CS 308 Embedded Systems Lab

Course Project Documentation

Power Saver Servant

Submitted in the partial fulfilment of the requirements for the degree of

CS 308 Embedded Systems Lab

By

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Table of Contents

Introduction

1.1 Introduction and Rationale

The purpose of this document is to present a detailed description of Power saver servant. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli.

1.2 The Idea

Energy is crucial factor responsible for human growth and success. In the era where energy resources are failing to provide the day to day need of mankind, it's highly essential to save whatever energy we have. In households, lots of energy is wasted only because of human ignorance, power saver servant serves the need of time; and by saving energy, not only helps to fight the energy crisis but also saves you some money.

This need of saving energy motivated us to come with an idea of Power Saver Servant.

Problem Statement

The aim of this project is to design an autonomous robot which will roam around in any house and detect for energy wastage if any.

Major tasks include:

- To build the hardware system which enables servant to read its environment accurately.

- To build software backend to interpret this data and take logical decisions.

- To build Smart-Switch Hardware as well as software.
    - It is a device which is intermediate between any power source and gadget. Which can control the flow of electricity to the gadget.

- Setting up Wi-Fi communication between Smart-Switch and the servant.

Requirements

3.1 Hardware Requirements

1. Firebird : The locomotive part of Power saver servant.
2. Light Detecting Sensors : To detect presence of ambient light.
3. Motion Detecting Sensors : To detect human presence in any room.
4. Spark-V : To implement Smart-Switch
5. Relay circuit : Component in Smart-Switch
6. Zigbee : For wireless communication between Smart-Switch and the Power Saver Servant.

3.2 Software Requirements

1. AVR Studio : For programming instructions on Power Saver Servant.
2. AVR Bootloader : For burning compiled files on the Servant.
3. X-CTU : For configuration of Xbee modules.

Implementation

4.1 Functionality

Movements:

The servant has to go room to room. It uses white line path for its movements. For any particular sensor configuration servant decides on which path to follow. After completion of one complete round robot moves to the starting position, ready for further commands.

Sensors:

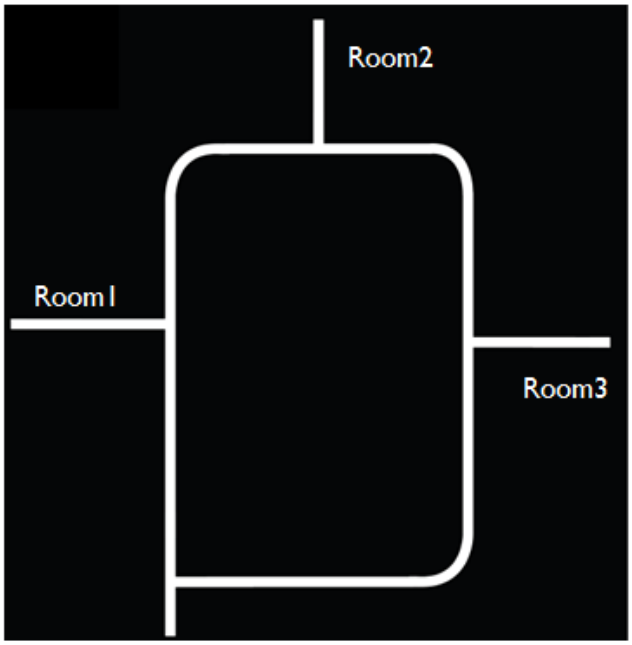
After entering any room, servant has to take an idea about its external environment. Servant uses PIR motion sensor (mounted on it) to detect human presence, if any. It then uses Light sensor if necessary to detect the ambient light. Using these values the servant takes smart decisions.

Smart-Switch:

Smart switch is a hardware unit consisting of µC and X-bee wireless communication module. It communicates with the servant wirelessly. The servant can control the state of any device connected to the smart-switch by sending apt commands via Wireless communication.

Testing strategies and data

5.1 Arena:

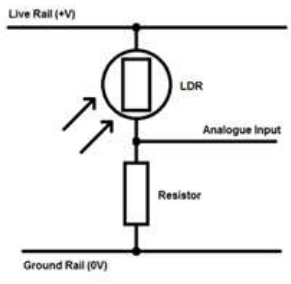


Start

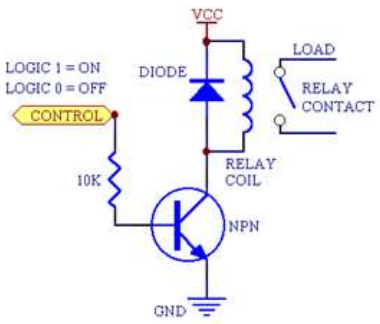
5.2 Accurate sensing of environment:

It's really crucial task of the project as reading data accurately is critical for servant's decisions to get actual sense of the surrounding environment, as falsified data may lead to improper actions.

To get over this, all the sensors are properly calibrated. Series of rigorous experiments are done to decide proper threshold values which can accurately detect environment. Proper delays are introduced wherever necessary.



Light Detection Circuit



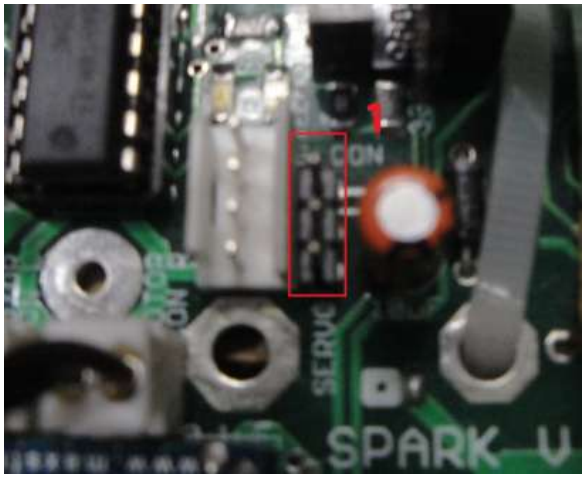
Relay Circuit for Smart Switch

5.3 Building the smart switch

Smart switch is the core part of our project. Its circuit can be seen in above diagram. Smart switch is made up using Xbee module and µC of Spark-V, which is used to control relay. Connections are done on Servo port of Spark-V. Connections can be easily understood in following diagram.

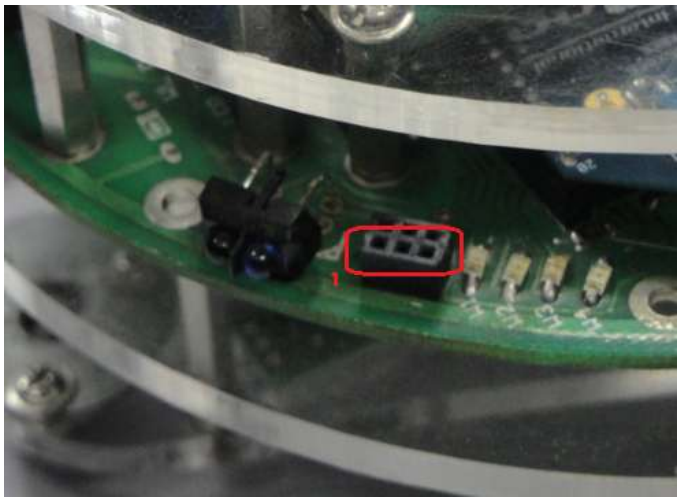
5.4 Connection diagrams

Connection Diagram for connecting Relay circuit to Spark-V



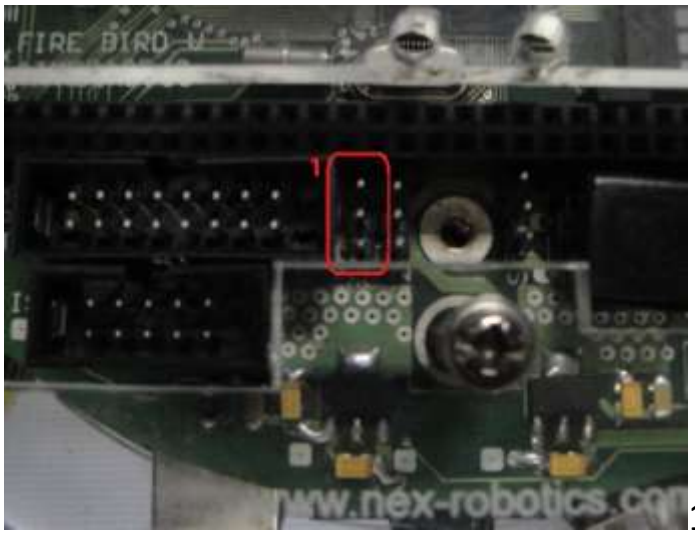
1-> Signal | 2-> Vcc | 3->Gnd

Connection Diagram for connecting light detection circuit on firebird:



1-> Signal | 2-> Gnd | 3->Vcc

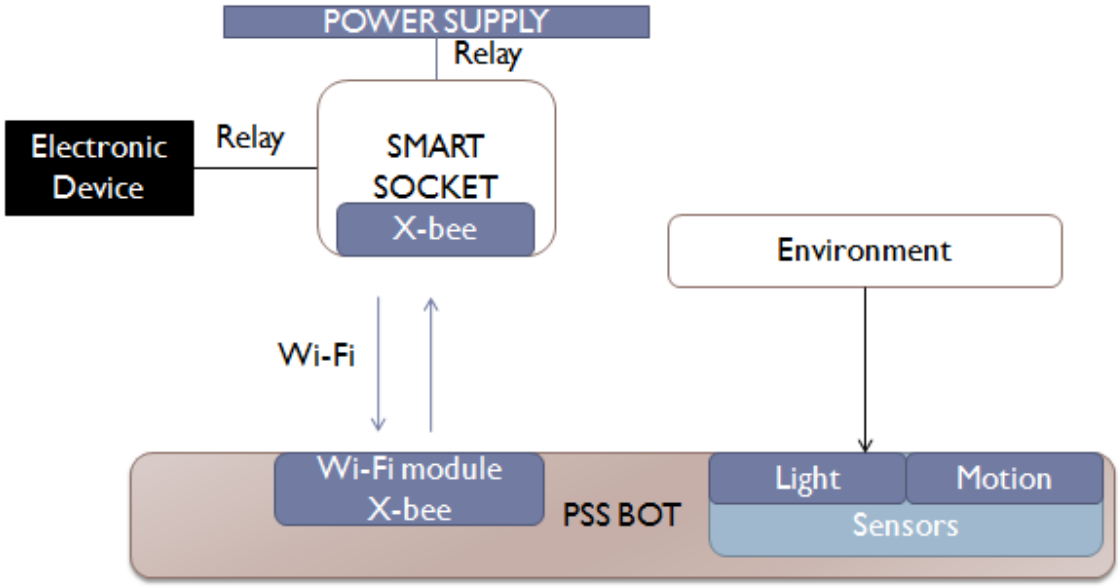
Connection Diagram for connecting light detection circuit on firebird:



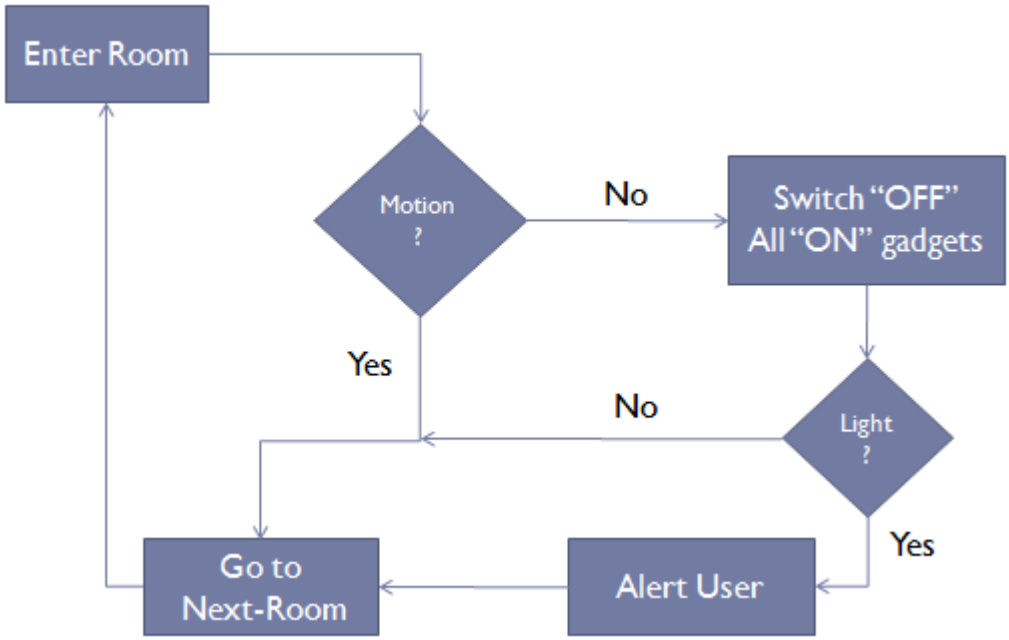
1-> Signal | 2-> Vcc | 3-> Gnd

Discussion of system

6.1 Workflow for the system



6.2 Algorithm followed by Servant



6.3 Plan and Execution

- ✓ Manoeuvring of servant in house.
- ✓ Make the sensor circuits.
- ✓ Calibrate sensors to interpret environmental conditions appropriately.
- ✓ Building the Smart-switch, Hardware as well as software.
- ✓ Setting up wireless communication between the robot and Smart-switch.

6.3 Something Extra

- ✓ Obstacle avoidance.

Future works

7.1 User communication platform

We can implement GPRS based remote communication platform on the robot so user can be alerted about power wastage.

7.2 Smart-Switch Optimisation

If worked upon, Smart-Switch can be used for following purposes:

- ✓ Measuring electricity consumption of any particular device.
- ✓ Estimation of electricity bill.
- ✓ Minimisation of bill using smart scheduling.

7.3 Generic servant implementation

This platform being generic in itself can be used for various servants like applications.

7.3 A Commercial Product

We can actually take Power saver servant to market as it is Compaq , cheap and has tremendous impact on power saving.

Conclusion

Our project can be seen as something than can help in saving electricity at household as well as industrial level. This project can be improvised with advanced sensing and movement technologies and made to be a viable product. Smart Socket which we built on our own can be used for various purposes. It also can be used to create energy profile of any particular household or industry.

The code is generic and can be used by future teams to improvise upon. The modular nature of the code can be of great help especially when someone wants to work with particular module only.

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