TEAM 26

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❖ Brief Description about the project idea and its approach:

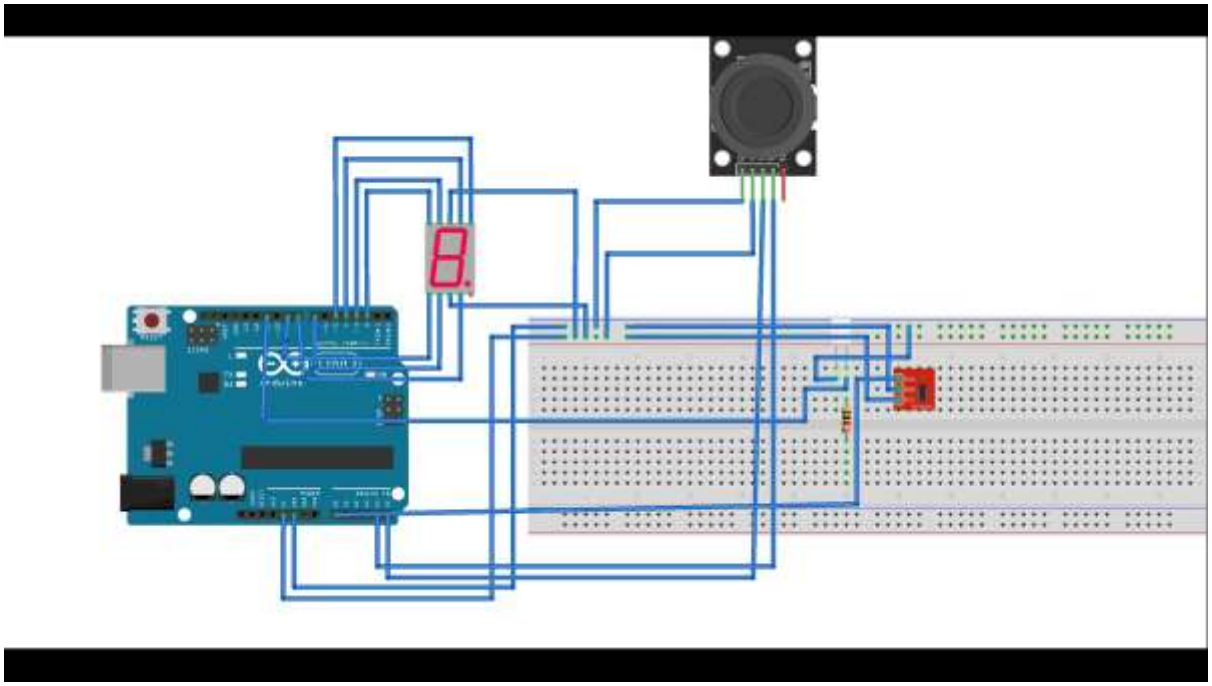
Our project idea is considering some cars' features implemented in the modern world cars such as **lane keep assist** (LKA) which helps the car in order not to drift away from its lane and follow a specific track and in case it drifts away a warning is made to the driver and the car returns back to its normal path and this is done by using sensors which senses the change in color when the car drifts away from the lane and reacts according to it and also the driver is notified using a buzzer. Moreover **control indicator** (CI) is another feature considered in our project where we consider the gear of the car and the changes made to it and this is controlled using a joystick and the changes are displayed on a 7-segment display and the headlights light intensity is also controlled with respect to the surrounding's light intensity for which we use light sensors to indicate the intensity of light in the outside environment and accordingly change the intensity of headlights which is represented by leds . Last but not least, the last feature considered in our project is the **radio system** (RS) where the driver can choose between different channels using a touch screen and also has the ability to turn the radio on or off; the radio is controlled by the driver through a touchscreen which displays the number of channels on it and the option of turning on or off the radio.

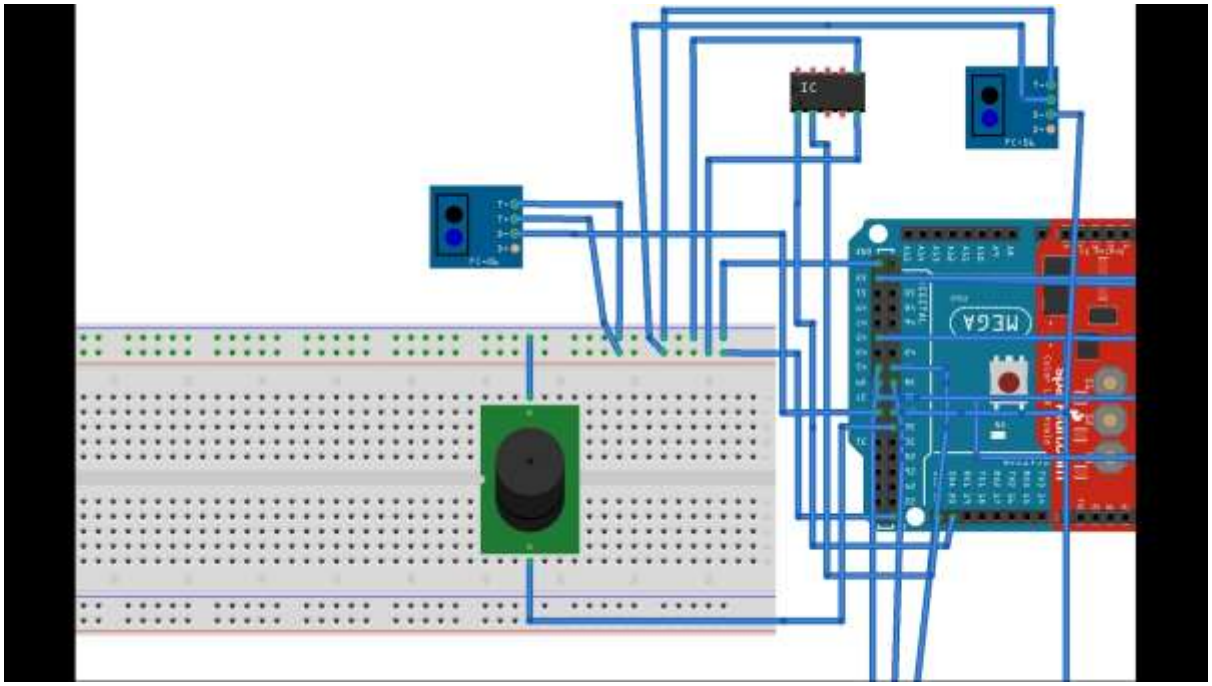
❖ Components used and their functionalities:

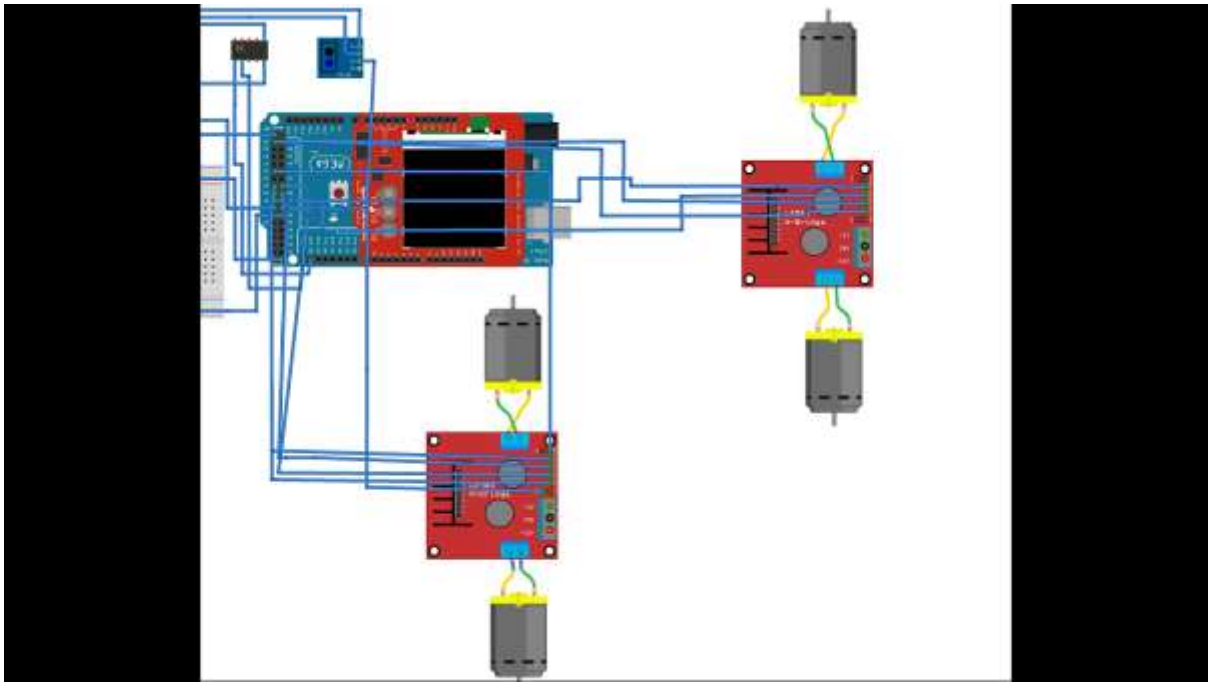
- Arduino Mega
  - ✓ Used to upload on it the code written on computer
  - ✓ Connected to it all the elements needed in the project
- BreadBoard
  - ✓ Connected to the ground and VCC of the Arduino so that we can connect to the other elements the ground and VCC
- Car model
  - ✓ Used to implement the project on it
  - ✓ Follow a specific lane
- LCD touch screen
  - ✓ Used to display the available channels of the radio
  - ✓ Provide the user with ability to turn the radio ON/OFF
- 7-segment display
  - ✓ Display the different gear status (P-N-R-D)

- Radio
  - ✓ Used to reflect the choice of the driver to the channels
  - ✓ Can be turned ON/OFF
- Light sensors
  - ✓ Used to detect the intensity of light in the surrounding environment
- LEDs
  - ✓ Its light intensity changes with respect to the output of the light sensors
- HBridge motor drive
  - ✓ Used to connect the DC motors with the Arduino to establish the car's movement
- Wires (male-male & female-female-male-female)
  - ✓ To do the different connections
- DC Motors
  - ✓ Used to move the car
- Joystick
  - ✓ Used as a controller to the gear

❖ Fritzing circuit:
- Gear & Headlights: 7 Segment Display, joystick, LED, light sensor (image 1)
- Buzzer, 2 line followers, radio component(image 2)
- HBridge, motors,LCD




IC
MEGA



- Libraries and their functions:
  - Adafruit_GFX.h, MCUFRIEND_kbv.h, MCUFRIEND_kbv.tft, TouchScreen.h , stdint.h
    - ✓ Allows us to write on the LCD screen and display text on it and to change the channels by touching the screen
  - Wire.h , TEA5767.h
    - ✓ To be able to play specific frequencies on the radio
  - Arduino_FreeRTOS.h
    - ✓ Used for scheduling and prioritizing and creating different tasks

- Handling and taking input:
  - Inputs to the car:
    - ✓ The 2 HBridges take their inputs from the Arduino mega where the I1,I2,I3 and I4 PINs are connected to the Arduino 36,37,38,39,40,41,52 and 53 PINs while enable A and B are connected to 44,45 which are defined as outputs
    - ✓ The 4 DC motors take their inputs from the 2 HBridges.2 motor per HBridge.
  - Inputs to the gear:

- ✓ The 7 segment inputs are taken from the Arduino UNO where it is connected to 2,3,4,5,7,8,9 PINs which are defined as output and these outputs depend on the inputs of the joystick
- Inputs to the headlights:
  - ✓ The LED input is taken from the Arduino UNO (PIN 11)which is the light sensor input to the Arduino calculated as square root(light sensor input) and then multiplied by 2.
- Inputs to the radio system:
  - ✓ The radio component inputs are taken from the Arduino which depends on the outputs of the LCD screen and correspondingly choose the correct channel to play
  - ✓ LCD inputs are the channels displayed to the driver on the touch screen

❖ Handling and configuring outputs:

- Output from the car:
  - ✓ The 2 line followers outputs are analogue data from the surroundings which they detect and then is inputted to the Arduino to be used to set the speed of the wheels in the car
- Output from the gear:
  - ✓ The joystick outputs depend on the changes done to the joystick which is controlled by the driver and then are inputted to the Arduino to be used to set the inputs to the 7 segment
- Outputs of the headlights:
  - ✓ Light sensor outputs are analogue outputs inputted to the Arduino which depend on the intensity of the surrounding light.
- Outputs of the radio system:
  - ✓ LCD screen outputs are analogue outputs(the coordinates of the position of the pen on the touch screen) which are inputted to the Arduino to be used in determining which channel to play on the radio

❖ FreeRTOS:

- On Arduino mega we have two tasks, task 1considers the lane assist and task 2 considers the FM radio and the LCD. We use FreeRTOS to set priorities of the two tasks, task 1 takes priority 2 and task 2 takes priority

1. While task 1 is executing and the car did not reach the end of the lane the priority of task 1 remains 2 which is higher than task 2 therefore task 1 keeps executing when it finishes the lane we set task 1 priority to 0 so that task 2 can begin executing .

- Arduino UNO we have 2 tasks, task 1 considers the gear and 7 segment while task 2 considers the light sensor and the LED. We used FreeRTOS to schedule and prioritize the 2 tasks where both have the same priority. In the beginning of the 2 tasks there are semaphores we take the semaphore in the beginning of the any task of them so that the other task would not be able to take it and after finishing executing the task gives the semaphore back.

❖ Limitations:

- IR sensors are hard to be set in place as it needs specific angle and to be close to the lane to detect different colors
- LCD is very fragile , it takes a lot of PINs from the Arduino and the touch screen is not very sensitive
- Light sensor is very small and is hard to be fixed in place
- Positioning of the joystick is hard to determine
- FM radio frequencies are not accurate therefore hard to detect

❖ Divide the work among team members:

- ✓ Somia Hossam: Lane Keep Assisst
- ✓ Alia Saddik: Radio system and LCD
- ✓ Salma Shreef: The Headlights
- ✓ Mariam Ayman: The Gear