



# Energy-Efficient Dynamic Motion Control for Wheeled Mobile Robots Using Low Cost Resources

Abrar Alajlan, Khaled Elleithy and Marwah Almasri

Department of Computer Science and Engineering  
University of Bridgeport, Bridgeport, CT

## Abstract

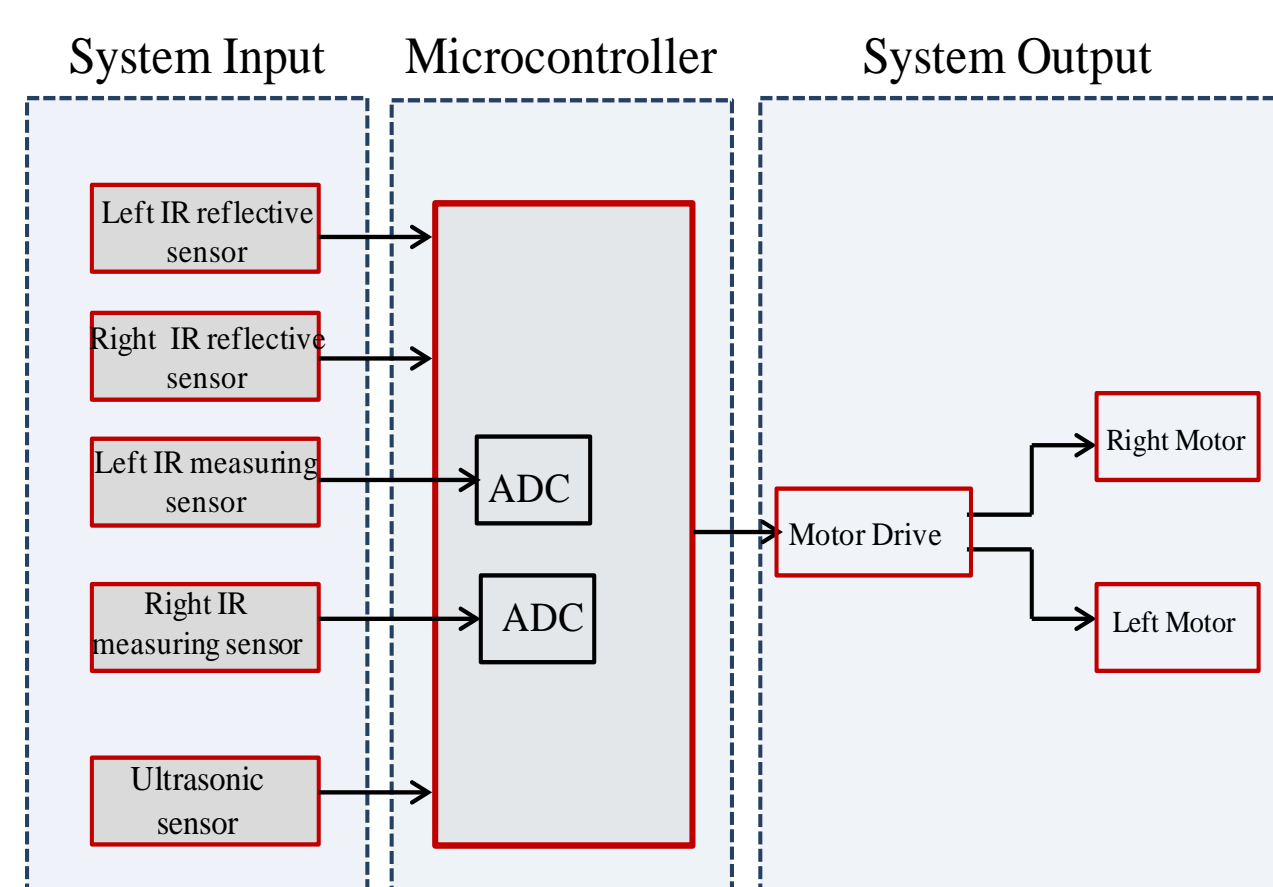
Mobile robotic systems have gained significant attention in human interest, where they represent such a complex interaction with challenging environments. Some applications require continuous operations, so the robots motions have to be optimized to reduce their energy consumption. In addition, total energy consumption in mobile robotic applications is one of the most important issues that has not been adequately considered. Mobile robots are limited by the amount of energy supplied by the batteries they carry where a new supply of energy while working is too expensive to be realistic. Thus, this work aiming to minimize the energy consumption of a wheeled mobile robot in dynamic environments.

## Introduction

Mobile robotic systems have significant growth in human welfare, where they represent such a complex interaction of high computational processes, outstanding mechanical design, and exceptional hardware. Majority of mobile robot applications are developed to perform some operations that require an extended level of autonomy such as security and exploration, search and rescue, inspection, etc.

Minimizing energy utilization of mobile robots can be achieved in multiple directions. For example, controlling the robot's velocity, using energy-efficient modules and performing simple calculations can reduce the total energy loss on mobile robots.

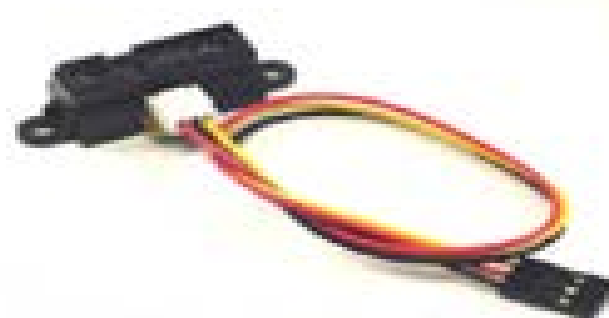
## Functional Block Diagram



## Infrared Reflective Sensors



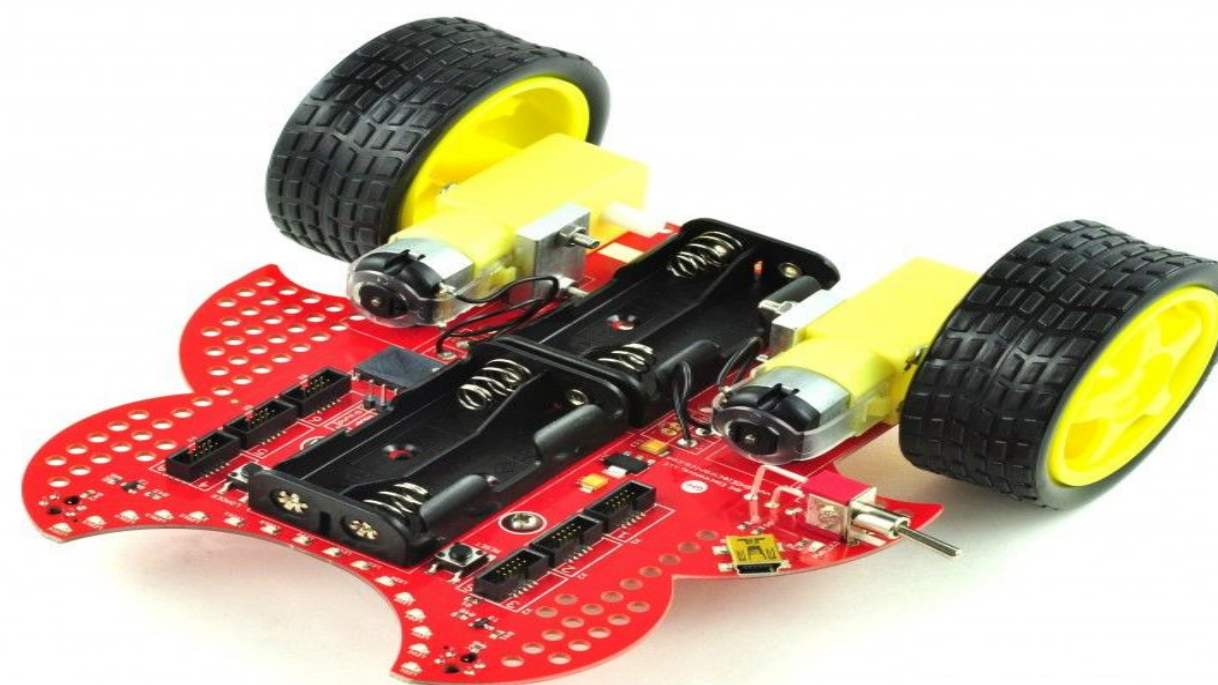
## Infrared Measuring Sensors:



## Ultrasonic Sensor



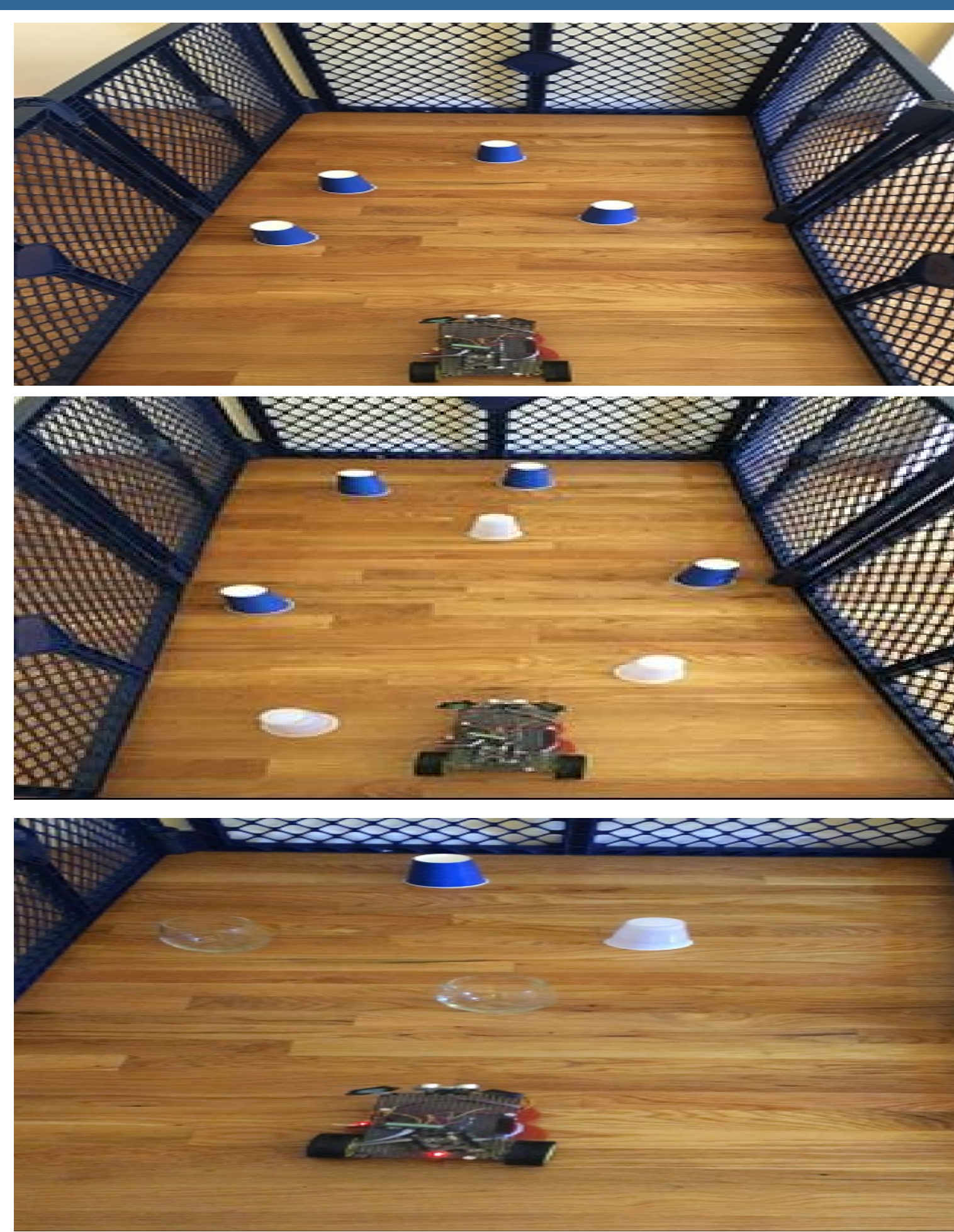
## Implementation Platform



The FEZ Cerbot robot

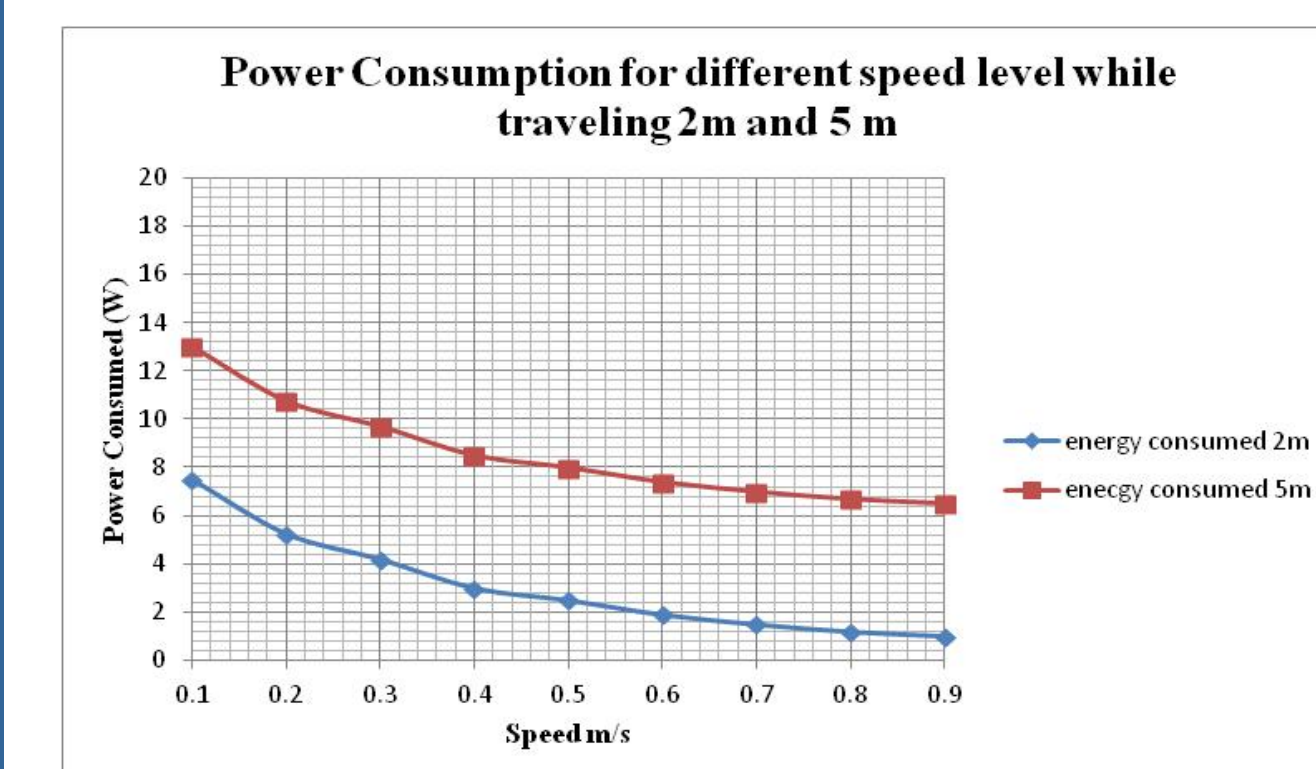
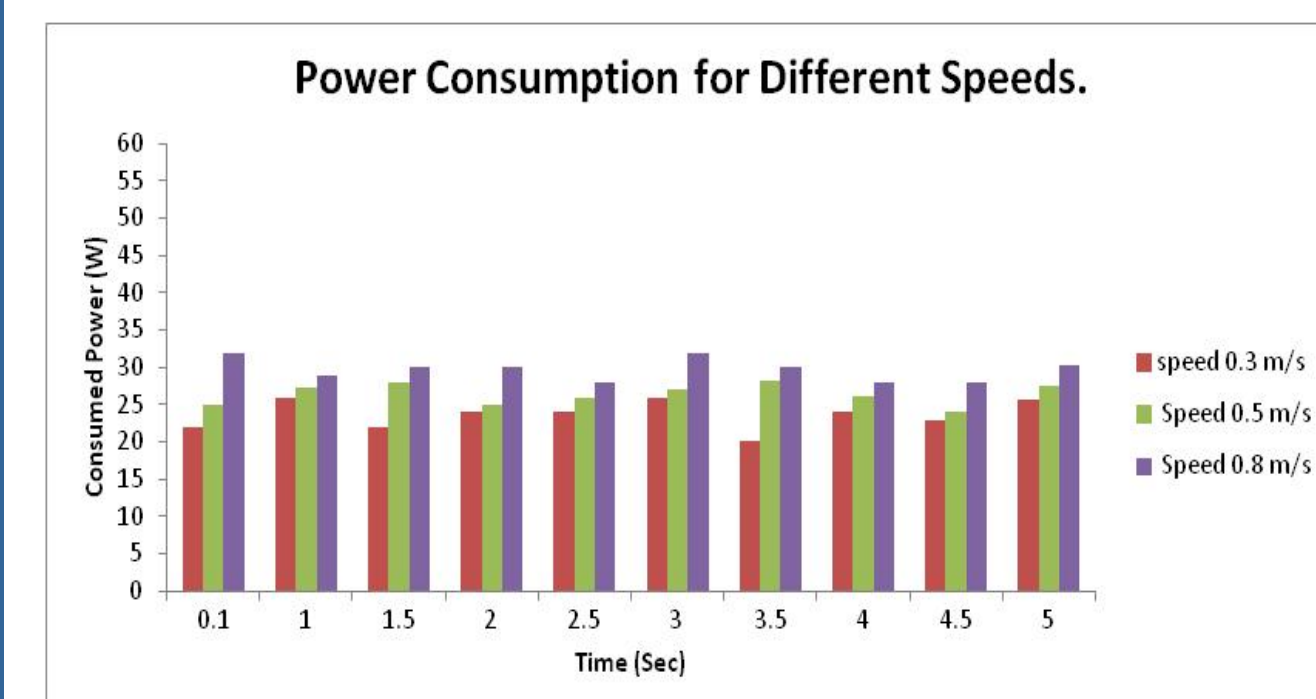


Test-bed prototype of the proposed model

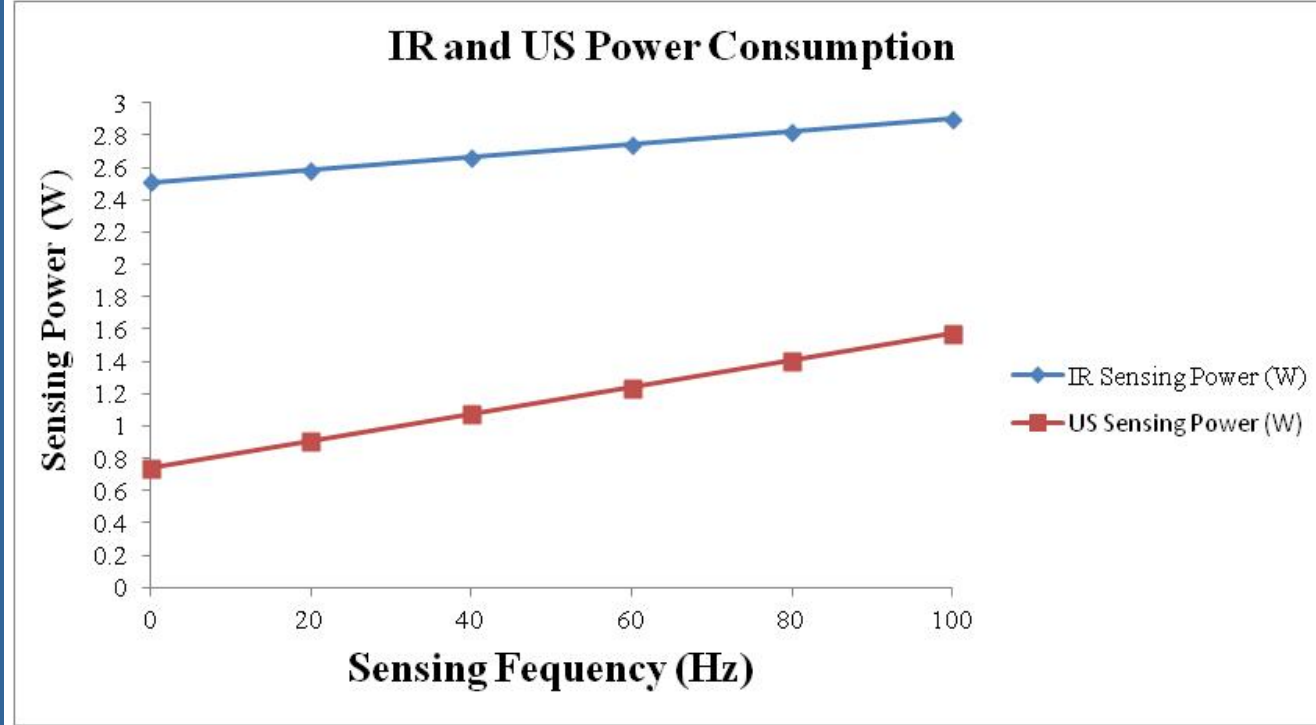
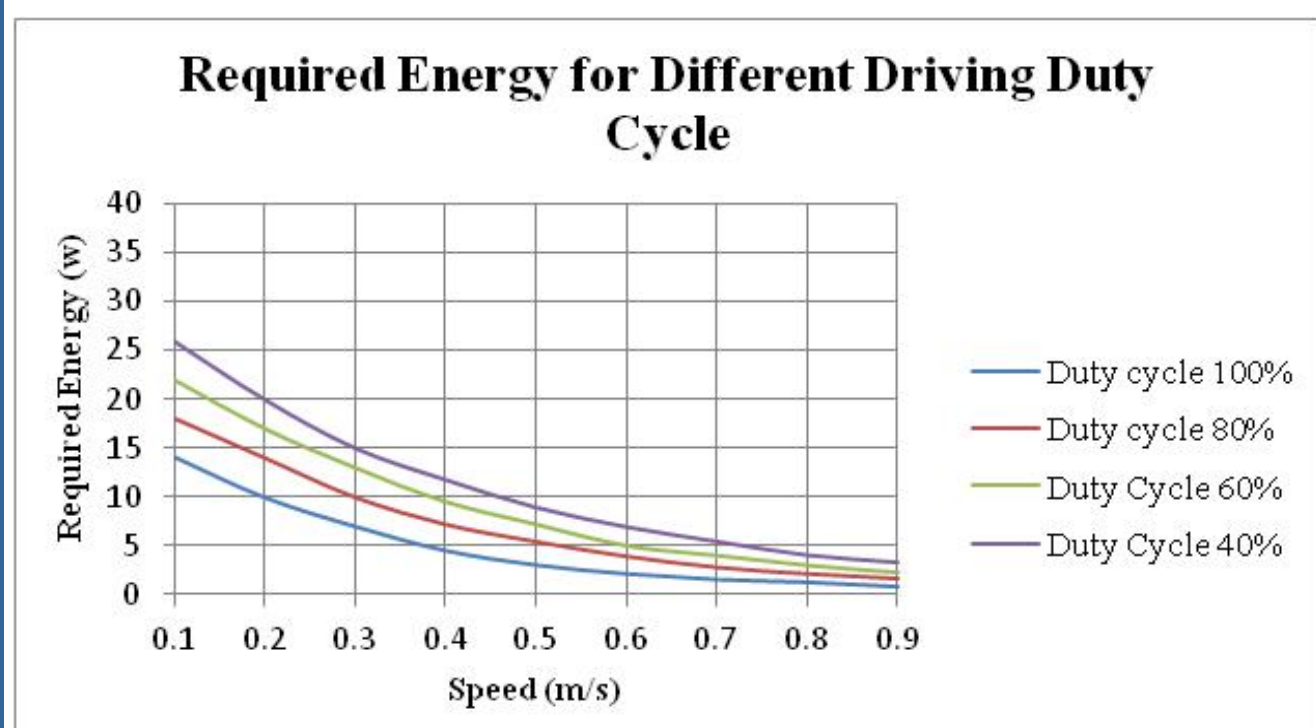


## Energy Consumption analysis

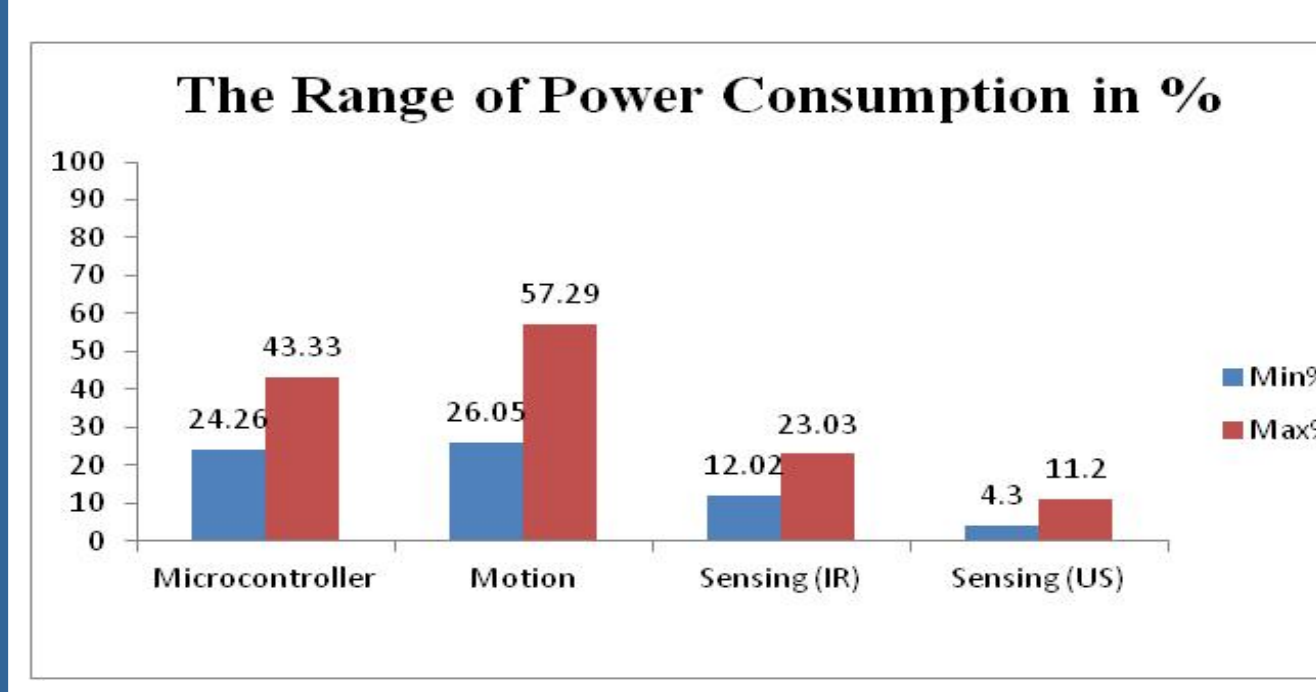
### Motional Energy Analysis



### Operational Energy Analysis



## Total Power Consumption



R. Siegwart and I. Nourbakhsh, Introduction to autonomous mobile robots. Cambridge, Mass.: MIT Press, 2004.

S. Liu and D. Sun, "Minimizing Energy Consumption of Wheeled Mobile Robots via Optimal Motion Planning", IEEE/ASME Transactions on Mechatronics, vol. 19, no. 2, pp. 401-411, 2014

Ghielectronics.com, "FEZ Cerbot - Assembled - GHI Electronics", 2016. [Online]. Available: <https://www.ghielectronics.com/catalog/product/403>. [Accessed: 10- Jan- 2016].

Abrar M. Alajlan, Marwah M. Almasri, Khaled M. Elleithy, "Multi-Sensor Based Collision Avoidance Algorithm for Mobile Robot", IEEE Long Island Systems, Applications and Technology Conference, March 2015. (Best Paper Award).

Y.Me, Y.Lu, Y. Hu and C. Lee, "A case study of mobile robot's energy consumption and conservation techniques", ICAR '05. Proceedings., 12th International Conference on Advanced Robotics, 2005.