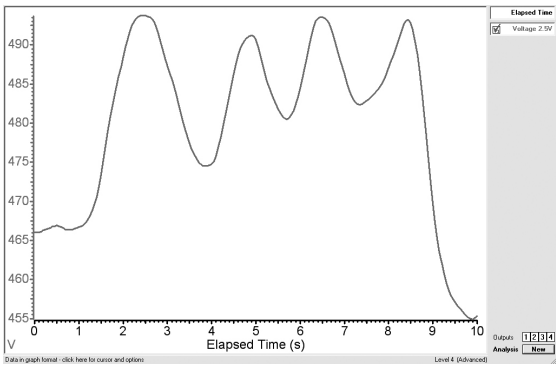
Search and Rescue.

Use the sensor to search for hidden bodies.
Try burying some hot water bottles in sand and use the sensor to locate the buried bodies.
Another similar example is placing a hot cup of coffee onto a table and scan over the top once the cup has been removed. Can you explain the shape of the graph?



Scan of table top where a coffee cup once stood.

Try scanning the table top once the hand has been removed.



How many fingers were on the table?

Herschel's discovery of IR.

Use a prism to split light into its component parts (Red, Orange, Yellow, Green, Blue, Indigo and Violet).
Scan the IR sensor along the colours and note when the energy rises.
This should be the IR part of the spectrum and forms the basis for the Herschel's discovery.

Take Away food

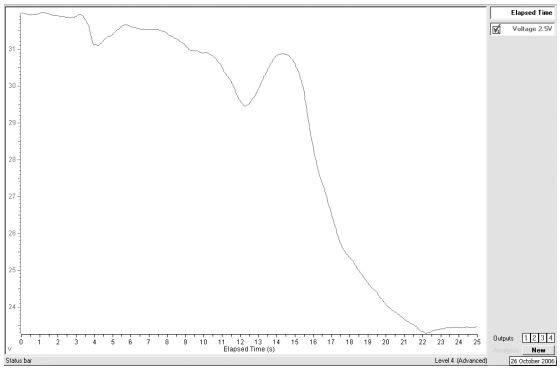
Why does take away food come in silver trays and food cooked at home in a microwave or conventional oven come in black trays?
How could you investigate the different properties?

Product number: D200175 Document number: D773160/1

Ideas for other experiments

Non contact thermometry.

By selecting temperature as the scale within the LogIT Lab software, you can use the IR sensor to monitor temperature without contact.
This could be used with the melting ice experiment so that students can relate to temperature rather than energy radiated.
Also, for Physiology, try scanning along the length of the forearm.

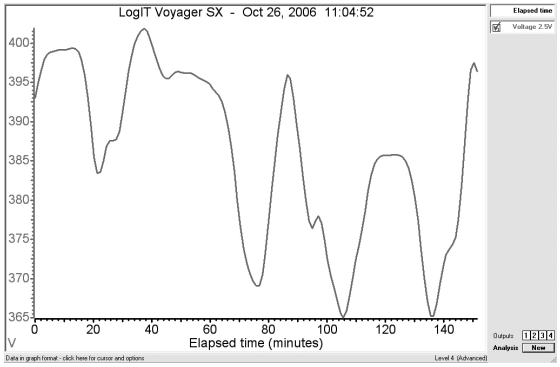


Scan of a forearm at a distance of 2 cm from the joint to the tip of the index finger (left to right).

The above plot shows the centre of the hand. Can you spot it? Why does the temperature of the hand drop here?

Solar Radiation monitoring.

Mount an IR sensor in a suitable stand and place it outside.
Then, monitor the IR levels during different days in different seasons eg. Winter Summer etc.



Insulation monitoring and loss of heat

Physics

Biology

Subject: Physics/Biology

Sensor: Infrared and Temperature sensors

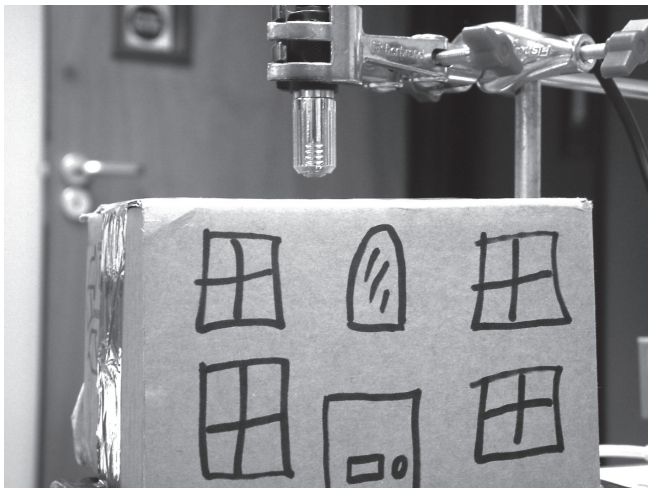
Overview:

To use the IR sensor to monitor heat loss from a house (small box) and to see what effect adding insulation has on this heat loss.
This experiment uses a small box as a house. A hot cup or beaker is placed inside the box to simulate a hot radiator that is slowly cooling down. Students could also make their own houses and subsequently test their houses to see how good they are at preventing the internal heat from escaping.

Equipment required: LogIT Infrared sensor
LogIT datalogger
Sensor extension lead
Small box or card for students to make their own house
Cup to hold the hot water (radiator)
Clamp stand
Insulation (foam or thick material)

Hazards:

Try not to let students handle genuine roof insulation material as this can be hazardous.
If using warm water, make sure the temperature of the water is suitable for the ability of the students. Water over 55^{O}C can scold.
Care must be taken if using kettles to heat the water.
Place the apparatus in a tray to catch any spilt hot water.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

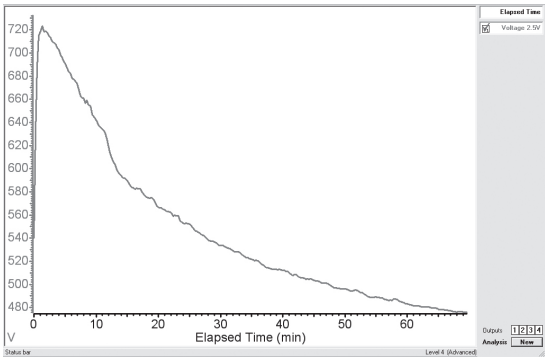


Suggested Method

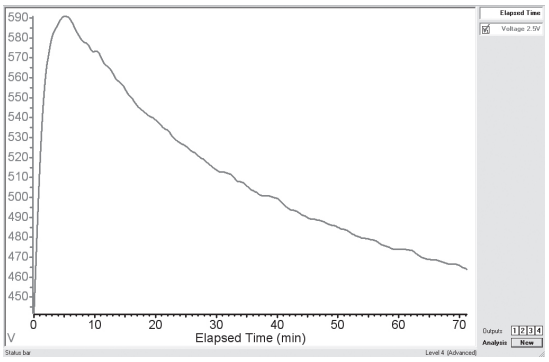
1. Clamp the IR sensor gently into a clamp stand as shown
2. Setup the logging software to either record for about 30 minutes or use 'Autolog'
3. Put hot water into a beaker or cup
4. Place the cup onto the stand base and place the 'House' over the top of the cup/beaker
5. Start logging
6. After about 30 minutes (we did 70 minutes) stop logging
7. Add insulation into the top of the house
8. Repeat from step 2, you can use 'Overlay' on the same graph or plot a new graph.

Insulation monitoring and loss of heat (continued)

Results:



Graph A – Uninsulated box



Graph B – Insulated box

This experiment can show a marked difference in roof insulation. In our example here, graph 'A' shows an uninsulated box and graph 'B' shows an insulated box.
Looking at the amount of energy radiated from the boxes, we get a change of 257 W/m2 radiated energy from the starting energy peak for the uninsulated box and a change of 126 W/m2 of radiated energy from the insulted box in the same time span. (In this example we used 65 minutes.)
What can be concluded from this?

Note: It is important to look at the overall shape of the graph. Why does graph (A) rise more sharply than graph (B) at the start for example? Can students explain this?
The starting temperatures of the 'Radiator' must also be the same. It's a good experiment to discuss experimental practice and how to make the experiment accurate.

Going further:

Students could look at cavity wall insulation in a similar way.
Also, clothing could also be investigated for their suitability in certain applications.

Physics

Biology

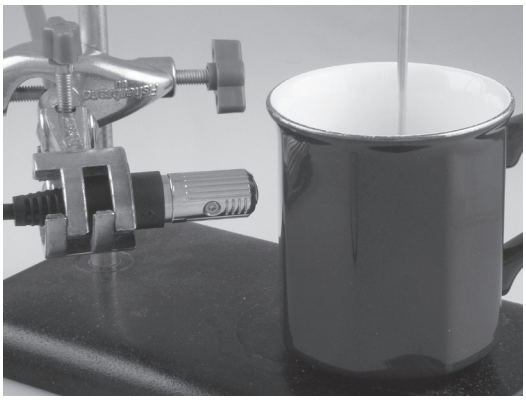
Relationship between Temperature and Energy

Physics

Subject: Physics

Sensor: Infrared and Temperature sensors

Overview:
By recording the temperature of water in a vessel and the energy emitted on the vessel's surface, the relationship between temperature and energy can be explored.



Equipment required:

LogIT Infrared sensor
LogIT temperature sensor
LogIT datalogger
Black beaker or similar

Hazards:

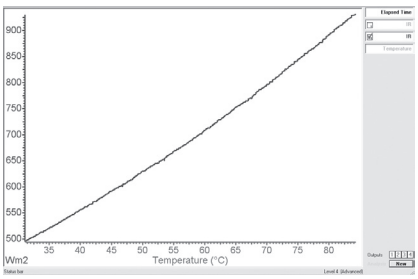
Place the apparatus in a tray to catch any spilt water.
Take care when handling hot water. Water over 55^{O}C will scald.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

Suggested Method

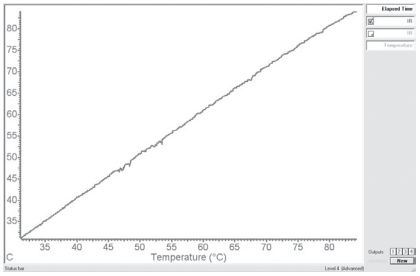
1. Clamp the IR sensor and Temperature sensor gently into a clamp stand as shown
2. Setup the logging software to use 'Autolog'
3. Place the sensor about 1 cm from the beaker as shown
4. Allow the heat to conduct through the wall of the vessel
5. Start logging
6. Stop logging after about 45 minutes

Results:

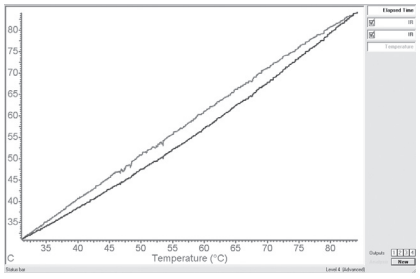
The results should show a curve when the radiated energy is plotted against the temperature of the water contained in the vessel as shown in graph (A). Why?



Graph (A)



Graph (B)



Graph (C)

Going further:

Repeat the experiment but this time record the surface temperature of the vessel. (This is achieved by changing the recorded scale from the IR sensor in LogIT Lab.) Plot a graph of internal water temperature against surface temperature of the vessel the results are shown in graph (B). A straight line graph should result.
Our results were achieved by using two IR sensors at the same time. One measuring radiated energy, the other temperature. Graph (C) shows the two plotted on the same graph and also shows the curve of the energy plot when compared to the temperature.

Leslie cube experiment

Physics

Subject: Physics

Sensor: Infrared and Temperature sensors

Overview:

This experiment uses the IR sensor for comparing the energy radiated from a dull black and shiny silver surface.

Equipment required:

LogIT Infrared sensor.
LogIT datalogger.
Sensor extension lead
Leslie cube, Silver & black kettle or similar.

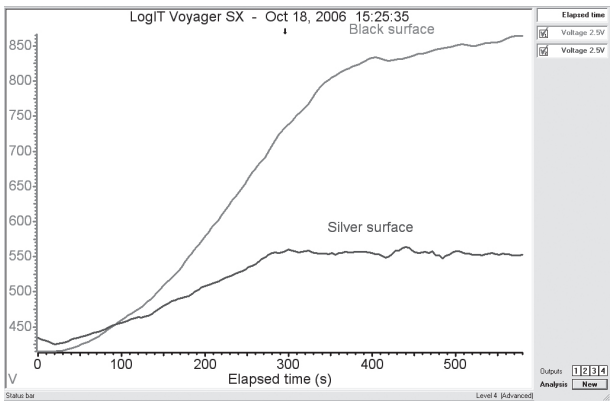
Hazards:

If using warm water, make sure the temperature of the water is suitable for the ability of the students. Water over 55^{O}C can scold.
Care must be taken if using kettles to heat the water.
Place the apparatus in a tray to catch any spilt hot water.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

Suggested Method:

1. Clamp the IR sensor gently into a clamp stand.
2. Setup the logging software to use 'Autolog'.
3. Place the sensor about 2 cm from the Silver part of the cube/kettle.
4. Start logging.
5. Stop logging when the plot no longer rises.
6. Repeat the experiment using 'overlay' and point the sensor at the black part of the cube/kettle.

Results:



Graph showing the energy released from the black and silver parts of a kettle.

The kettle was allowed to boil and the marker shown in the center of the graph is the point at which the kettle stopped boiling.

Going further:

By using a temperature sensor to monitor the temperature of the surface being monitored and then plotting Energy W/m^2 against temperature in ^{O}C, a curve should result.

Plot the energy from melting ice

Subject: Physics/Chemistry

Overview:

To use the IR sensor to monitor the change in energy given out from a cooling ice block.
Pose the question, does ice give out heat energy?

Equipment required:

LogIT Infrared sensor.
LogIT datalogger.
Sensor extension cable (optional).
Small plastic cup with ice in it.

Hazards:

Place the apparatus in a tray to catch any spilt water.
Avoid pupils handling the ice if straight from the freezer.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

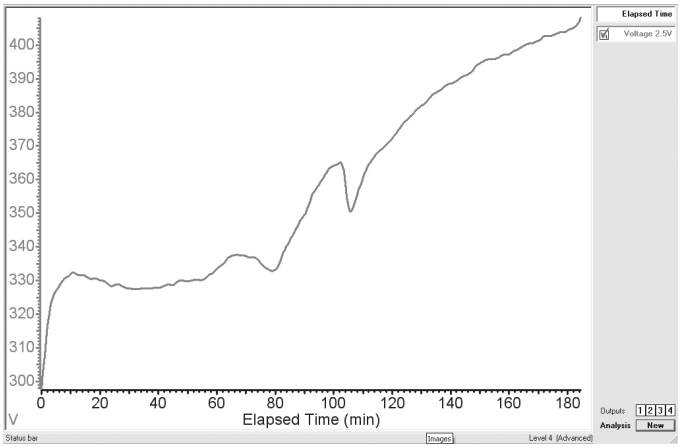
Setup:

Place a thin plastic cup filled with water into a freezer for a couple of days.

Suggested Method:

1. Clamp the IR sensor gently into a clamp stand as shown.
2. Setup the logging software to use 'Autolog'.
3. Place the sensor about 2 cm from the ice as shown.
4. Start logging.
5. Stop logging when the ice has totally melted.

Results:



Graph of Energy released from melting ice. What caused the sudden drop in Energy?

This experiment is a very simple take on the melting ice experiment only this time pupils are measuring the amount of energy leaving the ice as it melts.
Pupils can think whether this experiment will give the same graph if a temperature sensor was used.

Going further:

Insulating against cold could be investigated by seeing how effective different materials are at preventing energy escaping from the ice. This could easily be achieved by wrapping the cup in different materials.