SHAASTRA CIRCUIT DESIGN CHALLENGE (SCDC)

Green Circuit

BRIEF ABSTRACT

The aim is to build a **Green circuit** that can optimize the energy utilization in a room by avoiding unnecessary energy usage. For the purposes of this contest, you're expected to build a small-scale version of a Green circuit that can be suitably scaled up during actual implementation.

You've to mail a report by September 6, 23:59 hours to scdc@shaastra.org, with "SCDC Report" as the subject-line, clearly describing how you plan to design, build and demonstrate the Green circuit. Some of the details that must be included in the report are described below. Teams sending the **eight** best designs, evaluated on the basis of the reports, shall be shortlisted for the final round of SCDC and invited to demonstrate their designs at Shaastra 2009.

As a compulsory module, you need to build a robust real-time counter that can maintain and display a count of the number of persons in the room. Based on this count or otherwise, you need to come up with innovative ideas and implementations to optimize the energy usage of various electric appliances in the room. You can choose the appliances whose operations you intend to optimize (though you are expected to do some optimization for at least the fan(s) and light(s) in the room). You are also free to decide how to implement and demonstrate your designs for the different appliances you choose (clearly explain them in the report); the closer your demonstration is to the actual implementation, the higher will be your score. You can make any reasonable assumption during your design, but clearly **state** and **justify** all of them in the report.

Please keep in mind that in the report, just ideas stated in words aren't sufficient; you need to provide circuit implementations (schematics/self-explanatory block diagrams) of all your ideas in your report. It's a circuit design challenge, after all!

All participants interested in taking part in SCDC and preparing the report are requested to stay in touch with the event coordinators at scdc@shaastra.org.

DETAILS

The room has a single entrance (through which people enter/exit) as well as all appliances whose energy-utilization you choose to optimize.

A general but important note: Your entire circuit must be built out of fundamental electronic components (e.g., resistors, capacitors, transistors, SCRs, triacs, opamp ICs etc.). You may use simple digital logic ICs (AND, OR, NOT etc.) and flip-flops. Microcontrollers, microprocessors, SoCs or any programmable components cannot be used anywhere in the circuit; this contest is not a software design exercise!

Compulsory requirements

Real-time counter and Motion detector

The Green circuit must include a real-time counter + motion detector module. The motion-detector should be able to detect the direction of travel (i.e., whether a person is entering or leaving the room) and accordingly, increment or decrement the count. The counter should maintain and display a count of the number of people currently present in the room.

Extra points shall be awarded to designs that perform better in distinguishing actual entry/exit from fake movements (e.g., waving of hands in front of the detector).

Suggestive ideas

The following ideas are just suggestions regarding ways to optimize the energy-utilization of light(s) and fan(s) in the room; just to get your thought-process kick-started. You may choose to implement the following ideas or come up with your own ideas and implement them (if you think they are better) or do both. Needless to say, more the number of appliances whose operation you optimize and better the optimization technique & implementation, higher will be your score.

Light-controller + Ambient light detector

In order to avoid unnecessary usage of light-sources (say, a bulb, for the purpose of demonstration), your design can include a bulb controller + ambient light detector.

The ambient light detector module should be able to detect the ambient light intensity and provide an input to the light-controller to control the operation of the bulb. For demonstration, you can, for example, demonstrate three types of operation - (1) Bulb is OFF during bright ambient light (2) Bulb is ON (glows with full brightness) during no (or low) ambient light (3) Bulb is DIM during an intermediate ambient light intensity.

You can also make the light-controller ensure that the bulb turns OFF when the last person leaves the room and that the bulb glows only if there's at least one person in the room.

Fan-controller

Assume that you're permitted to save energy by limiting the maximum rotational speed of the fan on the basis of the number of people in the room, i.e., you can limit the fan to rotate at (say) 60% of the speed set by its regulator when there's just one person, 80% when there're two persons and 100% when there are 3 or more persons in the room.

For the purpose of demonstration, you can build a controller which can be placed in between the AC mains & (say) a table fan and which can control the speed of the fan based on the number of people in the room, as determined by the real-time counter.

You can also make the fan-controller ensure that the fan turns OFF when the last person leaves the room and that the fan rotates only if there's at least one person in the room.

EXTRA CREDITS

Extra points shall be awarded for:

- including extra mechanism in the motion-detector for distinguishing actual entry/exit from fake movements (e.g., hand-waving in front of the detector).
- building the circuit from as fundamental components (transistors, resistors, capacitors, opamps, simple digital logic ICs like AND, OR, NOT, flip-flops etc.) as possible (for e.g., building the counter using flip-flops and timers rather than using an Up/Down counter IC straightaway).
- implementing additional ways of optimizing the energy usage of fan(s)/light(s) other than those mentioned in 'Suggestive Ideas'.
- implementing methods for optimizing energy-usage of appliances other than fan/light.
- building and demonstrating the Green circuit on PCB(s), rather than breadboard(s).

WHAT SHOULD THE REPORT CONTAIN?

As mentioned in "Brief Abstract", you've to mail a report by **September 6, 23:59 hours** to scdc@shaastra.org, with **SCDC Report** as the subject-line, clearly describing how you plan to design and build the Green circuit. Your report must contain the following:

- A cover page with the following details clearly mentioned:
    - **Names** of team-members (Note: A team can have a minimum of 2 and a maximum of 4 members, from the same or different institutions)
    - Institute **roll numbers**, **departments/branches** and **institute-name(s)** of each team-member
    - **Contact details** (phone numbers and/or email IDs) of each team-member
- A detailed description of how you plan to **design**, **implement** and **demonstrate** the real-time counter + motion detector
- A **list of appliances** whose energy-usage you choose to optimize, your ideas on **how to optimize** the usages and **the ways you intend to demonstrate** the implementation of each of them
- Any (reasonable) **assumption** made about the room and/or context of operation and **justification(s)** for each
- **Circuit schematics** or **self-explanatory block diagrams** (in case you're not able to design the schematics within the deadline) for implementing **all** ideas that you describe for optimizing the energy usage of the different appliances. Ideas without circuit implementations (schematics/block diagrams) will not be credited.

RULES AND REGULATIONS

- Each team should consist of a minimum of 2 and a maximum of 4 team-members. All team-members needn't be from the same institution. Only college students with a valid ID card are eligible to participate.
- The Green circuit MUST implement **all** descriptions provided in the **Compulsory Requirements** section of the problem statement.
- The design should NOT use microcontrollers, microprocessors, SoCs or any other programmable component anywhere.
- The short listing of **eight** teams for the final round of SCDC shall be done solely on the basis of the reports submitted before the deadline.
- Only one report shall be accepted from each team. A team can re-send its report as many times as it wishes (in case, it discovers any errors in the previous report(s) or comes up with a better idea/design); however, the last report received before the deadline shall be deemed as the final report.
- The details of the final round of SCDC shall be explained to the finalists once the short listing is done.
- In case of any discrepancy, the decision of the event coordinators shall be final in all respects.

TIPS

- Attempt to build your circuit as neatly as possible. Arranging components perpendicular to one another on breadboard/ PCB and using similarly-colored wires for similar purposes is advised.
- Use bypass capacitors on DC supply lines.
- Use relays, SCRs and/or other suitable components to interface the controller modules with the AC mains, wherever required (for e.g., see "Suggestive Ideas" >> "Fan Controller")
- If you choose to build your circuit on breadboard, do some floor-planning of the breadboard before you start wiring up components. If you need to use multiple breadboards (which you'll need to do, most likely), divide the different modules of the Green circuit logically so that you don't have too many connections between the breadboards.
- Do not assemble the entire circuit and try to test it. Build and test each module, then connect them together one by one and verify that it works after each step.
- For standing a better chance to qualify for the finals, in addition to implementing the ideas suggested in "Suggestive Ideas", try to come up with at least one or two more ideas to optimize the energy usage of fan(s), light(s) or any other electric appliance.

REFERENCES

We found this to be a very good source of reference. This is another good source of information. Here are some other good references to get you started:

Person Counter

Motor Speed Control Circuits

Light Sensor Circuits

How to prepare a PCB?

CONTACT

Contact scdc@shaastra.org for any queries, clarifications, suggestions etc.!

ALL THE BEST

See you at Shaastra 2009!