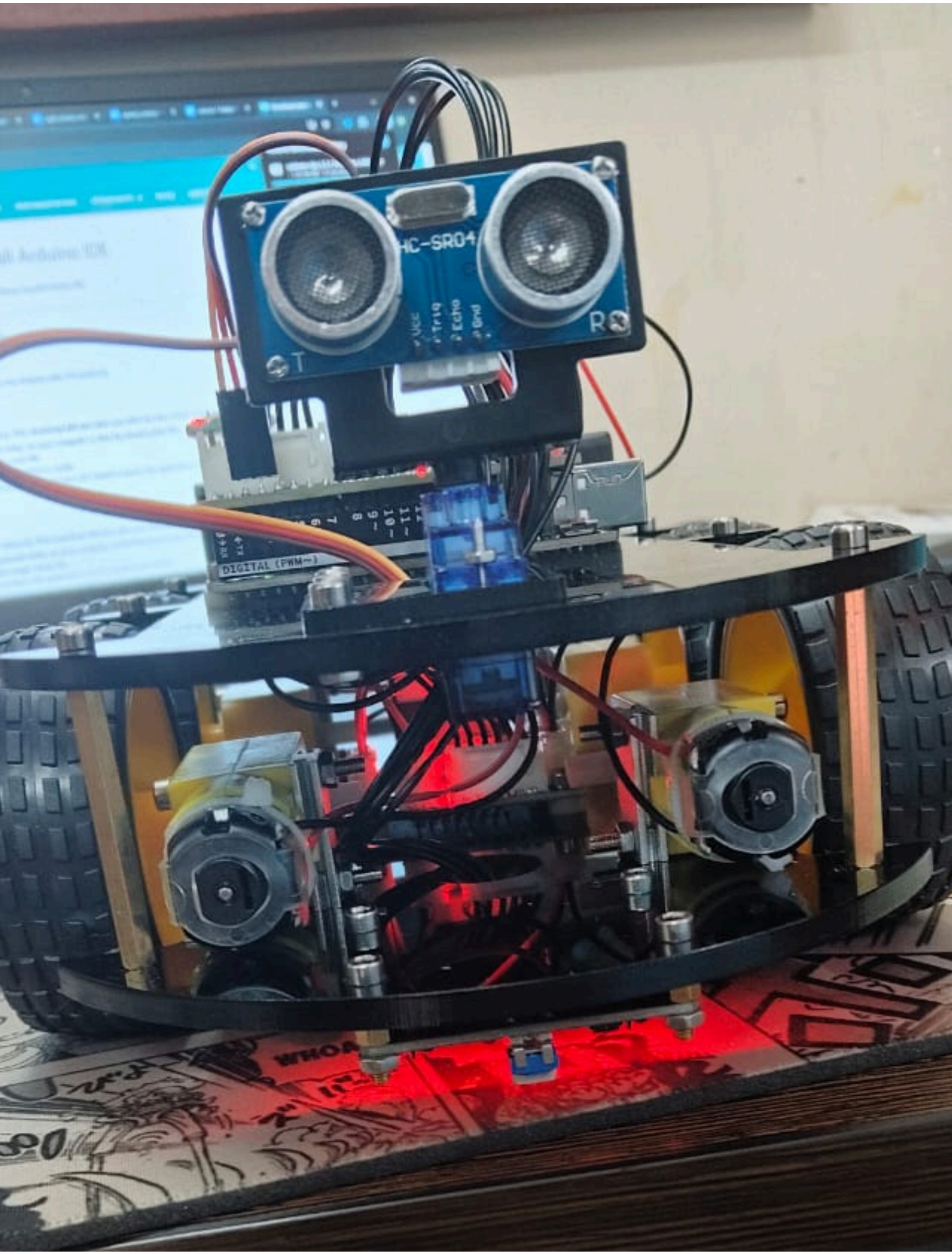
Bluetooth Controlled Arduino-Based Obstacle Avoidance Car

--Team Tesla


HC-SR04
Vcc
Trig
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DIGITAL (PWM~)

Acknowledgement :

We, Team **Tesla**, are proud to present our project, **Bluetooth Controlled Arduino-Based Obstacle Avoidance Car,** as a testament to our unwavering dedication, innovation, and teamwork. This project represents not only our understanding of advanced concepts in physics and technology but also our ability to collaborate effectively and think critically to solve challenges independently.

Throughout the course of this project, we relied solely on our collective knowledge, skills, and determination. The seamless integration of ultrasonic and infrared wave sensors with Arduino technology required extensive research, problem-solving, and hands-on experimentation, all of which were undertaken with enthusiasm and a commitment to excellence.

This project allowed us to explore the practical applications of theoretical concepts and pushed us to overcome technical challenges with creativity and persistence. The experience has significantly enhanced our understanding of embedded systems, sensor technology, and wireless communication, and has prepared us for future endeavors in the field of science and engineering.

We take immense pride in what we have achieved as a team and hope that our project serves as an inspiration for others to innovate and explore the fascinating world of technology. This acknowledgment stands as a reflection of our dedication and the collective spirit that made this endeavor a success.

Introducing our team members :

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ABSTRACT :

Bluetooth controlled Arduino based obstacle avoidance vehicle is a **model** designed to demonstrate the integration of sensor technology with embedded systems for autonomous navigation**. The vehicle can detect and avoid obstacles at a certain distance using** ultrasonic and infrared **sensors. It** can **also** be controlled remotely via Bluetooth, **connecting to books** and **personal functions.**

This project **uses the concepts** of wave propagation and embedded systems to create a functional obstacle **avoidance model.** The Arduino microcontroller processes **the** sensor data and **provides real-time feedback. This model demonstrates** the potential of automation in **creating high-performance, intelligent** solutions**.**

Aim and Introduction:

Using the concept of ultrasonic wave sensors, infrared wave sensors and Arduino technology to create a prototype of TESLA automatic car that avoids objects in front of it at a certain range.

In the rapidly **changing** world of technology, automation has become **the foundation** of innovation, **disrupting everything** from manufacturing to transportation. Among these **developments,** robotics has emerged as a **major** area of **research that paves** the way for **machines** that can interact with their **environment. The Bluetooth-controlled Arduino-based self-defense car** is **an example of** the integration of physics principles and engineering to **solve** real-world **problems.**

The **main** goal of **the** project is to **create** a **vehicle that can detect** and **avoid** obstacles in its path using ultrasonic and infrared sensors. **Using** Bluetooth technology, the **vehicle continues to operate without power, while also providing** the flexibility of remote **control.** This dual-mode **study demonstrates** the **possibility** of combining sensor-based automation with **user commands to create** a versatile and efficient system.

This project not only demonstrates the **use** of **techniques such as** wave propagation, **reflection** and embedded **programming,** but also **demonstrates** the **importance** of **control and performance** in **solving technical problems.** From **accident** avoidance to **job** automation, such technologies have the potential to **change the way** machines interact with their environment.

Using Arduino as the central controller, this project **demonstrates** the accessibility and **flexibility** of **open source** platforms **when creating new** solutions. The following report **will take an in-depth look at** the development, **commissioning** and **operation** of **a Bluetooth-controlled Arduino-based car protection system, detailing** the **design process** and **challenges.**

Materials and their function:

1.Arduino Uno R3

- Importance: Serves as the brain of the project.

- Function: Processes input data from sensors and modules and executes programmed commands for controlling the car's movement and obstacle avoidance.

2. Chassis Kit

- Importance: Provides the structural framework for the car.

- Function: Holds all components, such as the Arduino, motors, and sensors, ensuring stability and durability during operation.

3. Motor Driver Module (L293D)

- Importance: Acts as a bridge between the microcontroller and the motors.

- Function: Controls the direction and speed of the car's motors by managing the voltage and current supplied to them.

4. Ultrasonic Sensor (HC-SR04)

- Importance: Key sensor for obstacle detection.

- Function: Measures the distance between the car and any obstacles by emitting ultrasonic waves and calculating the time it takes for the waves to return.

5. Bluetooth Module (HC-05 or HC-06)

- Importance : Enables remote communication with the car.

- Function : Receives control commands from a smartphone or other Bluetooth-enabled devices to operate the car manually.

6. Power Supply

- Importance : Provides the necessary energy for all components to function.

- Function : Supplies consistent voltage and current to the Arduino, sensors, motors, and other modules to ensure smooth operation.

7. Jumper Wires

- Importance : Facilitates electrical connections between components.

- Function : Transfers signals and power between the Arduino, sensors, motor drivers, and other modules.

8. Breadboard

- Importance : Simplifies circuit prototyping.
- Function : Allows easy connection and testing of electronic components without soldering, making the design modular and adjustable.

9. Arduino Bluetooth Controller

- Importance : Provides an interface for user control.
- Function : Acts as the user's input device, sending control commands to the car via Bluetooth.

10. Servo Motor

- Importance : Enhances the precision of sensor alignment.
- Function : Rotates the ultrasonic sensor to scan the surroundings, improving obstacle detection by expanding the field of view.

Relevance to Physics :

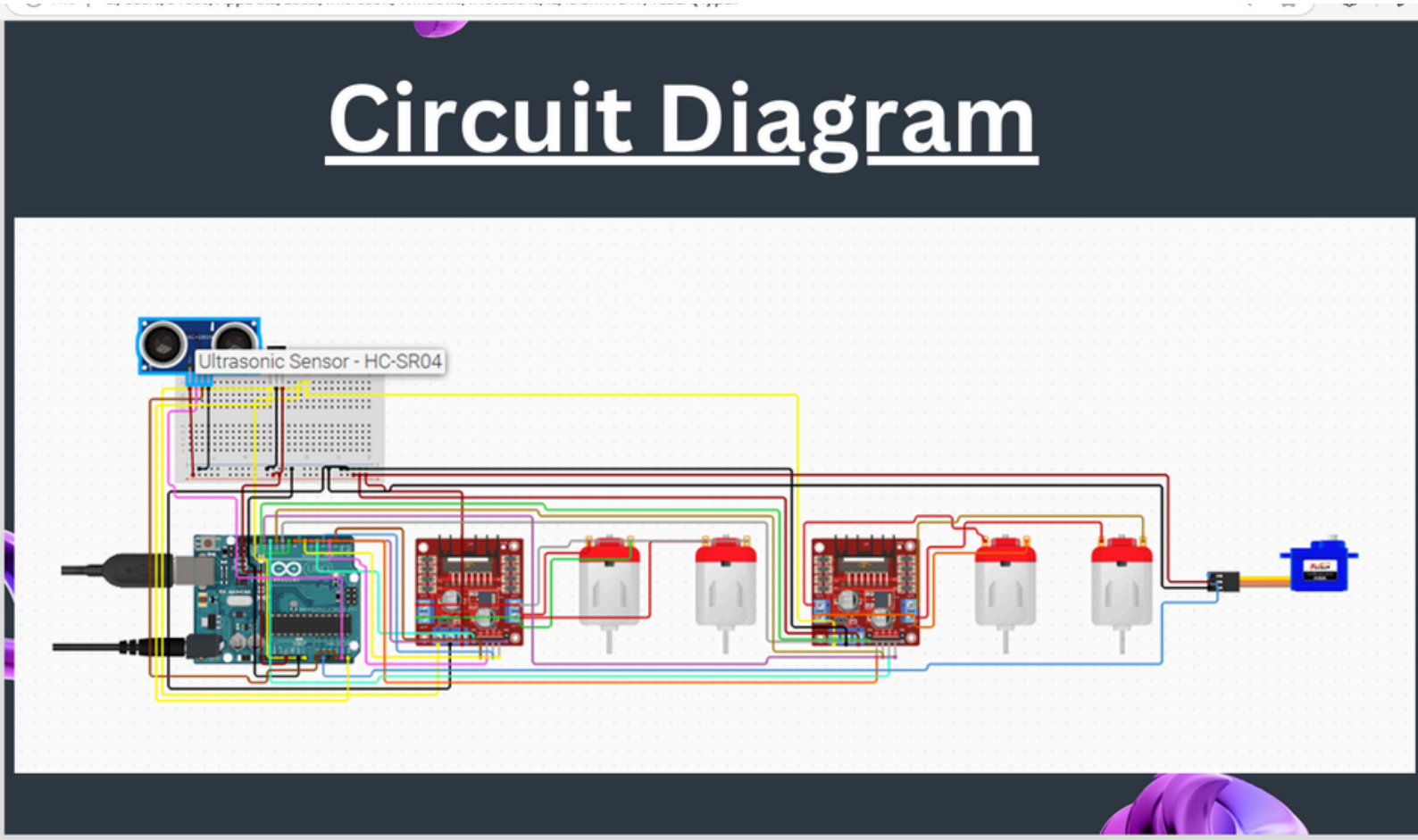
Bluetooth control Arduino as a car protection system incorporates various physics principles, especially in the **field** of wave mechanics, **motion** and energy. The **main function** of the car **is based** on ultrasonic **sensors that use** the physics of sound waves. **The** sensors emit ultrasonic **waves that** travel through the air, reflect **upon impact** and return to the sensor. **The** system calculates the distance to the **object by measuring** the **time it takes for the wave to return with the following** formula Distance=speedxtime/2. This application **demonstrates** the practical use of wave propagation and reflection in real-world technology.

Also, the motion **of the car** is **subject to Newton's** laws of motion. The **driver's engine powers** the wheels, **converting electricity** into kinetic **energy** to accelerate, decelerate, or change direction. This is a direct application of **Newton's** second law, where the force exerted by the **engine** determines the **speed of the car, depending** on its mass.

This work also **includes the** principles of energy conversion and **conservation of energy.** Electrical energy from **electronic equipment** is converted into **electrical** energy to drive the **engine** and into **acoustic** energy for the ultrasonic **sensor. This** efficient **use** of energy demonstrates the importance of energy **conversion** in the **design** of **working machines.**

This project integrates physical concepts, **combining** theoretical physics with **engineering concepts and showing** how **to use the** fundamental laws of nature to **create intelligent automation** systems.

Circuit Diagram :



Theory **behind** Bluetooth **controlled Arduino based vehicle**

The working principle behind Bluetooth controlled Arduino based vehicle protection system is based on many physics and engineering concepts including Wave propagation, motion, energy conversion and mechanical control. The main points that make the system work are: Ultrasonic sensor (HC- SR04) The project works mainly based on the principle of sound wave propagation and reflection. Ultrasound is a sound emitted by sensors with a frequency higher than the human audible range (usually more than 20 kHz). These waves will return to the sensor when they encounter an object. The time it takes for a wave to travel to an object and return (echo time) is measured and is used to calculate the distance between objects.

The theory is based on the physics of sound waves at room temperature (20°C), the speed of sound in air being about 343 meters per second. The sensor can determine the distance of an object to the sensor by calculating the time it takes for the echo to return. Newton's laws of motion apply, specifically the second law,

F=ma

Where: F is the power output of the motor. An electric current is used to control the direction and speed of the motor, and the electric current creates a force on the wheel, causing it to turn. This force causes the car to accelerate or decelerate based on the input from the Arduino. The balance of force, mass and acceleration determines how the vehicle moves in response to control commands or to avoid intervention. Energy transfer principle . Electrical equipment provides electrical power to the system. Motor converts electricity into mechanical energy , enabling the vehicle to move. Ultrasonic Sensor uses electricity to produce a weak sound, which is then converted back into an electrical signal to measure distance. Long distance communication. Thus, the system shows the conversion of electrical

energy into electrical energy, acoustic energy and communication required for the operation of the car.

The collision avoidance ability of the vehicle is based on the concept of Management Information . Arduino acts as a central controller by receiving input from the ultrasonic sensor regarding the distance to the object. When the vehicle detects a problem somewhere, the system will give feedback and start the engine to change the direction of the vehicle and prevent the problem. This feedback loop is a good example of a closed loop control system used in robotics and automation, where real-time information is used to adjust the appropriate behavior for the job. Bluetooth communication and remote control

The Bluetooth module (HC-05 or HC-06) can recognize the remote control of the vehicle, which is a wireless communication application. Bluetooth works using radio waves at short frequencies (typically 2.4 GHz). It allows the vehicle to receive control signals from a smartphone or computer and process them by Arduino. The theoretical basis of this communication is based on radio frequency (RF) waves and modulation used to encode and decode the signals of the controller and the vehicle.
As a result, Bluetooth Controlled Arduino as an Obstacle Avoidance Car integrates many physical theories such as wave propagation, energy conversion, energy dynamics, and control systems into a functional model. The project demonstrates that by using these principles, scientific ideas can be used to design and build autonomous systems.

Conclusion:

***Bluetooth control Arduino as a vehicle protection system* complements** the **use** of **physical** principles and embedded systems technology in **the creation of** an autonomous vehicle**.** Through the integration of ultrasonic and infrared **sensors and** Arduino programming, the **vehicle** can detect and avoid obstacles in real time, **thus** ensuring **safety** and **efficiency.** The **addition** of Bluetooth control further enhances its versatility, allowing for both **control** and **operation.** It also **demonstrates** the **ability to combine** theoretical knowledge with engineering **concepts** to create intelligent **tasks.** The **vehicle** design **demonstrates** the importance of **knowledge** in solving real-world **problems in collaboration with physical, electrical and computer sciences. The desired goals** also **form the basis** for future robotics and **automation innovation.** The skills and insights gained from **designing** and **developing these systems are paving** the way for more autonomous systems in **many areas,** including transportation, **robotics** and technology**.**