

Embedded Controller for Radar based Robotic Security Monitoring and Alerting System

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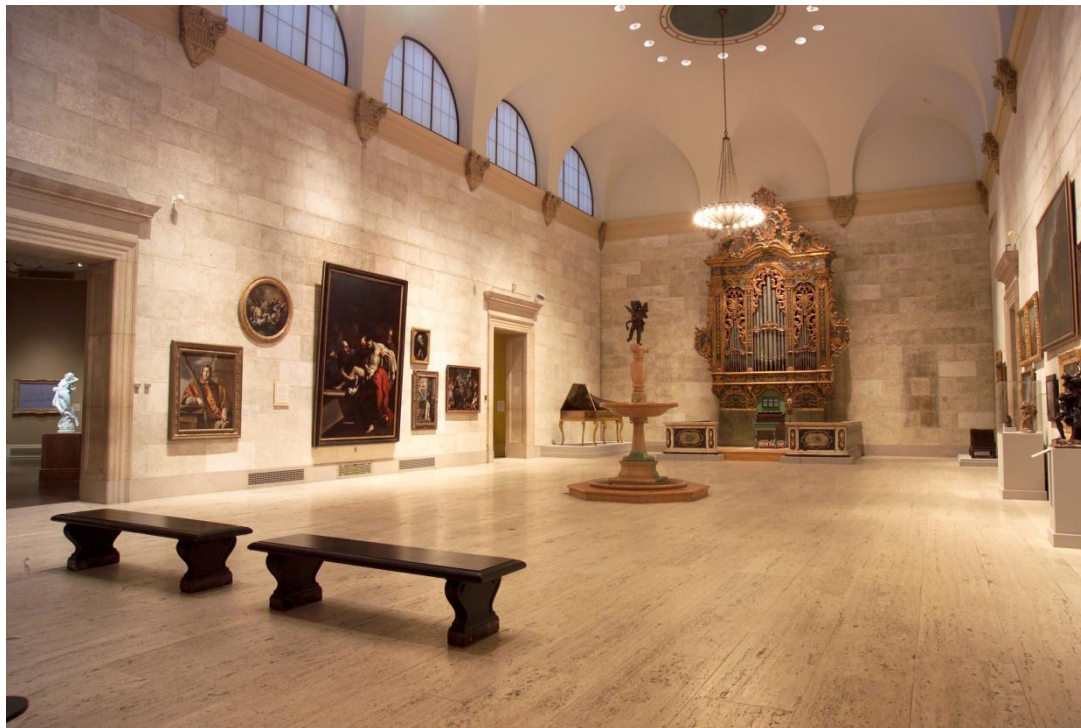
Presented by:
Robin Davidsson
UNC Charlotte
April 3, 2013

Agenda

- Introduction
- Background
- Design Process
- Hardware Description
- Software Description
- Implementation
- Future Improvements
- Conclusion

Introduction

- Robot used for obstacle detection
- Replaces humans in dangerous situations
- Security applications
- Alert via SMS message



[1]

Background

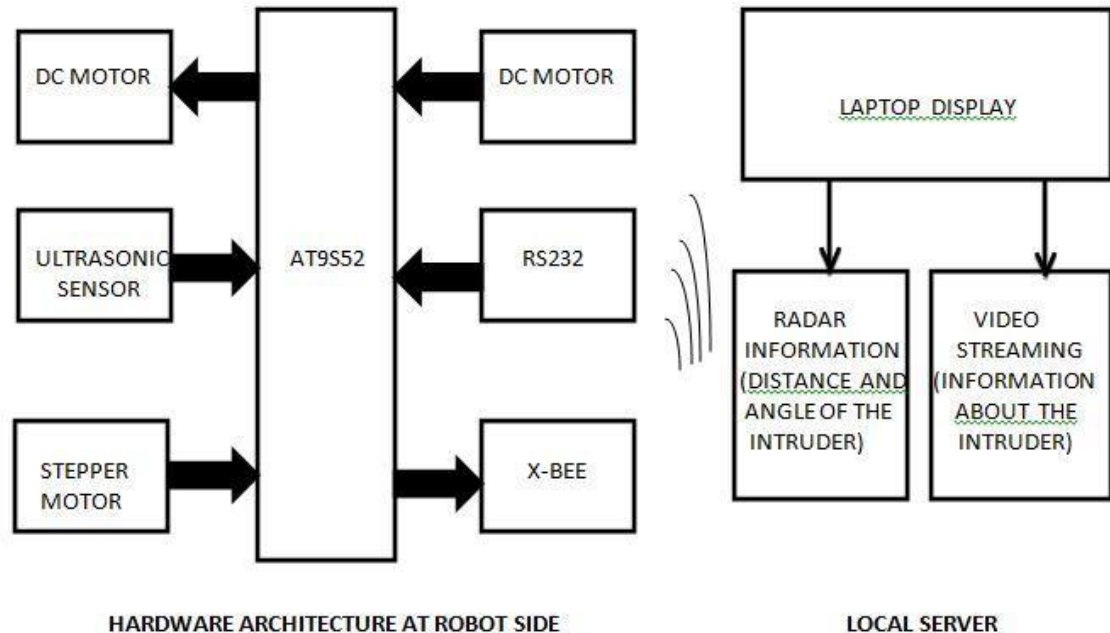
- Baifan Chen [3] – Obstacle detection using laser radar
 - Construct grids of environments
- Dong-Won Jung [4] – Mobile robot navigation system
 - Ultrasonic sensors
 - DSP
- Andrea Cherubini [5] – Remote control of robots
 - Sony AIBO
- Chidambar Ganesh [6] – Robotic control structure
 - Trajectory planning



[2]

Design Process

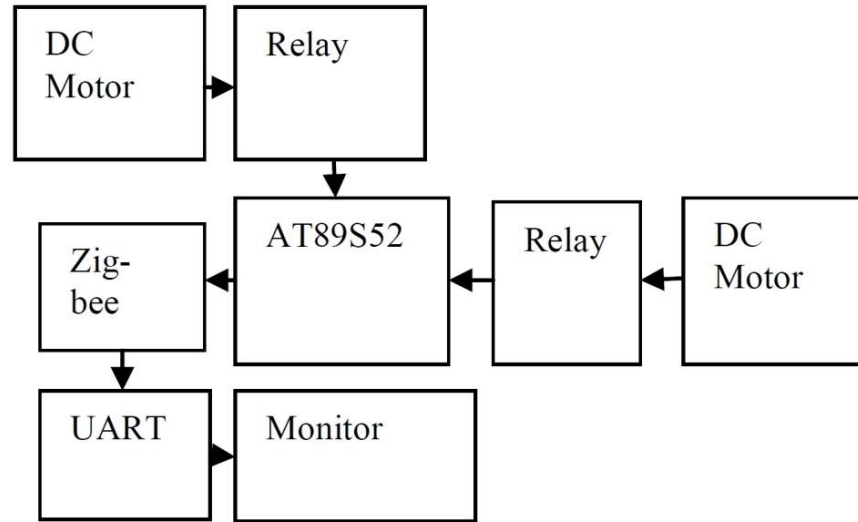
- System requirements
- Specifications:
 - Data received from Zig-Bee
 - User interfaces
 - Ultrasonic sensor data retrieval
 - Video streaming
 - SMS gateway
- Architecture:
 - System



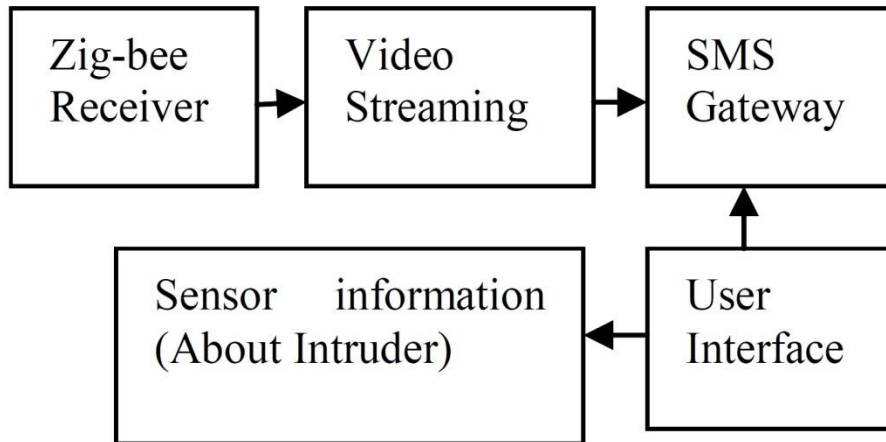
Design Process Cont.

- Architecture:

- Hardware

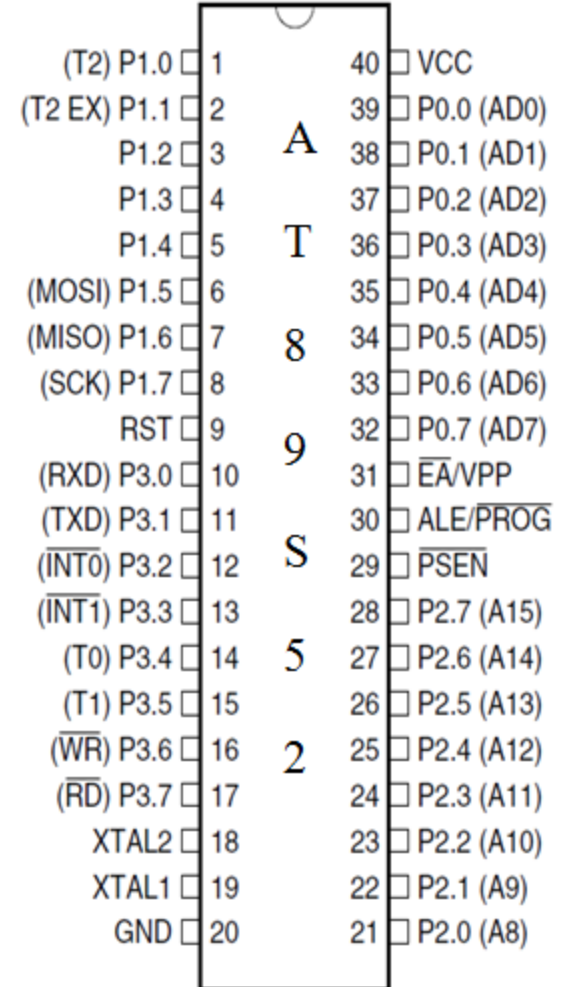


- Software



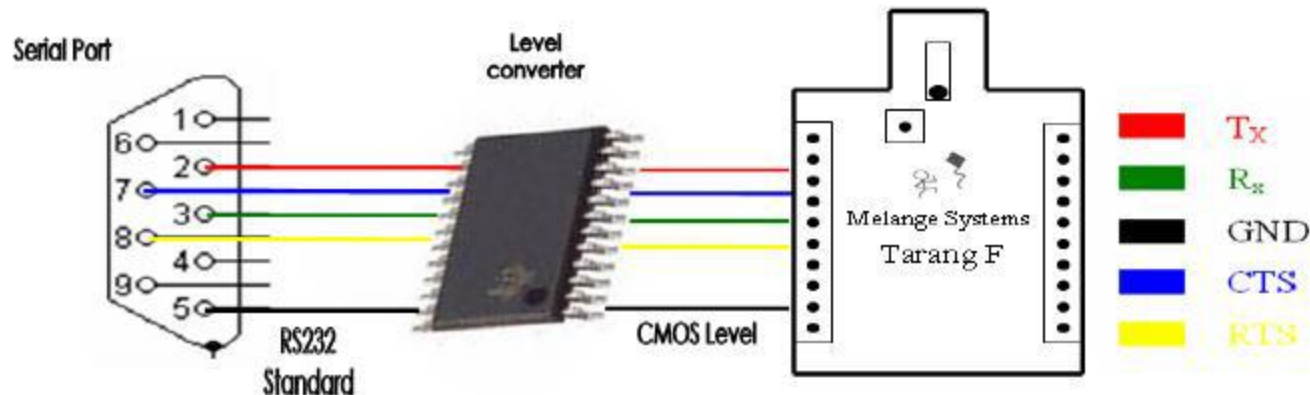
Hardware Description

- Atmel AT89S52 8-bit μ Controller
 - 8K System Programmable Flash Memory
 - 256B RAM
 - 32 Programmable I/O Lines
 - Three 16-bit Counters
 - Eight Interrupt Lines
 - Full Duplex UART Serial Channel
 - 0Hz to 33 MHz
 - Three-Level Program Memory Lock
 - 4.0V – 5.5V Operating Range
 - Low-Power Idle and Power-Down Modes



Hardware Cont.

- PCF8591 8-bit Analog to Digital Converter
 - 4 Analog Inputs
 - 1 Analog Output
 - I2C Serial Bus Interface
 - 3 Address Pins
 - Analog V Range From VSS to VDD
 - On-Chip Track and Hold Circuit



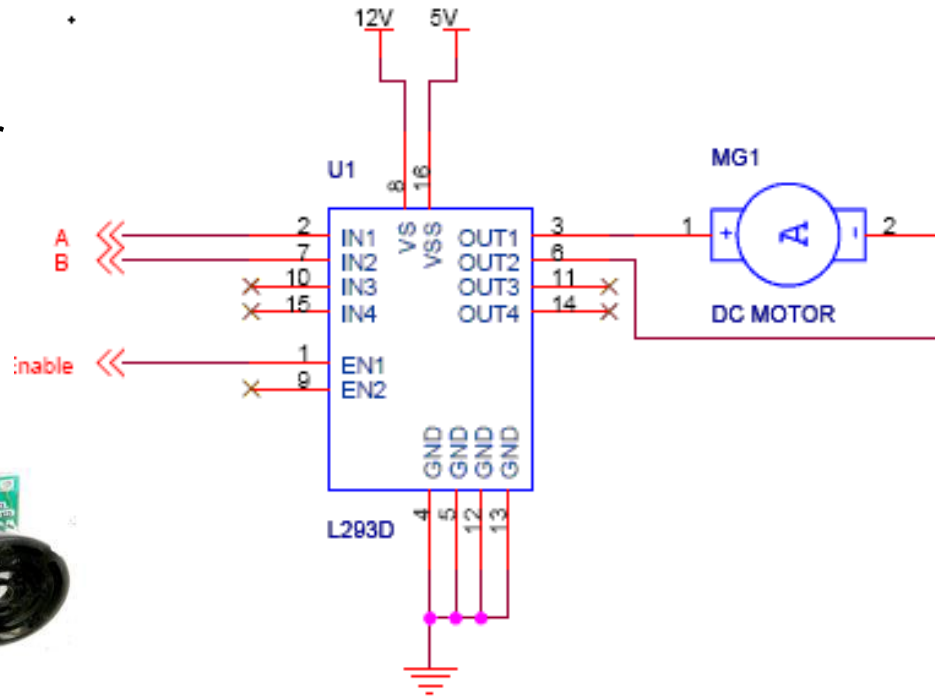
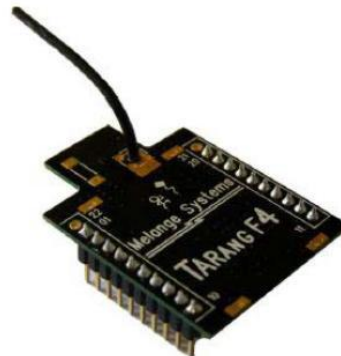
Hardware Cont.

- DC Motor
 - L293D Quadruple Half-H Driver

- Ultrasonic Sensor
 - LV-MaxSonar-EZ
 - 15cm-645cm Range
 - 1" Resolution



- Zig-Bee
 - IEEE 802.15.4
 - WPAN

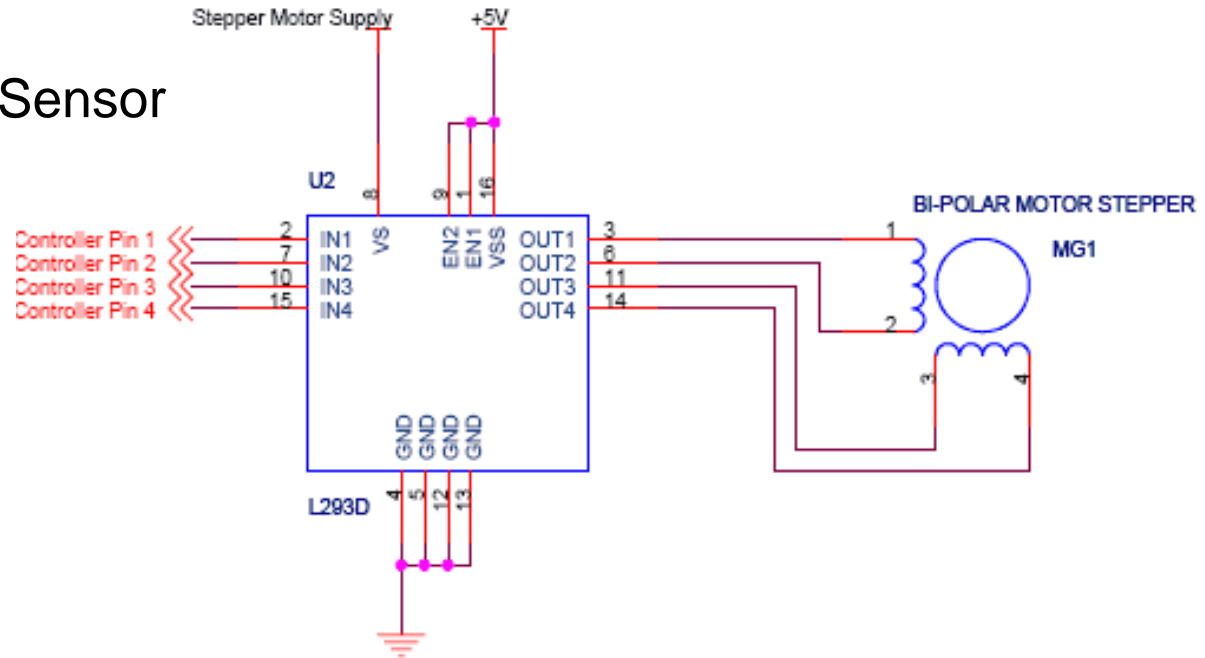


Hardware Cont.

- Relay
 - Switch currents from DC motors
- Stepper Motor
 - Controls Ultrasonic Sensor
- USB Camera
 - Microsoft VX-700
 - 60*80 Resolution
 - 30 fps



[7]

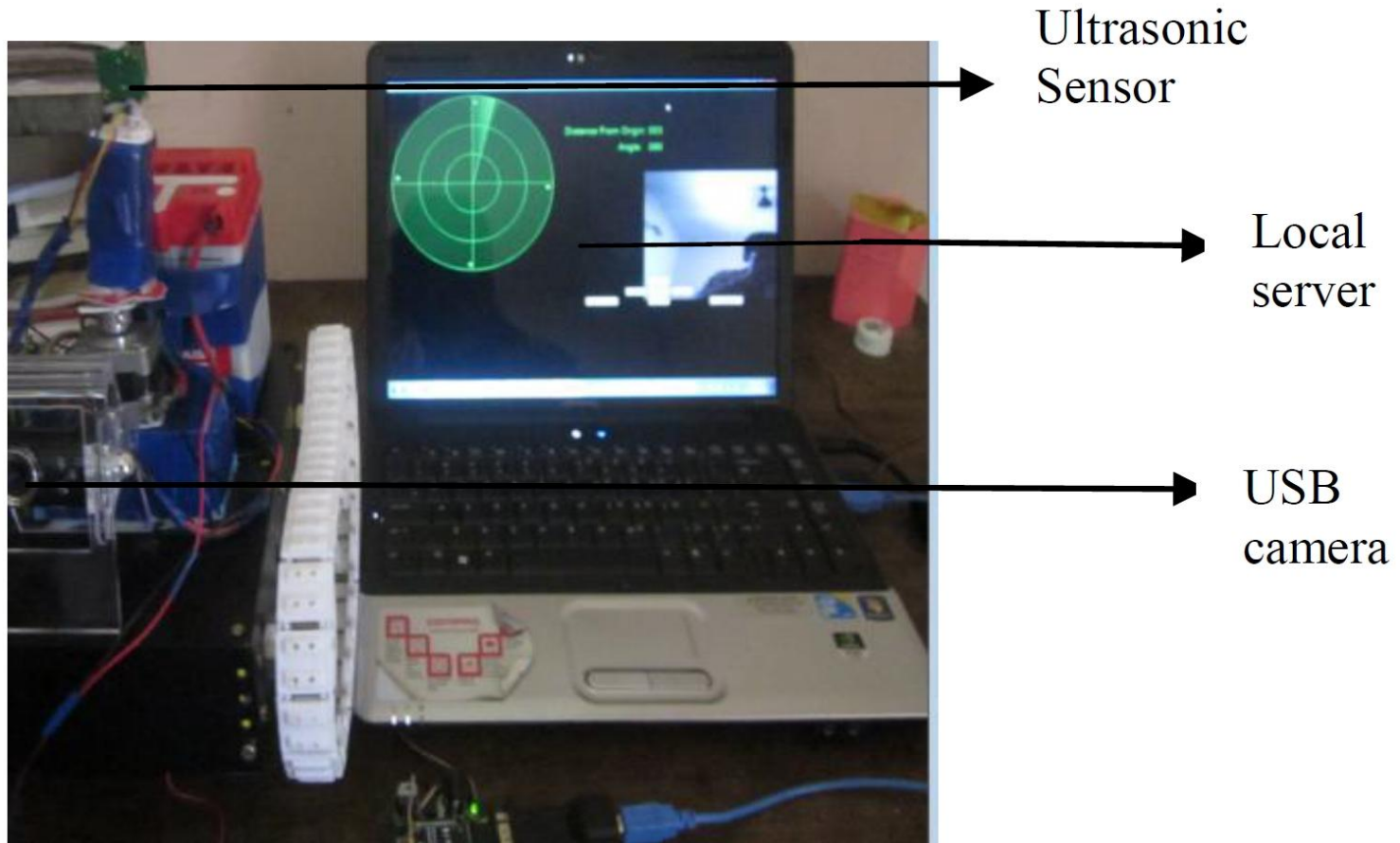


Software

- VideoCapX
 - Fath Software [8]
 - Windows
 - Video streaming on local server
- SMS Gateway
 - Java API
 - Provides SMS alerts
- Embedded C
 - Programming the μ Controller
 - C + Extensions

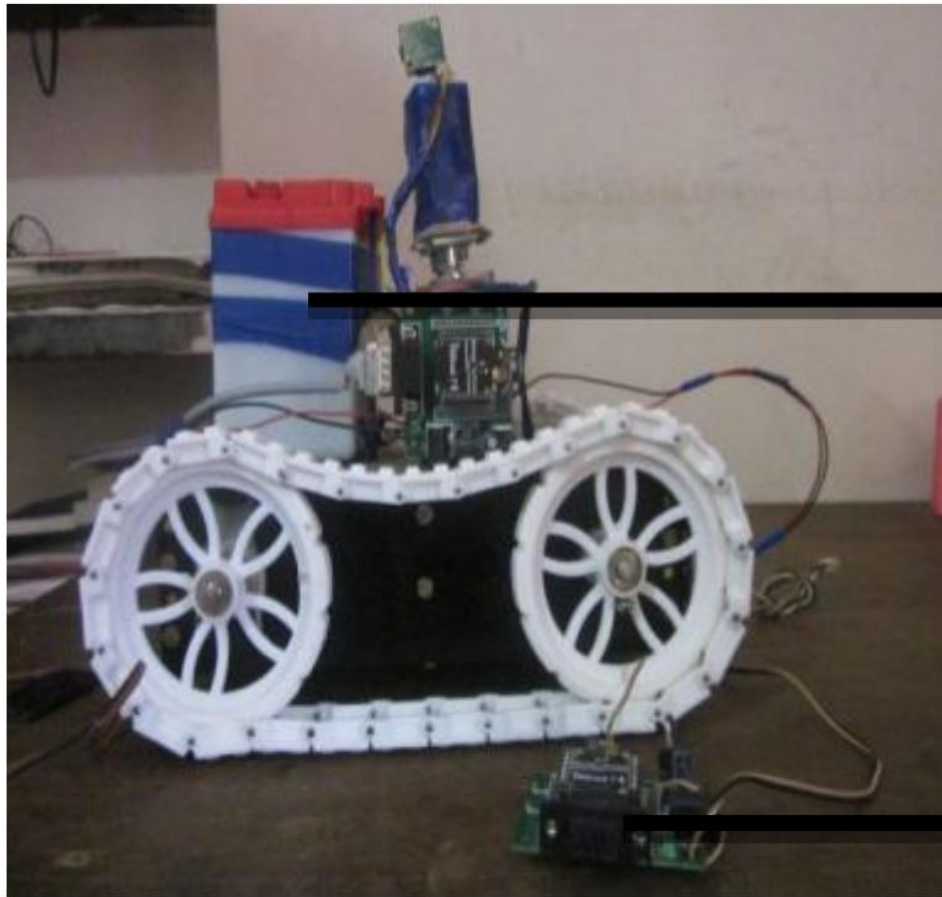
Implementation

- Prototype
 - Full System



Implementation Cont.

- Zig-Bee interface with robot

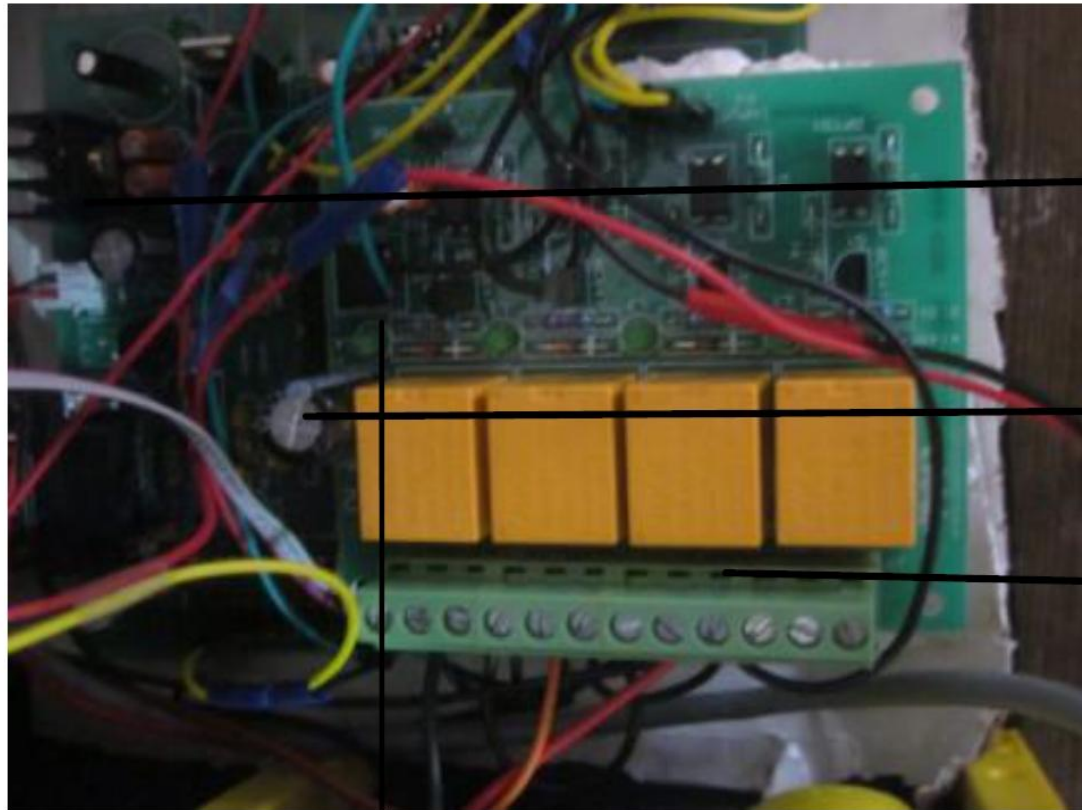


Power supply

Zig-bee

Implementation Cont.

- PCB with components



**VOLTAGE
REGULATOR**

CAPACITOR

RELAY

**MICRO
CONTROLLER**

Conclusions

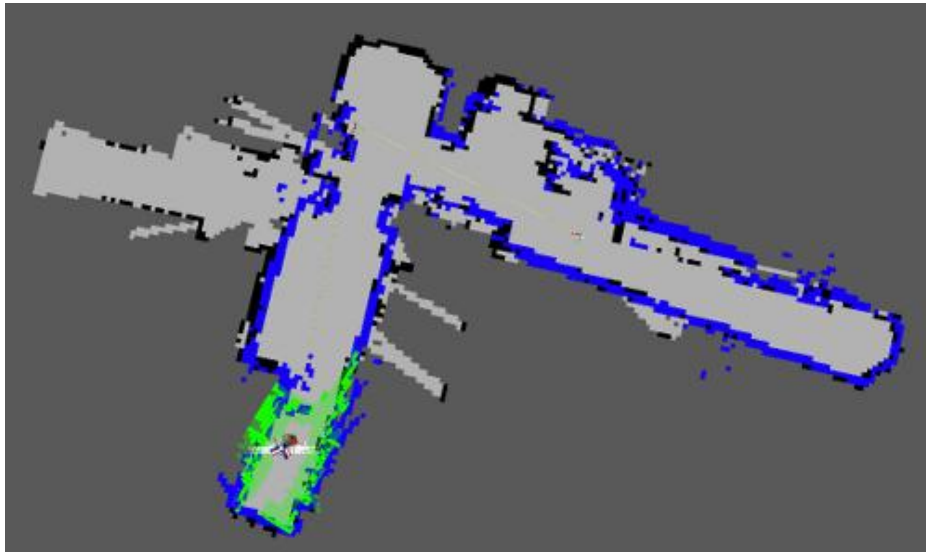
- System successfully detected object
 - Distance and angle to object
- Video streaming
- Worked in poor lighting/complete darkness
- Detected a crawling person at 30m
- System worked with the presence of dust

Future Improvements

- Better quality IP camera
 - IR capabilities
- Control of robot through the web server
 - Autonomous
- Usage of multiple ultrasonic sensors
- Mapping of the environment



[9]



[10]

References

- [1] "Fountain Court, Rochester"http://www.esm.rochester.edu/eroi/images/full_mag_fountaincourt.jpg
- [2] "Sony AIBO"<http://www8.pcmag.com/media/images/94113-sony-aibo-ers-7m2.jpg?thumb=y>
- [3] Bafen Chen, "System to detect the obstacle in unknown environment", 18th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Amsterdam-9 9.6.
- [4] Dong-Won Jung, "Multi-Channel Ultrasonic Sensor System for Obstacle Detection of the Mobile Robot", International Conference on Control, Automation and Systems 2007.
- [5] A.Cherubini, "Development of a multimode navigation system for an assistive robotics project" 2007 IEEE International Conference on Robotics and Automation Roma, Italy, 10-14 April 2007.
- [6] Chidambar Ganesh, "Ultrasonic Sensor-based Motion Control for Robotic Manipulators", Automated Systems Laboratory, Department of Engineering, Colorado School of Mines.
- [7] "Microsoft VX-700 USB Camera"http://www.egully.com/product_images/c/601/Microsoft_Webcam_VX_700_96217_zoom.jpg
- [8] "VideoCapX Fath Soft"
<http://www.fathsoft.com/products.html>
- [9] "Y-Cam IP Camera" <http://store.wirelesscams.co.uk/wp-content/themes/shopperpress/thumbs/YcamKnightIPCamera.jpg>
- [10] "Mappotino: A Robot for Exploration, Mapping, and Object Recognition"
<http://www.athoughtabroad.com/images/31.png>
- [11] "Embedded Controller for Radar based Robotic Security Monitoring and Alerting System". V. Ramya, B. Palaniappan, Subash Prasad. 2012.

