EE214 ELECTRONIC CIRCUITS LABORATORY
TERM PROJECT
NOTE CONTROLLED VEHICLE
(AKA PIED PIPER OF HAMELIN)

1. INTRODUCTION

"Once upon a time, there was a town called Hamelin. One day rats invaded the Hamelin. The rat were in everywhere and they consumed all the food. People did not know what to do and the village started to be known as the village with rat. After a while, a man came to the Hamelin and said: 'If you give me a bag of gold, I will save the village from the rats.' The villagers were so desperate that they immediately collected the gold and gave it to the village headman. The man took his pipe and played such a beautiful melody that all the rats followed him. He arrived at a river near the village. The piper crossed the river, but the rats choked in the water. Thus, the village got rid of the rats …" (Quoted from "Browning, Robert. *The pied piper of Hamelin*. Pioneer Drama Service, Inc., 1927".)

As the pied piper does in the story, you will control a vehicle with a pipe. We call it note controlled vehicle, but in general these types of vehicles are called remote controlled vehicles.

Remote controlled vehicles, such as cars, ships, helicopters or quadcopters, have been very common not only among kids but also among adults or hobbyists. There are very different remote controlled vehicles that appeal to different expectations, and such a variety also exist for the structure of vehicles and the communication between the controller and the vehicle.

Figure 1. Different remote controlled vehicles

These devices can be investigated under two main parts: controller and vehicle. Controller takes the input from the user for the direction and the speed of the movement, generates a control signal accordingly and transmits the control signal to the vehicle. On the other side, there is a receiver on the vehicle that receives and interprets the control signal transmitted by the controller and an actuating mechanism that control the motors on the vehicle.

2. PROJECT DESCRIPTION

In this project, you are supposed to make a very simple remote controlled vehicle on the ground by connecting two motors and wheels to the sides of the breadboard. The control signals are going to be the flute notes. In other words, commands like move forward, turn left or etc. will be given by playing the flute.

For example, if one plays ‘doh note (C)’, the vehicle should move forward, or if one plays ‘si note (B)’, the vehicle should turn right. Furthermore, there must be no action, if there is no flute sound.

The notes of the flute have different frequencies, and you are supposed to distinguish the notes by their frequencies not by their amplitudes.

2.1 Remote Control

Your remote controller will be a block flute. If one plays ‘C’, ‘F’ or ‘B’, the vehicle must move forward, turn left or turn right, respectively. The approximate frequencies of the notes are given in Table 1. You can benefit from this table while designing your receiver.

Table 1. Frequencies of the block flute notes

Notes	C	D	E	F	G	A	B	C (next octave)
Frequency (Hz)	523,25	587,33	659,26	698,46	783,99	880	987,77	1046,5

2.2 Vehicle

You are required to construct a simple vehicle by connecting two motors and wheels to the sides of a breadboard as shown in Figure 2, the vehicle should consist of two main parts: the receiver and the control unit.

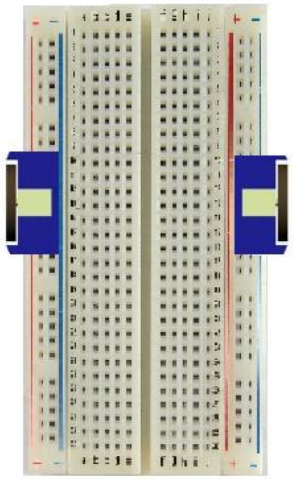

Figure 2. The constructed vehicle

2.2.1 Receiver

The receiver must receive the sound signal that comes from the flute and should turn this signal into an electrical signal by using a transducer called microphone.

2.2.2 Control Unit

The control unit should decide and perform the action to be taken. It contains decision and function subunits. The decision subunit distinguishes the notes by their frequencies and informs the function subunit accordingly. The function subunit, then, actuates the motors and provides proper motor drives.

The function subunit actuates the motors according to the differential drive technique. Differential drive is based on two separately driven wheels by DC motors and an optional free turning wheel for the balance of the vehicle. The differential drive system is illustrated in Figure 3. Blue arrows in the figure represents the individual movement of motors controlling the active wheels whereas the red arrow indicates the movement of the vehicle. As you can observe, if the motor controlling the right wheel moves in forward direction faster than the motor controlling the left wheel, the vehicle is supposed to turn to left or vice versa.

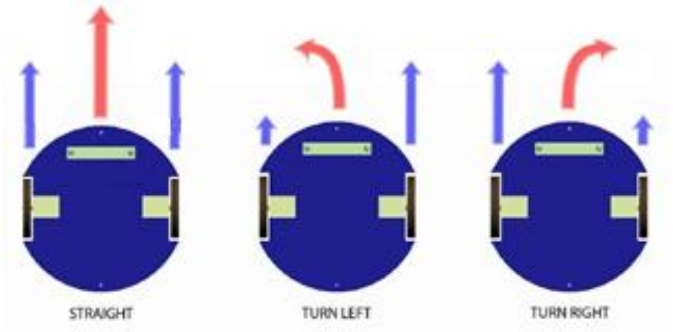

Figure 3. Differential Drive [image taken from https://www.robotix.in/tutorial/mechanical/drivemechtut/]

3 RULES AND REGULATIONS

3.1 Allowed Components

You are allowed to use +/-25 V output of DC power supply and you may use any types of resistors, capacitors, inductors, diodes, LEDs, LDRs, op-amps, transistors, transducers and DC motors.

3.2 Design Specifications

Further details about the project will be announced, in case of necessity.

3.3 Bonus

Will be announced later.

3.4 Groups

The project will be carried out in groups of two students. The students in the same group should be in the same laboratory session.

3.5 Important Dates

- April 6 : Project Announcement
- May 5 : Submission of the pre-report. (till 17:00)
- May 8-12 : First Project Session
- May 15-19 : Second Project Session
- May 22-26 : Third Project Session and Fundamental Knowledge Examination
- May 26 : Submission of demo-videos (until 23:59)
- May 27-28 : Demonstrations
- June 1 : Submission of the Final Report (till 17:00)

3.6 Documentation

You **must** submit two reports and a video for the term project.

3.3.1 Reports

As stated earlier, pre-report should include an introduction, pre-design of the project with circuit diagrams and overall circuit schematic, theory, formulations, simulation results and a conclusion.

Final report should also include all the parts in the first report for the overall design. In other words, should explain the overall design with an introduction, a block diagram and circuit schematic, operation of each sub-block with theory, formulations, simulation and experimental results. The filters should be modelled using **MATLAB** and **HPVEE** results should be presented for the filters in the final report. Final report should also include analyses for the cost and power consumption of the project and you should justify the use of each component. Conclusion of the final report is very important since it reflects your understanding of the project and the experiences you gained during the overall process. The objectives, results and the experiences should be clearly presented. This does not necessarily mean a long report, but definitely a well-organized one.

Late submissions for both reports will lower your report grades as:

- %20 off for one-day late submission
- %50 off for two-day late submission
- %90 off for three-day late submission
- Zero credit for more than three-day late submission.

You are referred to the report guideline which is available on the course website.

3.3.2 Demonstration Video

You should prepare a 6-8 minute video where partners of each group present the project in a collaborative manner. The video should include the explanation of main blocks, why they are used and how they are designed. This video should be regarded as a formal presentation to the related assistant. Note that you should always appear in the video together with your presentation material.

3.7 GRADING

- First Report : %10
- Final Report : %15
- Presentation Video : %10
- Design and Performance : %65 (partial credits are possible)
- Bonus : up to %30

3.8 REGULATIONS

- Attending the project demonstration is a must for both team members, otherwise, you will fail the course.
- Fundamental knowledge of the students will be tested at the third project session. However, the students, who will not be able to attend to the third project session with a valid excuse, may be tested at the first or second project session with permission of their assistants.
- Students get zeros credit from the project, if they cannot exceed the pre-score of the design test.
- Cheating is strongly forbidden and any indication of cheating will cause you to get zero credit from the project. You can collaborate with your friends by exchanging ideas, not copying the design details or the reports. Using the design of another group with slightly modified component values will also be regarded as cheating.
- Both members of the group are responsible for every single detail of their circuit.