Task-6: Analog-to-Digital conversion and reading sensor data

Experiment-1: Getting Familiar with ADC

The aim of this experiment is to get you familiar with ADC in Atmega 2560 based Firebird V robotic kit. In this experiment, you have to write a program to convert the analog values of the front sharp sensor into digital values.

The port pins of Port F and Port K act as ADC input channels and they are connected to different sensors of Firebird V. The front sharp IR range sensor is connected to ADC channel number 11 as listed below.

µcontroller Pin number	**Pin name**	**Channel number**	**Description**
86	PK3	ADC11	ADC input for Front Sharp IR range sensor

Note: Refer to ADC tutorial uploaded on the portal.

Your task is to write a code to display the position of the obstacle by using front sharp IR range sensor on LCD. You would have to convert the analog value of the front sharp IR range sensor into digital value and as per the digital value you have to display the following on LCD:

When obstacle is between 10cm to 20cm, it should display "**Obstacle is Near**" on LCD.
When obstacle is between 20cm to 50cm, it should display "**Obstacle is far** "on LCD.
When obstacle is between 50cm to 80cm, it should display "**Obstacle is Very far**" on LCD.

Please refer Figure 1 for more details.

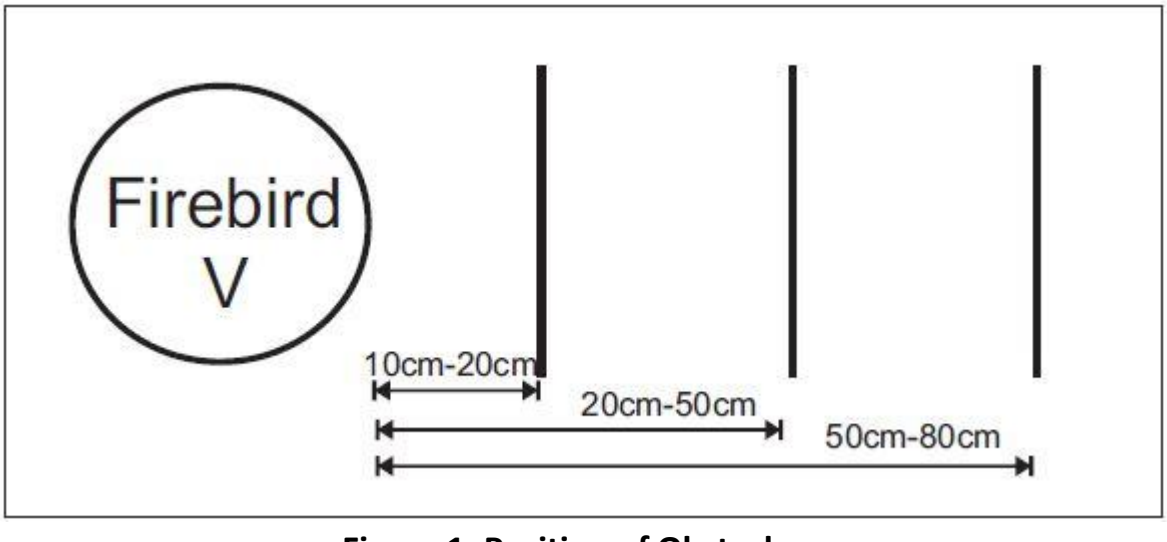

Figure 1: Position of Obstacle

To achieve this, function for ADC conversion have to be written in Experiment-1:

1. **ADC_Conversion_sharp_sensor–** Function to convert the analog value of front Sharp sensor to 8-bit digital value.
2. Refer to the tutorials (video and written) uploaded on the portal for assistance in writing this function.
3. You can use Sharp_GP2D12_estimation function which gives output distance in millimeters (mm) taking digital value of sharp sensor as input.

LCD Display format:

LCD should look like:

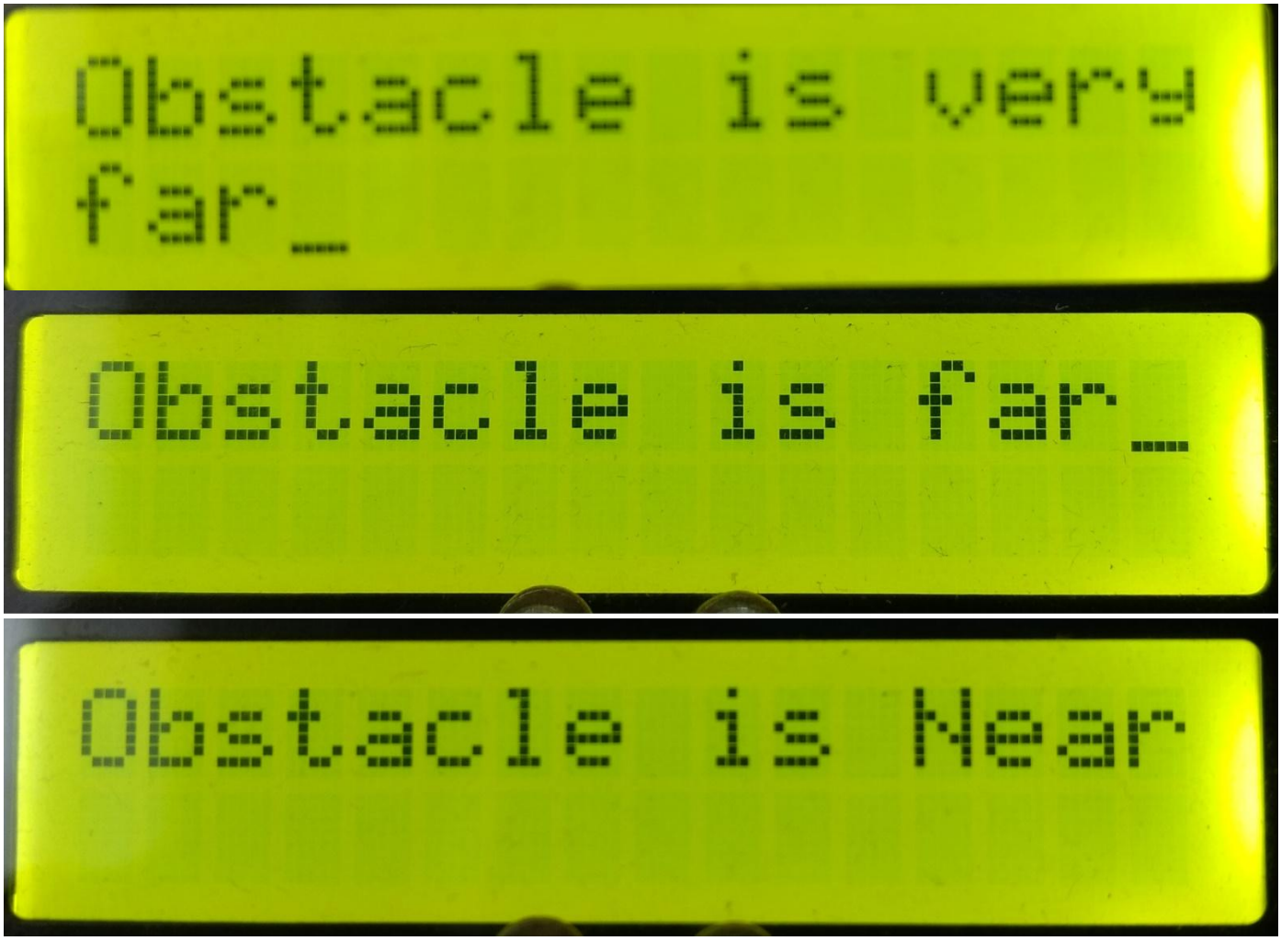

Figure 2: LCD Display format

Procedure:

Step-1: Open Experiment-1folder. Open the given project named “Experiment1.aps”in AVR Studio.

Step-2: You will notice some pre-written function declarations included for your assistance. Write program code to complete the functions with the help of function description and inline comments.

Step-3: Check and debug your code on the robot. Ensure that code performs as expected.

Step-4: Save the project and create a .zip file.

Step-5: Upload the.zip file of your saved project on the portal for evaluation

Note: We request you to strictly adhere to the code layout as given in the project C file and avoid deleting any function.
Click on the following link to see the example output of this experiment:
https://youtu.be/TN-Te2rKH34

Note:
You have to define one new function to read front sharp sensor values only

1) ADC_Conversion_sharp_sensor

You should not use the ADC conversion function given in the sample experiments. Using the ADC conversion function from the sample experiments as it is, will attract a penalty of **3 marks**.

Grading:

Maximum marks for this experiment are **10**, divided among the following tasks.

- Initialization of the ports and ADC as specified in the inline comments (**3marks**)
- ADC conversion function for the front sharp IR range sensor (**4 marks**).
- Position of Obstacle displayed on the LCD as per the specified format (**3 marks**).

Experiment-2: White line following

The aim of this experiment is to get you familiar with the three white line sensors and implement white line following using Firebird V.

In this experiment, you have to write a program to make the robot follow a white line and stop when an obstacle is detected on its path.

You have to use the white line strip provided in the accessory box. The obstacle can be the accessory box itself placed 30 cm away from the end of the white line strip as shown in Figure 4. The robot has to stop approximately 10cm before the obstacle, thus avoiding any collision/contact.

You can use the front sharp sensor to detect the presence of the obstacle (accessory box). The front sharp IR range sensor and the three white line sensors are connected to ADC channel numbers as listed below.

µcontroller Pin number	Pin name	Channel number	Description
96	PF1	ADC1	ADC input for White Line sensor 3(Right)
95	PF2	ADC2	ADC input for White Line sensor 2(Centre)
94	PF3	ADC3	ADC input for White Line sensor 1(Left)
86	PK3	ADC11	ADC input for Front Sharp IR range sensor

Figure 3: ADC channel Numbers

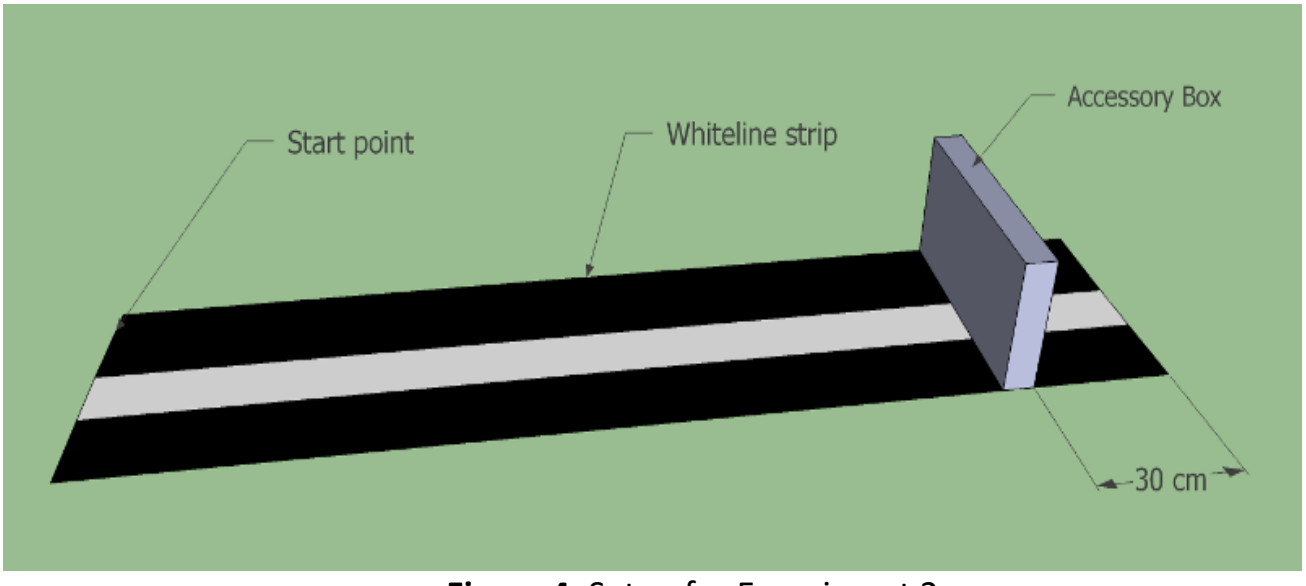

Figure 4: Setup for Experiment 2

Procedure:

Step-1: Open Experiment-2 folder. Open the given project named “Experiment2.aps” in AVR Studio.

Step-2: You will notice some pre-written function declarations included for your assistance. Write program code to complete the functions with the help of function description and inline comments.

You will have to write another function similar to the ADC conversion function implemented in Experiment 1 for converting white line sensor values to digital.
For white line following algorithm, you can refer to the tutorial uploaded on the portal and the reference code (included in the Task-6 folder).

Step-3: You will have to include motor direction control functions like forward, stop, left right etc. based on your white line following logic.

Step-4: Check and debug your code on the robot. Ensure that code performs as expected.

Step-5: Save the project and create a .zip file.

Step-6: Shoot a demonstration video of your robot performing this experiment and upload it on Youtube. Paste the link of your uploaded video in "**link1.txt**" file included in the **Task-6** Folder.

Step-7: Upload the .zip file of your saved project (folder includes the "link1.txt" file) on the portal for evaluation.

Note:

We request you to strictly adhere to the code layout as given in the project C file. You can declare and define new variables, add a new function if required.
You can refer to the "White_line_following_reference_code.c" for white line following.

You can print the three white line sensor and front sharp sensor values on the LCD for better debugging.

There is no need of using Sharp_GP2D12_estimation function for this experiment.

Click on the following link to see the example output of this experiment:
https://youtu.be/qBW-zZlbQB4

Grading:

Maximum marks for this experiment are **10**, divided among the following tasks.

- Initialization of the ports and ADC as specified in the inline comments (**2 marks**)
- ADC conversion functions for the three white line sensors and the front sharp IR range sensor (**2 marks**).
- White line following i.e. robot follows the white line **(4marks)**
- Robot stops avoiding collision with the obstacle **(2marks)**