

NeoPixel Sunrise Clock

An intelligent bed lamp



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Declaration

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the IEEE convention for citation and referencing. Each contribution to, and quotation in, this report from the work(s) of other people has been attributed, and has been cited and referenced.
3. This report is my own work.
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Acknowledgments

Abstract

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Chapter 1

Introduction

1.1 Background to the study

The human behavioural and anatomical activities are influenced by several internal cycles. One of these cycles, the **circadian rhythm** has been studied for many years and its impacts on the human activity has led to new interests in regulating these activities. Formally defined as a "*cyclical changes in hormones, body temperature, and other biological processes over the course of a 24 hour period*" [1], the **National Institute of Health (NIH)** defines it as "*a physical, mental and behavioural changes that follow a roughly 24-hour cycle, responding primarily to light and darkness in an organism's environment*"[1]. The circadian rhythm plays an important role as it also affects the human sleeping and rising pattern. The circadian rhythm is influenced by the production of *melatonin* produced by the *pineal gland* whose activities are dependent on the presence of light on the *retinal-hypothalamic tract*[3]. These studies have shown that the presence of light with specific wavelength at certain period of time during a day can affect the normal sleeping cycle.

According to the NIH, there is a correlation between long-term health problems and sleep disorders [6]. While stress levels and lifestyles affect the sleeping pattern, there is strong evidence that light has a greater effect. With the invention of the electric light and the recent human exposure to LED screens, humans have more exposure to light. Recent researches have shown that the usage of LED technologies at night is linked to sleep deficiency. Blueish light is said to have a huge impact on one of the human internal clocks. Sleep deficiency due to inappropriate light exposure can be cured using an optimal light exposure. Researchers were able to quantify, qualify and time the light that is suitable to maintain the natural sleep-awake cycles [2]. With these results, it is possible

to create an environment that will follow user specific light requirement needed to treat patient with sleep disorder.

1.2 Objectives of this study

1.2.1 Problems to be investigated

This project investigates the feasibility of making user friendly embedded system, relatively cheap that could be used as a personal medical device in solving human sleep disorder.

1.2.2 Purpose of the study

The purpose of this study is to create a device that can be used to improve the user's sleeping pattern and to create a user friendly and personalisable digital alarm clock. The product would need to be relatively cheap and have more features than its competitor. Ideally, the NPSC would use medical lighting requirements and patterns for its users in order to be used as a personal medical device in the cure of sleeping disorder.

1.3 Scope and Limitations

The scope of this project involves the design of an functional embedded system named **NeoPixels Sunrise Clock** also known as **NPSC**, capable of producing light of $460nm$ with an intensity of $30lux$ as mentioned by the paper "*Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor*". The code and design artefact repository and a full documentation including a user manual, for anybody who wants to make use of the code design resources, also need to be delivered. Moreover, a description of future use of the device in the study of the effect of light on the circadian rhythm will be required.

This project does not study the effect of light on the users. For ethical reasons, the NPSC will not be tested on human subjects in real situations of either waking humans or including lighting to facilitate sleep at night. Instead the system will be tested based on the recommendation from the research literature.

The design and creation of the NPSC is subject to several constraints listed below:

- **Time:** The project has a duration of 12 weeks within which the research, design, development, implementation, verification, and report writing need to be done.
- **Money:** The project budget allocation is **R1000**
- **Light:** The NPSC must be able to produce blue light with wavelength of $460nm$ while providing enough light to meet the requirement of the research paper and provide a various range of colour for sunrise simulation. These requirements narrow the options for choosing the right light emitters.
- **Size:** The NPSC is meant to be a bedside lamp, this implies that it should have a relatively small size to be able to fit on a $50cm * 50cm$ bedside table.

1.4 Plan of development

The project was broken into sections and subsections with an estimated timeline. The *Gantt Chart* used for this project is shown in Fig.1.1. The project started with the an intensive research on the science related to the human sleeping cycle. The research lead to the design of the NPSC consisting of its hardware and software modules. During the manufacturing process, the software framework of the NPSC was continuously improved. The NPSC hardware and software integration were done later after the assembly of the hardware. Finally, the software was improved during the remaining lifetime of the project.

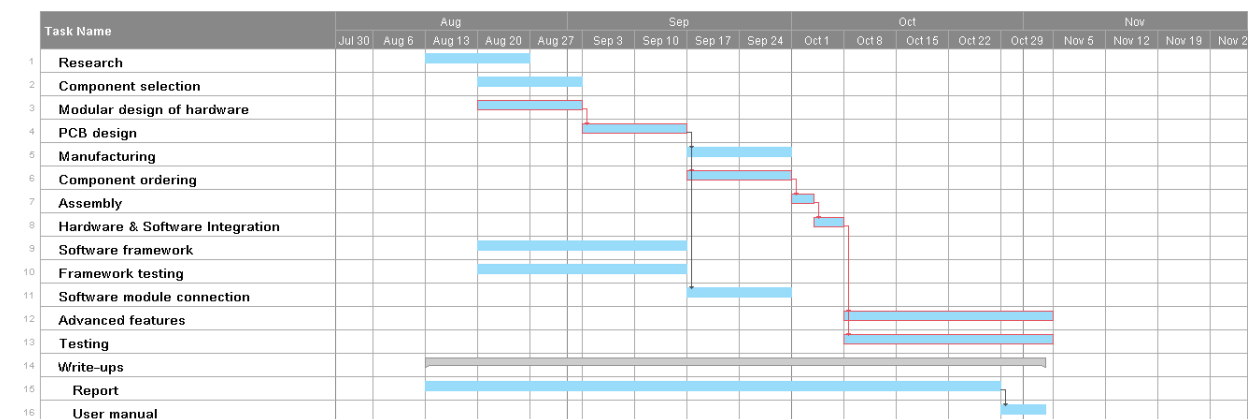


Figure 1.1: Gantt chart showing the timeline of every task in the project as well as its critical path.

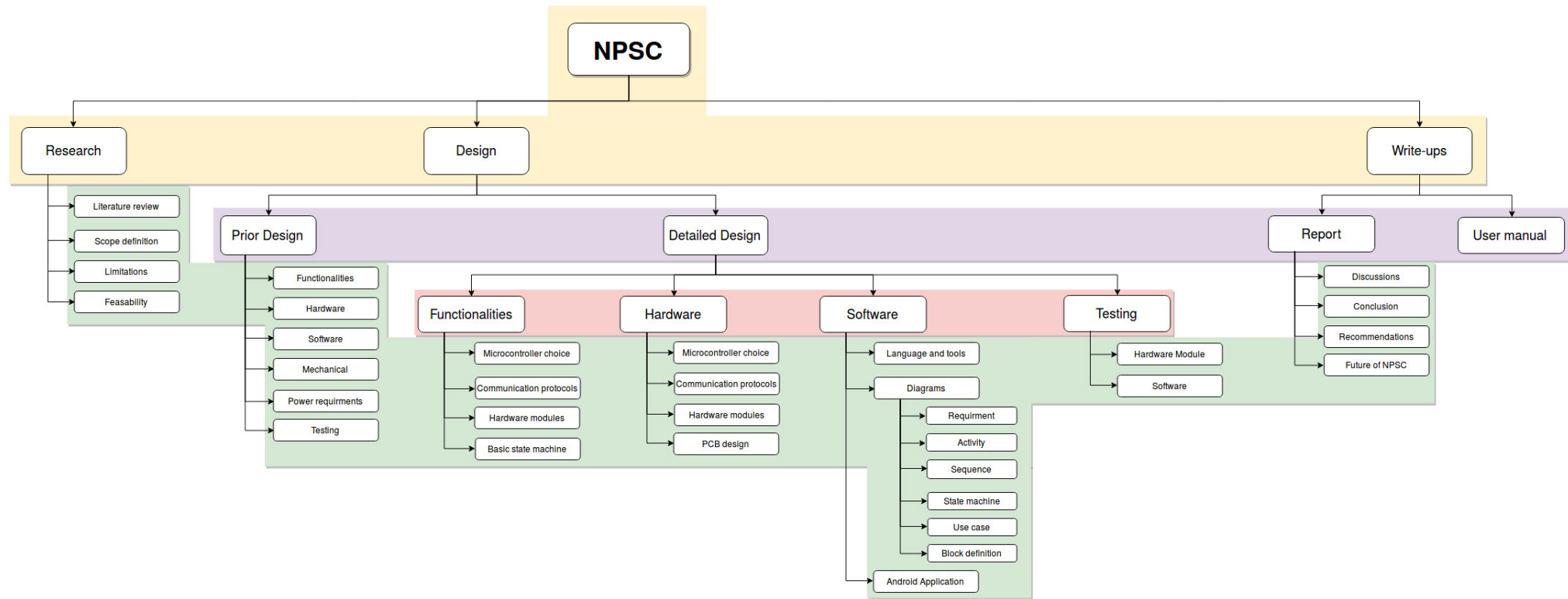


Figure 1.2: Report breakdown detailing the different sections needed to be included in the report.

1.4.1 Chronological progression of the report

The report organisation is displayed in fig.1.2. The sections of the report are explained below:

- **Research**

- **Introduction:** The feasibility of the project as well as its scope and limitations are defined in the introduction.
- **Literature Review:** The literature review gives an insight in the researches made for this project. This includes scientific discoveries on the human sleeping cycle, experiments and results performed by researchers on that matter, and some technical engineering design decisions.

- **Design**

- **Methodology:** This section covers the hardware, software, and mechanical design of the NPSC.
- **Results:** This section displays the results of the hardware and software testing.

- **Write-ups**

- **Discussion:** The analysis of the results obtained. Here, the performance of the NPSC is evaluated. A costs and functional analysis of NPSC done to evaluate its performance compared to its competitors. Moreover, the future use of the NPSC is elaborated.
- **Conclusion:** An evaluation of the project, did we achieve the intended goals.
- **Recommendations:** We dive into the solutions or recommendations that could improve the design of such device.
- **User manual:** This section is for any users of the NPSC. It provides a clear explanation of the features of the NPSC and a detailed manual.

Chapter 2

Literature Review

Once upon a time engineers and researchers believed... In this area of research, they used the following methods... [?]

Write this section first as it will take you the longest. I suggest you start writing this as soon as you have done your initial research at the beginning of your project. You can then return to it once you have completed your work to edit and adjust it.

A literature review forms the theoretical basis of your project. You need to read a large number of journal papers, sections in books, technical reports etc. relevant to your work at the start of project. This will give you a good idea of the field of research.

When writing your review start of with the general concepts and move to the more specific aspects explaining the necessary theory as you go. This section is NOT a copy and paste from others work or a rewrite-but-change-one-word section. I suggest you read all your material, and then put it down and write this section, referring back to the work only when you need to check something.

See your PCS textbook for more details on how to write a literature review.

If you include a figure or a table in your text please see the example in Fig. 2.1 as to how to caption it. Please make sure that all text in your figures is readable and that you reference your figures if they are from another source.

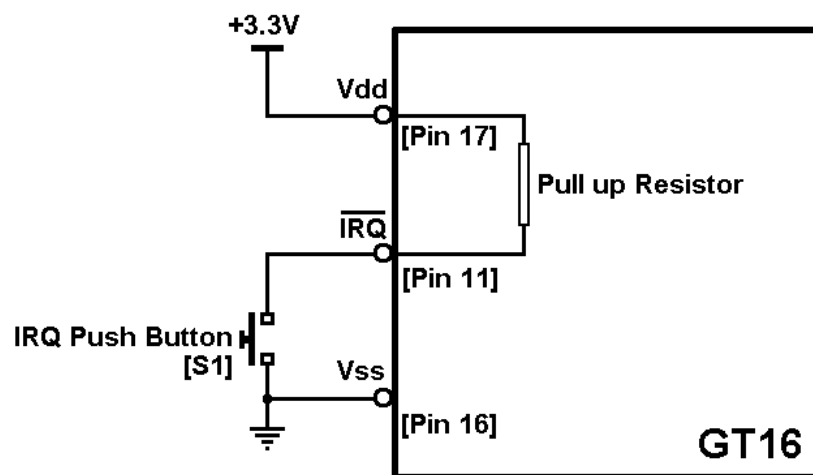


Figure 2.1: A block diagram illustrating the connections to the IRQ pin on the MCS08GT16A microcontroller (Please note that your headings should be short descriptions of what is in the diagram not simply the figure title)

Chapter 3

Methodology

This is what I did to test and confirm my hypothesis.

You may want to split this chapter into sub chapters depending on your design. I suggest you change the title to something more specific to your project.

This is where you describe your design process in detail, from component/device selection to actual design implementation, to how you tested your system. Remember detail is important in technical writing. Do not just write I used a computer give the computer specifications or the oscilloscopes part number. Describe the system in enough detail so that someone else can replicate your design as well as your testing methodology.

If you use or design code for your system, represent it as flow diagrams in text.

Chapter 4

Results

These are the results I found from my investigation.

Present your results in a suitable format using tables and graphs where necessary. Remember to refer to them in text and caption them properly.

4.1 Simulation Results

4.2 Experimental Results

Chapter 5

Discussion

Here is what the results mean and how they tie to existing literature...

Discuss the relevance of your results and how they fit into the theoretical work you described in your literature review.

Chapter 6

Conclusions

These are the conclusions from the investigation and how the investigation changes things in this field or contributes to current knowledge...

Draw suitable and intelligent conclusions from your results and subsequent discussion.

Chapter 7

Recommendations

Make sensible recommendations for further work.

Use the IEEE numbered reference style for referencing your work as shown in your thesis guidelines. Please remember that the majority of your referenced work should be from journal articles, technical reports and books not online sources such as Wikipedia.

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Appendix A

Additional Files and Schematics

Add any information here that you would like to have in your project but is not necessary in the main text. Remember to refer to it in the main text. Separate your appendices based on what they are for example. Equation derivations in Appendix A and code in Appendix B etc.

Appendix B

Addenda

B.1 Ethics Forms