



Maestría en Ingeniería en Automatización de Procesos Industriales

**Control of DC motors by Electroencephalographic (EEG)
signals generated from facial expressions**

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1. Introduction

This work shows the study of electroencephalographic (EEG) signals, which are generated from a series of facial expressions such as: smiling, furrow brow, smirk right and smirk left. The signals are obtained from a group of people by means of the device "Emotiv Epoc", which are analyzed and characterized, identifying the electrodes that detect greater neuroelectric activity for each of the facial expressions of the users.[1]

In recent years, technology has become an essential tool in the life of human beings, focusing on combating social problems to help people with disabilities. With the help of devices with sensors, capable of recording the electroencephalographic (EEG) signals, they facilitate the study, use and application of these signals to be used as control of a device without having to use any other part of the body. [2],[3]



Figure 1. Headset Emotiv Epoc.[4]

2. Objectives

2.1. General objective

To control of DC motors from facial expressions taken from electroencephalographic (EEG) signals with the Emotiv Epoc device.

2.2. Specific objectives

- To record and to analyze the electroencephalographic signals produced by facial expressions in different people.
- To program a brain computer interface (BCI) to control DC motors by means of facial expressions.

3. Methodology

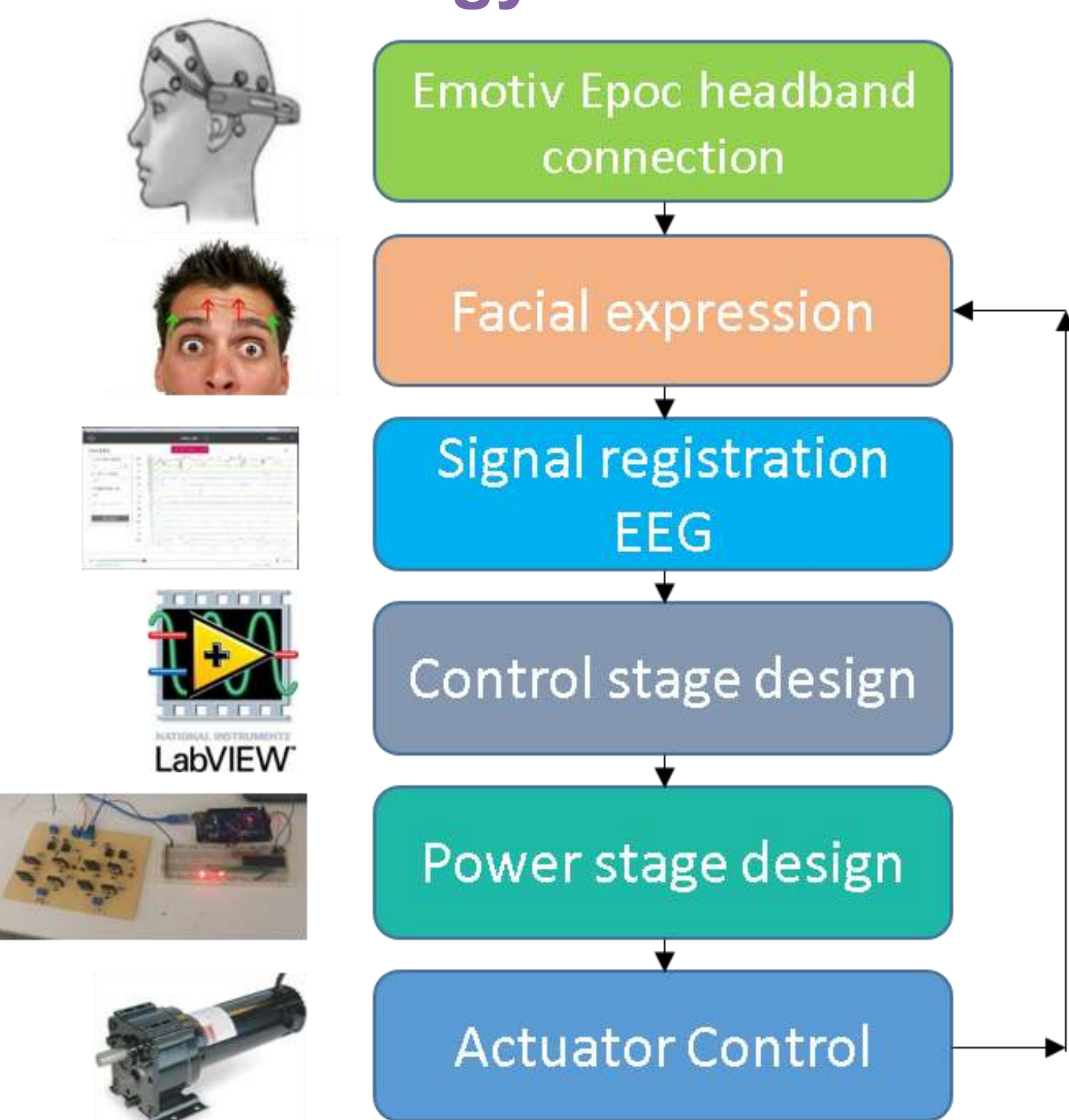


Figure 2. Methodology used in this research.

The test was performed in 19 facial expressions of which 4 were taken:

- Smile.
- Furrow brow.
- Smirk right.
- Smirk left.

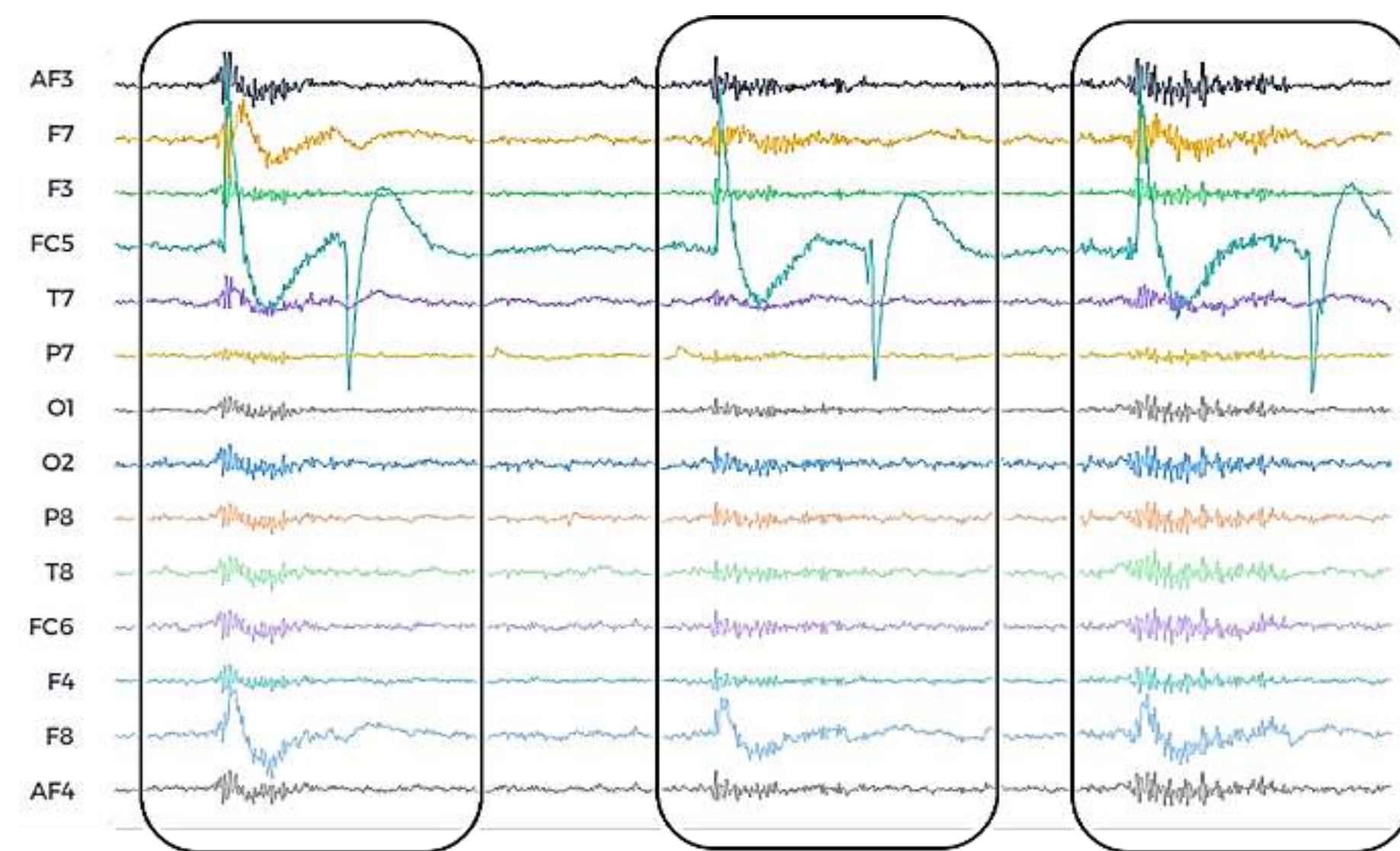


Figure 3. Activity of the electroencephalographic signal of the action Smirk left.

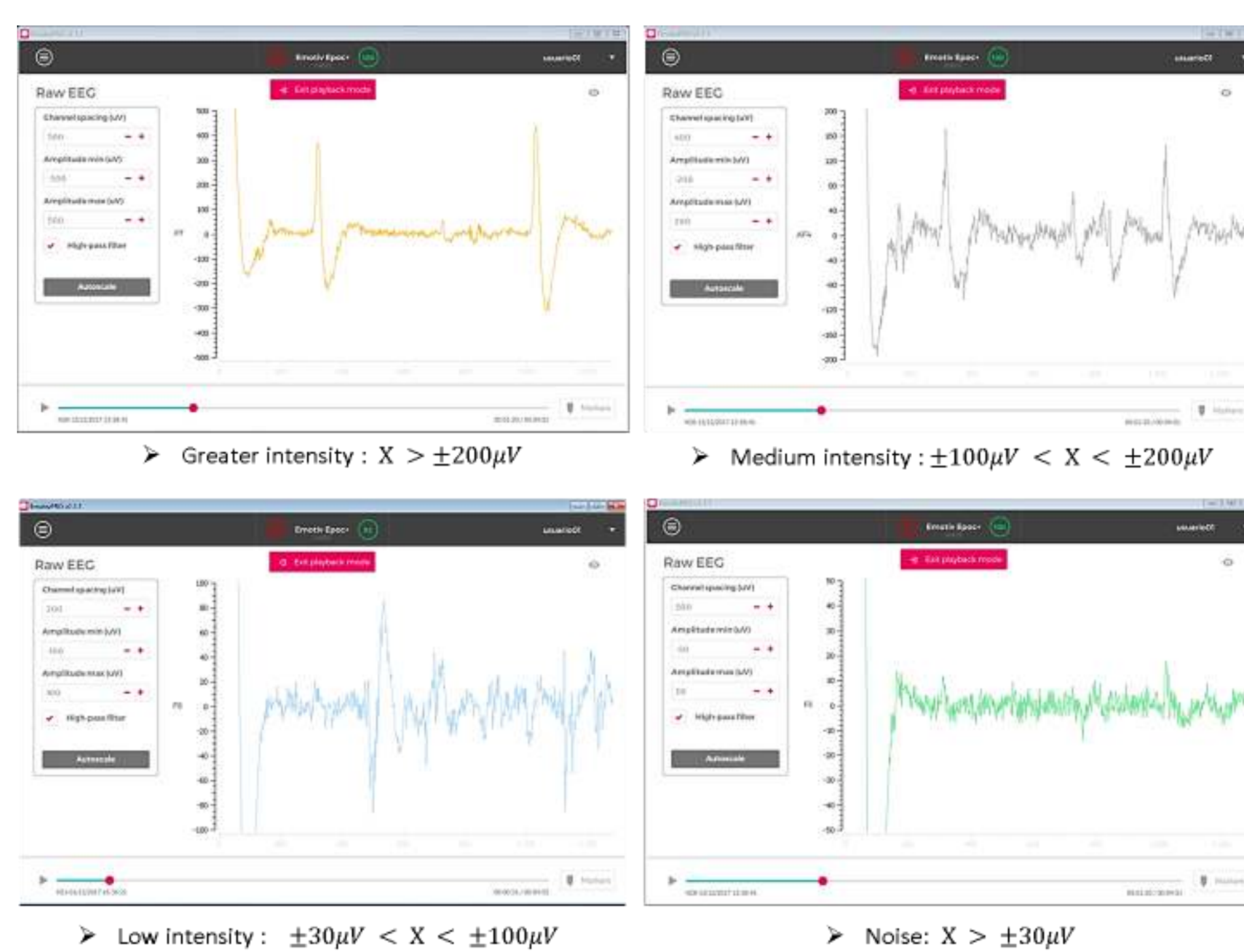


Figure 4. Classification of electroencephalogram signals by µV.

recorded:28	timestamp:12	sampling:12	subject:02	label:COU	chan:40	samples:377	units:emtiv
01-H23	4277,94873	4266,15381	4281,02539	4258,46143	4240,5127	4233,84619	4247,69238
02-H28	4264,61823	4294,58889	4283,07666	4257,43604	4255,64111	4230,76904	4244,10254
03-H23	4271,28174	4295,89746	4277,43604	4257,43604	4251,79492	4232,30762	4245,64111
04-H45	4262,05127	4306,15381	4272,30762	4262,05127	4249,74855	4231,28174	4237,48604
05-H22	4263,07666	4312,30762	4265,23047	4260,5127	4246,6665	4230,76904	4231,28174
06-H27	4252,82031	4298,46143	4264,10254	4253,84619	4251,28174	4232,82031	4237,48604
07-H22	4243,28984	4293,33031	4264,10254	4254,35889	4258,46143	4233,84619	4244,10254
08-H24	4254,87158	4296,42016	4273,84619	4262,05127	4254,87158	4233,84619	4247,1792
09-M24	4251,53857	4295,38428	4276,92285	4263,07666	4242,56396	4233,33031	4250,25635
10-H25	4268,97412	4294,87158	4270,76904	4256,92285	4241,83857	4234,35889	4252,82031
11-H38	4262,05127	4296,92285	4271,79492	4256,41016	4253,33031	4235,38428	4251,28174
12-H19	4264,10254	4295,89746	4272,82031	4259,4873	4254,87158	4234,35889	4247,69238
13-H19	4261,53857	4294,58889	4267,69238	4259,4873	4246,6665	4232,82031	4248,20508
14-H19	4262,56396	4290,76904	4266,15381	4257,43604	4251,28174	4232,82031	4248,20508
15-H19	4256,92285	4280,5127	4266,15381	4255,38428	4251,02539	4233,33031	4246,15381
16-H19	4248,71777	4267,1792	4264,61523	4253,84619	4251,28174	4232,30762	4244,61523
17-H19	4249,74855	4263,07666	4264,61523	4251,79492	4239,4873	4230,76904	4249,23047
18-H18	4250,76904	4265,64111	4255,12793	4252,38762	4244,61523	4232,82031	4257,48604
19-H20	4245,12793	4260,5127	4261,53857	4252,82031	4252,82031	4235,89746	4262,56396
20-H25	4243,07666	4254,87158	4262,05127	4249,74855	4248,71777	4234,35889	4258,46143
18-M19	4246,15381	4261,53857	4265,12793	4249,74855	4243,07666	4231,28174	4250,25635
19-H20	4247,1792	4269,74855	4265,64111	4256,41016	4248,71777	4231,79492	4249,23047
24	4246,15381	4266,6665	4265,12793	4254,87158	4250,25635	4235,38428	4250,76904
25	4245,12793	4262,05127	4263,07666	4248,20508	4250,25635	4234,87158	4247,1792

Figure 5. Database obtained from the Emotiv Epoc.

4. Results

Experimental results obtained from the EEG of the facial expressions performed.

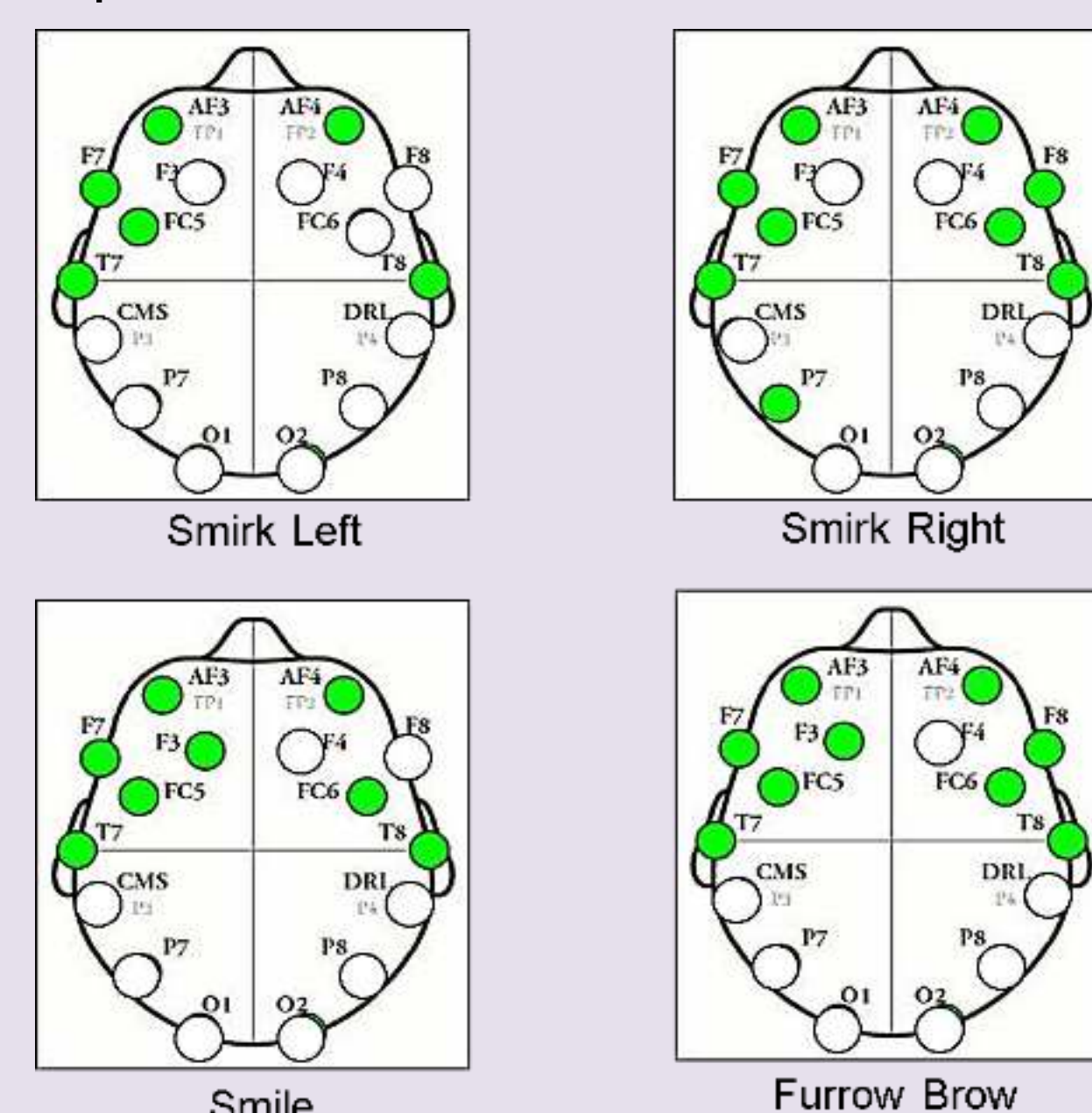


Figure 6. Activating electrodes for facial expressions

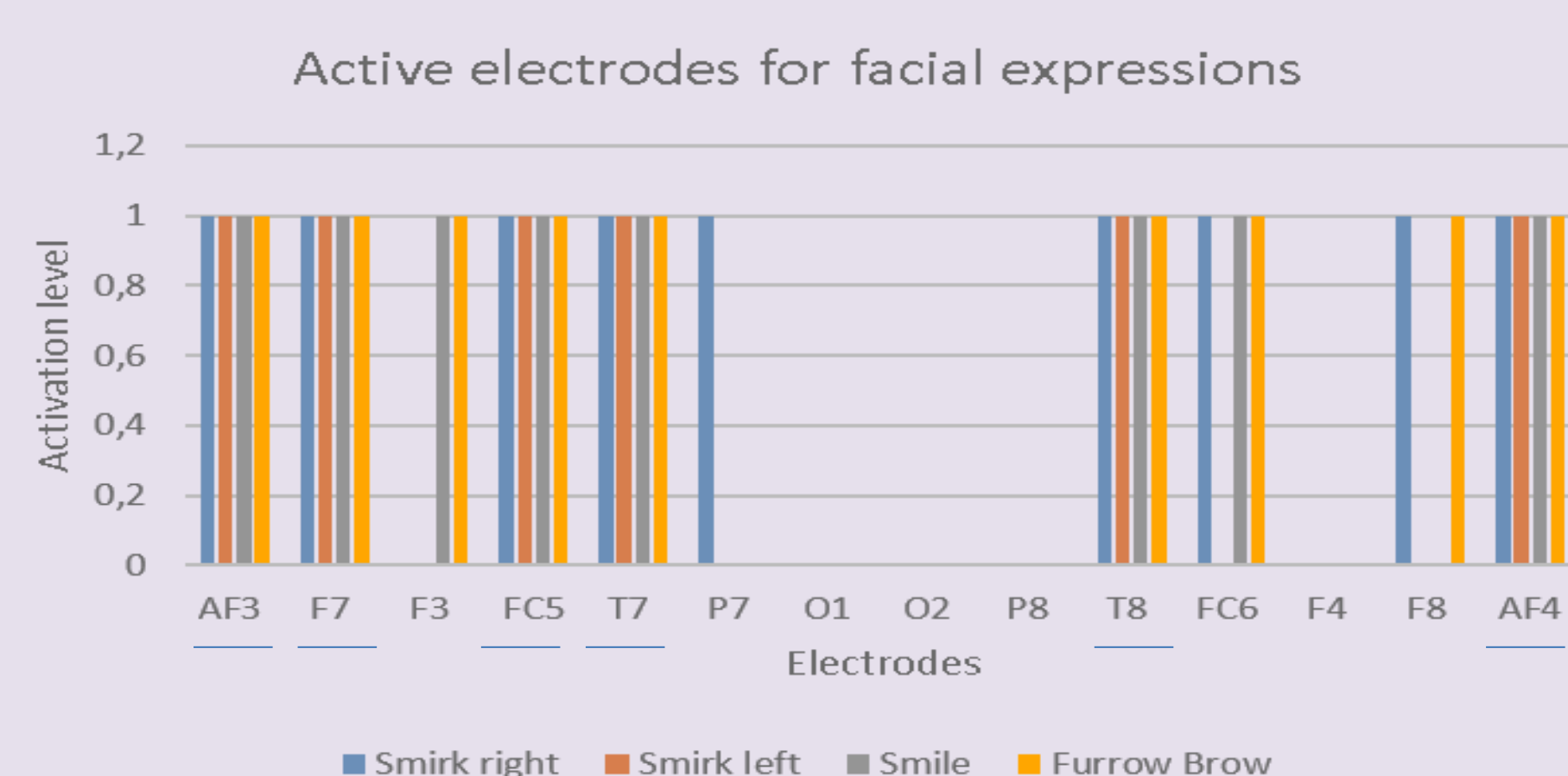


Figure 7. Common activation electrodes between facial expressions.



Figure 8. Interface Labview-Emotiv Epoc.

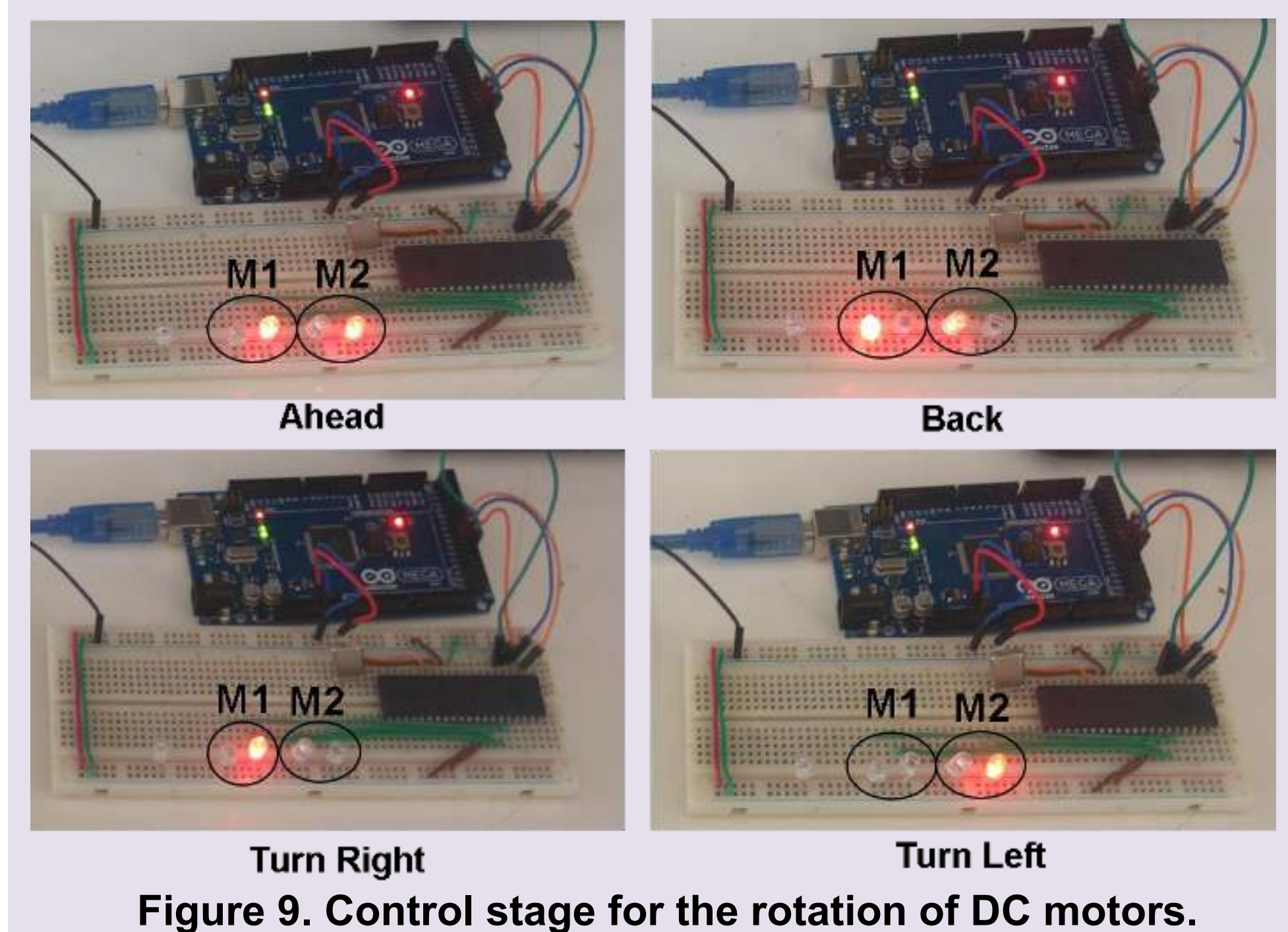


Figure 9. Control stage for the rotation of DC motors.

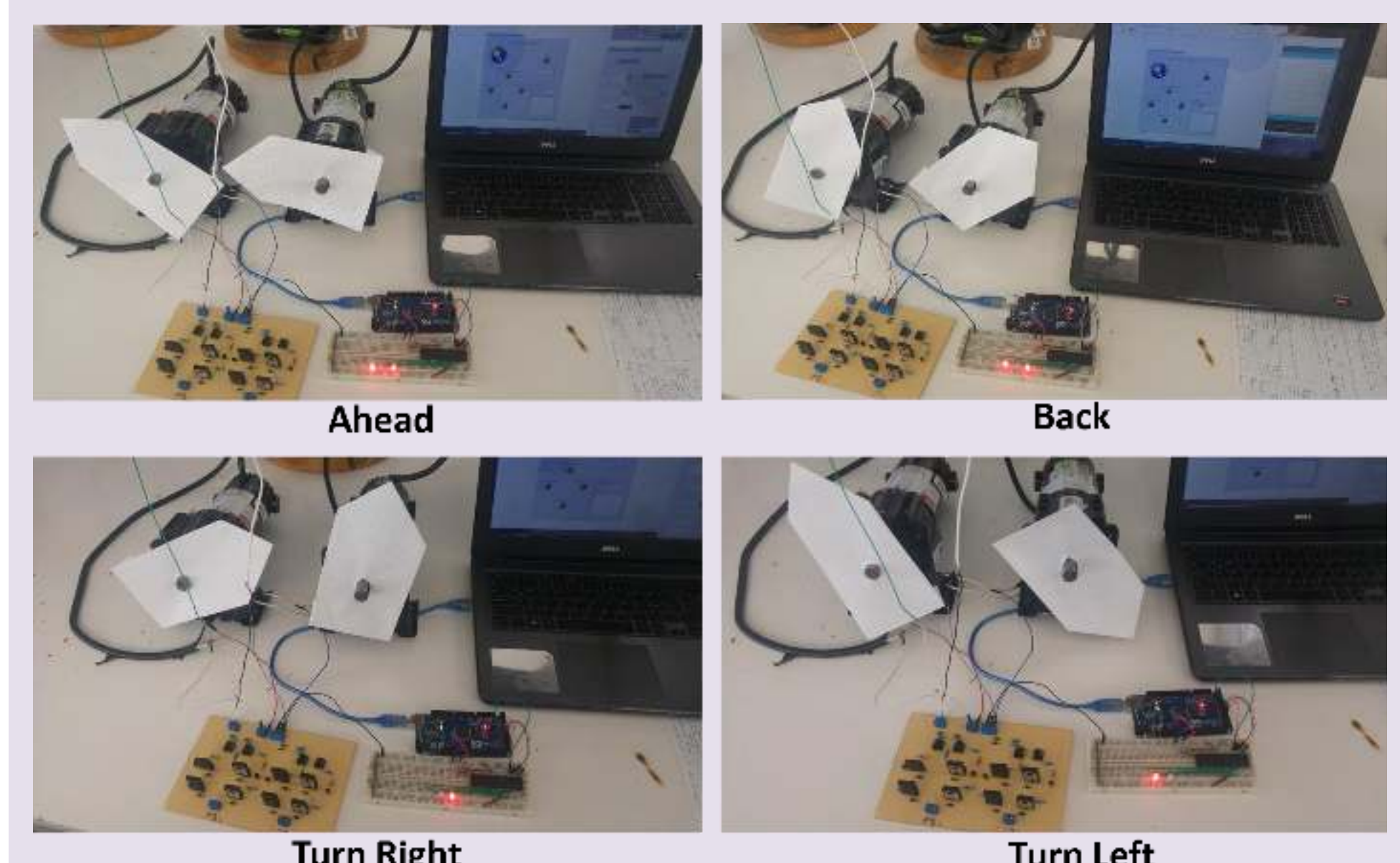


Figure 10. Control of rotation of DC motors by means of facial expressions.

5. Conclusion

According to the preliminary results, it is concluded that the proposed analysis determines and establishes a set of characteristics based on the electroencephalogram and the raw data provided by the Emotiv Epoc headset, which can be define the control signals for each facial expression. Having the signals characterized, these can be converted into a control signal, which they can be implemented in the rotation control for the DC motors.

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