# CASE STUDY ON BEAM ROBOTICS

BY

PRAGADEESH R

123012025018

B. Tech ECE(AI&ML)

PMIST

## INTRODUCTION

Modern robotics largely depends on microcontrollers, digital programming, and complex software. In contrast, BEAM robotics, pioneered by Mark Tilden in the late 1980s, demonstrates that lifelike behaviors can emerge from simple analog circuits without digital logic. This philosophy emphasizes;

• Minimalism - Do more with fewer components.

• Energy Efficiency - Use solar or low-power sources.

Biological Inspiration - Mimic insect-like reflex behaviors.

All three case studies underline BEAM's role as an accessible and creative platform for learning and experimentation.

## HISTORY OF BEAM ROBOTICS

BEAM robotics was pioneered in the late 1980s and early 1990s by Mark W. Tilden, a physicist and robotics.

researcher. His work was motivated by the desire to create simple, lifelike robots that mimicked natural behaviors without relying on digital computation.

BEAM robots were solar-powered and used minimalistic analog circuitry, such as neural oscillators and h-bridges, to create movement and responses. These robots inspired a culture of hobbyist robotics, educational projects, and research in alternative approaches to autonomous systems.

## LITERATURE REVIEW

Tilden (1995) introduced the concept of "nervous

networks" (Nv nets), analog circuits that generate emergent robotic behaviors.

Hrynkiw & Tilden (2002) published JunkBots, BugBots and Bots on Wheels, a guide that popularized BEAM robotics among hobbyists.

• Academic work in behavior-based robotics (Brooks 1991) provided theoretical grounding for BEAM's rejection of centralized programming.

Recent studies show that BEAM robots are useful for educational purposes, promoting low-cost, hands-on learning in STEM.

• Obstacle-avoidance designs often use simple

photodiodes, tactile whiskers, or bump sensors to alter motor circuits without programming.

## PROBLEM STATEMENT

Most conventionally robots require:

- High cost (due to processors, sensors, batteries).
- Complex coding skills.
- Large power sources.
- Difficult maintenance for beginners.
- BEAM robotics addresses these by:
- Using basic analog circuits.
- Eliminating the need for programming.
- reducing cost and power consumption.
- Allowing easy implementation in education and hobby projects.

## CORE PRINCIPLES & BEHAVIOURS

At its heart, BEAM robotics is an exploration of emergent behaviour - the idea that simple parts, when connected in thoughtful ways, can create unexpectedly rich actions. Several principles define this approach:

1. Simplicity of design: BEAM robots rarely include microcontrollers or digital logic. Sensors and motors are connected directly, creating natural cause-and-effect behavior.

2.Analog decision-making: Circuits respond continuously to input, rather than translating data into digital code. The result is smooth, organic reactions.

## LIMITATIONS

Of course, BEAM robots have their limits. Without microcontrollers, they cannot store instructions, perform complex decision-making, or learn from expericnce. They will not navigate mazes or perform industrial tasks with precision. But these limits are part of BEAM's message.

Rather than aiming for utility, BEAM demonstrates a different truth: life-like behavior does not require digital intelligence. Complexity can emerge from simplicity. Even today, BEAM's influence is visible—in hobbyist kits, in bio-inspired robotics research, and in broader conversations about sustainable, efficient design. Its ideas continue to remind engineers that elegance often lies in restraint.

## CONCLUSION

BEAM robotics is more than just a branch of robotics —it is a way of seeing machines. By stripping robots down to their essentials, it celebrates the power of analog circuits, recycled parts, and natural fedback loops.They are playful, accessible, and deeply educational. Sometimes, all it takes is a solar cell, a capacitor, and a curious mind to breathe a spark of life into a machine.