EE 337: Microprocessors Laboratory (Spring 2021)
Indian Institute of Technology Bombay

Project: 20 points Date: March 8, 2021

Autorickshaw Fare Simulator on Pt-51

1. [20 points] In this project, you will be writing a program to simulate the calculation of autorickshaw fare. The trip events will be indicated using the four switches on the Pt-51 board.

   - The autorickshaw fare calculation rules in Mumbai with effect from March 1st, 2021 are as follows:
     - The minimum fare is Rs 21 for upto 1.5 km distance.
     - After the first 1.5 km, the far is Rs 14.20 per km.
     - The waiting charge is Rs 1.42 per minute.
     - All paise values of 49 paise or less are ignored. Paise values from 50 to 99 are rounded up to the next rupee. For example, if the fare at some point is calculated to be Rs 12.30, then the LCD will display only Rs 12. If the fare is calculated to be 12.50, it is rounded up to Rs 13.
   - To enable faster simulation, assume that the waiting charge is Rs 1.42 every 5 seconds.
   - When the program starts, the LCD displays the message `Mumbai Auto` on the first line and `For Hire` on the second line.
   - The four switches connected to port pins `P1.3-P1.0` on the Pt-51 will be used to simulate autorickshaw driver behavior.
     - All the port pins are initially set to the Off position.
     - `P1.0` will be used to indicate the start and stop of the trip.
       * `P1.0` is set to On to start the trip and then set to Off to stop the trip.
       * When the trip starts, the `Mumbai Auto` and `For Hire` strings disappear from the LCD. They are replaced by the current fare and the state of the autorickshaw as described later in this document.
     - `P1.3` will be used to indicate whether the auto is stationary in waiting mode or not, for example at a traffic light.
       * Irrespective of the positions of the port pins `P1.1` and `P1.2`, port pin `P1.3` being set to On indicates that the auto is in waiting mode.
       * Setting `P1.3` to Off indicates the end of the waiting mode.
       * As mentioned before, a waiting charge Rs 1.42 applies for every 5 seconds of waiting.
       * If the waiting time is not a multiple of 5, then the remainder when the time is divided by 5 can be ignored. For example, a waiting time of 12 seconds will result in a Rs 2.84 waiting charge.
     - When `P1.3` is set to Off, the state of the pins `P1.1` and `P1.2` determines the speed of the autorickshaw as per the following table. Speeds have been inflated to simulate the fare changes quickly. For example, 720 km/h translates to 1 km being travelled in 5 seconds.

`P1.1`	`P1.2`	Speed
0	0	360 km/h
1	0	720 km/h
0	1	1800 km/h
1	1	3600 km/h

- When the trip is ongoing, the first line of the LCD should display the current fare and the second line should display either `Waiting` or the speed, i.e. `360 km/h` or `720 km/h` or `1800 km/h` or `3600 km/h`.
  - The fare amount should be rounded down or rounded up to the nearest rupee depending on whether the paise portion is below or above 49 paise.
  - The fare amount before rounding is given by the following formula where D is the distance travelled in km and T is the total waiting time.

$$\text{Fare} = 21 + 14.2 \times \max(D - 1.5, 0) + 1.42 \times \left\lfloor \frac{T}{5} \right\rfloor .$$

  - The changes in fare (if any) should occur after every second.
  - As the minimum speed is 360 km/h, the minimum increment in D is 0.1 km per second.