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# SMART CONTROL FOR VEHICLE HEADLIGHTS AND REAR-VIEW MIRROR

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## ABSTRACT

*Project SC-HR(Smart Control for Vehicle Headlights and Rear-View mirror) is basically designed and optimized to give people a hand-over on accidents caused by High Beam today (on Highways and in-city basically). SC-HR system works by automatically detecting the high beam from the vehicle behind us and adjusts the rear-view mirror in such position so that beam will not be a problem anymore for the driver. But as we speak of the wrong usage of High-Beam in the city, sometimes we may ourselves commit the same mistake. So to undermine our mistakes and reduce the manual work, SC-HR implements a switching behavior between low and high beam on the headlights, based on the presence of the vehicle in front of us (in the same or opposite lane). This project when applied in masses can help a lot in the reduction of wrong High-Beam usage in city and side by side allows you to use High-Beam on the highways without interrupting anyone's sight or yourself getting interrupted by others.*

**KEYWORDS-** ATMEGA16A, HEADLIGHTS, L293D, LDR, REAR-VIEW MIRROR, SUNROM'S DOPPLER SENSOR

## 1. INTRODUCTION

According to 'The Indian Express', article [1] dated 10th Dec 2012 about 4.65% of cases is registered in Bangalore City alone for wrong High-Beam usage. According to the Motor Vehicle Act the high beams should be made dim if one can see a vehicle in front, at a distance of 200 meters. The drivers having problems can also register their complaint against the driver, by nothing but the vehicle number. The highest number of accident cases and deaths in the city was reported during 6 pm and 8 pm. By July 31st last year, department had booked 11,

399 cases, and Rs 11, 39, 900 was collected in fines. I mean why even 4.65%, why not reduce it to null. Our project SC-HR is basically designed and optimized to give people a hand-over on accidents caused by High Beam today (on Highways and in-city basically). We have used Sunrom's Doppler Radar Sensors [4] for the vehicle detection in front and LDR [3] for detection of the following vehicle's High Beam (behind us). A Stepper motor is used to help rear view mirror adjust between its phases. An internal oscillator of 1 MHz is used as source for our microcontroller's internal timer. And a pushbutton is provided in case of requirement of external hardware rest. SC-HR provides a smart control for Vehicle's Head-Lights by automatic detection of vehicle in front (in same and opposite lane) and for Vehicle's Rear View Mirror by automatic detection of High-Beam behind.

## 2. OVERVIEW OF THE COMPONENTS

### 2.1 HIGH-BEAM DETECTION (BEHIND)

The High-Beam detection purpose for the SC-HR is handled by the LDR [3] photo resistor. It is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity.

As soon as the LDR [3] detects the dangerous level of light intensity it triggers the stepper motor to rotate to the safe phase (safe phase for our rear-view mirror). To provide our Bipolar Stepper Motor the required input we have used L293D [5] stepper interface IC.

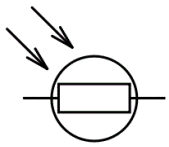

Figure 1. LDR BASIC DIAGRAM

### 2.2 VEHICLE DETECTION (FRONT)

Sunrom's Doppler Sensor [4] is used in the project as it helps in the detection of object (vehicle) in front of our vehicle using Doppler Principle. The receiving of the signal is done by a separate antenna to compare the received frequency with the reference frequency and determine the change or shift in the frequency. This sensor has a transmitter and receiver, transmitter generates a 10MHz wave which is captured when returns from the object and the shift in the frequency of the wave helps sensor to identify an object. In general, Doppler Effect

states that if a source is moving with a relative velocity in respect to the transmitter, the wave received will be having a shift in frequency or fluctuation. Astronomers use the color shift in the light waves coming to us from astral bodies to identify the speed of source body and whether they are travelling towards or away from the earth. In Doppler radar system, a known frequency signal is transmitted from an antenna which is pointed at a reference object. The basic formulas used for the calculation of the received frequency (fr) and other related parameters is stated as:

$$f_r = f_0\left(\frac{v \pm v_0}{v \pm v_s}\right) \quad [4]$$

Where, fr - is the received frequency

$f_0$ - the frequency of transmitted wave

vs - relative speed of the source with radar

$v_0$ - the speed of observer

v - the speed of the waves in the current medium.

For calculation of the shift in the frequency, the difference between the received and source frequency is takes, as shown below:

$$\Delta f = f_r - f_0 \quad [4]$$

Figure 2 is the block diagram [3] of sensor, a 10GHz oscillator is used for the generation of the source wave and the Mixer used provide us with the output according to the difference in frequency between transmitted and received (source frequency) frequencies. If there are no moving objects received frequency will be of the same magnitude as that of the transmitted wave and hence delivered output will be zero but if there is difference in frequency the output will vary.

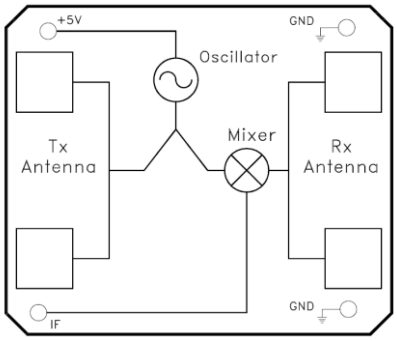


Figure 2. BLOCK DIAGRAM OF SUNROM'S DOPPLER SENSOR (1195) [4]

If there are no objects in front of the Doppler sensor it'll give a continuous analog output of 2.9V but as soon as an objects comes into play sensor will start showing fluctuation in its output depending on the motion of the object with respect to our Doppler module.

According to the DC levels provided by the Doppler Sensor [4] the SC-HR intelligently evaluates whether the vehicle needs to be in High-Beam mode or to switch to Low-Beam mode.

## 3. ARCHITECTURE AND METHODOLOGY

The architecture of the proposed physical system and methodology is given below. The purpose of the system is:

a) To detect the day time and night time (In case of Day Time SC-HR stops all its processes).

b) To detect a vehicle in front of us .

c) To detect whether the vehicle behind us is on low beam or high beam.

d) Arrive on a consensual decision and attenuate the head light and position of the rear view mirror.

### 3.1 DESIGN

In order for our system to operate efficiently, the system needs to be made as the integral part of every vehicle. Depending on the output of our Doppler sensor fetched through our ATmega16A's ADC module, we decide whether to stay at the High Beam (In case it's on and is being used by the driver) or to switch it to low beam (In case an object comes in front of us that may get affected with our High Beam intensity). LDR1 is used for checking

whether its day or night and LDR2 is used to sense the light intensity coming from rear of the vehicle. Based on the LDR2 output again fetched through ATmega16A's ADC we decide whether to switch our rear-view mirror to SAFE or keep it at the DEFAULT position. For rear-view mirror movement we are using a Bi-Polar stepper motor and an L293D IC from interfacing our stepper with the ATmega16A. A reset button is introduced to reset our microcontroller at the time of need.

The system architecture is shown in the figure below:

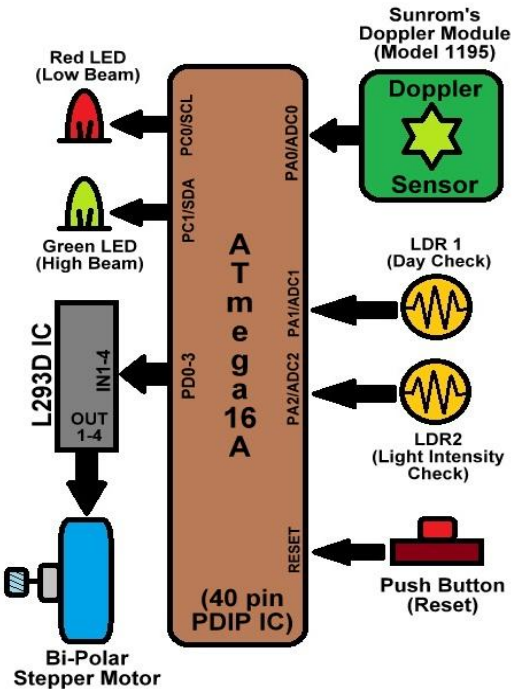


Figure 3. BLOCK DIAGRAM OF SC-HR

### 3.2 PROCEDURE

The presence of a vehicle is detected using Doppler sensor in our module. This information is transferred to the ADC of the microcontroller, which is responsible for processing the received inputs. The microcontroller then compares the processed information with empirical threshold limits set. For the Doppler radar sensor 2.9v is the continuous value given when no vehicle is present in front of it but if there is sudden change in this continuous value, it means a vehicle is present in front of us. This value ranges from 0-5v, which is also the working range of our microcontroller. So if the sensor detects the vehicle the microcontroller initiates the communication with the modules in the vehicle and attenuates the headlights. Simultaneously our module consists of two

LDR photo resistors. One of the LDR photo resistor is used to sense the daytime and night time based on the experimental values whereas the other one is used to detect whether the vehicle behind us is on high beam or not. Both the LDRs are directly interfaced with the microcontroller through PA1/ADC1 & PA2/ADC2 pins. Afterwards the microcontroller decides whether to change the phase of the rearview mirror using a bipolar stepper motor attached to it, which prevents the direct reflection of the light to disturb the sight of the driver. The stepper motor is interfaced with the microcontroller through an IC L293D.

## 4. SC-HR INTERFACING

### 4.1 LDR AND BIPOLAR STEPPER MOTOR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. We are using two LDRs, one for the detection of high beam behind us (LDR1) & other for the determination of day or night (LDR2). Both the LDRs are directly interfaced to ATmega16A through PA1/ADC1 & PA2/ADC2 pins, which have an internal Analog-to-Digital converter. This analog output is then converted to 10-bit digital data according to which our stepper motor is acted upon.

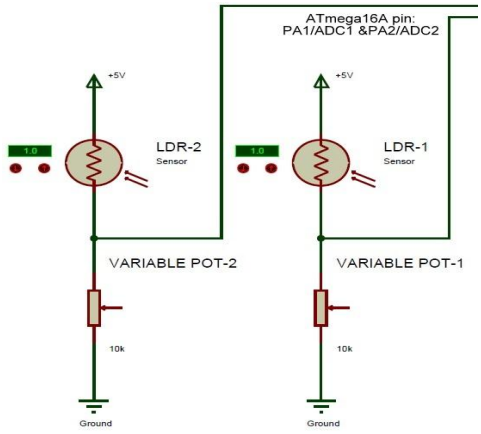


Figure 4. LDR1 & LDR2 INTERFACING WITH ATMEGA16A

To interface Bipolar-Stepper Motor with ATmega16A we have used L293D IC, which is connected to ATmega16A through PD0-PD3 pins. And stepper motor is connected to L293D through its OUT1-OUT4 pins.

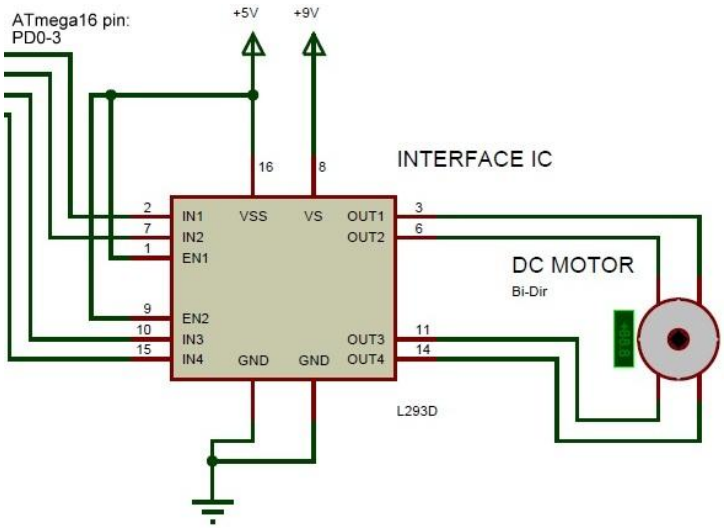


Figure 5. BIPOLAR STEPPER MOTOR INTERFACING WITH ATMEGA16A

### 4.2 DOPPLER SENSOR AND LED INTERFACING

Sunrom's Doppler Sensor (Model No. 1195) [4] have 3 pins out of which first and third are used as Vcc and Ground respectively. Third pin is A.Out (Analog Output) which is interfaced to AtMega16 [2] through PA1/ADC1 pin, which have an internal Analog-to-Digital converter. This analog output is then converted to 10-bit digital data according to which our SC-HR decides whether to be on High-Beam (Red LED) or Low-Beam (Green LED). Our Red LED and Green LED is interfaced with AtMega16 [2] through PC0 and PC1 respectively via 1K resistors to avoid LEDs getting fused.

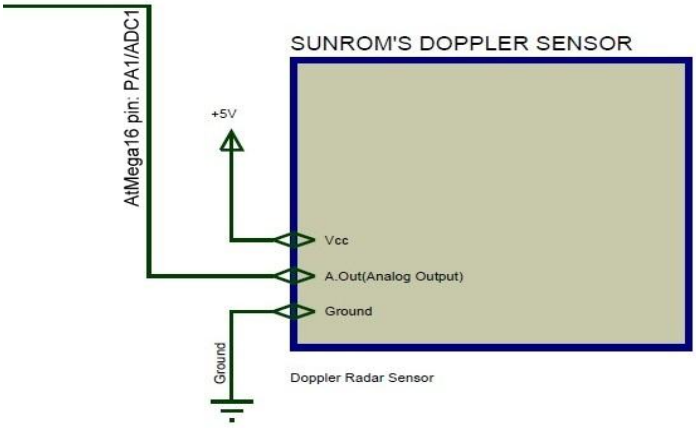


Figure 6. DOPPLER SENSOR INTERFACING WITH ATMEGA16A

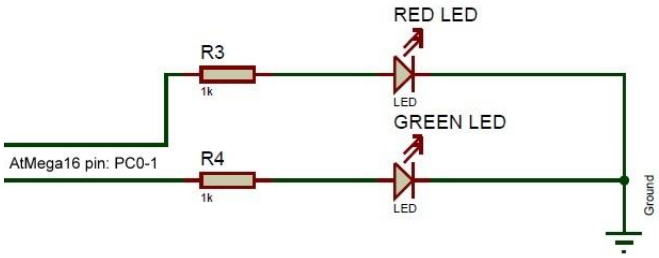


Figure 7. RED & GREEN LED INTERFACING WITH ATMEGA16A

### 4.3 Push Button Interfacing (RESET)

Push-Button is introduced in the circuit to hard reset our micro-controller when needed.

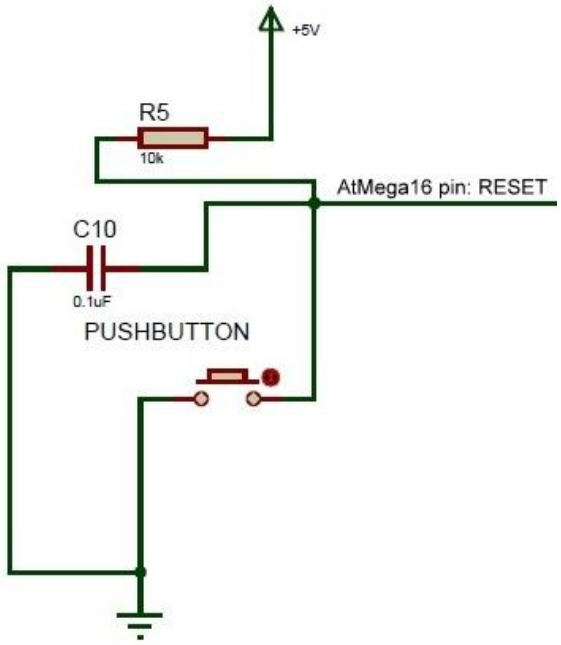


Figure 8. PUSH BUTTON INTERFACING WITH ATMEGA16A

## 5.BASIC FLOW DIAGRAM

### 5.1 MAIN FUNCTION

In our main function of the firmware we have done all necessary kinds of definitions, declarations and initializations for the execution of our firmware. On the base line, we are calling our LDR and DopplerR functions repeatedly for infinite times using while(1) loop only when our function LDR_Day_Check allows us to do so. F_CPU definition is used by the delay_ms() function of <util/delay.h> for giving appropriate user defined delays in between program. Macros are used for easy manipulation of the experimental values. Peripherals and Port values are defined within the main function itself

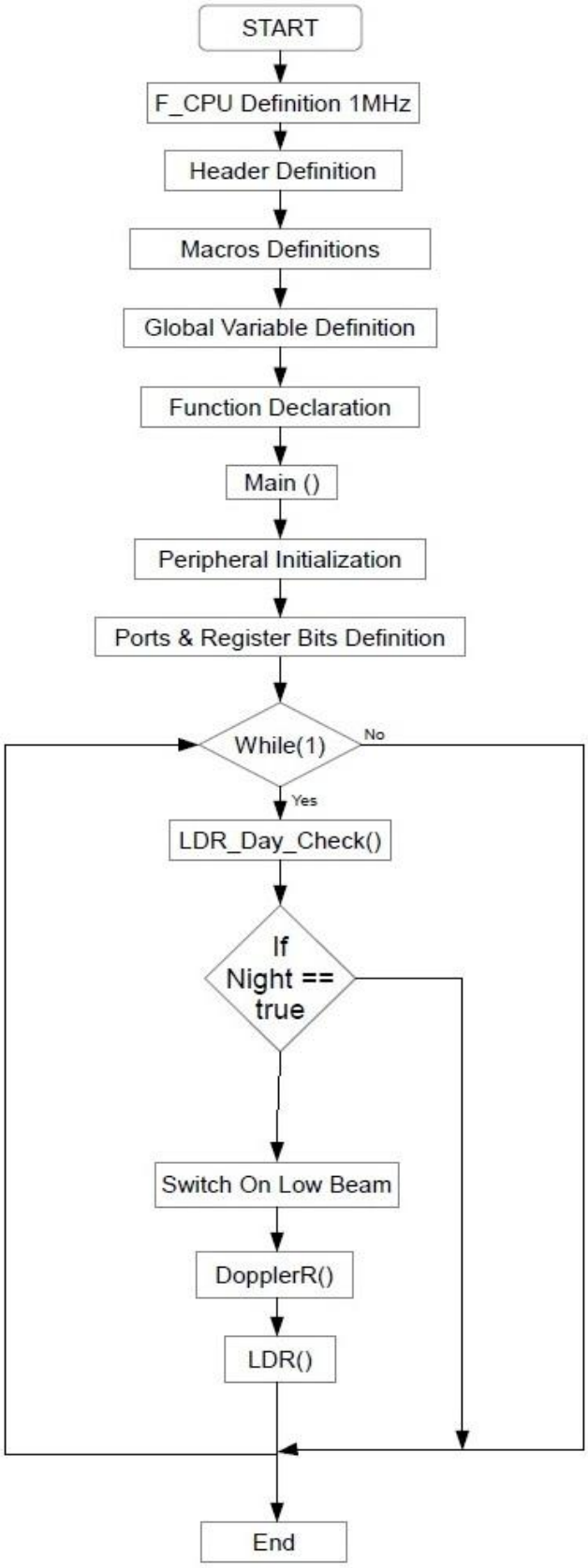


Figure 9. FIRMWARE'S MAIN FUNCTION

### 5.2 ISR (INTERRUPT SERVICE ROUTINE)

Interrupt Service Routine in short called as ISR is the segment of the firmware to which our compiler goes when it experiences an interrupt, the interrupts can be software or hardware interrupts. Here each time program comes to ISR (in our case it comes after 250 ms each time Timer1 counter overflows) we increment two variables, First_Overflow & Second_Overflow, and as soon as that variable satisfies our condition respective Initialize variables are getting a true value. These Initialize variables will help us in a controlled and timed execution of our LDR and DopplerR functions.

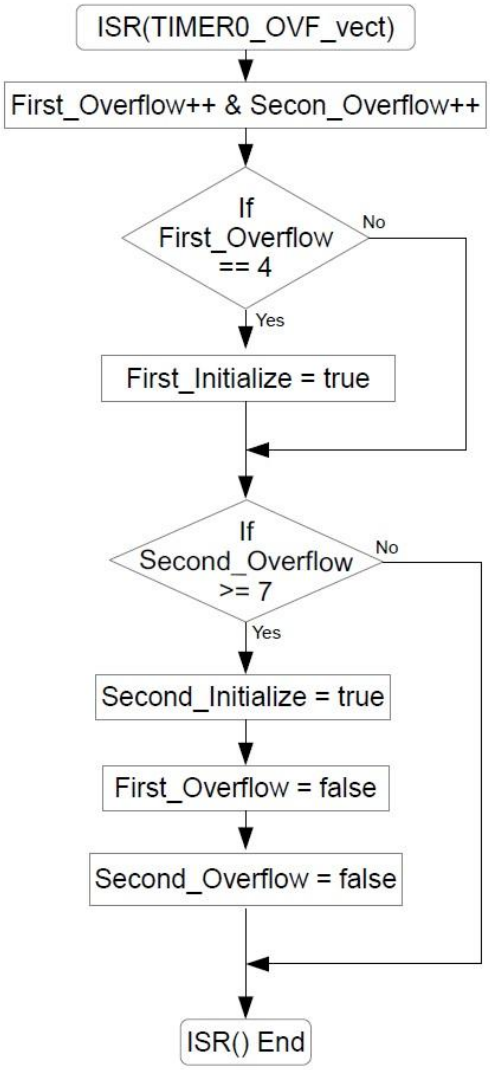


Figure 10. FIRMWARE'S ISR

### 5.3 DOPPLERR FUNCTION

In our project we have used DopplerR function to basically fetch and process the digitally converted output (through internal AtMega16 ADC) of the Sunrom's Doppler Sensor [4] and set our headlights to an appropriate mode based on the presence of the vehicles in front of us. We're using a variable 'check' to help us in checking the output value twice before switching our headlights to the High-Beam mode. This dual check is required so as avoid switching of our headlights on the basics of so called 'by-chance values'. As our Doppler sensor shows fluctuating voltage when there is an object motion in front, hence there is a chance of getting 2.9V by chance.

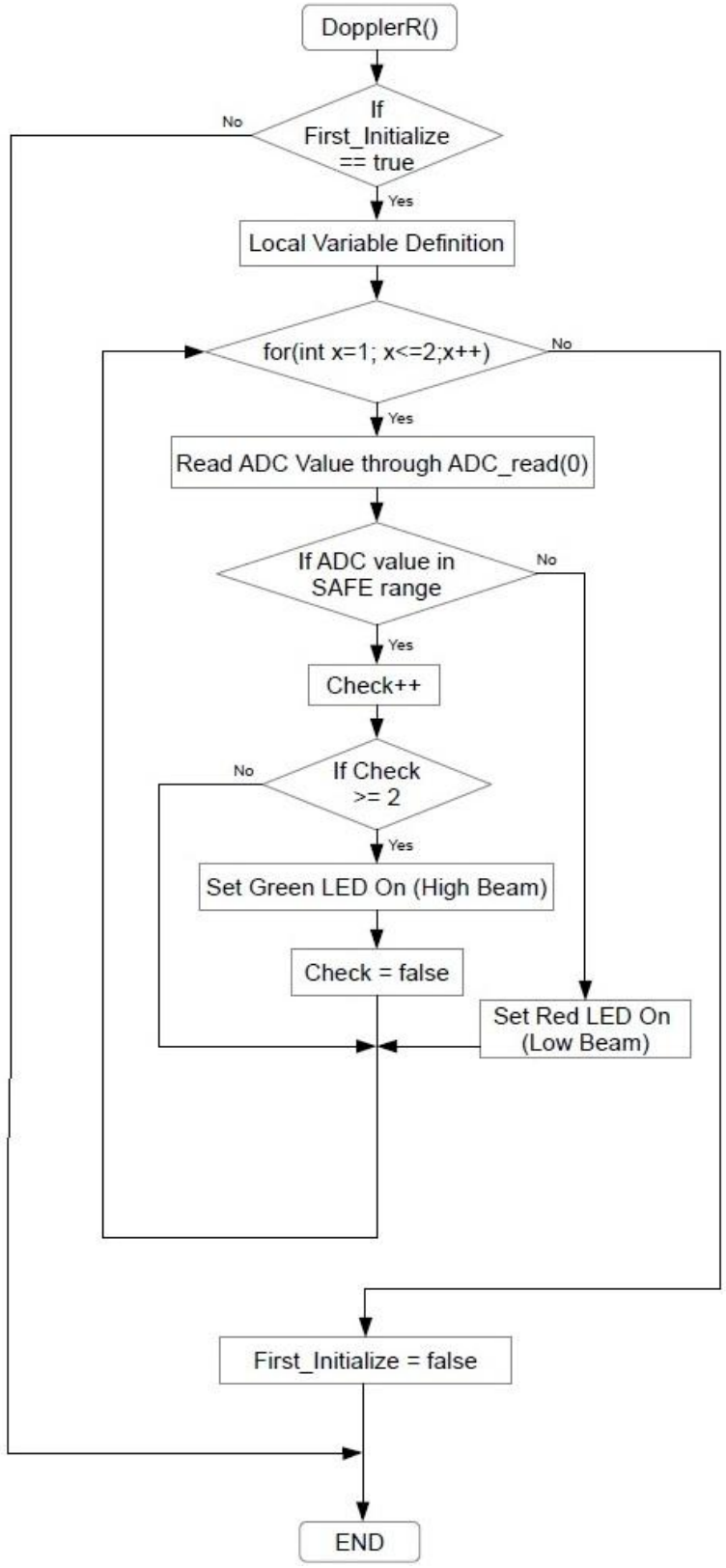


Figure 11. FIRMWARE'S DOPPLERR FUNCTION

### 5.4 LDR FUNCTION

LDR function is defined to fetch the ADC value from micro-controller's ADC2 pin and based on the value decides whether to switch rear-view mirror to DEFAULT and SAFE position.

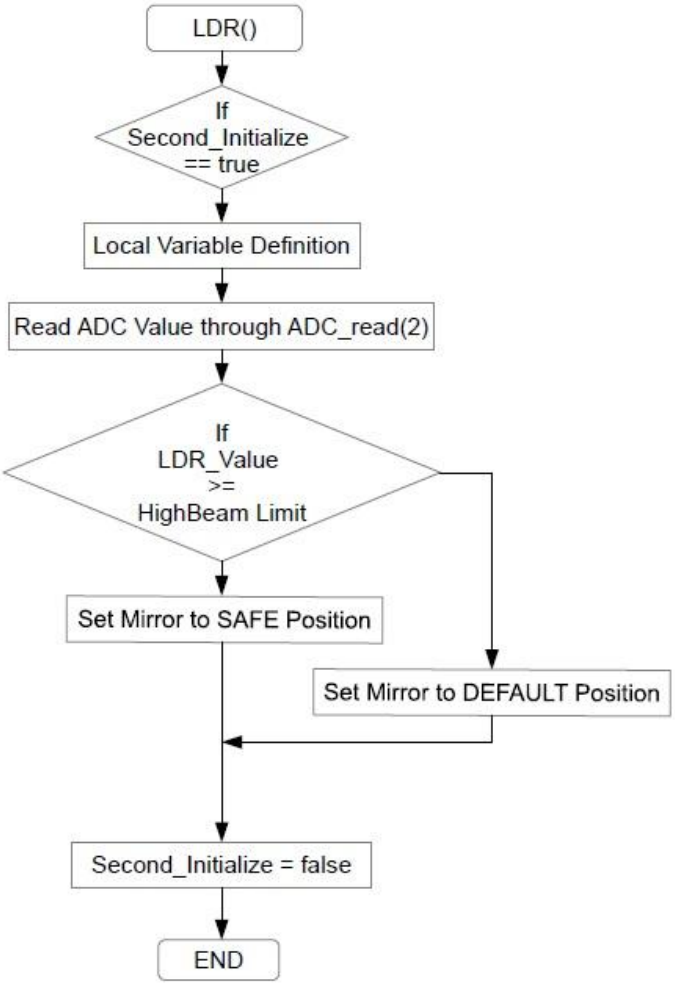


Figure 12. FIRMWARE'S LDR FUNCTION

### 5.5 LDR_DAY_CHECK FUNCTION

LDR_Day_Check function helps SC-HR in distinguishing between day and night. Based on this function's output SC-HR decides whether to run LDR and DopplerR function or not.

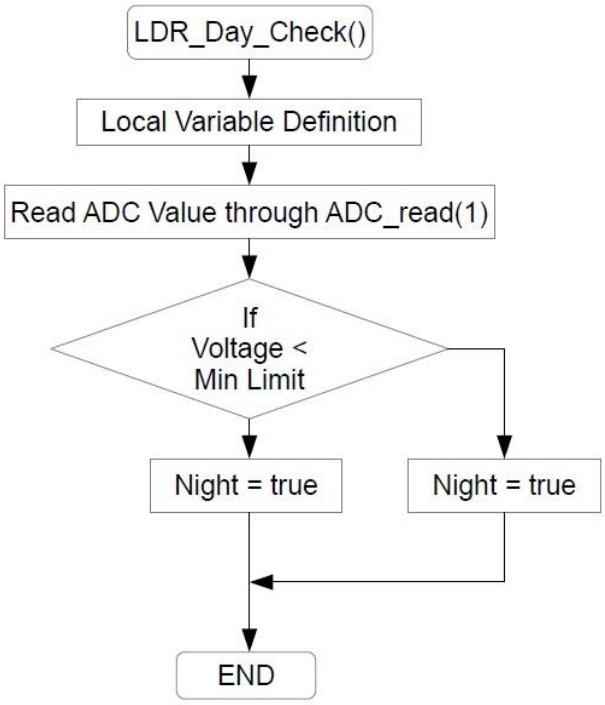


Figure 13. FIRMWARE'S LDR_DAY_CHECK FUNCTION

## 6. CONCLUSIONS

SC-HR senses the High-Beam intensity through LDR [3] coming from the vehicle behind us and gives us a dc output which then converted to 10-bit digital data through ADC. If the light intensity is over the danger level the stepper motor switches the rear-view mirror to the safe position and soon as the light intensity drops the rear-view mirror will come back to its default position. We used Sunrom's Doppler Sensor (Model No. 1195) [4] which help us in the detection of any vehicle in front of us and helps us switching our headlights from High-Beam mode to Low-beam mode in the case any vehicle is present. This headlight switching behavior helps us in utilizing the High-Beam for our purpose while not disturbing any other drivers moving in front of us. This overall system (SC-HR) is designed for being integrated with any vehicle irrespective of their model or type, and in mass application will solve a lot of problem for citizen and our Traffic Police department.

## REFERENCES

[1] The Indian Express Article,
Link:http://www.newindianexpress.com/cities/bengaluru/article1373116.ece

[2] AtMega16A Datasheet, Link: http://www.atmel.com/devices/atmega16a.aspx

[3] LDR, Link: http://www.resistorguide.com/photoresistor/

[4] Sunrom's Doppler Sensor Datasheet, Link: http://www.sunrom.com/p/microwave-doppler-radar-sensor-for-motion-and-speed-sensing

[5] L293D IC, Link: http://www.ti.com/product/l293D

[6] About High-Beam and its adverse effect on driving, Link: https://safedriving.wordpress.com/2013/10/05/the-best-way-to-use-high-beam-headlights/

[7] HIGH Beam Assist, Link: http://www.audizine.com/forum/showthread.php/487621-HIGH- Beam-ASSIST

[8] High Beam Control, Link: https://www.mazda.ie/videos/technology/high-beam-control-making- driving-safer-and-more-convenient/

[9] Electronic Devices and Circuit Theory by Boylestad, Pearson Education India, Link: http://books.google.co.in/books/about/Electronic_Devices_and_Circuit_Theory.html?id=32RJvfgkJgwC

[10] Analog and Digital Circuits for Electronic Control System Applications by Gerald Lueck, Link: https://books.google.co.in/books?id=lKy56FZkNzsC&printsec=frontcover&dq=Digital+Circuits+and+System&hl=en&sa=X&ei=xglFVdzxKImTuAS7jYG4CQ&redir_esc=y#v=onepage&q=Digital%20Circuits%20and%20System&f=false

[11] Rear-View Mirror, Link: http://en.wikipedia.org/wiki/Rear-view_mirror

[12] Head Lamp, Link: http://en.wikipedia.org/wiki/Headlamp