Software Requirements Specification

CS101 Course Project – Spring Semester

SELF CHARGING BOT
GROUP CODE - CUSE

GROUP MEMBERS:

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1. Introduction

The purpose of this document is to present a detailed description of a bot that can charge itself with solar power with more efficiency. It will explain the purpose and features of the bot, the interfaces of the bot and what the bot will do the constraints under which it must operate and how the bot will react to external stimuli. This document is intended for both the stakeholders and the developers of the system.

1.1 Definitions, Acronyms and Abbreviations

- **LDR: LIGHT DEPENDENT RESISTOR**

  It is used to measure the intensity of light using resistance.

- **SP : Solar Panel**

  It is used to convert sun's energy into electrical energy.

- **USB** :

  It is used to connect the bot with laptop and burn the program in the bot.

1.2 References

References to the document are -

1) www.electronicshub.org
2) www.e-yantra.org

1.3 Scope of Project

The project bot developed here can have multiple functionalities such as:

- It can charge itself while doing some other functions. Eg: During irrigation if a bot is stationary, it can detect the angle for maximum intensity of sunrays and orient the solar panel to charge itself simultaneously.
- It can charge the battery of itself or external battery.
- With few additional implementations it can charge the mobile phones battery directly by connecting by USB.
- It can be used as master bot whose job is to find the angle of maximum intensity at local time for the small mounted panel and send the angle to other local panels in small region as terrace.

2. Overall Description

The product described in this document is charging bot with solar energy. The bot can generate enough power to charge its battery and the batteries of cell phones, watches that requires maximum of 6V. The basic functionality of bot is to align the mounted solar panel at maximum intensity to light using LDR.

2.1 Product Perspective

ATMEGA 2560: It is the master microcontroller which has been used in the bot.

White line sensors: IR rays are sent by bot which are received by IR sensors if they get reflected from the surface beneath.

Zigbee: It is used to communicate between bot and user.

Servo motors: It is used to align the panel.

LDR: It will detect the maximum intensity of light through its property of variable resistance in varying intensity of light.

2.2 Product Functions

The primary function of bot is to reach the predefined points sequentially, wait there for user defined interval of time. In that time interval, bot will align the panel at an angle in order to receive the maximum intensity of light and charge its battery.

2.3 User Characteristics

User has to define the time interval for which the bot will remain at each predefined point. User can either charge the bot itself or any external battery. Other than these he must have little knowledge of C to input the time interval of charging.

2.4 Constraints

The bot is completely designed to follow few particular path and it can't charge the battery everywhere in its locality. In other words the arena is completely known to bot. User will have to set the time interval for each point. Bot will only follow the white line to reach the desired point. No obstacles should be present on the path defined by the white lines. The solar panel can be aligned only at certain angles due to the fact that minimum resolution of rotation of bot is 4.1 degrees. We can overcome this by using a servo motor which has a better resolution.

2.5 Assumptions and Dependencies

The following is a list of assumptions made about the charging bot that affect the proper functionality of bot:

(a) The region of charging in arena is predefined.

(b) Only a particular path connects all the points.

(c) The maxima will be relative with respect to the measurements obtained by aligning at possible angles only

2.6 Requirements Subsets

The hardware required for the project are:

(a) ATMEGA 2560 Firebird V (Research Robotics Platform)

(b) SP

(c) Two LDR's

(d) An external battery

(e) Two zigbees

(f) Servo Motor

3. Details

3.1 Functionality

The basic function of the bot is that it has to reach every predefined point and charge its battery during the time it stays at the point.

The complete function of bot is:

3.1.1 Getting to a predefined points:

The bot will get information from the pc, using zigbee, about the points that it has to reach and also the duration of time for which it will stay there. By following the white line it will reach there. The arena is shown below.

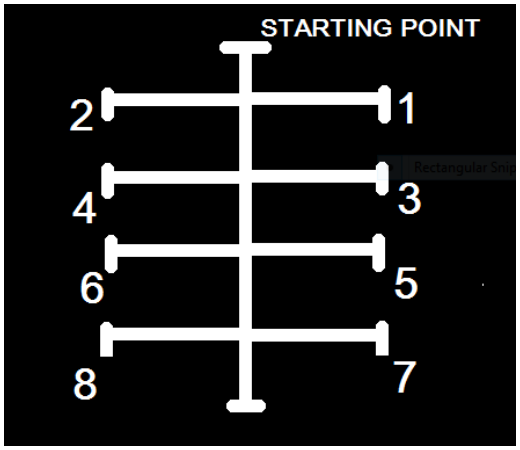


FIG 1: THE ARENA

3.1.2 Aligning the solar panel at maximum intensity:

After reaching to desired point the bot will start checking for the angle of maximum intensity of light at that point. After getting the angle of maximum intensity the panels will get align accordingly.
For achieving the maximum intensity two LDRs are used.

The point of maxima is supposed to reach when the intensity received is equal on both the LDR.
Due to resolution the absolute maxima can't be achieved since the alignment of the panel will always result in some difference in the intensity received at both the panels. Therefore the local maximum is supposed to attain when the intensity difference at both LDR is less than 5% of the minimum intensity. The figure is shown below.

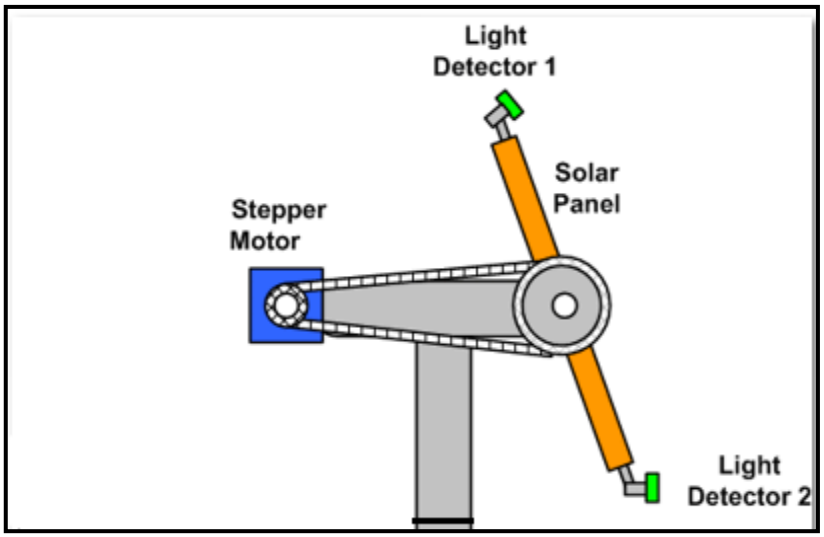
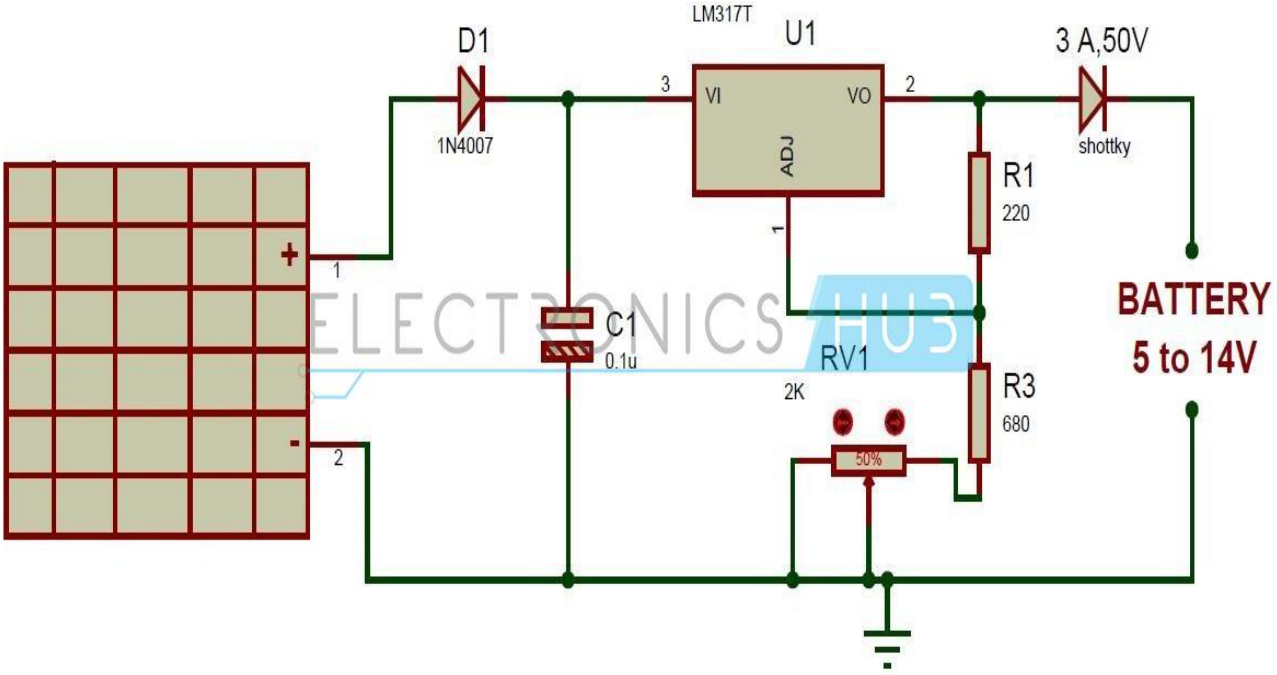


FIG 2: LDR WITH PANEL

3.1.3 Charging the battery:

After detecting the maximum intensity, the connected battery gets charged at a greater efficiency.



Courtesy:www.electronicshub.org

3.2 Supportability

3.2.1 Basis for future work:

1) It can be used in urban agriculture as the bot will self-charge while doing agricultural work.

2) It can be used in missions like mars rover.

3.2.2 Distinguished modules of the project:

1) Programming the bot to follow the white line to reach predefined points using Atmel Studio 6.0

2) Zigbee communication module for wireless communication.

3) Control of servo motor and alignment of panel using Atmel Studio 6.0

4) Maximization of power throughout the entire run of the bot.

Any of the modules can be used in other projects requiring the functionality.

3.2.3 Documentation

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

3.3 Design Constraints

The design constraints of the project are as follows:

(a) Big panels can't be mounted on bot.

(b) The mounted panel can't generate more than 5V due to its small size.

3.4 Interfaces

3.4.1 User Interfaces

Atmel studio 6.0 will be used to set the duration of time. The signals will be communicated to bot through Zigbee.

3.4.2 Communications Interfaces

The command to go to the predefined points will be communicated through Zigbee. Also the data collected by LDR's will be communicated with the user through Zigbee.

3.4.3 Hardware Interfaces

- LDR will be used to detect the maxima of light incident.
- Solar panel would act as a collector for collecting the incident energy.
- Servo motors will help align the solar panel in the direction of maximum intensity.
- IR sensors would be used to follow the white line path to reach the predefined points.
- Zigbee module would act as a communicating device between the user and the bot.

3.4.4 Software Interfaces

- Atmel studio 6.0 will be used to write the code for white line following and aligning the solar panel.
- AVR boot loader will be used to program the designed code into the bot.
- Zigbee will be used to communicate between the bot and the user.

4. Quality Control

4.1 Test Data

1) Movement of bot along the white line to reach the predefined points.
2) The bot will remain stationary at the points for user defined time interval.
3) The bot will align its solar panel as well as itself to detect the maxima of light intensity.
4) The bot will calculate the energy received by it at each point during its stay.

5) Finally the bot will display the total energy harvested during its run.

5. Risk Management

(a) The white line markings may not be proper which can misguide the bot.

(b) Due to external lighting, LDR may not be able to find correct angle for maximum intensity.

(c) The panels may not get aligned at an angle of absolute maximum intensity due to low precision of servo motor.

(d) The source of energy may be too dim to generate enough power.

(e) If the panel is not successful in aligning in every plane, it will be made sure that it aligns in at least one plane properly.

THE END