IFTS 14 – ROBOTICA – INGLES TECNICO II

TASK 4

A) READING COMPREHENSION:

1- Read the text and choose one of the following titles for it:
   a) Biological Robotics
   b) EcoBot: two serious drawbacks.
   c) EcoBot: a robot with an artificial digestive system.
   d) Ecobot technology.

There are several different approaches to converting biomass into electrical energy. One is to ferment the biomass, generate biogas (methane), then burn the methane in a fuel cell. Another conceptually much simpler approach is to make use of a microbial fuel cell. A microbial fuel cell, or MFC, is rather like a battery except that instead of generating electrical energy from a chemical reaction, it makes use of a biochemical reaction.

Just like an ordinary battery, an MFC has two sections: the anode and the cathode. But in the MFCs developed in the Bristol Robotics Lab (BRL), the anode compartment contains a liquid 'soup' of microbes capable of literally digesting food. Typically this might consist of sewage sludge, chosen because it contains a broad spectrum of bacterial species capable of digesting (and breaking down) more or less any biological material.

A side effect of that process of digestion is that ions are produced which, of course, have an electrical charge. The cathode in the BRL MFCs is open to air, and oxygen is absorbed, which helps to exchange electrons across a membrane between the anode and cathode. If the MFC is connected within an electrical circuit, then a current flows from the anode to the cathode, and we have a working biological battery that runs on food.

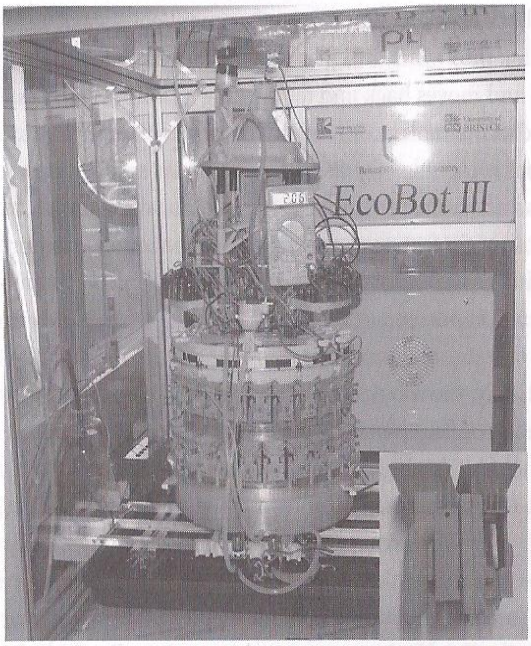
MFCs generate very low levels of power—typically a single MFC provides just a few microwatts (1,000 times less than a standard AAA cell), and during the early development of the BRL MFCs, researcher Ioannis Ieropoulos tested different foodstuffs to try and find one with the best energy efficiency. The material he discovered worked best is the polysaccharide chitin, found

typically in insect exoskeletons. Remarkably, an early prototype of the EcoBot was powered by only eight dead houseflies (Musca domestica), one per MFC.

Eight MFCs wired in series generate too little power to continuously operate a robot, so the electrical energy generated by the MFCs is used to charge a bank of super-capacitors until there is enough saved energy to power the robot for action. EcoBot thus operates in a pulsed mode in which it cycles between periods of inactivity, while it is digesting food, and rather shorter bursts of activity when it senses its environment, transmits data, and drives its motors. Thus EcoBot II was not only the world's first dead-fly-powered robot, but also perhaps the slowest, moving at about 13 cm per hour. However, fuelled by just eight dead flies, it operated continuously for nearly two weeks.

While it was a considerable achievement, EcoBot II had two serious drawbacks. The obvious one was that it had to be 'fed' by hand; in other words, the food was manually introduced into the anode chambers of the eight MFCs. Unlike its ancestor Slugbot, EcoBot II was unable to capture its own food. A second, equally serious, problem stemmed from the design of the MFCs and in particular the closed anode chamber. Digestion produces waste products and, eventually, those products will poison the digester micro-organisms, so the MFC will stop working until its digester inoculum is refreshed. EcoBot III was designed by Ioannis Ieropoulos, John Greenman, Chris Melhuish, and Ian Horsfield to overcome both of these limitations.

A critical innovation in EcoBot III is in the design of the individual MFC. As shown in Figure 9 (inset), input and output ports have been added to the anode chamber so that the MFC's microbial inoculum can be cycled. Also important is that the MFC has been shrunk to around 1 cubic cm; tests showed that a larger number of smaller MFCs is the best way to increase the power output of the robot's artificial digestion system. EcoBot III is fitted



9. EcoBot III: a robot with an artificial digestive system. The inset image shows a single MFC

with a total of forty-eight MFCs in two rings around the body of the robot.

In another innovation, EcoBot III has a flytrap at the top of the robot. Inspired by the pitcher plant, a combination of colour and artificial pheromones attract flies to enter the trap, where they fall into a pond containing the microbial inoculum. In the pond, the flies start to be digested and result in a nutrient-rich solution, which is then transferred via tubes to the forty-eight MFCs, where the digestion process is completed and energy generated to power the robot. To extract the maximum amount of energy, the inoculum is recycled twice through the MFCs. Solid waste products are filtered from the solution and, literally, excreted by the robot. EcoBot III thus represents the only known example, to date, of a robot with a complete artificial digestive system.

The robot's experimental test environment consists of a closed glass tank into which live flies are introduced. The robot runs on wheels and moves back and forth along a short set of rails, from one end of the tank to the other. This serves to demonstrate that the robot is capable of generating enough energy for locomotion, over and above that required to operate its own internal metabolism. In fact, for energy autonomy, the robot requires hydration as well as protein and is able to collect water from a water tube at one end of its track. Providing there is a continuous supply of water and protein in the tank (in the form of flies), then, theoretically, the robot should be capable of continuous operation (unlike its predecessor EcoBots).

EcoBot III is, I believe, significant for several reasons. First, it provides a proof-of-concept demonstration of energetically autonomous robots that collect and digest food for energy, and can do so while generating enough surplus power to do work. Second, EcoBot III demonstrates the novel application of design and fabrication approaches, making extensive use of 3D printing for complex plastic shapes and structures (that integrate some of the robot's plumbing, for instance). Third, the robot demonstrates a cross-disciplinary collaboration between robotics and biochemistry. While it might be regarded as only rather loosely bio-inspired (by the pitcher plant), EcoBot III can truly be described as a biological robot.

What are the potential applications of EcoBot technology? One could imagine, for instance, a gardener robot that is able to identify and selectively pick weeds and larger pests (like slugs, in fact), power itself with what it has collected, and then excrete its waste as fertilizer. Such a robot would in effect 'live' in your garden, quietly and autonomously getting on with its work. In horticulture and agriculture one could imagine groups of such robots self-organizing (see swarm robotics in Chapter 5) to collectively—and organically (since no herbicide or pesticide is involved)—control weeds and pests in fields and greenhouses.

2) Read the text again and answer the following questions in Spanish:

a- What is a microbial fuel cell?

b- How does the BRL MFC work?

c- How much power do MFCs generate?

d- What material generates the most power?

e- How was EcoBot II powered?

f- Which limitations did EcoBot II have?

g- How was the MFC design improved in EcoBot III?

h- Explain how EcoBot III artificial digestive system works.

i- How significant is EcoBot III to Robotics?

j- What are the potential applications of EcoBot technology?

A) LANGUAGE FOCUS

TEXT ORGANIZATION

Every text has a structure. It is not just a random collection of sentences. The parts that make up the text are related in a meaningful way to each other. Recognising the way in which a text has been organised will help you to understand it better.

Paragraphs and Topic Sentences

A paragraph is a series of sentences that are organized and coherent, and are all related to a single topic. Almost every piece of writing you do that is longer than a few sentences should be organized into paragraphs. This is because paragraphs show a reader where the subdivisions of an essay begin and end, and thus help the reader see the organization of the essay and grasp its main points.

Paragraphs can contain many different kinds of information. A paragraph could contain a series of brief examples or a single long illustration of a general point. It might describe a place, character, or process; narrate a series of events; compare or contrast two or more things; classify items into categories; or describe causes and effects. Regardless of

the kind of information they contain, all paragraphs share certain characteristics. One of the most important of these is a topic sentence.

TOPIC SENTENCES

A well-organized paragraph supports or develops a single controlling idea, which is expressed in a sentence called the topic sentence. A topic sentence has several important functions: it substantiates or supports an essay's thesis statement; it unifies the content of a paragraph and directs the order of the sentences; and it advises the reader of the subject to be discussed and how the paragraph will discuss it. Readers generally look to the first few sentences in a paragraph to determine the subject and perspective of the paragraph. That's why it's often placed at the very beginning of the paragraph. In some cases, however, another sentence appears before the topic sentence—for example, a sentence linking the current paragraph to the previous one, or one providing background information.

Although most paragraphs have a topic sentence, there are a few situations when a paragraph might not need a topic sentence. For example, a paragraph that narrates a series of events, or a paragraph that continues developing an idea that was introduced (with a topic sentence) in the previous paragraph, or if all the sentences and details in a paragraph clearly refer—perhaps indirectly—to a main point. The vast majority of paragraphs, however, have a topic sentence.

PARAGRAPH STRUCTURE

Most paragraphs in an essay have a three-part structure—introduction, body, and conclusion. You can see this structure in paragraphs whether they are narrating, describing, comparing, contrasting, or analyzing information. Each part of the paragraph plays an important role in communicating meaning to the reader.

Introduction: the first section of a paragraph; includes the topic sentence and any other sentences at the beginning of the paragraph that give background information or provide a transition.

Body: follows the introduction; discusses the controlling idea, using facts, arguments, analysis, examples, and other information.

Conclusion: the final section; summarizes the connections between the information discussed in the body of the paragraph and the paragraph's controlling idea.

The following paragraph illustrates this pattern of organization. In this paragraph the topic sentence and concluding sentence (CAPITALIZED) both help the reader keep the paragraph's main point in mind.

SCIENTISTS HAVE LEARNED TO SUPPLEMENT THE SENSE OF SIGHT IN NUMEROUS WAYS. In front of the tiny pupil of the eye **they put**, on Mount Palomar, a great monocle 200 inches in diameter, and with it see 2000 times farther into the depths of space. **Or they look** through a small pair of lenses arranged as a microscope into a drop of water or blood, and magnify by as much as 2000 diameters the living creatures there, many of which are among man's most dangerous enemies. **Or**, if we want to see distant happenings on earth, **they use** some of the previously wasted electromagnetic waves to carry television images which they re-create as light by whipping tiny crystals on a screen with electrons in a vacuum. **Or they can bring** happenings of long ago and far away as coloured motion pictures, by arranging silver atoms and colour-absorbing molecules to force light waves into the patterns of original reality. **Or** if we want to see into the centre of a steel casting or the chest of an injured child, **they send** the information on a beam of penetrating short-wave X rays, and then convert it back into images we can see on a screen or photograph. THUS ALMOST EVERY TYPE OF ELECTROMAGNETIC RADIATION YET DISCOVERED HAS BEEN USED TO EXTEND OUR SENSE OF SIGHT IN SOME WAY.

George Harrison, "Faith and the Scientist"

COHERENCE

In a coherent paragraph, each sentence relates clearly to the topic sentence or controlling idea, but there is more to coherence than this. If a paragraph is coherent, each sentence flows smoothly into the next without obvious shifts or jumps. A coherent paragraph also highlights the ties between old information and new information to make the structure of ideas or arguments clear to the reader.

One way of achieving cohesion in texts is to use transition words or phrases between sentences and between paragraphs. Transitional expressions or connectors emphasize the relationships between ideas, so they help readers follow the train of thought or see connections that they might otherwise miss or misunderstand. The following paragraph shows how carefully chosen transitions (**bold type**) lead the reader smoothly from the introduction to the conclusion of the paragraph.

There are three separate sources of hazard related to the use of nuclear reactors to supply us with energy. **Firstly**, the radioactive material must travel from its place of manufacture to the power station in containers that are not solidly built. Unfortunately, the two normal methods of transport, road or rail, both involve close contact with the general public, **since** the routes are bound to pass near, or even through, heavily populated areas. **Secondly**, there is the problem of waste. The wastes that all nuclear power stations produce will, in most cases, remain radioactive for thousands of years and cannot be de-activated, **so** they must be stored: **for example** they may be buried under the ground, dropped into disused mineshafts, or sunk in the sea. **However** these methods do not solve the problem; they merely store it, **since** an earthquake could crack open the containers like nuts. **Thirdly**, there is the problem of accidental exposure due to a leak or an explosion at the power station. **Although** this is extremely unlikely, it can happen, as the inhabitants of Harrisburg will tell you. Separately, these three types of risk are no great cause for concern. **However** taken together, and especially over much longer periods, the probability of a disaster is extremely high.

SOME USEFUL CONNECTORS

- ADDITION : again, and , also, besides, equally important, furthermore, in addition, in the first place, moreover, too

- EXAMPLES: for example, for instance, in fact, specifically, that is, to illustrate

- COMPARISON: in the same manner/way, likewise, similarly

- CONTRAST: although, yet, but, however, nevertheless, nonetheless, on the other hand, on the contrary, instead

- CONCLUSION: all in all, in conclusion, in other words, in short, to sum up, in brief, in summary, on the whole

- TIME: at first, then, after, afterwards, meanwhile, in the meantime, earlier, finally, thereafter, when, while, later

- PLACE: above, below, beyond, close, farther on, opposite, to the left (north, etc)

- RESULT: As a result, as a consequence, therefore, thus, accordingly

- REASON: because, due to, as a result of, since

- SEQUENCE: first, firstly, to begin with, for one thing, second, secondly, for another thing, third, thirdly, finally, last, lastly

- ORDER OF IMPORTANCE: most importantly, primarily, above all, essentially, basically

- EXPLANATION: that is to say, that is, namely, in other words, put differently

- FOCUSING: with respect to, regarding, with regard to, as far as … concerned, talking of

- EMPHASIS: as a matter of fact, in fact, actually, indeed

- DISMISAL: anyway, anyhow, at any rate

- PARTICULARIZATION: in particular, particularly, more specifically