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CASE STUDY REPORT

BEAM ROBOTICS

XCSHA -3

INTRODUCTION TO MEACHINE LEARNING

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Introduction:

BEAM Robotics (Biology, Electronics, Aesthetics, and Mechanics) is a field of robotics that focuses on simple, efficient, and nature-inspired robot designs. Unlike traditional programmable robots, BEAM robots often rely on analog circuits, solar power, and minimalist designs to achieve tasks such as movement, sensing, and interaction with the environment.

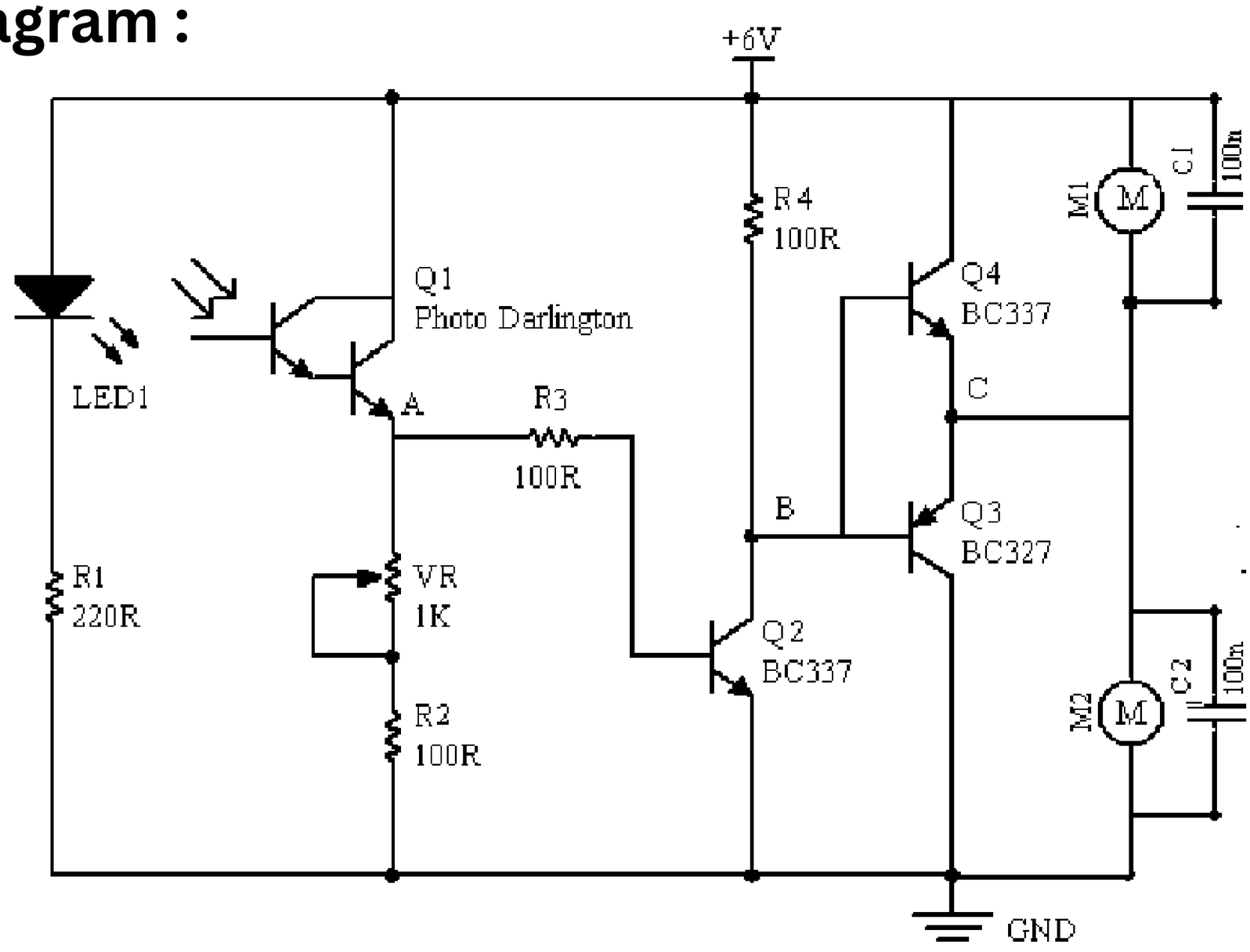
This case study explores two types of BEAM robots

1. Straight-Line Robots
2. Obstacle-Avoiding Robots

1. Straight-Line BEAM Robots

Straight-line BEAM robots are designed to move in a single linear path. Their primary function is to travel forward without deviation using very simple circuitry.

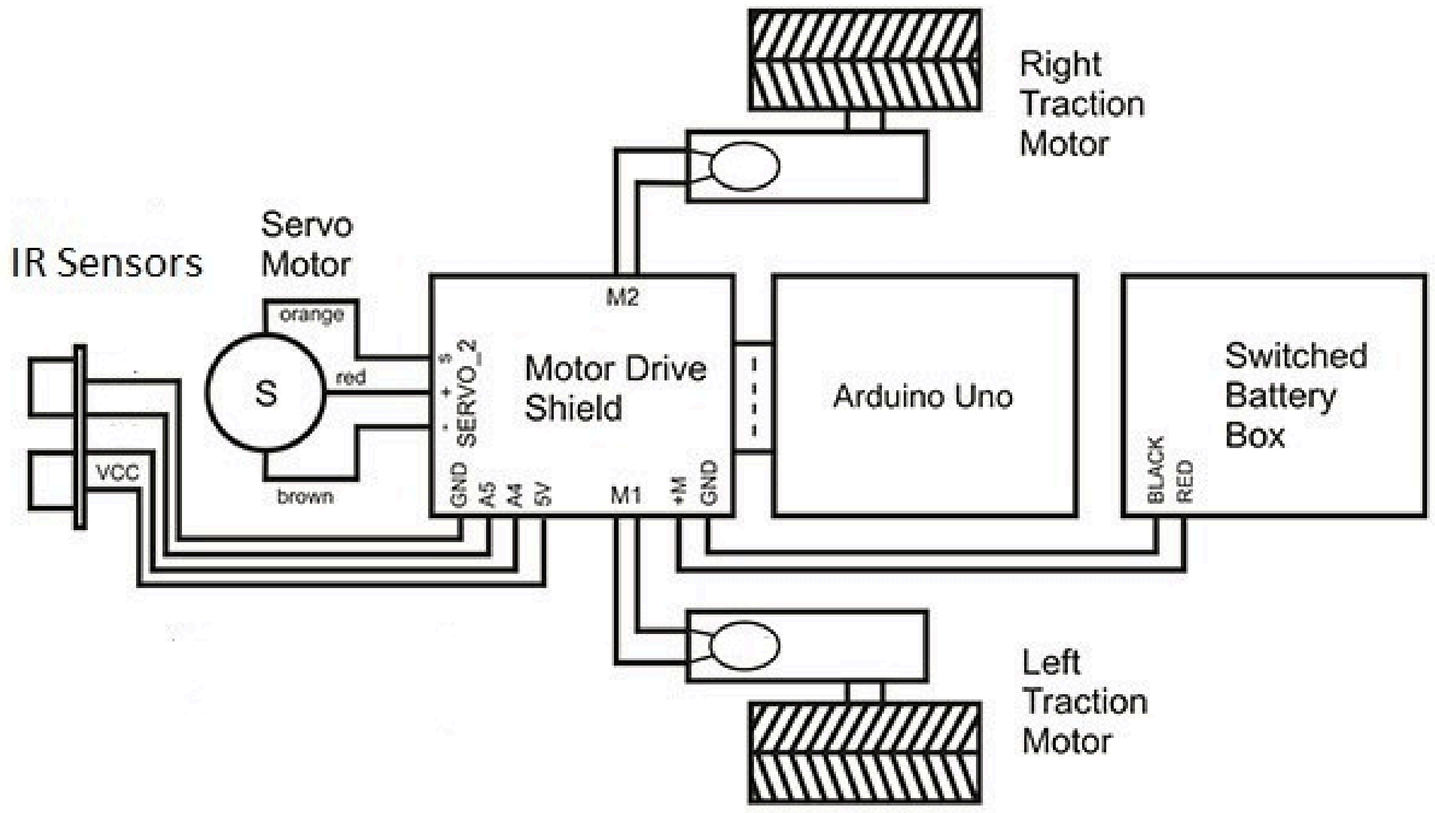
Circuit diagram :



Working principle:

The capacitor charges through the solar cell and resistor. When sufficient voltage is reached, it triggers the transistor Q1, allowing current to flow to the motor. This results in periodic bursts of forward motion, enabling straight-line travel.

Block diagram:



Applications:

- Educational projects for beginners.
- Demonstrations of BEAM principles in workshops.
- Simple motion demonstrations powered by solar energy.

Advantages:

- Simple construction.
- Low cost and energy-efficient.
- Illustrates capacitor charging and transistor switching concepts.

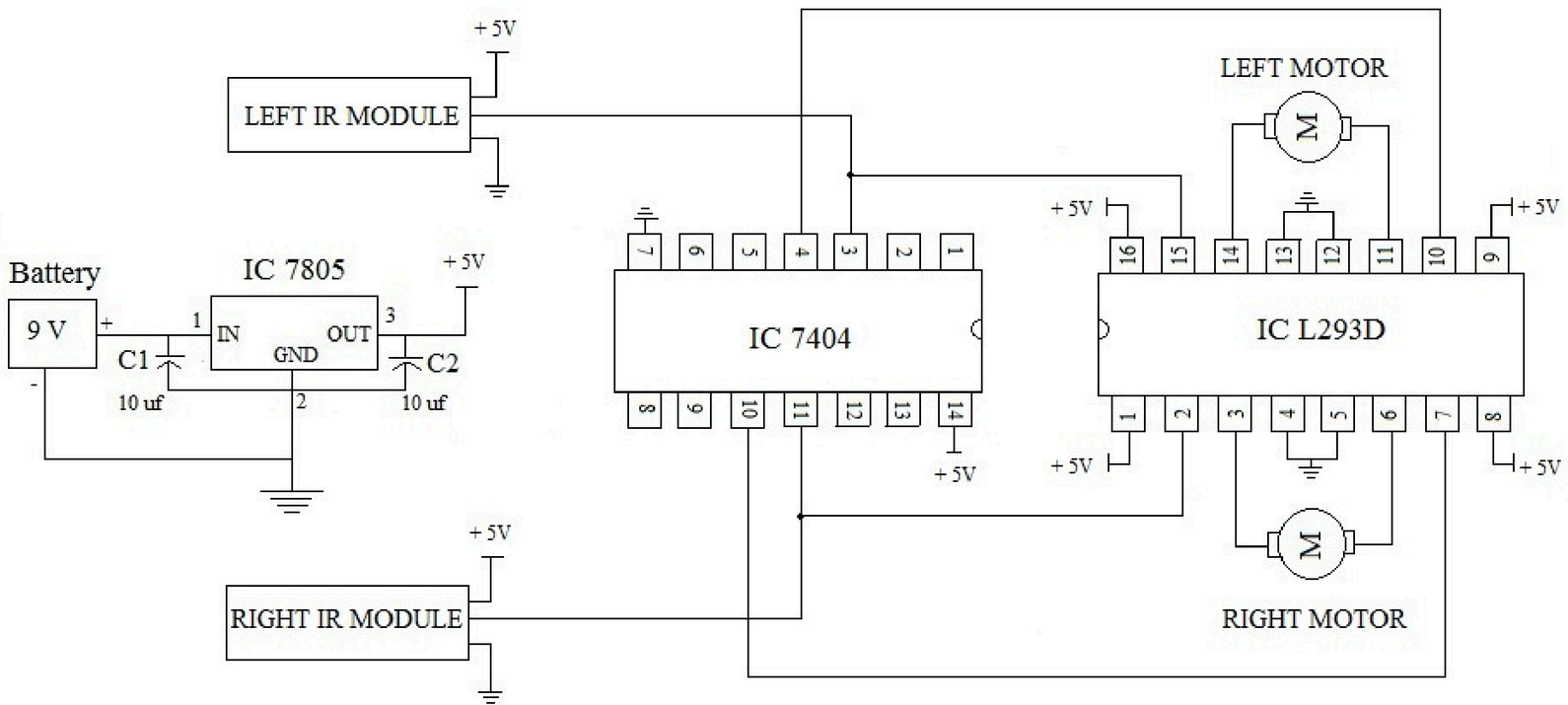
Limitations:

- Cannot adapt to obstacles.
- Limited to controlled or open environments.

2. Obstacle-Avoiding BEAM Robots

Obstacle-avoiding BEAM robots are designed to detect and navigate around objects in their path. The circuit introduces additional feedback elements to alter motor behavior when obstacles are encountered.

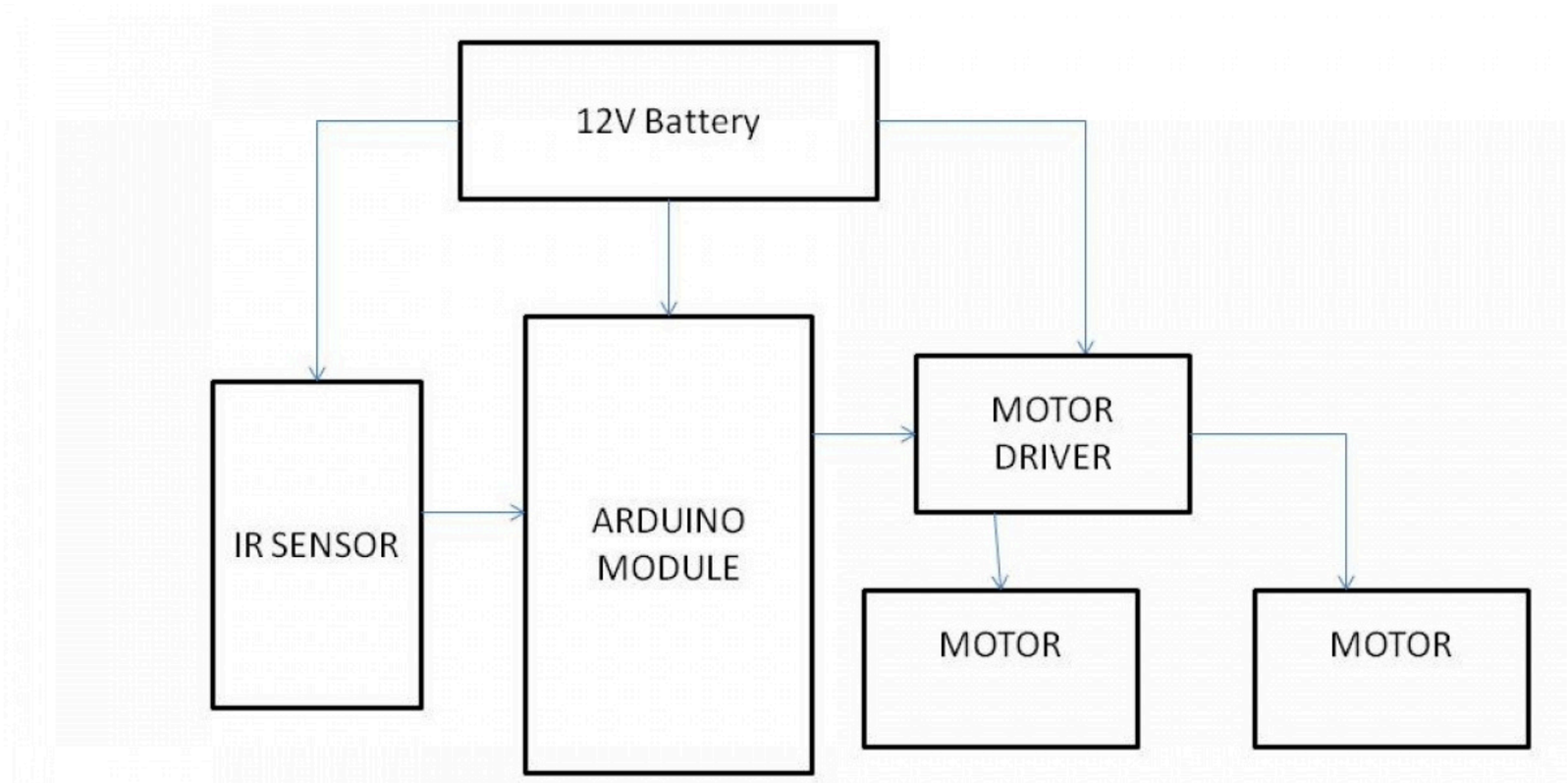
Circuit diagram :



Working principle:

The timing network charges and triggers the transistor as in the straight-line robot, but the added feedback resistor alters the motor response when obstacle sensors (such as whiskers or bump switches) interact. When an obstacle is detected, the motor response changes direction or stops briefly, allowing avoidance.

Block diagram :



Applications:

- Exploration in unknown environments.
- Demonstrations of autonomous navigation.
- Foundation for more advanced adaptive robots.

Advantages:

- Capable of adapting to environmental changes.
- Demonstrates feedback-based motion control.
- Good for learning autonomous robot design principles.

Limitations:

- Limited intelligence compared to microcontroller-based robots.
- Works best in simple obstacle scenarios.

Conclusion:

Both straight-line and obstacle-avoiding BEAM robots demonstrate robotics fundamentals using minimalist analog circuits. The straight-line robot showcases basic energy storage and release concepts for simple forward motion. The obstacle-avoiding robot introduces adaptive behavior using feedback, making it more versatile and interactive. Together, these designs provide excellent educational value and highlight the BEAM philosophy of simplicity, efficiency, and biomimicry.

Reference:

- Tilden, M. (Founder of BEAM Robotics). Principles of BEAM design.
- BEAM Robotics Online Community and Resources.
- Educational Robotics Project Documentation.