Senior Design Project

Team Members:
Abdulrahman Bataweel && Adnan AlSinan && Husam Habarah

Advisors:
Dr. Muhamed Mudawar (Primary)
Dr. Yahya Osais (Secondary)

Outline

- Problem Statement
- System architecture and integration
- Design of custom components
- Design decisions
- Inter-component interfaces
- Conclusion
- Demo
- Questions

Problem Statement

- To Assist elderly or disabled people in supermarkets, our goal is to design and build a robot that is capable of following them, and carry weight for them.

- Many other applications:
  - Security and rescue missions.
  - Medical applications.
  - Commercial applications.

Requirements

- **Functional user requirements.**

- The robot should be able to identify any person and be able to follow him/her.
- It should be able to recognize the person from different directions.
- It should be able to recognize obstacles and avoid them.

- **Non-functional user requirements.**

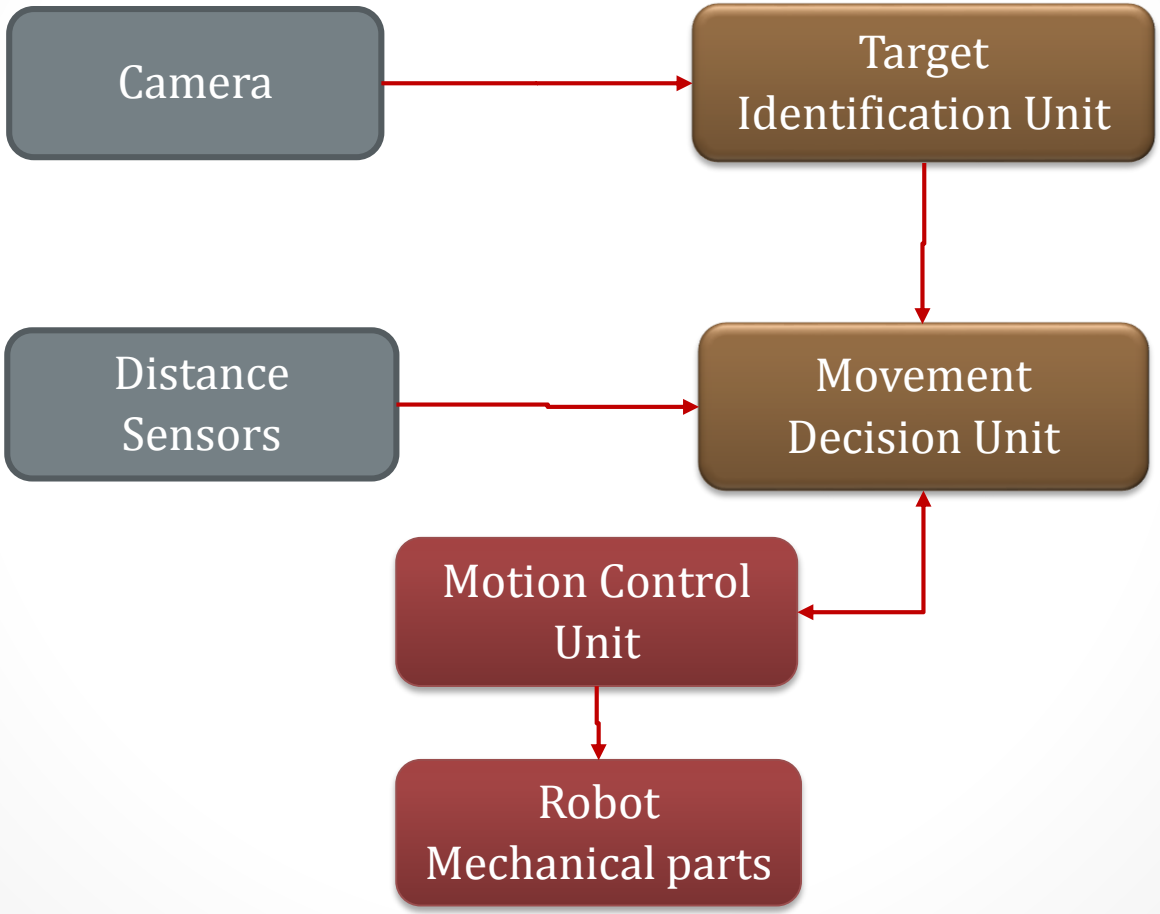
- The robot should be able to carry at least 1 kg of weight.
- The robot can follow a subject within 2-5 M.
- Response time should be within 2 seconds

Specifications

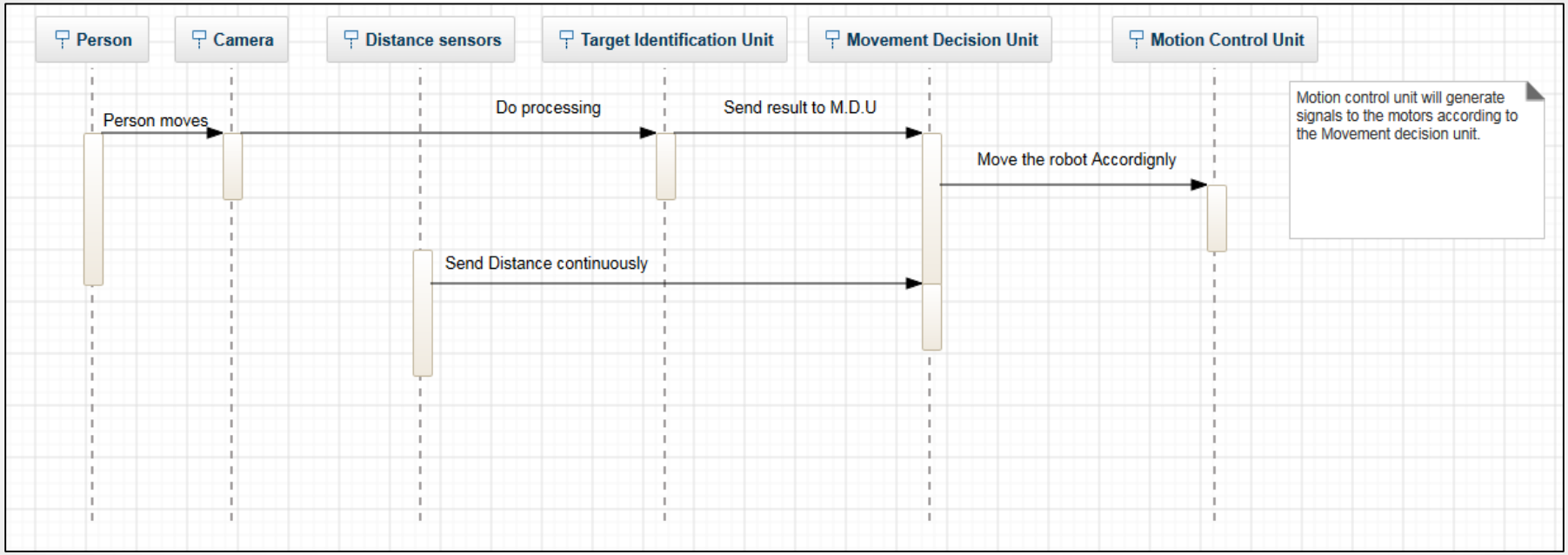
- **Technical Specification.**

- Identify subject to follow by camera.
- Robot can carry up to 1 kg.
- Movement speed is 6 km/h to Follow-up human at maximum speed of 6 km/h.
- Keep distance of <2 meters to the followed person.
- Usage of distance sensors to avoid bumping into the user
- Height between camera and robot is 1.5 -2 meters.

System Architecture



System Integration

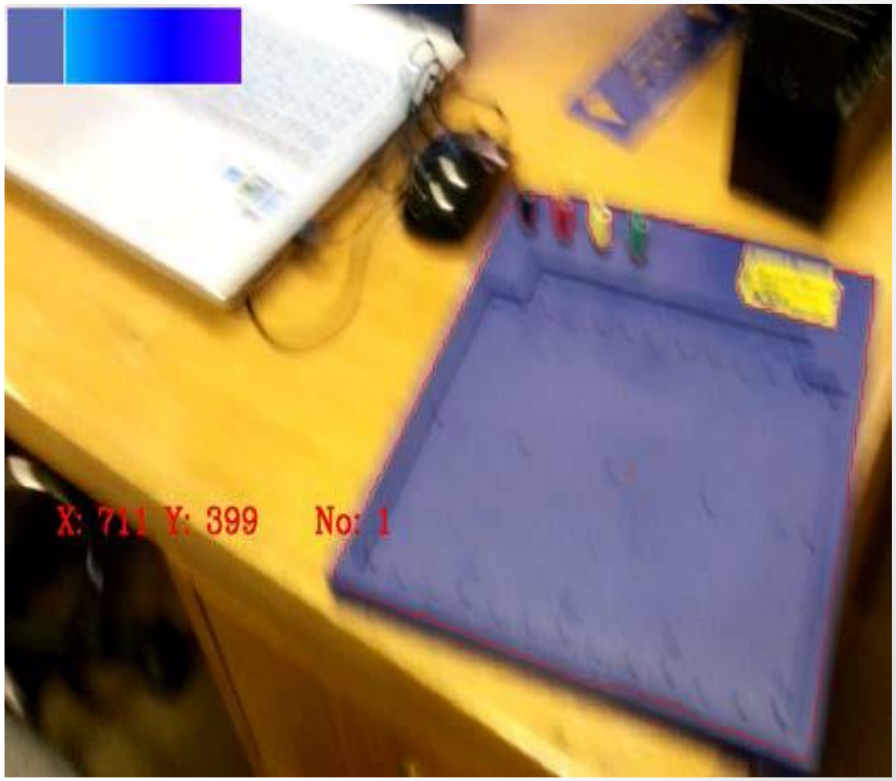


Target Identification Unit

- Two approaches :
  - Color detection
  - Human feature detection.

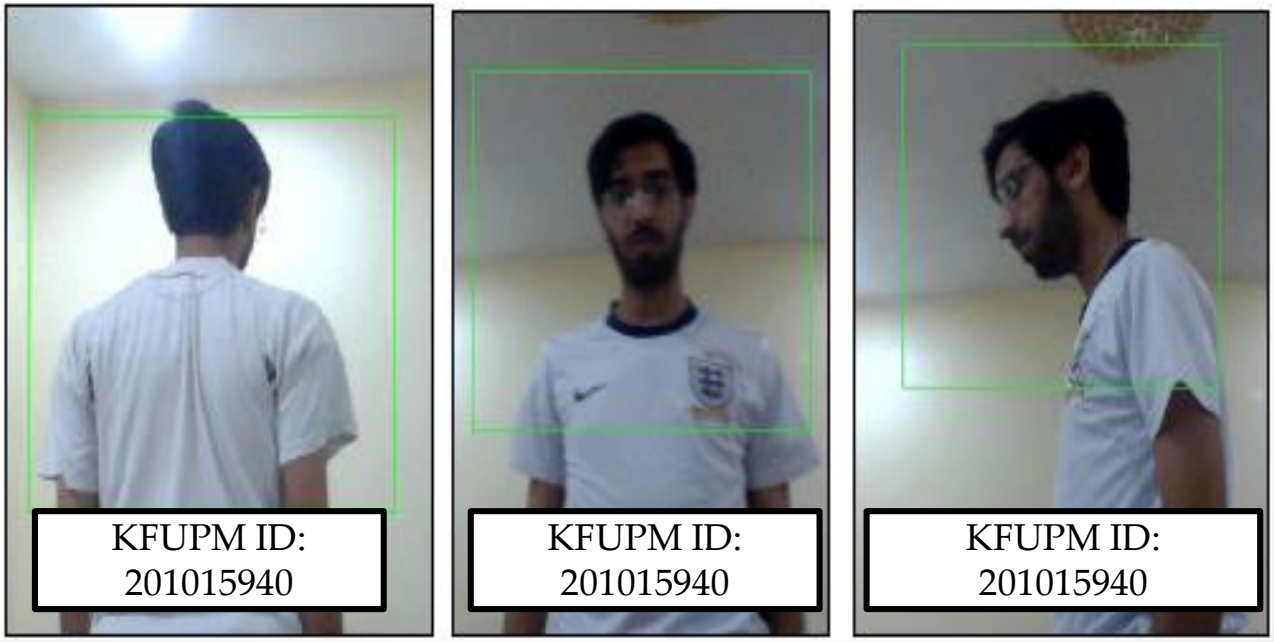
Target Identification Unit

- Color detection



Target Identification Unit

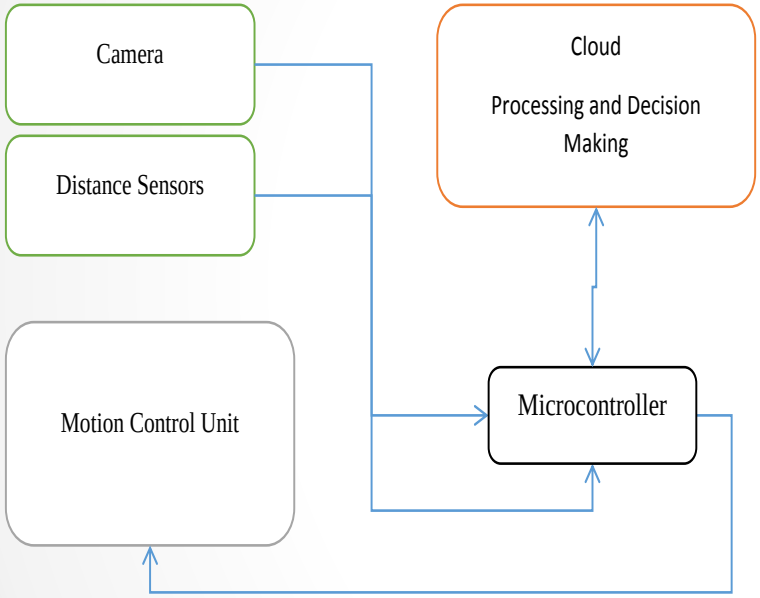
- Human feature detection
  - Trained by Haar-like features.
    - by 100's positive and negative images
  - Classifying : Cascade classifier.

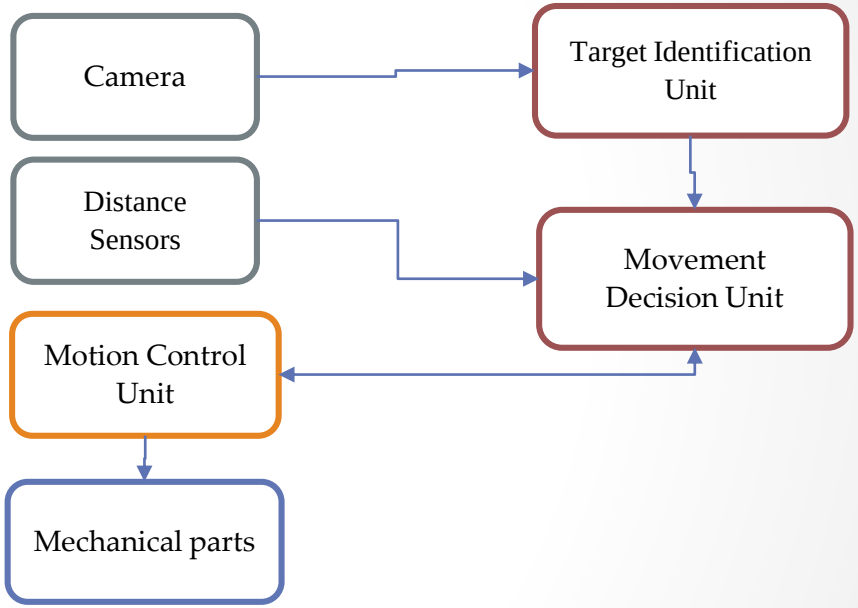


Movement Decision Unit

- Custom component.
- Two inputs :
  - X (position of person in the frame)
  - *d* (distance reading from sensors)
- Frame consist of 3 regions:
  - Center
  - Left
  - Right
- Synchronization

Design decisions



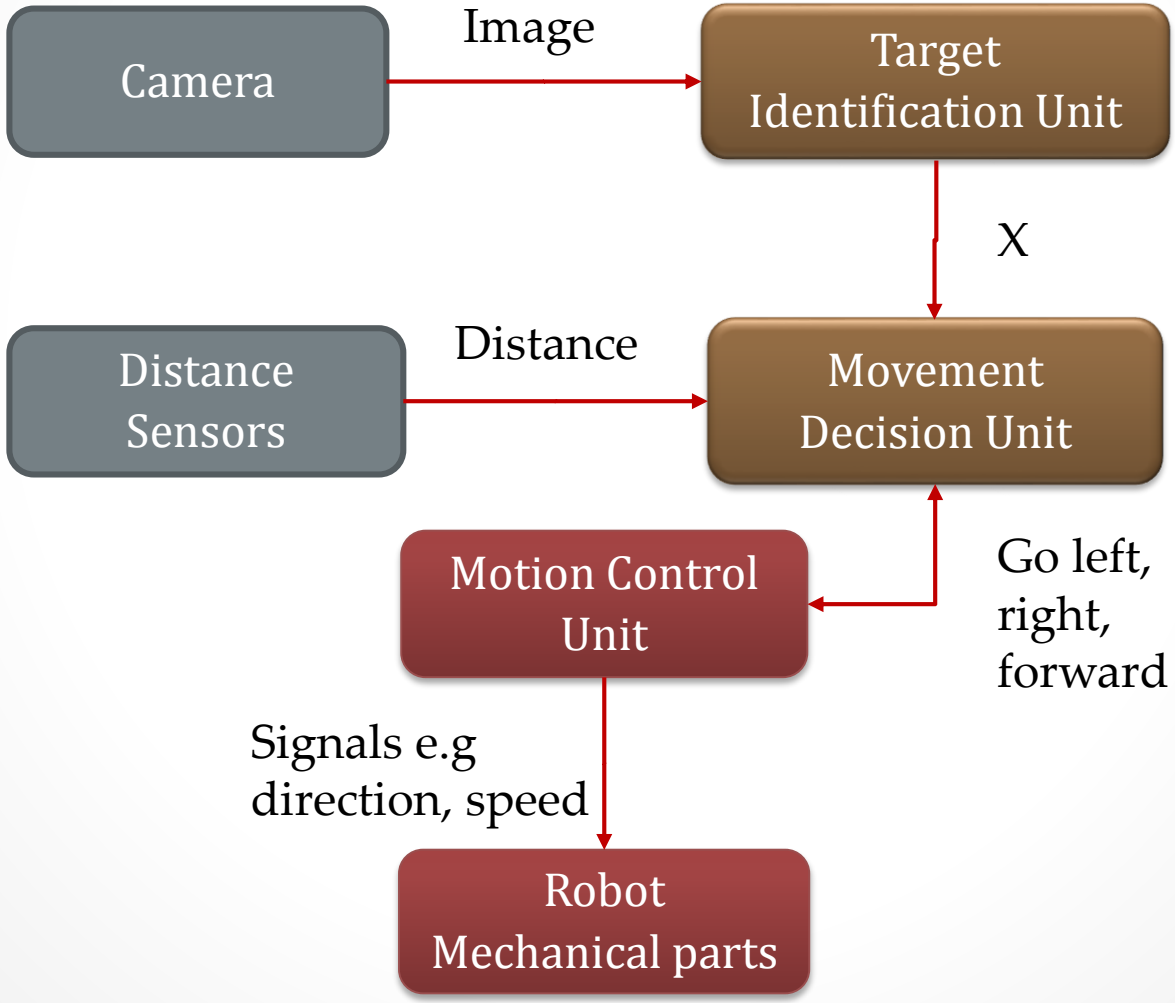


Design decisions

- Mobile phone vs Microprocessors
  - Raspberry pi 2, Beaglebone

Option	OS	CPU	Storage	RAM	Camera	Interface	BT	Connectivity	Cost	Total cost
Beagleboone black	Linux	Dual-core 1.3GHz	4GB eMMC, and micro SD	512MB DDR3	180 SR	4.3 inch Touchscreen (140 SR)	No need	Ethernet	SR 190	190 + 140 + 180 = **SR 510**
Raspberry PI 2 B	Can run Linux/ windows	Quad-core 900MHz	Micro SD	1GB	180 SR	4.3 inch Touchscreen (140 SR)	No need	Ethernet	SR 150	150 + 140 + 180 = **SR 470**
Android phone	Android	1 GHz dual-core– up to octal-core	Built in 16 GB -	1 GB – 3 GB	Built-in	Built-in	SR 30	Wi-Fi + cellular	SR 450 -	450 + 30 = **SR 480**

Inter-component interfaces



Conclusion

- Problem Statement
- System Architecture
- Design decisions

Demo Video

Live demo is available after Questions

Questions

& comments