System Requirements Specification
CS308 Embedded Systems Lab

B. Sravan Kuamar (09005046)
S S Chandra Mouli (09005045)
B Kiran Maruthi (09005047)
Sonika Malloth (09005054)
D Venkata Ramana (09005049)

March 2, 2012

Contents

1 Introduction

The document presents a detailed description of our project, Remote controlled robotic arm. It will explain the basic idea and design of the system, hardware and software components and interfaces. The fucntions and technical details of various modules of the system are specified here. We have also tried to give some real life applications of the system at the end, which are possible by extending the project. This document is intended for the developers and users of the system.

1.1 Overview of the project

The basic idea is to allow a user to control a robotic arm from a remote place. The remote control is a mechanical arm with controls for jaw movement of the robotic arm. The user makes the desired movements in the mechanical arm which are replicated in the robotic arm, thus allowing fexible movements of the arm which can be at a considerable distance from the user.

A computer acts a coordinator in between both the arms. The mechanical arm is wired to the computer, while the robotic arm communicates with the computer over a wireless medium. The respective technical details are presented in the following sections.The following link will show the model : http://www.youtube.com/watch?v=58DIp7NblzU&feature=player_embedded

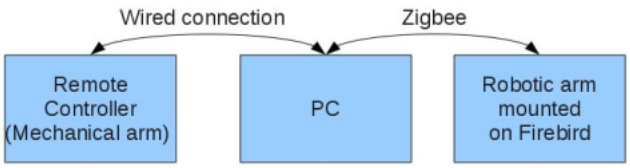

Figure 1: Overview of the Project

1.2 References

1. http://www.youtube.com/watch?v=58DIp7NblzU&feature=player_embedded
2. http://www.nex-robotics.com/products/motors-and-accessories/position-encoder-kit.html
3. http://www.nex-robotics.com/products/motors-and-accessories/position-encoder-kit.html

2 General Description

2.1 System Environment

The remote controlled Robotic Arm has 3 modules. The remote controller module has a mechanical arm similar to the robotic arm. Second module has a PC which coordinates the first and third module. The third module has a robotic arm mounted on the firebird.

2.2 Product Perspective

The movements of the mechanical arm which are controlled by the user are replicated in the robotic arm through this system. The movements of the mechanical arm are captured by the accelerometer and sent to the PC through wired communication.

The PC processes the input from the mechanical arm and translates it to signals using Esterel. Zigbee wireless Interface is used to exchange signals between the PC and the firebird. The arm is actually mounted on the firebird and hence it controls the movements of the arm.

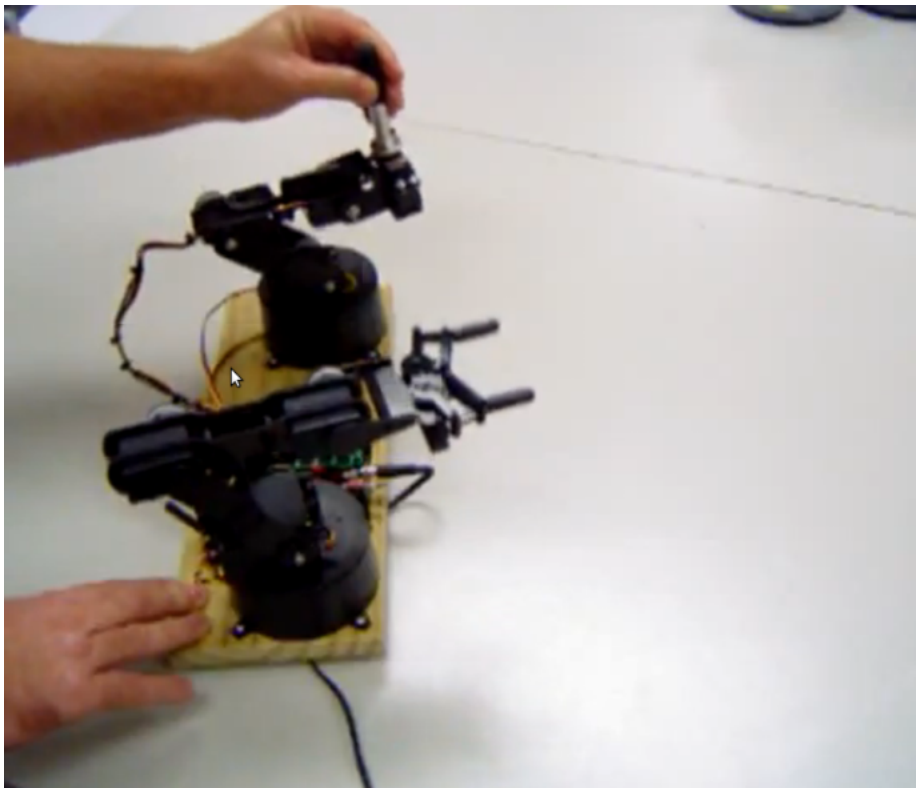

Figure 2: Working model of the project

2.3 Product functions

This section outlines the use cases of the product.

2.3.1 Description

The user interacts with the mechanical arm which acts as a remote control for the robotic arm. When the user desires a particular movment from the arm, he makes a similar movement in the mechanical arm. The jaws of the robotic arm can be opened and closed by the user by a rotating control on the mechancial arm.

On the other hand, the robotic arm replicates the movements of the mechanical arm. Its jaws also react the rotation of the control on the mechanical arm. As soon as the user makes some actions on the mechancal arm, the respective actions will be seen in the robotic arm as well, be it movement or jaw opening and closing.

2.3.2 Step by step procedure

When all the connections are established and confirmed, the following use case can be tested:

1. User makes the desired actions on the mechanical arm.
2. The mechanical arm sends the corresponding data to the computer.
3. The computer analyses the data and generates appropriate commands using esterel.
4. These commands are sent to the robotic arm through wireless communcation.
5. The arm or firebird (in case the arm doesnt have enough hardware to communicate) receives the commands and the motors act accordingly.

3 Details

3.1 Functionality

The system will be designed to develop a wireless communication to control a robotic arm. Using our Remote Robotic Arm Controller System the user can handle the robotic arm far away from him using a mechanical arm. The user replicates the desired movement of the robotic arm on this mechanical arm which would be communicated to the robotic arm through the system. The usability to the system is improved without compromising the ease of understanding the same.

More specifically, this system is designed to allow a user to control and communicate with the arm via remote wireless connectivity. The software will facilitate recognition of the movement patterns of the mechanical arm which inturn are converted to signal the movement of the robotic arm.

3.2 Supportability

3.2.1 Basis for future work

This project will be the basis of more sofisticated human controlled arm which have extensive applications in industrial/minig areas.The robotic arm can be controlled to do dangerous tasks from a safe environment.

3.2.2 Distinguished Modules of the Project

There are three distinguished modules of the project:

1. Remote Controller (Mechanical Arm) to capture the desired input.
2. PC with Esterel signal generation capability for different input commands.
3. Firebird V with ZigBee communication for wireless communication. ...

Any of these modules can potentially be used in other projects requiring their functionality.

3.2.3 Documentation

Documentation in terms of embedded comments and other explicit write-ups will help others in future.

3.3 Interfaces

3.3.1 Hardware Interface

This section states the essential physical equipment required to interact with the application designed. They are as follows:

1. Mechanical Arm with accelerometers to detect the movements of the user.The arm will consist of two or more rods which are connected to each other with the help of a hinge.We need to support the arm manually with the help of our hands.This project is a more crude version of the one shown in the video.An accelerometer(android phone) is placed on each part of the arm.
2. Computer System to coordinate the mechanical arm with robotic arm.
3. A Robotic Arm mounted on the firebird to enact the signals given to it,or simply the arm if it has enough hardware.

3.3.2 Software Interfaces

This section states the requirements to development the application which will use the data feed from the various interfaces and use them to control the robotic arm. They are as follows:

1. Windows 7
2. Atmel AVR Studios
3. Esterel

3.3.3 Communications Interfaces

This section states the requirements to create a communication between various modules of the system. They are as follows:

1. Wired Communication
2. ZigBee Wireless Modules

3.4 Performance Requirements

We don't have an exact idea of the performance requirements at this stage. Maybe at this stage we can say:

1. Mechanical arm : A flexible mechanical arm which can move smoothly.
2. Robotic arm : The robotic arm should be well placed on the firebird so that it can replicate the movements well.

3.5 Quality Control

The accelerometers in the mechanical arm should have the ability to recognize the desired movements of the user accurately. The robotic arm capability might be constrained by the amount of weight and dimensions of the objects it can lift.

4 Risk Management

This section provides the risk management for the project.

The accuracy of the accelerometer is low , that is it gives a 10 degree accuracy and it keeps on fluctuating which can give non-reliable results and causes failures in the system. Solution to the above problem: We plan to give a demo model using the accelerometer which can be done in less time and then use more sophisticated rotatory encoders to find the angle.Link to position encoders : `http://www.nex-robotics.com/products/motors-and-accessories/position-encoder-kit.html`