BTH545 Assignment 1

The Problem

The new generation of electric vehicles will have sensors and electronics like no vehicles built before. We can take advantage of these capabilities to design new and useful user interfaces for the driver to interact with the vehicle. The vehicle will have an LCD display in front of the steering wheel which will present the following information to the driver:

- speed,
- battery charge (as %, time remaining and distance remaining),
- Gear state (forward or reverse),
- lights (off, driving, low bean, high beam)
- turn indicators,
- odometer and trip odometer.

The car will have standard controls for wipers, turn signals, and lights that are hardwired but you will have access to duplicate controls available through software interfaces.

The display in front of the steering wheel has been designed and you do not have to worry about it nor do you have any ability to change it. There is an additional display in the centre of the dash which will provide all additional information about the vehicle and the controls necessary to change how the vehicle behaves. Your job is to design the user interface for the display in the middle of the dash and make it as useful as possible while allowing it to control all other functions of the vehicle, inform the driver of important events, yet not distract the driver unnecessarily.

The display in the centre of the dash is an LCD colour touch screen of size 25 cm wide and 20 cm high. You can use any windowing system and/or widget set you feel is appropriate for the application.

The vehicle will have the following inputs available to you:

- proximity sensors on the front left and right, rear leaf and right and on each side and the front and back of the vehicle. These will give you approximate distances to objects within 3 meters to the decimeter. The side sensors are placed so that they can do curb detection as well as detecting other vehicles,
- front and rear facing cameras of 1024x768 pixels in colour that are refreshed 24 times per second,
- 4-way D controller on the steering wheel with a centre button. You can detect when these buttons are pressed individually or in combination or the centre button with one of the directional buttons,
- 5 programmable buttons on the steering wheel which have an icon in each button shown on an LCD which you can change at any time. You can detect when these buttons are pressed individually or in any combination,

- One slider control on the steering wheel which will detect a finger pressed on it or dragged across it. It will report either a single value from 0-100 for a click or a range of values from 0-100 for a drag. A range will go from the value where the finger contacted the slider to when the finger was removed and can detect motion left to right or right to left.
- sensors on each door (2-5 doors, depending on model) indicating if the door is open or closed,
- sensors on each door indicating if locked or unlocked,
- gear indicator telling you if you are going forward, reverse, neutral or parked,
- brake state from 0 (not pressed) to 1000 (fully pressed),
- accelerator state from 0 (not pressed) to 1000 (fully pressed),
- speed as a floating point number,
- wheel rotation for each wheel in RPM,
- direction front wheels are pointing in fractional degrees where 0 degrees is straight ahead and direction goes from 0-359.999 where positive is clockwise,
- system clock with real time to millisecond resolution. There is an API for you to set the time as well as get it.
- electric window position from 0 (closed) to 100 (fully open) for each electric window,
- motor RPM for each of up to 4 motors, battery strength in percent, last time battery was charged and percent it was charged. You are also notified when battery charging begins and ends.
- internal and external temperature sensors accurate to 0.1 C,
- heater control from 0 (off) to 10 (full) in 10 increments,
- air conditioner control from 0 (off) to 10 (full) in 10 increments,
- electronic radio with the ability to read/write volume, tuning and band (AM/FM),
- GPS to report current location of the vehicle,
- WiFi that can be used to connect to WiFi in range. The car does not have a cellular data connection,
- Bluetooth which can be connected to multiple Bluetooth devices,
- microphone which can be used to pick up sound in the passenger compartment,
- stereo front and rear speakers,
- light status (off, driving, low beam, high beam), passenger light status (on/off) for left and right front and single rear passenger lights, wiper status (off, slow, fast, interval (1-10 in increments of 1), turn indicator status (off, left, right, 4-way),
- external light sensor from 0(very dark) to 10(very bright) in 1 unit increments,
- ignition status (off, accessory only, on).

You software will be running on an 8-core CPU with a separate graphics chip capable to rendering multiple real-time video streams. There will also be either an Intel Movidius or Nvidia Jetson Xavier chip available for use in applications.

Your Mission

Your have been asked to design and build the best possible user interface for the vehicle. You will do the project in 3 phases.

1. Develop the requirements for the interface by building personas and creating scenarios and use cases. Each of these should be submitted along with a textual list of requirements not captured in the use cases.
2. A design which meets the requirements shown via a prototype that is wire framed and has some basic animation to show navigation. This can be handed in as an XD file or a series of images drawn with other tools where the navigation is clearly shown.
3. A working implementation of the interface running on a PC with simulated inputs from keyboard and mouse, and prerecorded input from other sensors that can be used to drive demonstrations of the various features of the interface. These can also be generated in real time by using a separate control panel on the PC if needed.
   The implementation can be implemented in any tool you with that will provide the required functionality. You will demonstrate the GUI in one of the lab periods and will need a computer on which to run the demonstration.

Grading

Mark	Criteria
90-100	An outstanding piece of work which is well above average and distinguishes itself from the rest of the class.
80-89	Good work that could be turned into a good interface but has room for improvement.
70-79	Good, covers all the bases, but has more room for improvement. The interface could be improved and there might be obvious features not offered.
50-69	Satisfactory, does the basics but not the best interface and probably leaves gaps in functionality.
<50	Not satisfactory. Less user friendly and less complete. Can be difficult to use or lead to errors being easily made.