Learning Analytics Tools

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Lecture 56

Affective Computing-I

In this video we will talk about Affective Computing, there will be two parts. In this video, we will focus on what is Affective Computing?

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Affective Computing (this particular slide) is basically based on the papers by Sidney D'Mello and paper by Professor Ryan Baker. And also some of the content is from the imotions software blogs.

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So, Affective Computing or sometimes called as Emotional Intelligence or emotion. Nowadays, people are talking about not just IQ but EQ also to improve other things. So, what is this Affective Computing? Let us see a very brief introduction. If you watched the movie 2001 Space Odyssey, there is an AI called HAL.

So with different versions, I think stall 200 is what is used in the spacecraft. In this movie, a bunch of scientists travel to space for mission and the whole space is controlled by a computer actually AI. And the interestingly this AI rates what people tell, what people are speaking based

on lip reading and everything, you know, facial analysis, and it also asked the people, are you confused?

How are you feeling? Those kinds of questions. It is giving emotion to the missions. The movie directors and scientists always think about and write books about robots and giving emotion to the robot as in this case. By the way, this movie was released in 1968. So what is emotion detection or Affective Computing?

So let us say if you we want to develop a system or a device or any system, the purpose is to recognize emotions of the participant that is the humans and interpret. So, first, you have to recognize that there is some emotion going on in the face and interpret what is that emotion and why it happened, you know, interpret. Then you have to analyze, you know, why it has happened.

And then you have to simulate based on that emotion, you have to speak in the same tone or you have to give feedback. So the artificial intelligence mission - how the agents in the intelligent systems can show the simulated emotions in their face, like smiling or sad face is possible. So how to do that in our learning analytics. So this is called Affective Computing, it is widely used in marketing and also in basically the management side, they try to understand the people's emotion when we are going through multiple problems and try to provide some feedback or counselling.

So it gets huge popularity, in the Affective Computing, after the technical report, in 1995 paper by Professor Rosalind Picard and she also did a wonderful TED talk in I guess, around 2000 or something. Then please check it if you get time, so it is an interesting talk.

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Activity

- How do we express emotions? List 2 or 3 methods
- How can we detect emotions.

So let us think about it. How do we express emotions you know how humans express emotions? Think about it and write down 2 or 3 ways we express the emotions. If you can list down those ways, then you can say how do you detect emotions when you are speaking with someone? Imagine you are speaking with another person and that person is expressing his emotion then how you can detect that. So what are the modalities? What is the data you can collect to detect the motion? Think about it and that is the idea. Write down the answers and resume to continue.

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So you might have thought about facial expressions, speech i.e. the tone changes, or posture or gestures. The emotions actually are indicated by the posture (a lot the hand movements). Facial expression is the key and other things are also important.

Also, you can use physiological monitoring systems like EEG, EMG or GSR. If you are asking the students to write something in the laptop or a computer you know the environment they are typing based on the typing speed or the words they use, the mistakes they make s and the way they form sentences also can tell what is the emotions.

And that is all the channels you can collect data. Imagine you are in a classroom as a student is talking based on the noise they make, the utterances, can you say they are bored? Or are they excited? Are they happy? All these things can be detected. So, you can collect all this data from different modalities.

Here, the modality of expressing emotion is not just a face but different modalities. If you collect all this data and analyze to predict students emotion, that is called multimodal analysis. For

example, you can use the facial expressions, then gesture posture, and also the eye movements or the voice to combine it to create the model to detect the emotions, then it is called multimodal analytics.

So the modality of expression is different. That is why it is called multimodal. It is interesting field and multimodal is gaining popularity. The problem is each sensor to detect these modalities like facial expressions, the sample data is different. You might have a webcam which is 25 frames per second, which means you capture the learners face or the humans face 25 frames per second that are 25 pictures per second.

Eye tracker might give 90-hertz frequency that is it captures 90 hertz per second. Then how do you combine these? How do you abstract this information? And how do you combine this? That is a challenge. And some works as has been done in this field and people are working on it is kind of a new field. And that is interesting to start with, but how to combine and sync is still an open-ended problem.

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Review Article on Affective Computing

- Affect Detection: An Interdisciplinary Review of Models, Methods, and Their Applications Rafael A. Calvo, and Sidney D'Mello, 2010
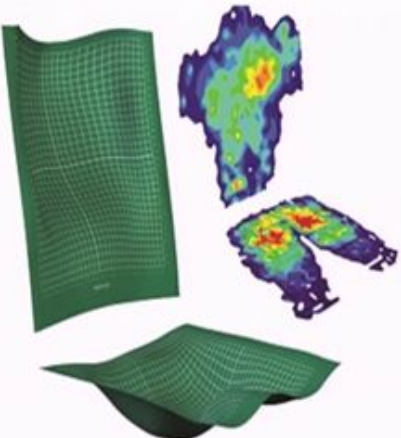
So, I would recommend you check this article, interdisciplinary review of models methods and their applications by Professor Calvo and Sydney D'Mello and it was published in 2010, it actually reports data direction after detection in multi-channel and they have tables for each modality like a voice only, text-based or facial expression based.

It is a very interesting paper and we did not find any other paper after that the mainly because not much work happened in the field of other modalities other than the facial expressions or human observations. Detecting emotion based on facial expression is focused more compared to other channels of data. Mainly because we cannot take these instruments out of the lab. You cannot use those systems in the real classroom settings.

And recently there are a lot of portable devices are coming which gives us the hope that we can take these devices like EEG, GSR to the classroom and collect data. So I would recommend you guys to check this paper, it is an interesting paper.

So, let us look at a couple of data collections methods, one is body language and posture. So there are pressure-sensitive seats. You can put it on top of a chair and you can sit on it and it measures the pressure points. If the student's posture changes that can be recorded and viewed.
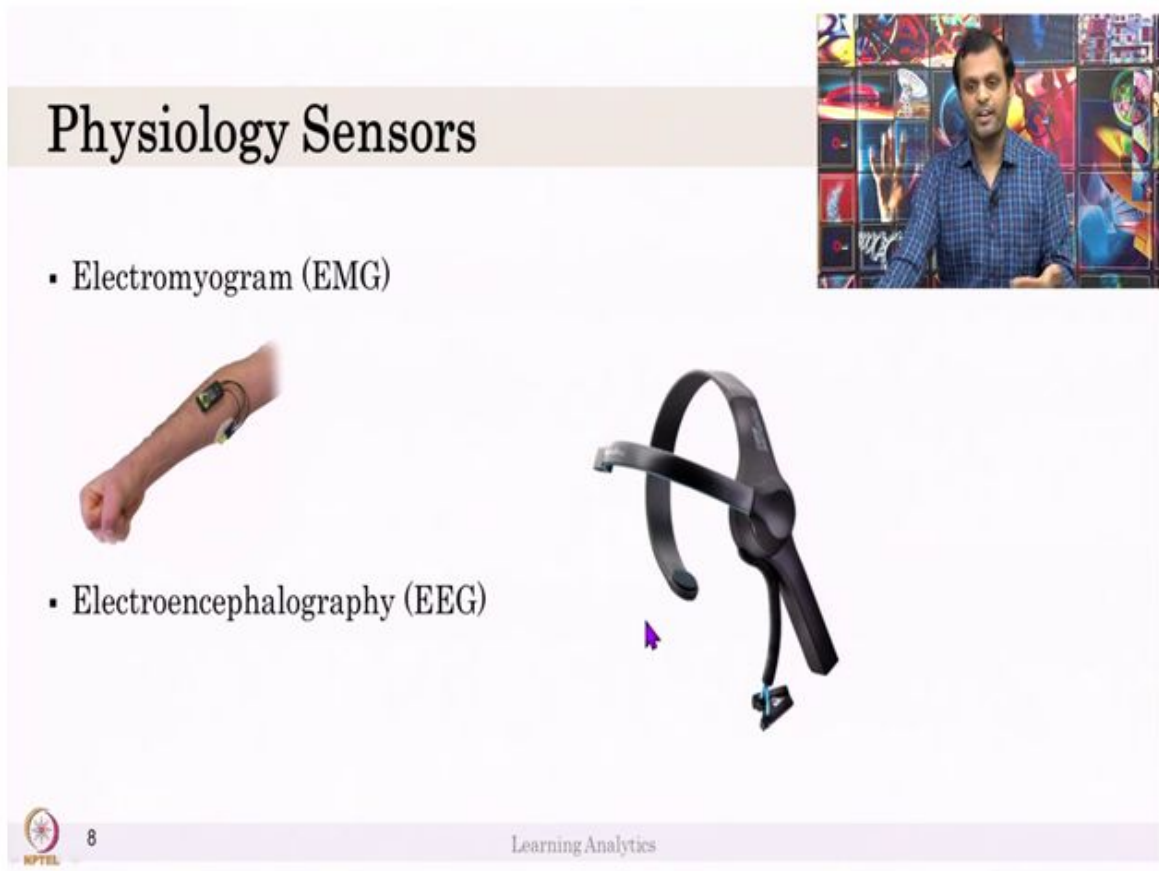
But the problem is, there are not enough studies to prove its performance or improve it or to make it reliable. The machine learning methods using the data collected through the pressure-sensitive seats can detect emotions at 83 per cent accuracy. But the problem is if you try to detect a particular emotion, say frustrated or boredom it is not enough.

So you know 83 per cent accuracy may not be correct. You have seen that or what is important is not just accuracy, it is a Kappa score or recall values. We can say it is good but recall and precision is not really great in these systems. And another thing is you cannot take it to collect 30 students data in the real classroom or real lab, you can do only laboratory collections.

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And there are some others like the electromyogram, which are portable and small. This is promising that you can take it to classes or you can take it to the field where 3 or 4 students are interacting in the lab and they are working on something, you can connect these devices and collect data. Also, we use EEG devices, this is a bit old Nowadays, we have the 4 channel or 8 channel, multiple channels eeg devices.

There is a lot of research going on this field and it is not really costly, the device is also getting cheaper. It used to be really huge and costly but now portable things are coming. So now it is easy to collect this data so going forward, we might collect more data using these kinds physiological sensors.

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Physiology Sensors — Electrodermal Activity (EDA)

Also EDA and in fact, most of the smartwatches or myoband. You may have seen myoband which collects a lot of data about acceleration, rotation, everything can be collected based on that. We can even detect the student's posture, what are they thinking? What are they doing? All this data can be collected, then we can automatically detect students affective states. So these are some sample sensors I just want to show.

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And the key part is, as I mentioned, facial expression analysis, we will look into it in detail in the next video, but let us start the introduction. In facial affect analysis, we want to observe the learners face and detect and classify the emotion (fear or surprise or sadness).

Professor Paul Ekman actually did cross-cultural research in you know, in the Papua New Guinea Island, where the "Aboriginal peoples" i.e. the people who are not really in the modern world, they are still living in an old-world culture, old tradition.

So he went to the Papua New Guinea Island and he collected the people's face, and he did a lot of studies, then he reported that based on the emotions, from the facial expressions, we can detect emotions, the six emotions, the basic emotions, he reported is anger, disgust, fear, happiness, sadness, and surprise. This is 1960 and he did a lot of studies after that. The database is available that reports how to detect the emotions.

Paul Ekman's facial analysis coding system has become very famous. And what Paul Ekman suggests these emotions, these facial expressions are, you know, generalizable, and it is not that the emotion by Indian continent people will be different from the other country people. People usually think that Asian people show fewer emotions, or they do not show emotion, something like that.

I am not talking about South Asian people. So Paul Ekman says it is not true. Although, it is true that if I am observing the Indian participants, I would be able to observe better than participant from non-Indian like like from America or from Europe. So I may not be able to detect emotions correctly. So that is kind of established, but the emotional expression is kind of generic there have been a lot of studies conducted and it is proved that.

So, do not worry that these reports are for the other countries or not for India. No, that is not true, it is possible that these kinds of rubrics can detect emotions in Indian students also.

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So it is an interesting question now, why do you think we have to think about Affective Computing in learning analytics? So as I was telling that learning analytics we also have to collect data about Affective states. Why do you think we have to do that? Write down, list down 2 or 3 answers, please pause this video after writing it down please resume to continue.

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Activity – Response

- Why this topic in Learning Analytics?
  - Understanding Learning without emotions!
  - Emotions are related to moods and other parameters (motivation, attitude, interest) but not equal.

- Interaction between Affective States and Actions in computer learning environment
  - Affective states: anger, anxiety, *boredom, confusion, curiosity,* disgust, fear, *frustration, flow/engagement,* happiness, sadness, and surprise.
  - Method: Student Self reporting

Learning Analytics

So you might have got many answers, the main reason is can we understand students learning without emotion? Is it even possible? It is a question. Are the student learning or is she bored? Is she confused? When she got confused? So without that, it is not possible. If you are a teacher you would say no. We use it when teaching in a real classroom. You know the traditional classroom uses face to face method, you will be observing the student's facial expressions when you are teaching based on the student's facial expressions, you might ask them what is the problem or conduct a short quiz and then explain in more detail to clarify the doubts.

Suppose you see most of the students are bored or not focused, you might ask them to stand out get energy or something like that, right? So, that is important, without emotions, we cannot understand what is happening. So, Affective Computing is important for learning analytics and emotions related to moods and other parameters like motivations attitude interest, but they are not actually equal you know, they are not equal to attitude or interest.

But emotion parameter can impact motivation, attitude or interest towards the subject. So, understanding emotion is more important to know to keep the student motivated to keep the students interest high so that they can spend more time on learning content. So, the interaction between affective states and actions in the computer learning environment. In order to study the affective states in a computer-based learning environment, we cannot use the 6 basic emotions we saw that.

So, there has been a paper a couple of papers, we will see them in the next slide. And they try to understand what is the interaction between affective states what is the interaction between boredom, confusion and frustration. And here we cannot use the basic emotions only. So we have to use learner-centric emotions, like boredom, frustration, confusion, and disgust or surprise, delight, those kinds of emotion has to be considered, these are called learner-centric emotions.

So in this particular paper, they use the method of self-reporting, we will discuss that in detail.

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So in this slide, we saw what is Affective Computing and what are learner-centric emotions, why it is important to consider Affective Computing in learning analytics. Thank you.