

Project Proposal

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1. Principle Investigator

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2. Project Title

The project is proposed under the title of:

An Investigation into Mobile and Web-based methods of Interacting with LEGO NXT

3. Statement of the Problem

The NXT is a programmable, intelligent, computer-controlled LEGO brick capable of performing a variety of different operations [3]. The conventional style of programming and interacting with the NXT using the bundled LEGO NXT software is done in a flowchart manner. The purpose of this project is to investigate and implement means of controlling and interacting with the NXT from both a mobile platform and web-based platform and being able to retrieve ambient information of the environment it is in by making use of the included NXT sensors and using third party development tools.

4. Objective of Research

Based on the problem statement, the objectives of this research are:

- Investigate the different programming languages compatible with the NXT
- Interpret NXT sensor readings
- Develop a web interface to communicate with the NXT
- Develop a mobile platform to communicate with the NXT
- Evaluate the above mentioned implementations
- Investigate the efficiency and effectiveness of Bluetooth communications

Possible future objectives or extensions include:

- Integrate a certain degree of autonomy
- Image processing
- Other means of collaboration

5. Background

The LEGO Mindstorms NXT system was released in August 2006 [4]. It replaced the older LEGO Mindstorms Robotics Invention System which was released in 1998 [4]. Most of the research that I have come across thus far is based on the older system. There has recently been a lot of interest in achieving educational and research objectives through the use of low-cost robot kits such as the NXT [2]. In the past, the ability to program robotic applications relied on multiple disciplines. Generally a team consisting of electrical, mechanical and computer engineers were required to build functional robots. LEGO Mindstorms NXT has eliminated this need and allows a computer scientist to work independently [1]. There are a variety of languages and development environments that can be used to program the NXT. These include:

- NXT-G – The bundled software
- LabVIEW Toolkit
- NXC – Not eXactly C

- RobotC
- leJOS
- Microsoft Robotics Studio

6. Approach

The first phase of this project involves becoming familiar with the NXT, its capabilities, sensors and also reading the relevant literature. Understanding and becoming familiar with Microsoft Robotics Developer Studio as well as evaluating some of the other available NXT programming languages will also be done in this phase.

The second phase will be to develop an application to monitor and control the NXT robot using Bluetooth technology. The NXT has built in Bluetooth class 2 support. The application would then need to be extended to serve as a web service so that the NXT robot could be controlled remotely over the Internet.

The third phase of the project will involve controlling the NXT using a supported mobile phone with Bluetooth support, thereby getting the mobile phone to communicate directly with the NXT without the need for a PC. A Java midlet may also be developed to communicate with the web service as another means to interact with the NXT, making it truly accessible and controllable from almost anywhere.

The final phase of the project will include the evaluation of all the mentioned implementations as well as possible extensions such as autonomy.

7. Requirements

Hardware requirements for the project:

- The LEGO Mindstorms NXT system
- A compatible PC
- Bluetooth dongle

- Compatible mobile phone

Software requirements for the project:

- Microsoft Windows XP/Vista (32-bit versions for compatibility reasons)
- Microsoft Robotics Developer Studio
- Microsoft Visual Studio
- LabVIEW
- Other development languages (to be confirmed)

8. Project Progression Timeline

Deadline (approx)	Activity
2 March	Proposal handed in
9 March	Proposal presentation to staff and students
27 March	Become familiarized with the LEGO NXT system
27 March	Develop project website
30 April	Be familiar with Microsoft Robotics Developer Studio and other languages
15 May	Progress towards literature survey
30 May	Literature survey completed
30 May	Initial application prototype developed
30 July	Working application finalized and tested
16 August	Mobile support added
28 August	Evaluation of implementations
September/October	Significant progress in writing of paper and draft submitted
2 November	Final project submitted

9. References

- [1] FESTA, D. *Microsoft Robotics Studio & LEGO Mindstorms NXT*. 2008.
- [2] GREENWALD, L., AND KOPENA, J. Mobile Robot Labs. In *IEEE Robotics & Automation Magazine* (June 2003), pp 25.
- [3] LEGO MINDSTORMS. *User Guide*. The LEGO Group., 2007.
- [4] LEGO MINDSTORMS. *What's NXT? LEGO Group Unveils LEGO® MINDSTORMSTM NXT Robotics Toolset at Consumer Electronics Show*. The LEGO Group., Online, March 2009.