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To Development of Driver Sleep Detection and Alarming System to Prevent Road Traffic Accident

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Abstract:

Feeling sleepy while driving could cause a hazardous traffic accident. However, when driving alone on the highway or driving over a long period of time, drivers are inclined to feel bored and sleepy, or even fall asleep. Nowadays most of the products of driver anti-sleep detection sold in the market are simply earphone making intermittent noises, which is quite annoying, and few of the cars that are sold in the Indian market having sensors for auto braking system for the safety of the driver and the passengers are quite expensive for a Indian middle class person to afford and quite heavy on the pockets. As such, there is a high demand for cheap and efficient driver sleep detection. Therefore, we came up with an idea and successfully developed a sleepy detection and alarming system, which could effectively meet this demand.

Keywords : Road Traffic Accident, Driver Sleep Detection, Sleep Alarming System

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Introduction

The goal of this project is to develop a system that can accurately detect sleepy driving and make alarms accordingly, which aims to prevent the drivers from drowsy driving and create a safer driving environment[1-2]. The project was accomplished by a glass which is worn by the drivers constantly while driving, a sensor on the glass that always has a watch on the iris of the eye processing algorithm of sleepy detection[3], a feedback circuit that could generate an alarm and a power supply system and an ***Arduino and a relay motor*** [4].

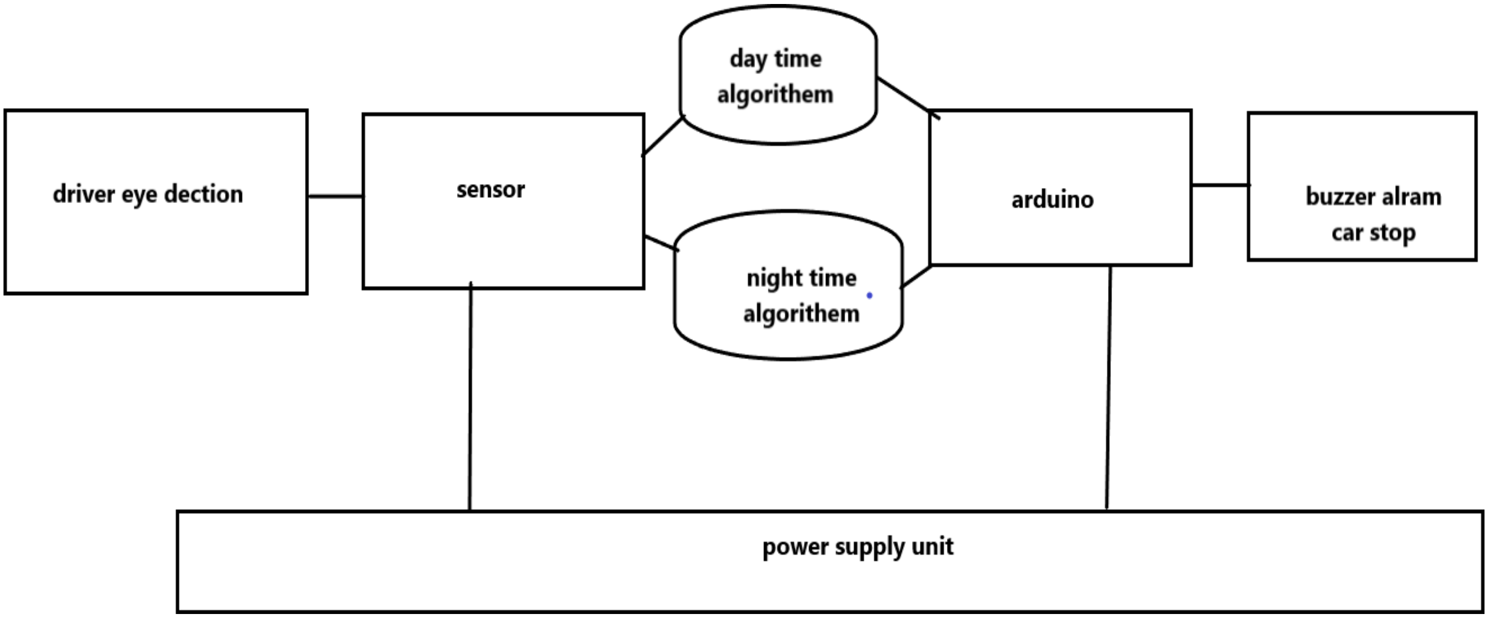

Figure 1. The systematic level block diagram

Design of Project

General design alternatives

The first alternative design between the final implementation and the initial plan, was the choice of the glasses. We desired to use the white glass shade instead of dark shade glass because of the late night time so that Driver can see in night without any shade barrier , because we have gone for the white shade glasses even the drivers who have a weak eyesight can choose these lens as their driving partner because mostly the power glasses have white shade , not only white shade glass help the driver to see in the night but also help us to get an accuracy of 97% in night time which is pretty much near to daytime accuracy that is 99% . The accuracy is pretty high. Another advantage of using a white shade glass is that they are much cheaper than the other shade glass.

A normal white shade glass will cost you around 100 rupees to anywhere around 1000 rupee. Another alternative is the adding of the battery. In order to meet the rigorous requirement of power supply of Arduino board[5], a lithium-ion battery is used intermediately[6]. This alternative solution makes the product more portable and sustainable since the Battery can be easily and constantly removed[7].We have also provided a charge socket to the battery which can be charged by a dc power converter which can be supplied by a cigarette power jack installed on the car, which turns this alternative into an advantage[8].

Simulation Circuits Schematic and Calculation

Cadence simulation of switching regular

The first stage simulation was done in Spice for the TI 61030 dc-dc regulator[9]. The recommended inductor and capacitor value is calculated. Afterwards, due to the real application requirements, the design used both the TO 61030 boost dc-dc converter and TI 2679 buck dc-dc switching regulator in a later phase [9]. The figure shows the prime simulation for TI 610303 boost converter. There are tally 5 simulations finished and three of five are shown from figure 3 to figure5. The input power supply is changed from 1.8V to 5V to simulate the extreme conditions. A sinusoidal function generator is used to emulate the high frequency noise possible delivered from car charger inverter[10].

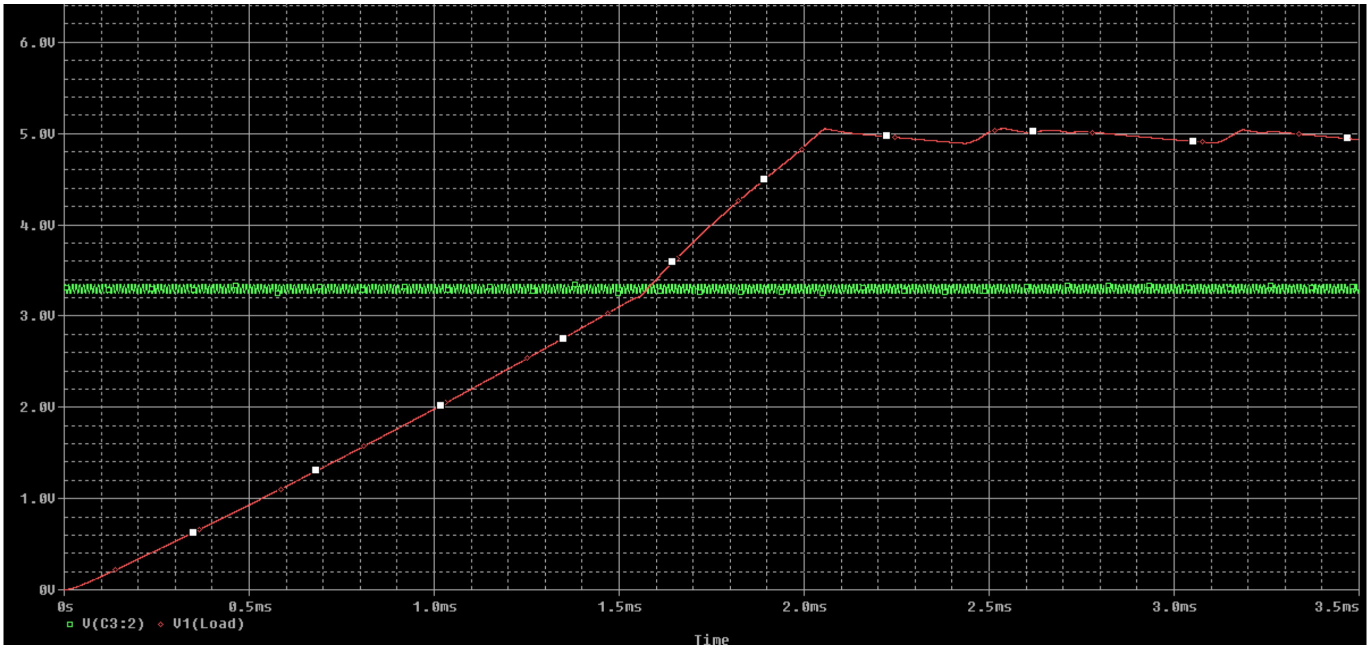

Figure 3.The voltage output (Red) while the input is at low value 3.3 V with small noise with magnitude 0.1 V (Green).

As the graphs show, the output from the chip can be stabled at 5V regardless of the noise and the input voltage value. Moreover, the noise of the signal is filtered apparently in the output. The simulation is conducted with a load approximated 10 W. The figure 6 and figure 7 shows the simulation circuit schematic for both TI 61030 and TI 2679-5.0 dc-dc switching regulators.

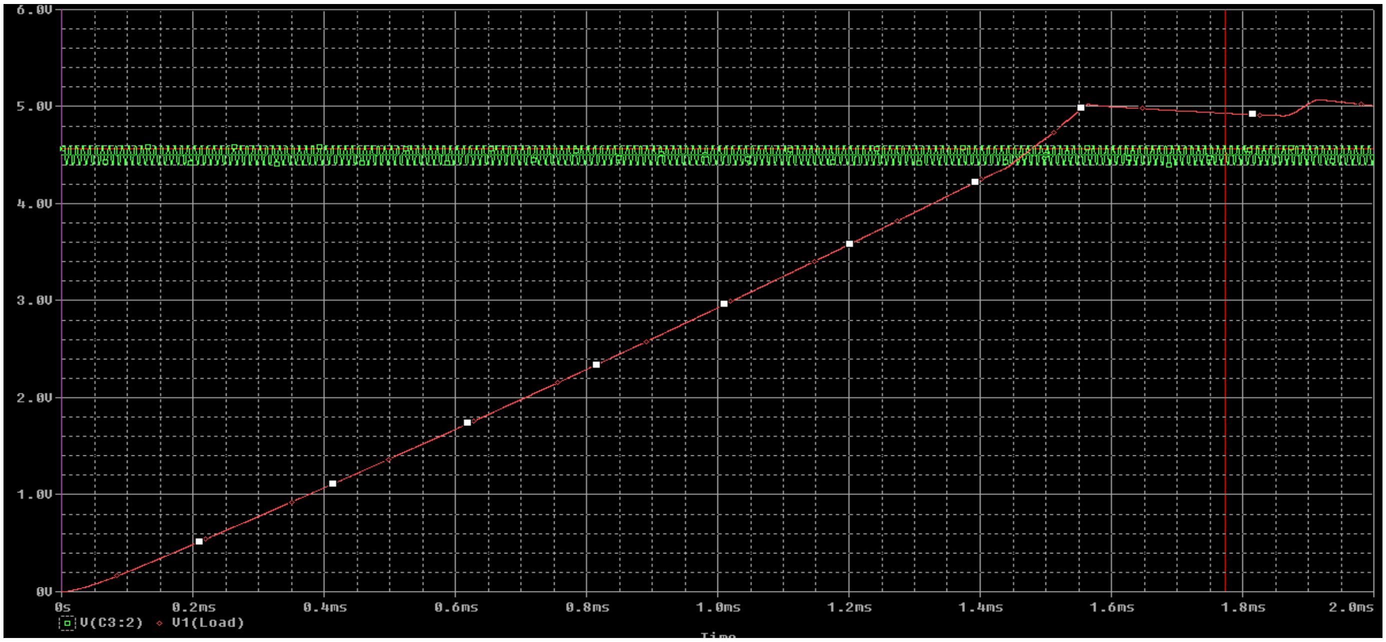

Figure 4.The voltage output (red) while the input is at low value 4.5 V with small noise with magnitude =0.1 V (Green).

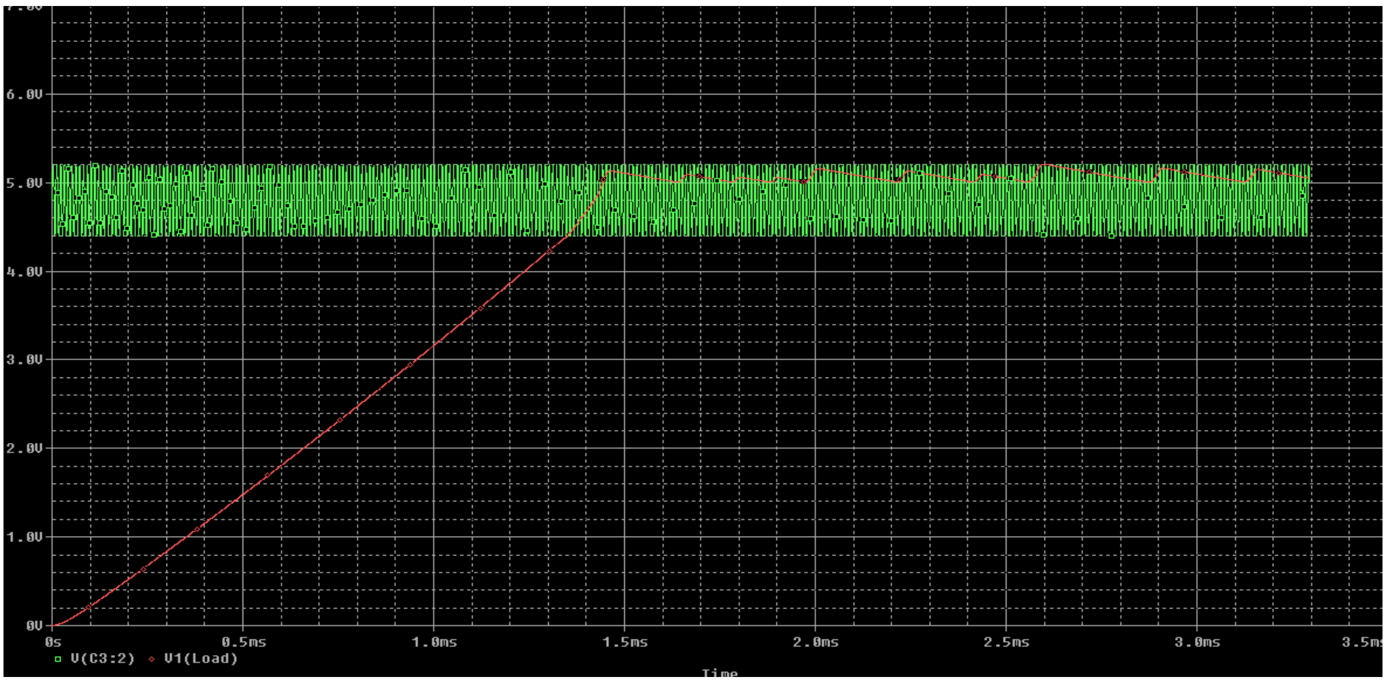

Figure 5.The voltage output (Red) while the input is at lowvalue 4.8 V with large noise with magnitude =0.5V (Green).

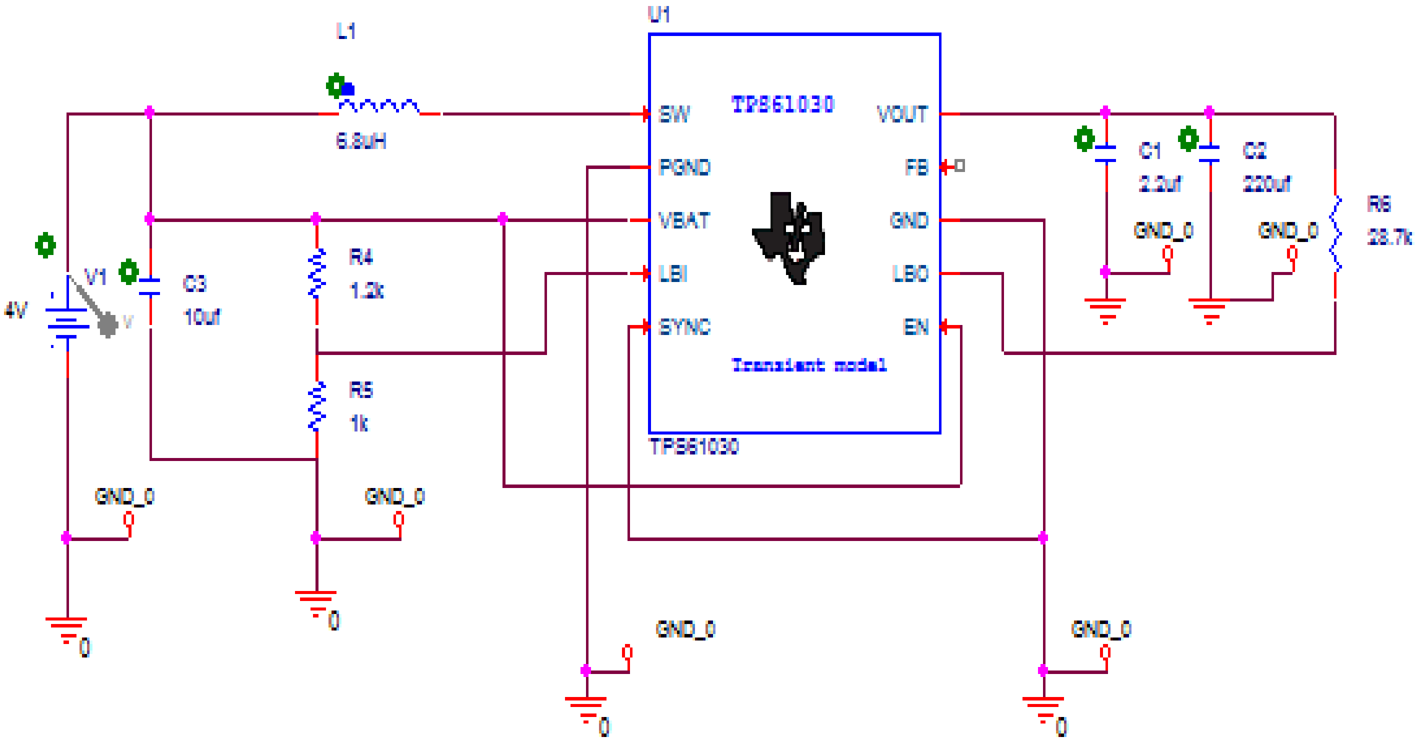

Figure 6--- Chip Spice simulation circuit

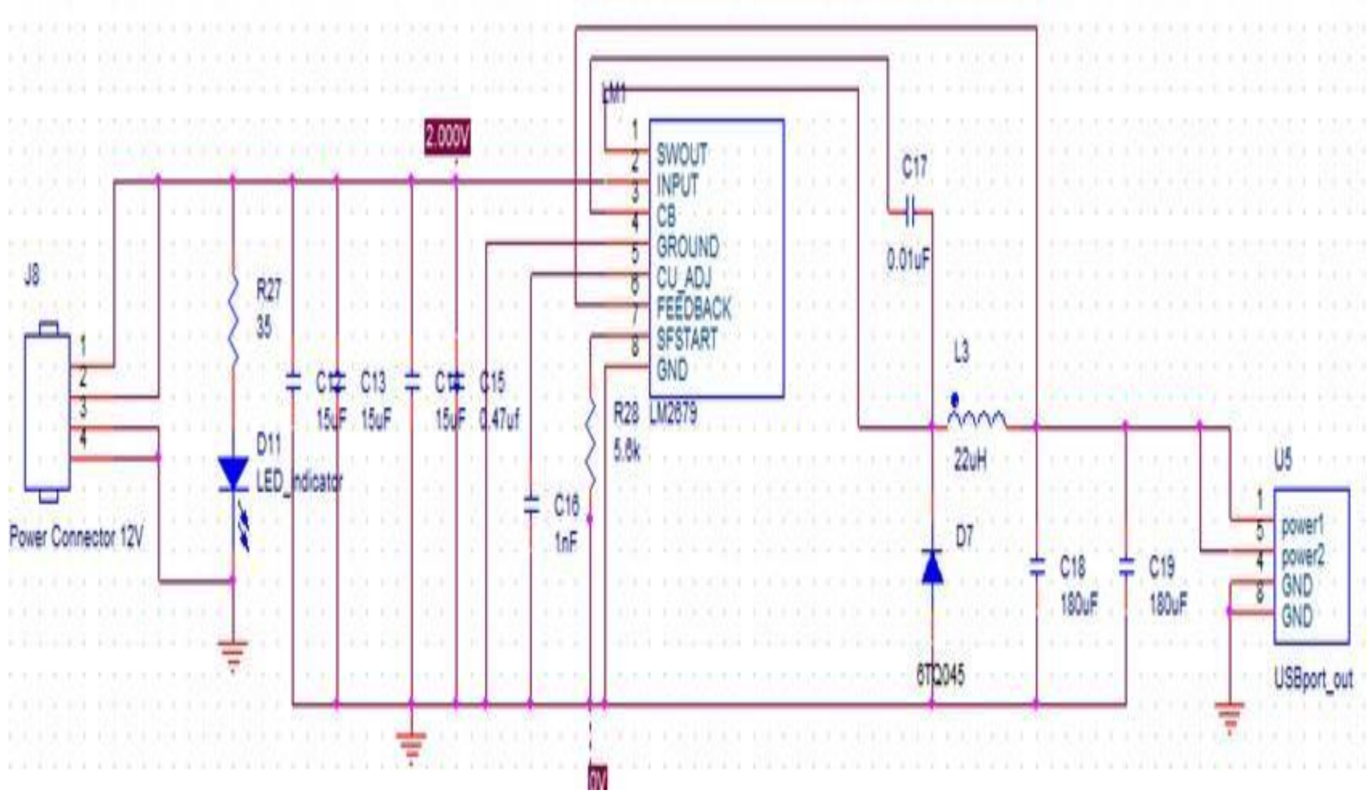

Figure7. Chip Cadence schematic design

2.1.1 Circuit parameters calculation

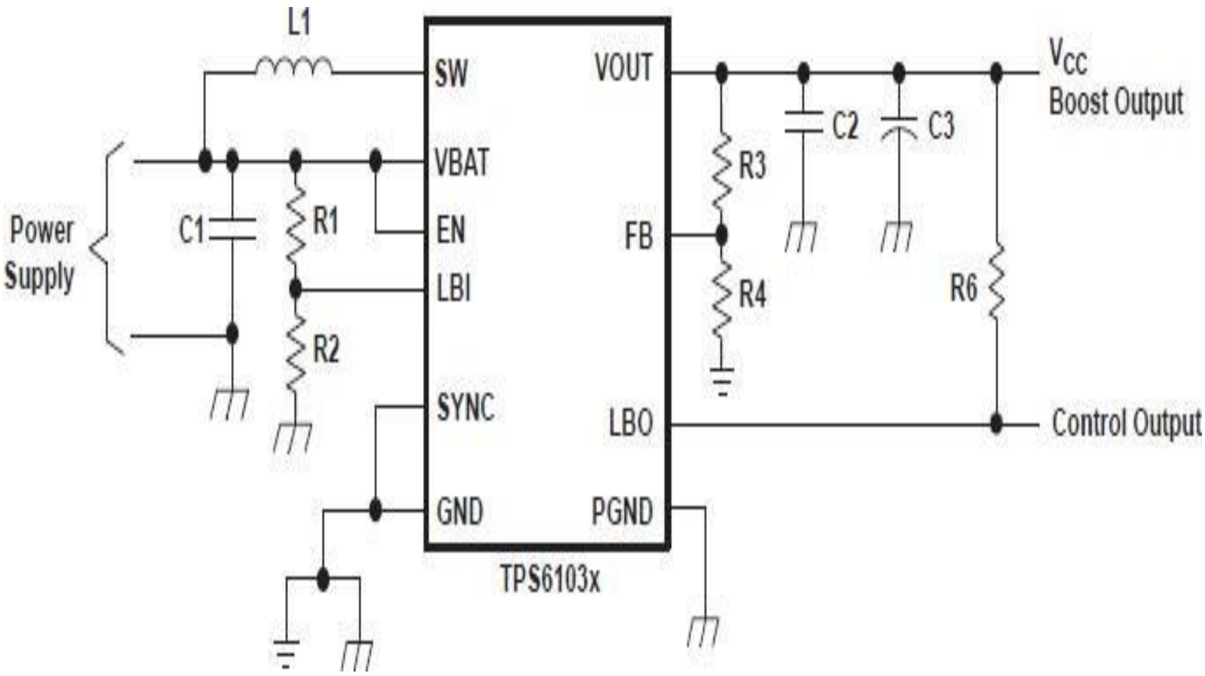

Figure 8.Recommended connection for 5V DC output

Flowchart and algorithm description

The algorithm aims to accurately detect the sleepiness of the driver by open eye and close eye recognition. The sleepy detection algorithm is built on C++and OpenCV libraries [11]. The test was first implemented and tested on the computer, then on the Arduino. The algorithm includes two parts: daytime detection and night detection. First and Foremost, based on the average intensity of sensor sensitivity, the algorithm classifies the environment as daytime or night. For daytime, the image quality is good enough, therefore no iris scan enhancement is required; for night, because of the poor lighting condition of the night, histogram equalization, a method to expand the color range of the image from 0 to 255, is implemented. In this case, we need a light that slightly illuminates the driver. In the next step, as soon as the driver has worn the glasses, two base scans are recorded automatically –open eye as well as close eye. These two scans are used as the base for further determination of whether the drivers' eye is open or closed. Afterwards, the driver could start driving. The detection algorithm is in real time and the eye portion is extracted by using the iterative Haar Classifier[12]. After the current eye portion is extracted, we use a template matching function built in OpenCV to determine if the eye is open or closed. If the eye has been closed for more than two seconds, sleepiness is detected and the program will send a signal to Arduino[13]. The detailed flow chart of the algorithm is shown below.

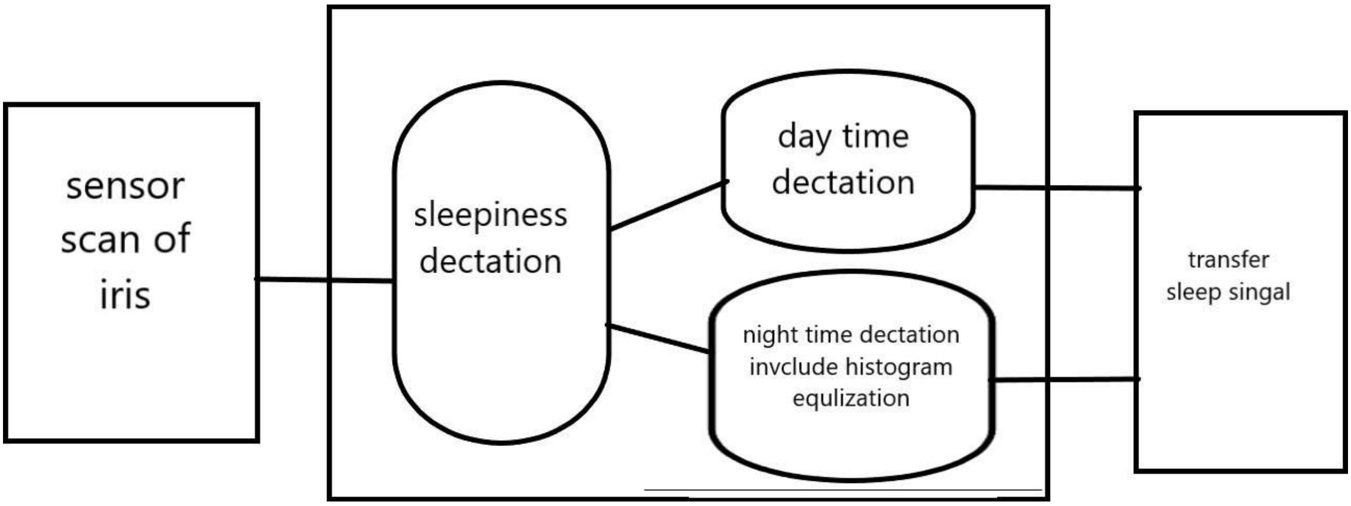

Figure 10. Framework of Algorithm

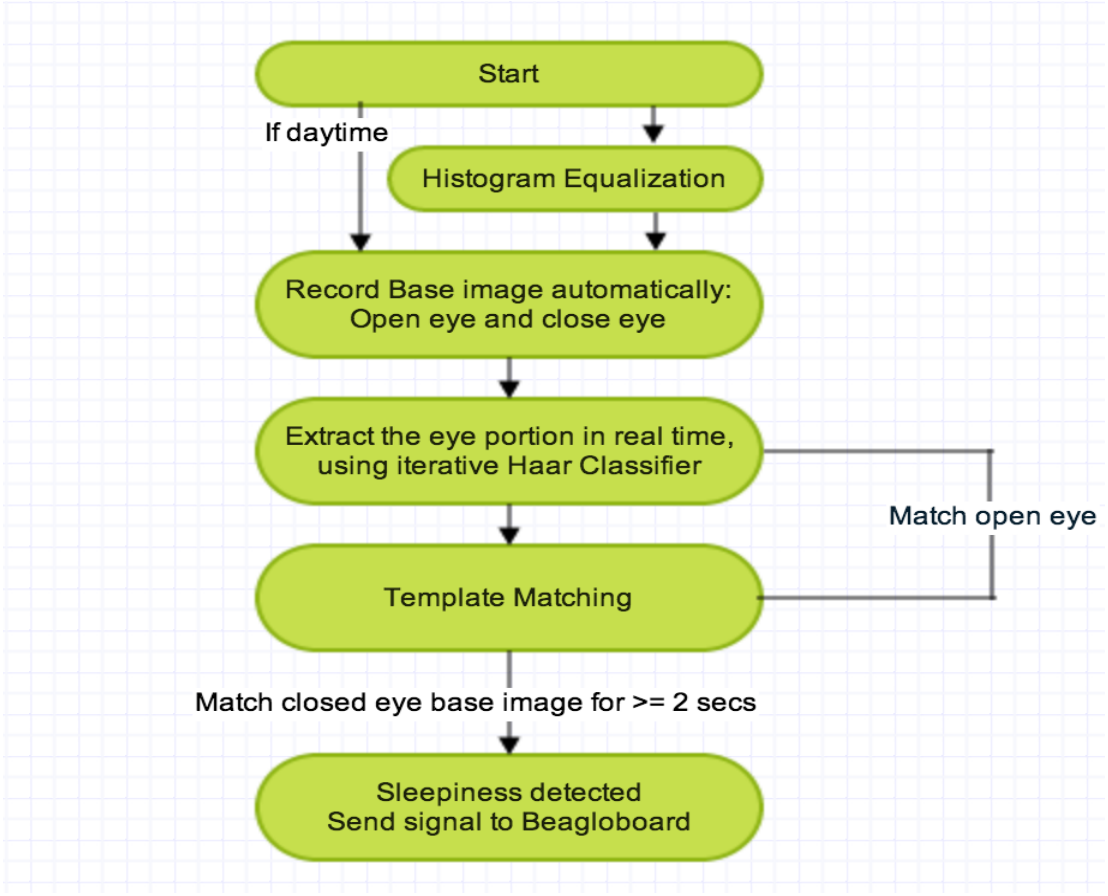

Figure 11. Flowchart for algorithm

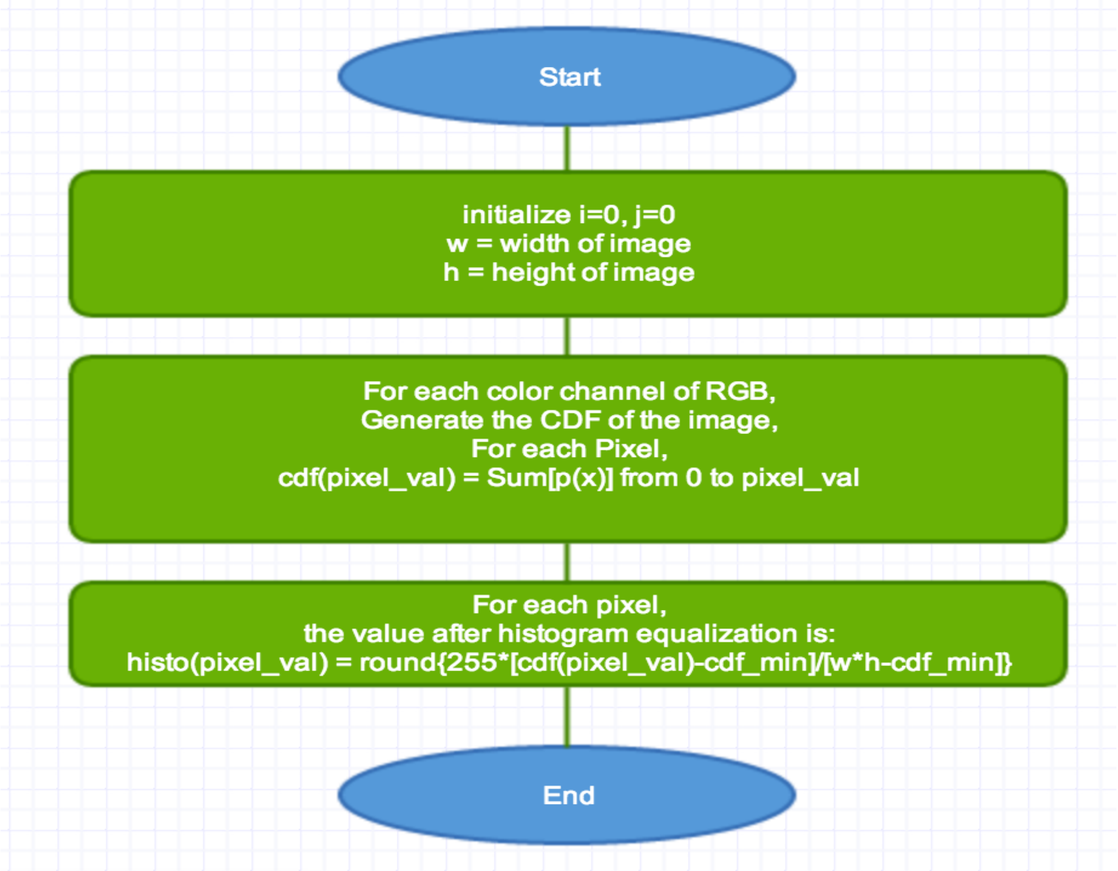

Figure 12. Flow chart for histogram equalization

Histogram Equalization:

The histogram Equalization is an image enhancement algorithm that could effectively expand the color contrast[14]. Due to the poor quality of contrast, this algorithm is specifically used for night detection. Traditional histogram equalization is implemented on black and white images; for our design, we used it for each channel of the images, which are R, G, and B. In detail, a cumulative distributive function of the image is generated and we get a statistical model, then we assign new value to each pixel so that the CDF can be more evenly distributed in the range from 0 to 255. The flow chart is shown below.

Discussion of results and performance

The software detection algorithm part is implemented successfully. The performance is fast, efficient and very accurate. The program can run smoothly on the computer in real time with no delays. In addition, we tested the algorithm 200 times, the accuracy achieved 93% in daytime and 82% at night, which is very high compared with the products sold on the market, for which the highest accuracy is 90%. As for the Arduino board, most of our requirements are satisfied. The Average time of a main loop is less than 0.33 second, which gives us a scanning frequency of 3Hz. GPIO pins are able to output a signal of 1.788V to 1.835V. Button press is able to send a ground signal through GPIO pin to start the process of scanning[15]. Besides, we made a few changes regarding the original description. First, we take a white shade glass which is much less expensive. And we are still able to achieve the 3Hz scanning rate as in the requirement. Second, we made a button press to send a ground signal instead of a 1.8V signal because we later found out that the GPIO pin is active-low. And we are still able to identify a button press and scan correctly.

Conclusion

As for the software part, we fulfilled our goal successfully. The detection algorithm could not only work effectively and accurately at daytime, but also at night. The Eye portion extraction is smooth and in real time with no delays on the computer. In addition, there is a bonus function in the software part –detection with glasses. For the ARDUINO, we achieved two major difficulties. First, we were not able to power up the board with any commercial chargers initially, including the ones for iPhone, for Assume, or the USB charger on the car. But later we added a LITHIUM-ION battery to power our board and used the power supply we designed to charge the battery to solve the problem. Second, we experienced a few difficulties while installing the Open CV library on ARDUINO, but were able to solve it by changing flags in make files to the one corresponding to ARM board architecture. The power supply unit basically completes all its design requirements. By adding the extra battery stage, the problem of powering the entire microcontroller and alarming system has been solved. Moreover, the alarming system works as we supposed. The voltage ripple of the power supply unit can be mitigated by applying more resilient capacitor components.

It is apparent that the overall project success is not derived from one team member's mind but the keen coloration within our group. Each part is indispensable and every team member made great dedication on the completion of this design project. The pace is intense, the learning, immense.

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