PROJECT REPORT

ON

AUTOMATIC BIKE TURN INDICATOR WITH SIDE STAND SENSOR

DHARMSINH DESAI UNIVERSITY

FACULTY OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

PREPARED BY	GUIDED BY
Parva Chandarana (EC 051), Sem V	Prof. Smith S Thavalapill
Ritvik Tiwari (EC 072), Sem V	Prof. Hetal B Shah

CERTIFICATE

This is to certify that the project on **AUTOMATIC BIKE TURN INDICATOR WITH SIDE STAND SENSOR** and term work carried out in the subject of Term Project is bonafide work of **PARVA CHANDARANA** (Roll no.: **EC 051**) and **RITVIK TIWARI** (Roll no.: **EC 072**) of B. Tech. semester V in the branch of **Electronics & Communication**, during the academic year 2018-19.

Prof. Smith S. Thavalapill	Prof. Hetal B Shah	Dr Nikhil Kothari
Project Guide, EC Dept.	Project Guide, EC Dept.	HOD, EC Dept.

ACKNOWLEDGEMENT

On the very outset of this report, we would like to extend our sincere & heartfelt obligation towards all the people who have helped us in this endeavour. Without their active guidance, help, cooperation & encouragement, this project's completion would not have been possible.

Every work that one completes successfully stands on the constant encouragement, goodwill and support of the people around. We, hereby, avail this opportunity to express my heartfelt gratitude to a number of people who extended their valuable time, full support and cooperation in developing this project.

We extend our sincere gratitude to our dean, Prof. D.G. Panchal for providing us with the resources and the infrastructure to carry out our project. We would also like to extend our gratitude to our Head of Department, Dr N.J. Kothari for providing us with a platform to showcase our skills and gain practical insights. We are grateful to our project mentors, Prof. Smith S Thavalapill and Prof. Hetal B Shah for their guidance and motivation. We are thankful for their encouragement to accomplish this assignment. They acted as a constant source of motivation and were always ready to help us, without which we would not have been able to achieve success.

We also acknowledge with a deep sense of reverence, our gratitude towards our parents who have always supported us morally as well as economically. At last but not least gratitude goes to all of our friends who directly or indirectly helped us to complete this project report. Any omission in this brief acknowledgement does not mean lack of gratitude towards them.

Thanking You,

With sincere regards,

Parva Chandarana

Ritvik Tiwari

ABSTRACT

The prime objective of our prototype is to design an auxiliary safety mechanism that senses a turn and indicates the turn in case the driver is driving the vehicle absent-minded. For bike drivers, we decided to have an additional safety feature that would indicate that the driver has not lifted his side stand. The design is targeted towards sensing a turn and indicate it accordingly and at the same time, check if the driver has lifted the side stand or not. With our design, we hope to keep a check on fatal accidents caused by lack of safety checks while driving. We wish to make a safety feature unique to luxury vehicles available for all at an affordable price.

INDEX

1.INTRODUCTION

1.1PROJECT DETAILS

This project is focused on designing an auxiliary safety mechanism for absent-minded drivers. This design is targeted towards sensing a turn and indicate it accordingly and at the same time, check if the driver has lifted the side stand or not. With our design, we hope to keep a check on fatal accidents caused by lack of safety checks while driving.

1.2 PURPOSE

The purpose of this project is to design a cost-efficient safety mechanism to keep fatal accidents under control.

1.3 SCOPE

This project is designed as a prototype for testing purposes. The accelerometer and infrared sensors used for detection are project grade, due to which their sensitivity ratings are not ideal for commercial usage.

1.4 BRIEF INTRODUCTION

Absent-minded driving constitutes a large number of accident-related deaths. A large number of accidents are caused in a fraction of a second. Throughout all ages, absent-minded driving is a major cause of fatal accidents and close calls or near accidents. And the figures too, are quite shocking. In 2018, Indians witnessed approximately 1300 accidents on a daily basis out of which 821 prove to be fatal which cost them their lives. And this huge number of accidents are damaging the economy too. According to a study conducted by the Law Tribunal, approximately 80,00,000 insurance claims are filed on a yearly basis.

A study conducted by the International Association of Traffic and Safety Sciences in July 2015, concluded that absent-minded driving and lack of conducting safety checks are a major reason for accidents throughout all age bands. A lack of simple indication on time can prove to be fatal and this can be avoided with the help of a simple additional safety mechanism. Although this mechanism is not new, this essential need remains a feature of high-end luxury cars and premium bikes. Unfortunately, no add-on is available in the market to tackle this situation. We wish to design a circuit to tackle this situation.

2. BLOCK DIAGRAM

2.1 AUTOMATIC BIKE TURN INDICATOR

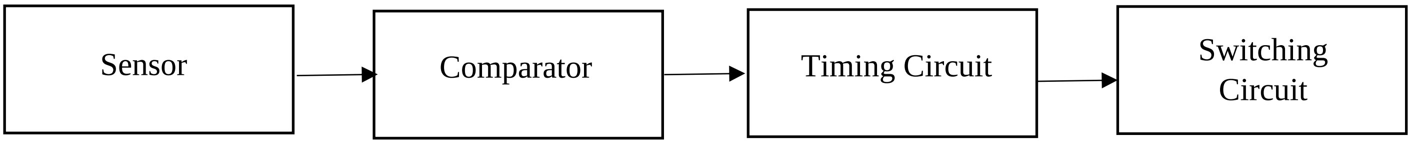

Fig 3.1 Block Diagram of Automatic Turn Indicator

2.2 SIDE STAND SENSOR

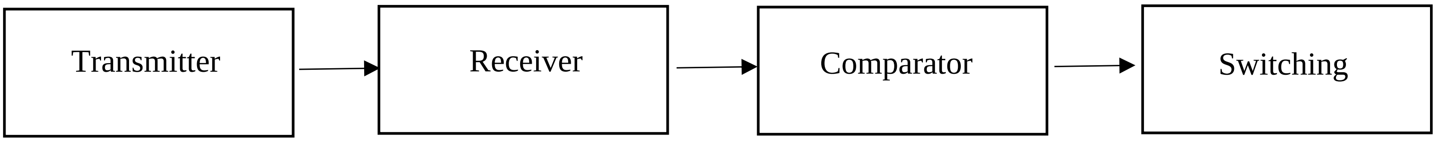

Fig 3.2 Block Diagram of Side Stand Sensor

3. CIRCUIT DIAGRAM

3.1 AUTOMATIC BIKE TURN INDICATOR

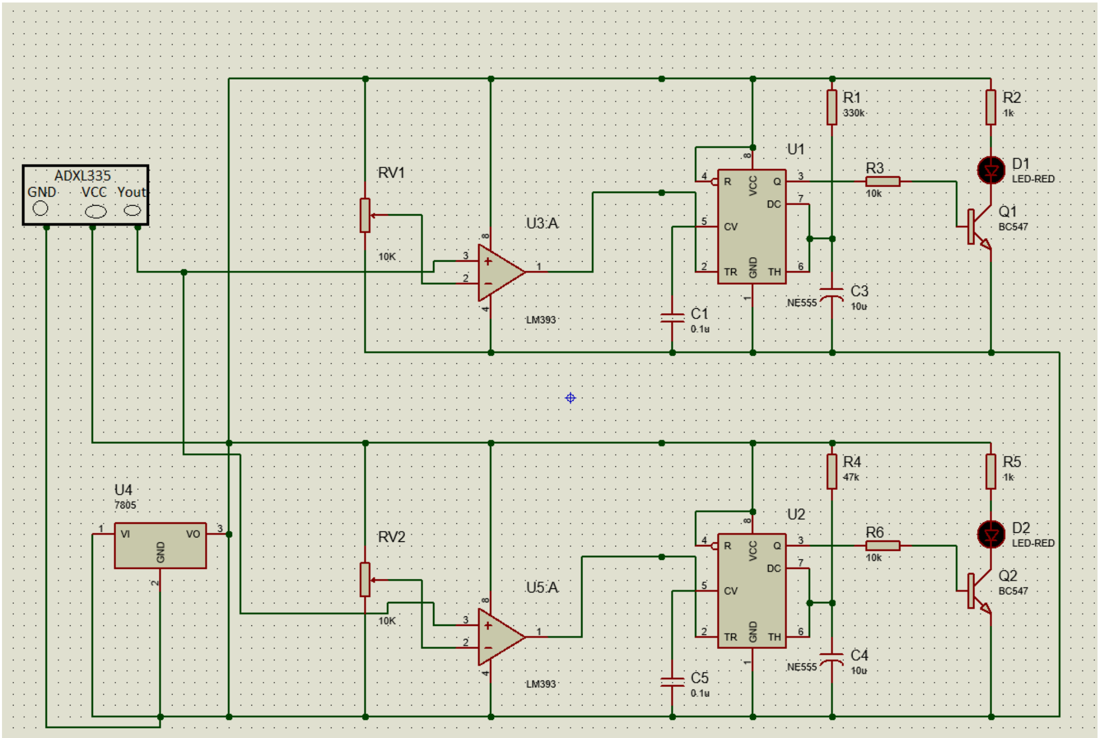

Fig 3.1 Circuit Diagram of Automatic Bike Turn Indicator

3.2 SIDE STAND SENSOR

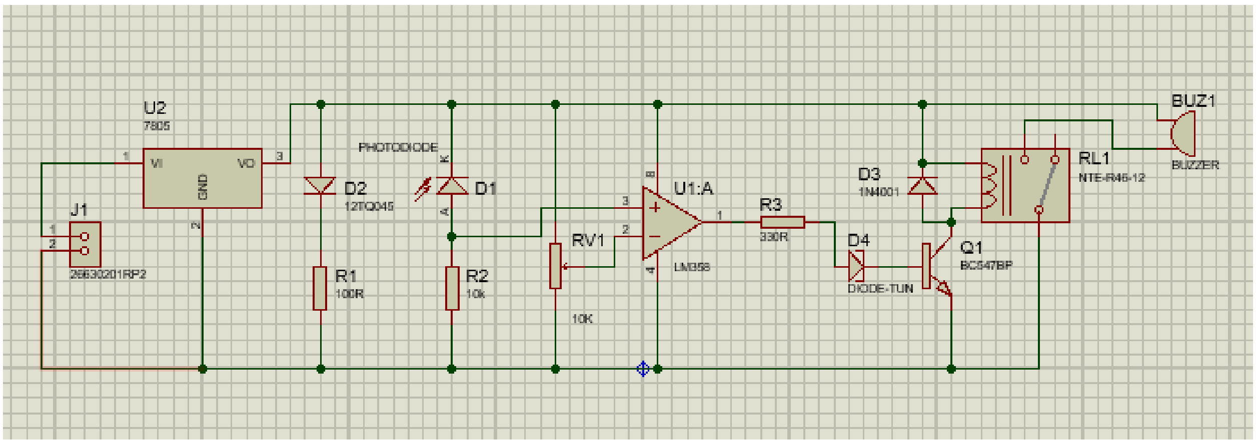

Fig 3.1 Circuit Diagram of Side Stand Sensor

4. COMPONENT DESCRIPTION

4.1 ADXL335 ACCELEROMETER SENSOR

Accelerometers are widely used in cost-sensitive, low power, motion and tilt sensing applications like mobile devices, gaming systems, image stabilization and sports and health devices like fitness bands. Accelerometer sensors detect a change in the cartesian coordinates and show a variation in the output accordingly. The module is a small, low power rated triple-axis accelerometer (from Analog Devices in our case) with extremely low noise. The sensor has a sensing range of ±3 g. It can measure the static acceleration due to gravity due to tilt, as well as acceleration resulting from motion, shock, or vibration.

As mentioned earlier, the accelerometer shows a variation in output with respect to change in coordinates. The range of the sensor lies from 1.6 to 3.3 V. The sensitivity of the ADXL335 sensor is rated at 330 mV/g and is safe to operate at a supply voltage of 5 V.

The pin diagram of the adxl335 accelerometer sensor is as follows

Pin 1 - Vcc supply

Pin 2 – GND

Pin 3 - X_{out}

Pin 4 - Y_{out}

Pin 5 - Z_{out}

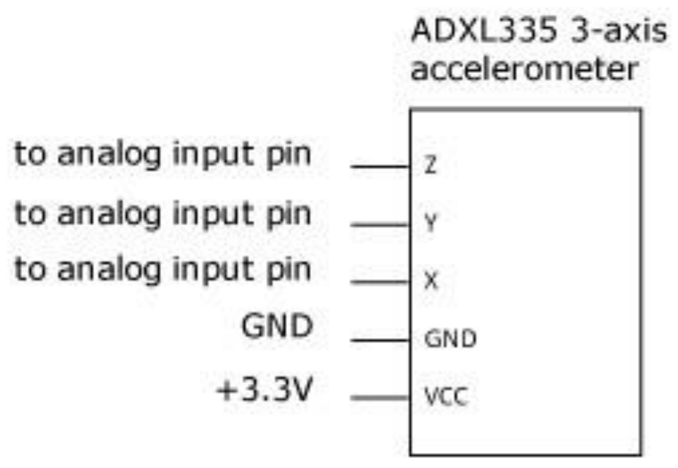

Fig 4.1.1 Pin Layout of ADXL335 3-Axis Accelerometer Sensor

SPECIFICATIONS

T_A = 25°C, V_S = 3 V, C_X = C_Y = C_Z = 0.1 μF, acceleration = 0 *g*, unless otherwise noted. All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
SENSOR INPUT	Each axis				
Measurement Range		±3	±3.6		*g*
Nonlinearity	% of full scale		±0.3		%
Package Alignment Error			±1		Degrees
Interaxis Alignment Error			±0.1		Degrees
Cross-Axis Sensitivity[1]			±1		%
SENSITIVITY (RATIOMETRIC)[2]	Each axis				
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	V_S = 3 V	270	300	330	mV/*g*
Sensitivity Change Due to Temperature[3]	V_S = 3 V		±0.01		%/°C
ZERO *g* BIAS LEVEL (RATIOMETRIC)					
0 *g* Voltage at X_{OUT}, Y_{OUT}	V_S = 3 V	1.35	1.5	1.65	V
0 *g* Voltage at Z_{OUT}	V_S = 3 V	1.2	1.5	1.8	V
0 *g* Offset vs. Temperature			±1		m*g*/°C
NOISE PERFORMANCE					
Noise Density X_{OUT}, Y_{OUT}			150		μ*g*/√Hz rms
Noise Density Z_{OUT}			300		μ*g*/√Hz rms
FREQUENCY RESPONSE[4]					
Bandwidth X_{OUT}, Y_{OUT}[5]	No external filter		1600		Hz
Bandwidth Z_{OUT}[5]	No external filter		550		Hz
R_{FILT} Tolerance			32 ± 15%		kΩ
Sensor Resonant Frequency			5.5		kHz
SELF-TEST[6]					
Logic Input Low			+0.6		V
Logic Input High			+2.4		V
ST Actuation Current			+60		μA
Output Change at X_{OUT}	Self-Test 0 to Self-Test 1	−150	−325	−600	mV
Output Change at Y_{OUT}	Self-Test 0 to Self-Test 1	+150	+325	+600	mV
Output Change at Z_{OUT}	Self-Test 0 to Self-Test 1	+150	+550	+1000	mV

Fig 4.1.2 Datasheet of ADXL335 3-Axis Accelerometer Sensor

4.2 LM358 COMPARATOR

LM358 is a dual package comparator IC ideal for low voltage applications. It is a great, low power and easy to use dual channel op-amp IC. It was designed and introduced by national semiconductor. It consists of two internally frequency compensated, high gain, independent op-amps. This IC is designed for specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip-sized package and applications of this op-amp include conventional op-amp circuits, DC gain blocks and transducer amplifiers.

This particular IC is best suited for the design as it can be operated safely up to input current of 2 mA and the sensor block of our design provides an output current of 1 mA. A more commonly used comparator for project purposes is IC LM758. But LM758 IC provides only one comparator and our design requires two comparators. Hence using LM358 makes more sense as it saves space and power.

The pin layout of the LM358 IC is as follows

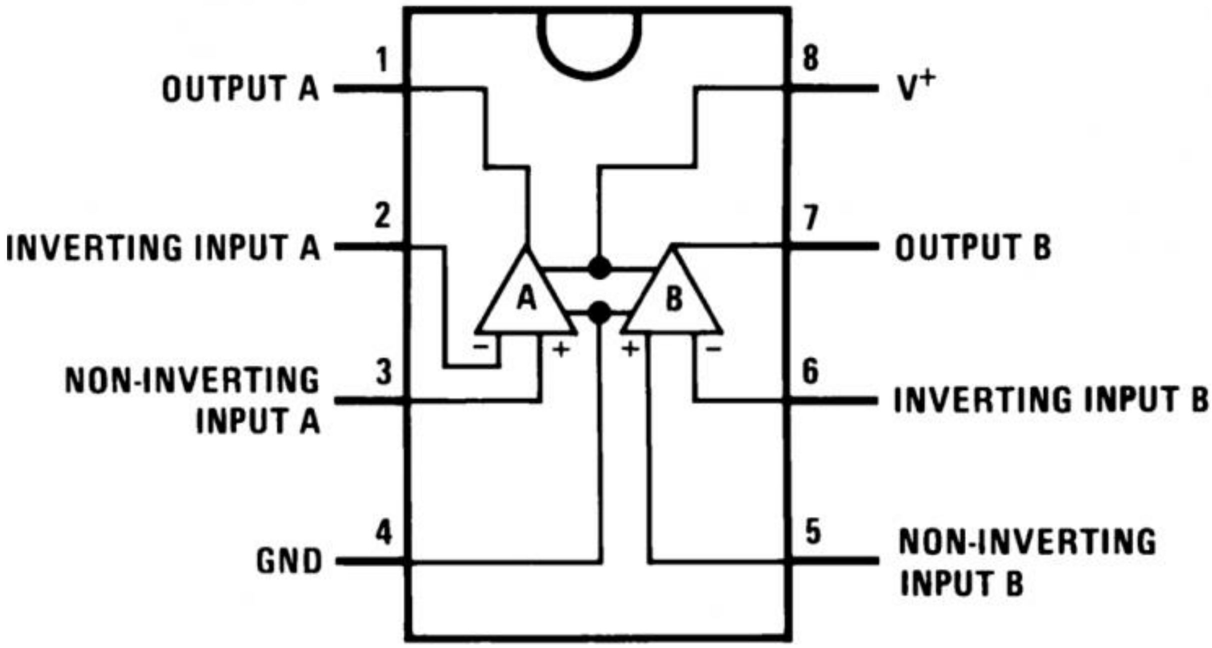

Fig 4.2.1 Pin Layout of LM358 Comparator IC

			LM158, LM258, LM358, LM158A, LM258A, LM358A		LM2904		UNIT
			MIN	MAX	MIN	MAX	
Supply Voltage, V^+				32		26	V
Differential Input Voltage				32		26	V
Input Voltage			−0.3	32	−0.3	26	V
Power Dissipation[4]	PDIP (P)			830		830	mW
	TO-99 (LMC)			550			mW
	SOIC (D)			530		530	mW
	DSBGA (YPB)			435			mW
Output Short-Circuit to GND (One Amplifier)[5]	$V^+ \leq 15$ V and $T_A = 25°C$			Continuous		Continuous	
Input Current ($V_{IN} < -0.3V$)[6]				50		50	mA
Temperature			−55	125			°C
	PDIP Package (P): Soldering (10 seconds)			260		260	°C
	SOIC Package (D)	Vapor Phase (60 seconds)		215		215	°C
		Infrared (15 seconds)		220		220	°C
Lead Temperature	PDIP (P): (Soldering, 10 seconds)			260		260	°C
	TO-99 (LMC): (Soldering, 10 seconds)			300		300	°C
Storage temperature, T_{stg}			−65	150	−65	150	°C

Fig 4.2.2 Datasheet of LM358 Comparator IC

4.3 NE555 TIMER

555 timer IC is a precision timing circuit capable of producing accurate time delays or oscillations. In the time-delay or mono-stable mode of operation, the timed interval is controlled by a single external resistor and capacitor network. In the astable mode of operation, the frequency and duty cycle can be controlled with two external resistors and a single external capacitor. The threshold and trigger levels are normally set at two-thirds and one-third, respectively, of V_{CC}. These levels can be altered by use of the control voltage terminal. When the trigger input falls below the trigger level, the flip-flop is set, and the output goes high. If the trigger input is above the trigger level and the threshold input is above the threshold level, the flip-flop is reset and the output is low. The reset (RSTT) input can override all other inputs and can be used to initiate a new timing cycle. When RST goes low, the flip-flop is reset, and the output goes low. When the output is low, a low-impedance path is provided between discharge and ground.

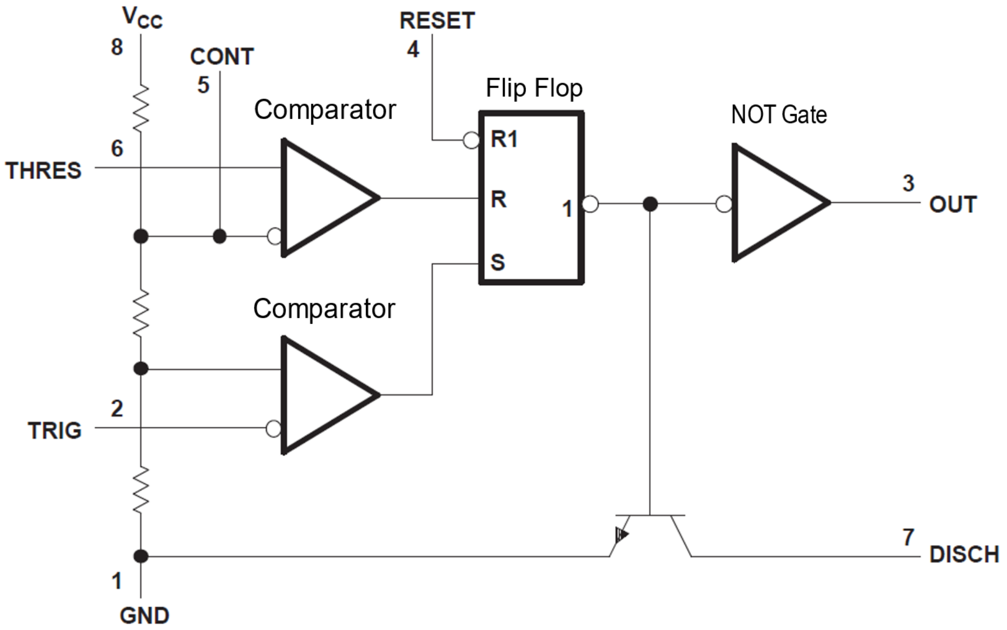

Fig 4.3.1 Internal Circuit of 555 Timer IC

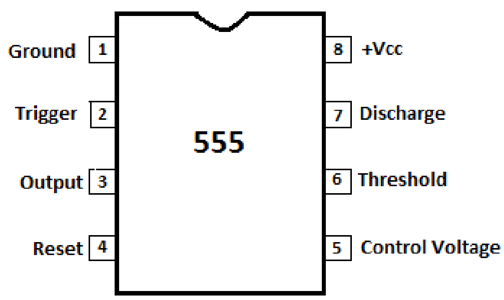

Fig 4.3.2 Pin Layout of NE555 Timer IC

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage		4.5		16	V
Supply Current	V_{CC} = 5 V, R_L = ∞		3	6	mA
	V_{CC} = 15 V, R_L = ∞ (Low State) [3]		10	15	
Timing Error, Monostable					
Initial Accuracy			1 %		
Drift with Temperature	R_A = 1 k to 100 kΩ,		50		ppm/°C
	C = 0.1 μF, [4]				
Accuracy over Temperature			1.5 %		
Drift with Supply			0.1 %		V
Timing Error, Astable					
Initial Accuracy			2.25		
Drift with Temperature	R_A, R_B =1 k to 100 kΩ,		150		ppm/°C
	C = 0.1 μF, [4]				
Accuracy over Temperature			3.0%		
Drift with Supply			0.30 %		/V
Threshold Voltage			0.667		x V_{CC}
Trigger Voltage	V_{CC} = 15 V		5		V
	V_{CC} = 5 V		1.67		V
Trigger Current			0.5	0.9	μA
Reset Voltage		0.4	0.5	1	V
Reset Current			0.1	0.4	mA
Threshold Current	[5]		0.1	0.25	μA
Control Voltage Level	V_{CC} = 15 V	9	10	11	V
	V_{CC} = 5 V	2.6	3.33	4	
Pin 7 Leakage Output High			1	100	nA
Pin 7 Sat [6]					
Output Low	V_{CC} = 15 V, I_7 = 15 mA		180		mV
Output Low	V_{CC} = 4.5 V, I_7 = 4.5 mA		80	200	mV
Output Voltage Drop (Low)	V_{CC} = 15 V				
	I_{SINK} = 10 mA		0.1	0.25	V
	I_{SINK} = 50 mA		0.4	0.75	V
	I_{SINK} = 100 mA		2	2.5	V
	I_{SINK} = 200 mA		2.5		V
	V_{CC} = 5 V				
	I_{SINK} = 8 mA				V
	I_{SINK} = 5 mA		0.25	0.35	V

Fig 4.3.3 Datasheet of NE555 Timer IC

4.4 BC547 NPN TRANSISTOR

BC547 is a bipolar junction transistor commonly used for switching and amplification purposes. The word transistor is a combination of two words, transfer and resistor. So, the basic purpose of a transistor is to transfer resistance. A transistor is normally used for amplification of current.

The larger current at the emitter and collector can be controlled by the small amount of current at the base. BC547 can be used commonly for amplifiers and switches. Similar to all the other transistors BC547 has also three terminals e.g. collector terminal, base terminal and emitter terminal respectively. The amount of current flowing from base to the emitter controls the amount of the current flowing through the collector. BC547 is usually used for amplification and switching purposes. Its maximum current gain is around 800. A fixed DC voltage is required for its proper operation in the desired region.

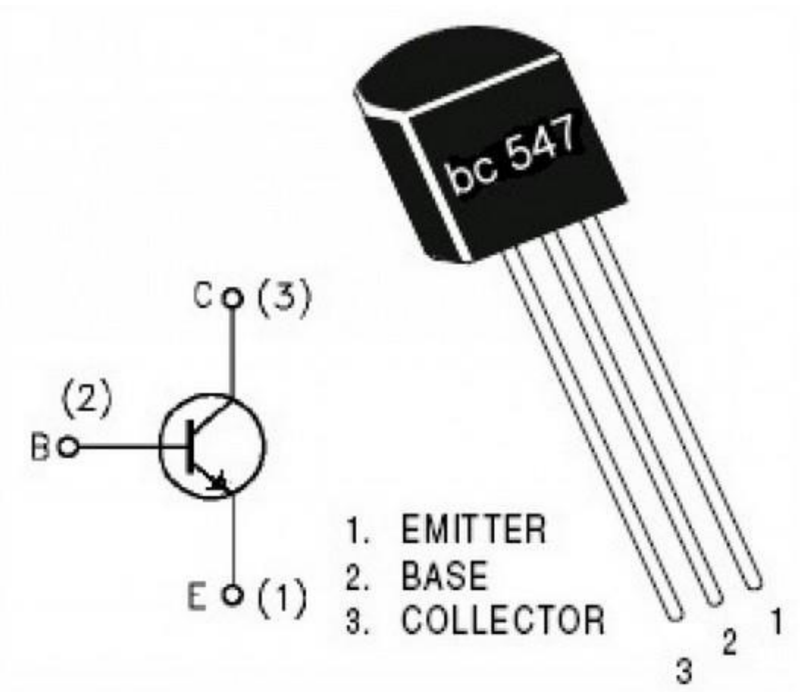

Fig 4.4.1 Pin Layout of BC547 NPN Transistor

NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings T_a=25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage : BC546	80	V
	: BC547/550	50	V
	: BC548/549	30	V
V_{CEO}	Collector-Emitter Voltage : BC546	65	V
	: BC547/550	45	V
	: BC548/549	30	V
V_{EBO}	Emitter-Base Voltage : BC546/547	6	V
	: BC548/549/550	5	V
I_C	Collector Current (DC)	100	mA
P_C	Collector Power Dissipation	500	mW
T_J	Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65 ~ 150	°C

Electrical Characteristics T_a=25°C unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I_{CBO}	Collector Cut-off Current	V_{CB}=30V, I_E=0			15	nA
h_{FE}	DC Current Gain	V_{CE}=5V, I_C=2mA	110		800	
V_{CE} (sat)	Collector-Emitter Saturation Voltage	I_C=10mA, I_B=0.5mA		90	250	mV
		I_C=100mA, I_B=5mA		200	600	mV
V_{BE} (sat)	Base-Emitter Saturation Voltage	I_C=10mA, I_B=0.5mA		700		mV
		I_C=100mA, I_B=5mA		900		mV
V_{BE} (on)	Base-Emitter On Voltage	V_{CE}=5V, I_C=2mA	580	660	700	mV
		V_{CE}=5V, I_C=10mA			720	mV
f_T	Current Gain Bandwidth Product	V_{CE}=5V, I_C=10mA, f=100MHz		300		MHz
C_{ob}	Output Capacitance	V_{CB}=10V, I_E=0, f=1MHz		3.5	6	pF
C_{ib}	Input Capacitance	V_{EB}=0.5V, I_C=0, f=1MHz		9		pF
NF	Noise Figure : BC546/547/548	V_{CE}=5V, I_C=200μA		2	10	dB
	: BC549/550	f=1KHz, R_G=2KΩ		1.2	4	dB
	: BC549	V_{CE}=5V, I_C=200μA		1.4	4	dB
	: BC550	R_G=2KΩ, f=30~15000MHz		1.4	3	dB

Fig 4.4.2 Datasheet of BC547 NPN Transistor

4.5 INFRARED SENSORS

An Infrared light-emitting diode (IR LED) is a special purpose LED emitting infrared rays ranging from 700 nm to 1 mm wavelength. Different IR LEDs may produce infrared light of differing wavelengths, just like different LEDs produce light of different colours. IR LEDs are usually made of gallium arsenide or aluminium gallium arsenide. In complement with IR receivers, these are commonly used as sensors. An IR sensor consists of two parts, the emitter circuit and the receiver circuit. This is collectively known as a photo-coupler or an optocoupler.

The emitter is an IR LED and the detector is an IR photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED. The photodiode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor.

The type of incidence can be direct incidence or indirect incidence. In direct incidence, the IR LED is placed in front of a photodiode with no obstacle in between. In indirect incidence, both the diodes are placed side by side with an opaque object in front of the sensor. The light from the IR LED hits the opaque surface and reflects back to the photodiode.

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Rating	Units
Continuous Forward Current	I_F	100	mA
Peak Forward Current	I_{FP}	1.0	A
Reverse Voltage	V_R	5	V
Operating Temperature	T_{opr}	-40 ~ +85	℃
Storage Temperature	T_{stg}	-40 ~ +85	℃
Soldering Temperature	T_{sol}	260	℃
Power Dissipation at(or below) 25℃ Free Air Temperature	P_d	150	mW

Fig 4.5.1 Datasheet of Infrared LED

5. WORKING OF CIRCUIT

5.1 AUTOMATIC BIKE TURN INDICATOR

5.1.1 SENSOR BLOCK

The sensor block consists of an accelerometer sensor. The accelerometer shows a variation in output with respect to change in coordinates. The range of the sensor lies from 1.6 to 3.3 V. The sensitivity of the ADXL335 sensor is rated at 330 mV/g and is safe to operate at a supply voltage of 5 V. When we take a right turn, the output voltage increases by a factor of 330 mV/g and while taking a left turn, the output decreases by the same factor of 330 mV/g. With this knowledge, we can set a reference voltage on an approximate basis.

5.1.2 COMPARATOR BLOCK

The comparator block consists of an LM358 dual package comparator IC and preset resistance for setting the reference voltage. As mentioned earlier, output voltage increases while taking a right turn and decreases while taking a left turn. With the help of error and trial method, the reference voltage is set accordingly. Each comparator of the dual comparator IC is assigned to indicate a particular direction. The output of the comparator IC is defined by the inputs applied at the inverting and the non-inverting terminal of the comparator. When the bike handle is turned to the left, it gives the output in the form of 1.2V to 2.6V voltage. Inverting terminal of the comparator is connected to the ADXL335 sensor's Y signal, and the non-inverting terminal is connected to preset. Pin 1 of comparator denotes the output of left indication block.

When the bike handle moves towards the right, it gives output in the form of 2.6V to 1.2V voltage. Inverting terminal pin 6 of the comparator is connected to preset, and non-inverting terminal pin 5 to ADXL335 sensor Y signal.

5.1.3 TIMER BLOCK

The output of the comparator block is fed to a 555 timer IC. Since we are providing a pulsating input to the IC, the timer would be working in monostable mode. Basically, in this design, monostable multivibrator is used for timer block. When a negative (0V) pulse is applied to the trigger input (pin 2) of the Monostable configured 555 Timer oscillator, the internal comparator detects this input and sets the state of the flip-flop, changing the output from a low state to a high state. This action, in turn, turns off the discharge transistor connected to pin 7 and hence, removing the short circuit across the external timing capacitor, C1.

Due to this the capacitor charges through the resistor, R1 until the voltage across the capacitor reaches the threshold (pin 6) voltage of 2/3Vcc set up by the internal network. Now, the comparator output is high and it resets the flip-flop back to its original state which in turn turns on the transistor and discharges the capacitor to ground.

The duration of the output waveform can be defined by setting the values of R and C to get the desired delay. This is set by the equation

$$\tau = 1.1 * R * C$$

Now, we could assume the value of any one component and get the value of the second. But we have preferred to assume the value of the capacitor and find the value of the resistor accordingly. This is because we have a wide variety when it comes to the resistance values but that is not the case for capacitors. We have made an assumption that an indication of around 4 seconds would be ideal. The values of R and C have been designed accordingly

Assuming C=10µF and a delay of 4 secs

$$\tau = 1.1 * R * C$$

$$4 = 1.1 * R * 10 * 10^{-6}$$

$$R = 330 K\Omega$$

With the help of these values, we get a delay of approximately 4 seconds.

5.1.4 SWITCHING BLOCK

The output of the timer block is fed to the switching block for indicating. Here, a BC547 transistor is used as a switch for turning on and off the indicator. We have provided the input to the base and are taking the output from the collector. Hence, we are using the transistor circuit in the common-emitter configuration. Assuming a voltage drop of 2 V across the LED, a resistance of 1 KΩ has been added in series with the collector terminal where the LED terminals are connected.

5.2 SIDE STAND SENSOR

5.2.1 SENSOR AND COMPARATOR BLOCK

A photodiode is connected in reverse bias, inverting end of LM358 is connected to the variable resistor, to adjust the sensitivity of the sensor. And the non-inverting end is connected to the junction of the photodiode and a resistor.

When we turn on the circuit there is no IR transmission towards photodiode and the output of the comparator is low. When we take some object in front of IR pair, the IR rays emitted by IR LED are reflected by the object and absorbed by the photodiode. When reflected rays fall on the photodiode, the voltage across photodiode drops, and the voltage across series resistor increases. When the voltage at the resistor is higher than the voltage at inverting end, then the output becomes high and the LED turns on

The voltage at inverting end that is the threshold voltage can be set by rotating the variable resistor. Higher the voltage at inverting end, less sensitive the sensor and lower the voltage at inverting end, more sensitive the sensor.

5.2.2 SWITCHING BLOCK

The output voltage provided by the comparator IC is not enough to drive the indicators. Hence, we have used a 5V relay to drive the LED and buzzer circuit at optimal values of voltage. For safe operation of the relay, a silicon diode is connected in parallel with the relay. This is because when the relay is deactivated, the coil tries to maintain the current flow. As there is no way for the current to circulate, a diode is placed parallel to the coil. In this way, the current circulates through the diode and voltage peaks are prevented from damaging other components of the circuit. And to drive the output of the comparator is fed to a BC547 transistor to use the transistor as a switch.

6. PRACTICAL SETUP AND TROUBLESHOOTING

The first problem we faced was in the sensor block of the bike turn indicator. Initially, we took into consideration the effect of all the coordinates on the output. Now the sensor gave the output voltage accordingly. But the values of output voltages were difficult to comprehend and there was no direct relationship that could be set. For this, we took into consideration the coordinate axes and tried to observe the change of coordinates when a point moves. We then concluded that the change in Y coordinate would be the most reliable. And hence, we decided to take into consideration the effect of Y-axis only. Also, to avoid false triggering of the 555 timers, we added a small capacitance to the pin 5 of NE555 IC to filter out the ripples that caused false triggering

Another problem that we faced was on the side stand sensor circuit. Here, we used a PIR sensor for sensing the distance between the side stand and the ground. We were hoping to get a reliable and accurate output. But the range of the PIR sensor was too large to suit our needs. Due to this, even when the stand was lifted, the circuit gave an indication. To avoid this, we decided to use a low range IR sensor pair instead of the PIR sensor.

We obtained the desired output on breadboard after these steps. But when we tried to implement the same circuit on a PCB, we could not get the output. We checked for the desired output of each block and tried to troubleshoot accordingly. We concluded that the comparator got damaged while testing purposes. We replaced the comparator but still, couldn’t get an output. This could be due to the possibility that some faulty component could be shorting the path and hence damaging the remaining circuit.

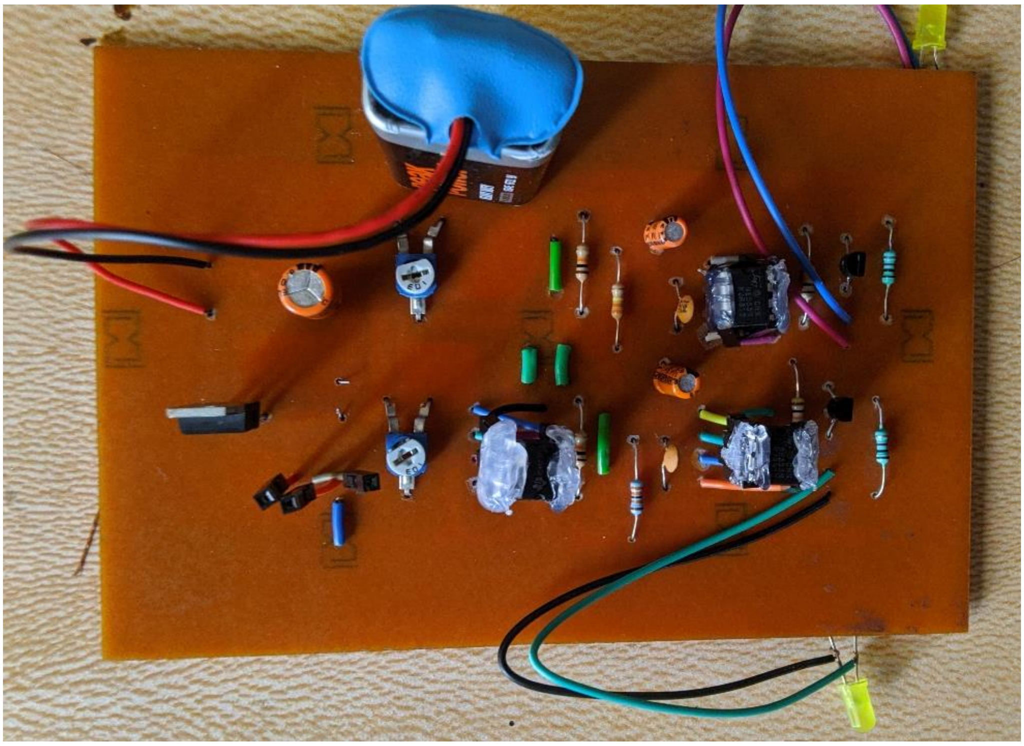

Fig 6.1 Practical Setup of Automatic Bike Turn Indicator

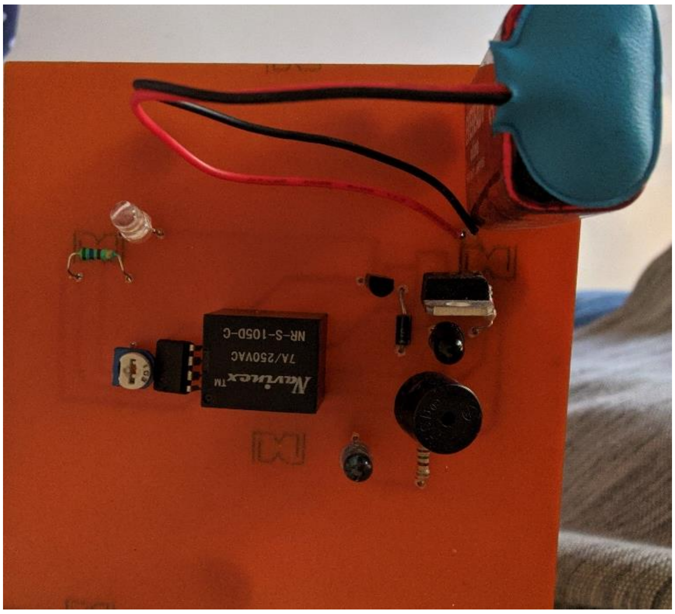

Fig 6.2 Practical Setup of Side Stand Detector

7. LIMITATIONS OF CIRCUIT

7.1 AUTOMATIC BIKE TURN INDICATOR

1. The sensitivity of the project grade accelerometer sensor used is less (0.05 degrees).
2. The circuit is turned on even for small manoeuvres where an indication is not necessary, hence wasting power.
3. The circuit is turned on only after the handle is moved.
4. Hardware limitations affect the sensitivity of the circuit.

7.2 SIDE STAND SENSOR

1. The circuit does not work for black surfaces
2. Desired output not obtained on wet surfaces
3. Undesired output caused by the false triggering of the circuit.

8.CONCLUSION

After implementing this project, we can conclude that this turn detector is quite useful for bike drivers for preventing accidents. We also implemented a circuit for side stand detection which further prevents accidents. These safety features can be implemented at very low cost and are fruitful for careless drivers. We have implemented a delay mechanism due to which the indicators would be turned on for a delay of around 4 seconds. This value was set by designing the values of R and C accordingly. Due to this, once the driver takes a turn, the indicator would be on for a period of 4 seconds after which it would be turned off automatically. We also tested the side stand sensor to approximate its reliability. We concluded that this circuit works well with an exception for black and wet surfaces.

9. APPLICATIONS AND FUTURE WORK

9.1 APPLICATIONS OF THE CIRCUIT

1. Safety measure for absent-minded drivers
2. Feature of luxury cars available to all at affordable rates
3. The indicator is turned off automatically, hence saving power
4. Indicates if the side stand is not raised
5. Saves time while changing lanes

9.2 FUTURE EXPANSION

1. Use of microcontroller for improving the reliability and operating time of the circuit
2. Replacing the components used with commercial-grade components for better sensitivity

10. REFERENCES

1. Op-Amps and Linear Integrated Circuits, Fourth Edition by Ramakant Gayakwad
2. Integrated Electronics, 3rd Edition by Jacob Milman and Christos Halkias
3. https://www.electronics-tutorials.ws/
4. https://economictimes.indiatimes.com/news/politics-and-nation/400-deaths-a-day-are-forcing-india-to-take-car-safety-seriously/articleshow/62439700.cms
5. https://www.livelaw.in/motor-accident-claims-2018-annual-round-up/