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Automatic Gear Transmission System in Duo wheel Automobile via Entrenched Method

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ABSTRACT
In this study, a gear shifting mechanism was designed and applied on an auto clutch featured bike to make the gear transmission process faster and less destructible for the diver using entrenched system design. The present automatic transmission is fully mechanically controlled and costs very high and it is not suitable for small displacement engines. But the gear transmission mechanism designed makes driving easier and to achieve efficient driving. This new device must be reliable, has small dimensions, economical and low maintenance cost. This project aims to improve the gear shifting process with a suitable control mechanism to implement in clutch featured bikes. According to the suggested gear shifting method, the microcontroller selects the transmission gear as per the speed of the vehicle without any human interference. The head light control is designed which dims and dips if any vehicles comes opposite with high beam. This is a safety feature installed to avoid accidents caused due to high beam lights having blinding effect on drivers coming from the opposite direction.

Keywords: Automatic gear transmission, automatic headlight control, digital speedometer, inductive proximity sensor, microcontroller AT89s51.

1. INTRODUCTION

1.1 Overview
The topic of current interest in the area of controller development for automatic transmission with a finite number of gearshifts which transmits the gears automatically with respect to speed. Gearshifts in automatic transmissions involve a change in the power flow path through the transmission. Advantages of these automatic transmissions include simplicity of

mechanical design and savings in transmission weight and size, which are beneficial in terms of fuel economy and production costs. This enables gain in fuel economy while meeting drivability and performance goals, these savings become more significant.

The designed automatic transmission is done in an auto-clutch featured bike which can be applied effectively and efficiently in a clutch featured bikes with suitable control techniques. The ultimate goal of our project is to transmit the gears without the human interference and to attain efficient, safe and easy driving in cost effective way. Microcontroller is the heart of the system which handles all the sub devices connected across it. We have used Atmel 89s52 microcontroller.

1.2 Automation

Automation is the use of control system to control a process replacing the human operators. It is a step beyond mechanization, where human operators are provided with the physical requirements of work.

Automation is now often applied primarily to reduce the human effort thereby to attain desired operation. Another major shift in automation is the increased emphasis on flexibility and convertibility in different process.

One safety issue with automation is that it is often viewed as a way to minimize human error in the system, increasing the degree and the levels of automation also increase the sequence of error that accidently created in automated systems. Different types of automation tools that exist in today's environment are Programmable logic controller, Microcontroller, SCADA, etc.

1.3 Types of Transmission

Manual transmission
Automatic transmission

1.3.1 Manual Transmission

A manual transmission or sequential type is a type of transmission used on motorcycles and cars, where gears are selected in order, and direct access to specific gears is not possible.
With traditional manual transmissions, the driver can move from gear to gear, by moving the shifter to the appropriate position. A clutch must be disengaged before the new gear is selected, to disengage the running engine from the transmission, thus stopping all torque transfer.

1.3.2 Automatic Transmission

An automatic transmission is one type of motor vehicle transmission that can automatically change gear ratios as the vehicle moves, freeing the driver from having to shift gears manually and to achieve efficient driving.

1.3.3 Advantages of Automatic Transmission

- Easier to drive in stop-and-go traffic and available in most cars, an automatic transmission has definite benefits
- The main benefit of automatic transmissions is that they are simply easier to use.
- Fuel efficient.

1.4 Embedded System

All embedded system uses either a microprocessor (or) microcontroller. The software for the embedded system is called firmware. The firmware will be written in assembly language (or) using higher level languages life 'C' (or) 'Embedded C'. The software will be simulated using micro code simulation for the target processor. Since they are supposed to perform only specific tasks, the programs are stored in ROM.

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An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with programming interfaces, and embedded system programming is a specialized occupation.

An Embedded system is a special-purpose computer system, which is completely encapsulated by the device controls. It has specific requirements and performs pre-defined tasks, unlike a general purpose personal computer.
Avoids lots of Electronic components.
Build in with rich features.
Probability of failure is reduced.
Easy interface.

1.5 Block Diagram Description

The presented project is aimed to perform operations such as automatic gear transmission, automatic headlight control, and digital speedometer. Here the speed is the inputs to the microcontroller unit.
The inductive speed sensor senses the speed of the vehicle from the front wheel and sends train of pulses as output to the microcontroller unit. The microcontroller unit checks the pulses for sample time period and calculates the speed of the vehicle.
As programmed, the microcontroller actuates the Relay 1 and Relay 2 through the driver unit depending on the speed of the vehicle. The DC motor function is to transmit the gear lever by pole reversal technique which is performed using the relays.

Since it requires slowing down the engine at the time of gear transmission, the supply to the ignition coil is grounded so as to slow the engine.

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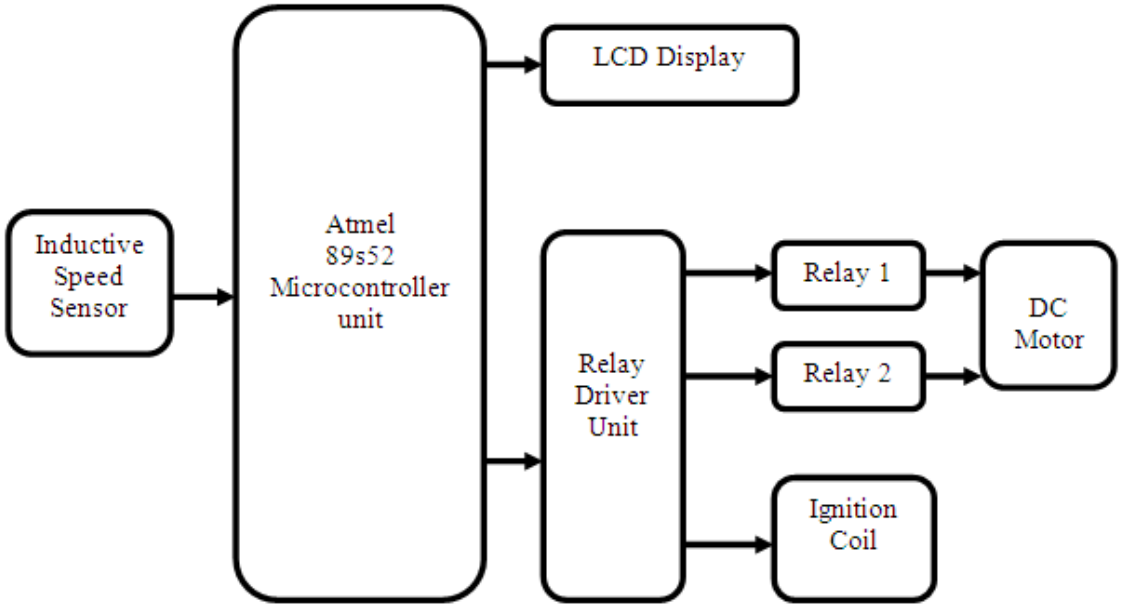

Fig.1: Block Diagram of Automatic gear transmission in Two Wheelers Using Embedded System

2. HARDWARE DESCRIPTION

2.1 Inductive Speed Sensor

Inductive proximity sensors are designed to operate by generating an electromagnetic field and detecting the eddy current losses when a ferrous metal target enters the field. The sensor consists of a ferrite core, an oscillator, a trigger-signal level detector and an output circuit. The oscillator creates a high frequency field radiating from the coil in front of the sensor centered on the axis of the coil. When a metal object enters the high-frequency field, eddy currents are induced on the surface of the target. As a metal object advances into the field, eddy currents are induced in the target. This results in a loss of energy in the oscillator circuit and consequently smaller amplitude of oscillation.

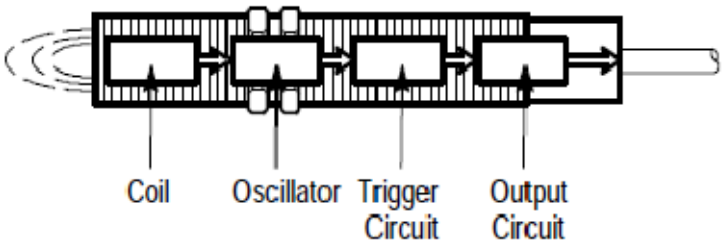

Fig. 2: Inductive proximity pickup

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The detector circuit recognizes a specific change in amplitude and generates a signal which will turn the solid state-output "ON" or "OFF". When the metal object leaves the sensing area, the oscillator regenerates allowing the sensor to return to its normal state.

The inductive speed sensor has a built-in hysteresis to avoid unwanted switching of the sensor due to,

- Mechanical vibration of the sensor or the gear wheel
- Electrical interference
- Circuit oscillation at very low rotational speed

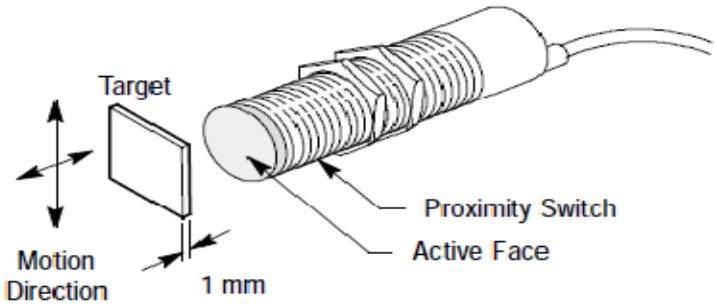

Fig.3: Sensor mounting

A larger hysteresis provides a better immunity to disturbances but, on the other hand, reduces the maximum sensing distance d, as the sensor signal must exceed the hysteresis levels to be recognized.

2.2 Microcontroller

Microcontrollers are microprocessors with peripheral devices and memory embedded in a single chip. They are used in almost all modern day appliances controllers and so it is produced in millions. The most popular microcontroller architecture is Atmel 89s52. There are many

number of IC manufacturers offering microcontrollers based on this architecture. Atmel is one of them. The microcontroller 89s52 from Atmel is chosen for this project.

2.2.1 AT89s52

The AT89s52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry standard 80C51 and 80C52 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89s52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

Features

- 8K Bytes of In-System Reprogrammable Flash Memory
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

2.2.2 Oscillator Characteristics

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier that can be configured for use as an on-chip oscillator, as shown in Fig.4. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven, as shown in the figure. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

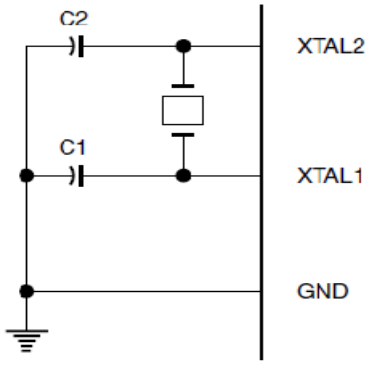

Fig.4: Oscillator connection

2.3 Liquid Crystal Display (LCD)

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCDs do not emit light directly. The LCD display used in this project is 16*2 type LCD display it consists of 14 pins.

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2.4 Relay Driver Unit

Relays are devices which allow low power circuits to switch a relatively high current and voltage ON/OFF. For a relay to operate a suitable pull-in and holding current should be passed through its coil. Generally relay coils are designed to operate from a particular voltage at 5V or 12V.

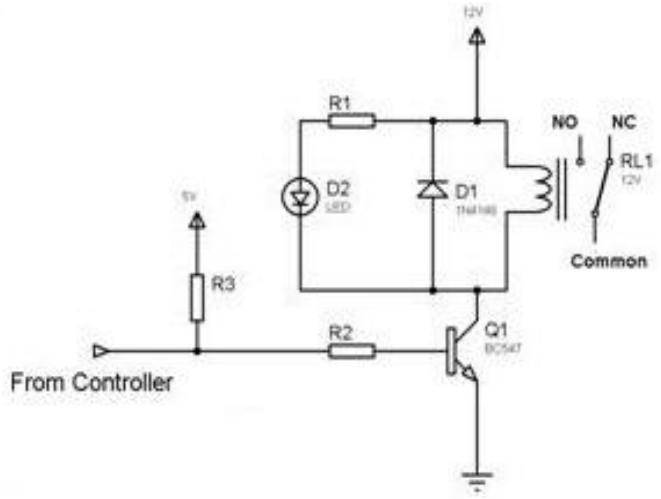

Fig.5: Relay Driver Unit

The fig.5 shows the basic relay driver circuit. The NPN transistor BC547 is used to control the relay. The transistor is driven into saturation (turned ON) when logic 1 is written on the port pin thus turning ON the relay. The relay is turned OFF by writing logic 0 on the port pin. A diode is connected across the relay coil to protect the transistor damage due to back EMF generated in the relays inductive coil when the transistor is turned OFF. The LED is used to indicate that the relay is turned ON or OFF.

2.5 Relays

Relays come in various configurations for their switch contacts, as well as different DC voltages for to operate their coil. They may be as simple as an on/off switch or as complex as integrating several switches into one unit. In a "double-pole" configuration, one switch terminal toggles between two different output terminals. Regardless of the configuration, each switch on a relay can be "normally open" (NO) or "normally closed" (NC); that is, when the coil is at rest and not energized, the switch contacts are NO or NC. In an open circuit, no current flows, similar to a wall light switch in the "Off" position. In a closed circuit, metal switch contacts touch each other to complete a circuit, and current flows, similar to turning a light switch to the "On" position.

In the accompanying schematic diagram, points A and B connect to the coil. Points C and D

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connect to the switch. Voltage applied across the coil at points A and B creates an electromagnetic field that attracts a lever in the switch, causing it to make or break contact in the circuit at points C and D (depending if the design is NO or NC). The switch contacts remain in this state until the voltage to the coil is removed.

Rated load	: 12-28VDC
Coil resistance	: <=100m ohms
Coil rated voltage	: 3-24VDC

2.6 DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. The armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. The ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine. The stator coils will be referred to as field coils they are connected in series or parallel with each other to create changes of torque in the motor.

2.7 Photo Detectors

The MRD500 photodiode used is a p-intrinsic-n (PIN) silicon diode operated in reverse bias. The very thin p-type conducting layer acts as a window to admit light into the crystal. The reverse bias voltage maintains a strong electric field throughout the intrinsic region forming an extended depletion layer. The depletion layer should be thicker than the absorption length for photons in silicon in order to maximize the efficiency. Any incident photon whose energy exceeds the band-gap energy is absorbed to produce an electron-hole pair by photoelectric excitation of a valence electron into the conduction band. The charge carriers are swept out of the crystal by the internal electric field to appear as a photocurrent at the terminals. The photocurrent is proportional to the rate at which light is entering the diode.

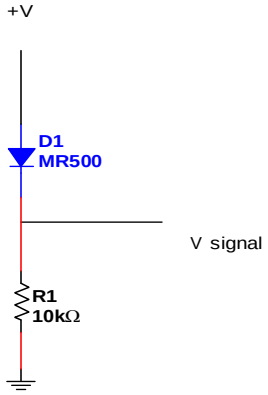

Fig.6: Photo Detector Circuit

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2.8 Power Supply Unit

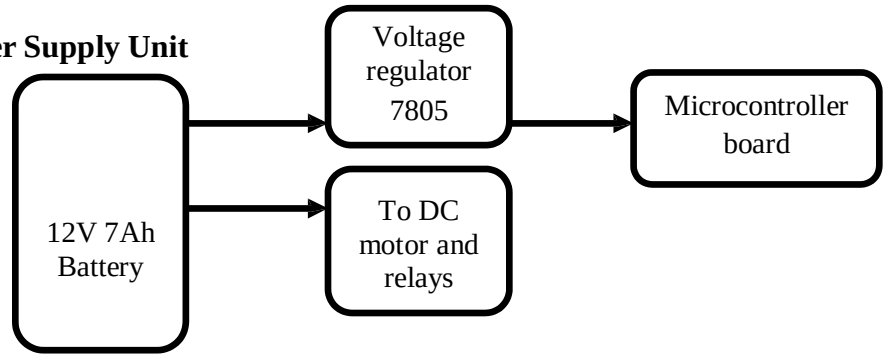

Fig.7: Block diagram of power supply unit

The 7805 is a family of self-contained fixed linear voltage regulator integrated circuits .The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the *xx* is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx lines are positive voltage regulators: they produce a voltage that is positive relative to a common ground. There is a related line of 79xx devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit. These devices support an input voltage anywhere from a couple of volts over the intended output voltage, up to a maximum of 35 or 40 volts, and typically provide 1 or 1.5 amperes of current (though smaller or larger packages may have a lower or higher current rating).

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3. HARDWARE IMPLEMENTATION

3.1 Overall Circuit

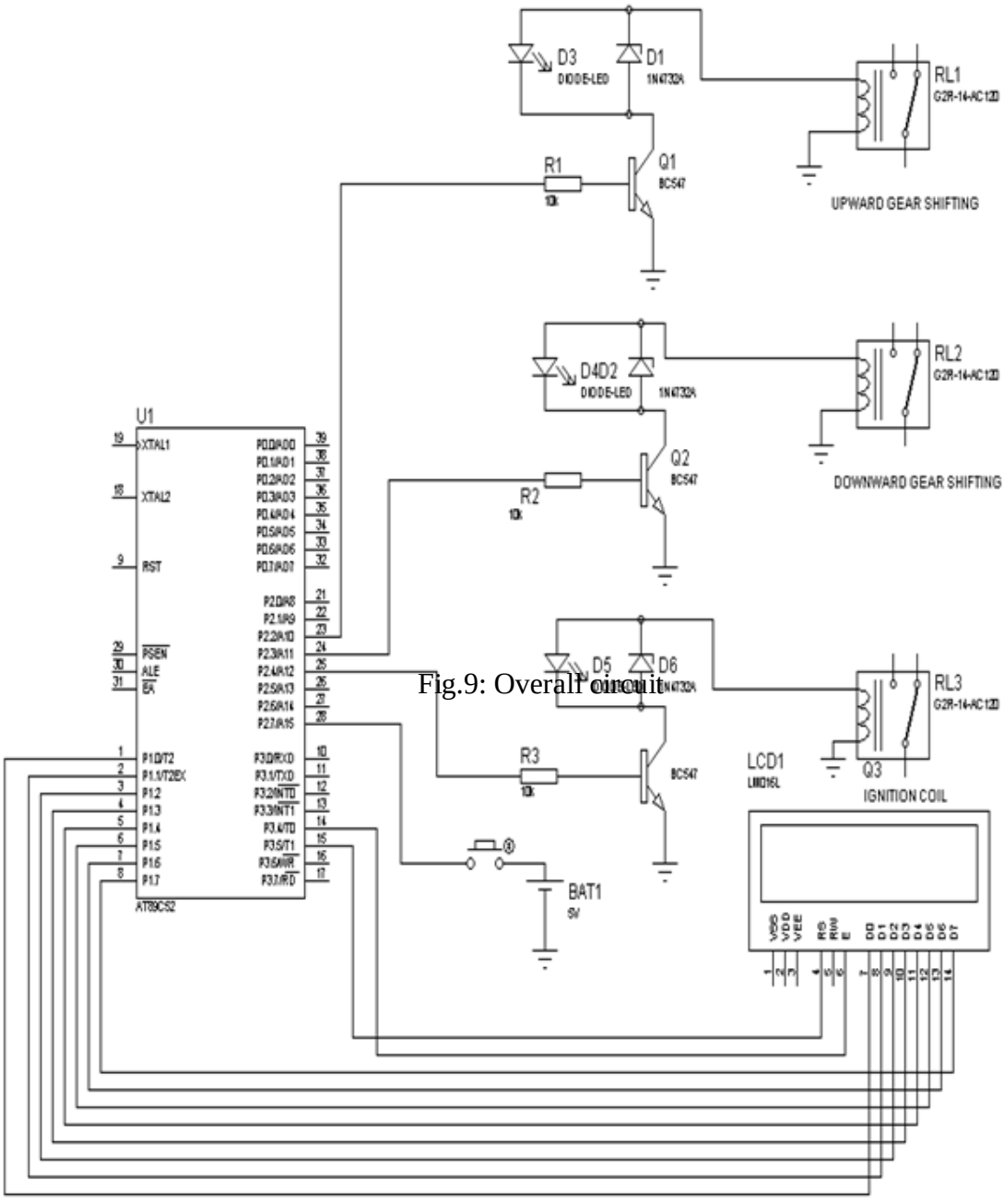

Fig.9: Overall circuit

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3.2 Pin connection

P2.7 - Inductive proximity sensor
P2.2 - To Relay 1 (upward gear shifting)
P2.3 - To Relay 2 (downward gear shifting)
P2.4 - To Relay 3 (ignition cut off relay)
P3.4 - Enable (LCD command word)
P3.5 - To select data/command register (LCD command word)
P1.0 - D0 (LCD data line)
P1.1 - D1 (LCD data line)
P1.2 - D2 (LCD data line)
P1.3 - D3 (LCD data line)
P1.4 - D4 (LCD data line)
P1.5 - D5 (LCD data line)
P1.6 - D6 (LCD data line)
P1.7 - D7 (LCD data line)

3.2 DC Motor Connections

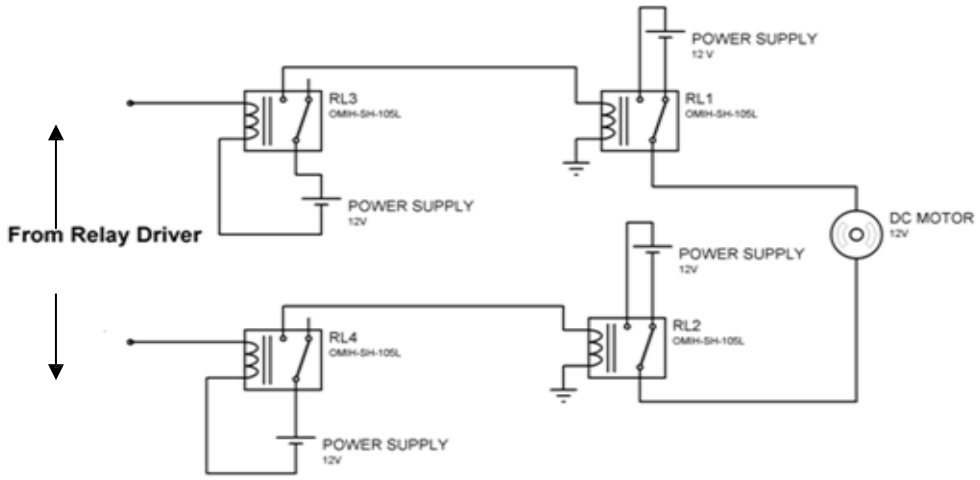

Fig.10: DC motor connections

Relay specification:
Relays 1 and 2 – 12V, 25A
Relays 3 and 4 – 12V, 5A

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To run the DC motor in both directions to shift the gear up and down pole reversing technique is adopted. Here relays 1 and 2 are connected to the DC motor and the relays 3 and 4 operate the relays 1 and 2 through the microcontroller respectively. When relay 3 is energized through the microcontroller units relay 1 is energized and thus the motor runs in anticlockwise direction and shifts the gear upwards and when the relay 4 is energized opposite action takes place and shifts the gear downwards.

3.3 Photo Detector Circuit

MR500 is used as a sensor to detect the light intensity which is silicon photodiode. This photodiode operates under an oscillator with frequency of 2 KHz correspondingly current is obtained as output which is proportional to the intensity of the light. A current to voltage amplifier is used with input current from the photodiode is applied to the inverting terminal of the amplifier.

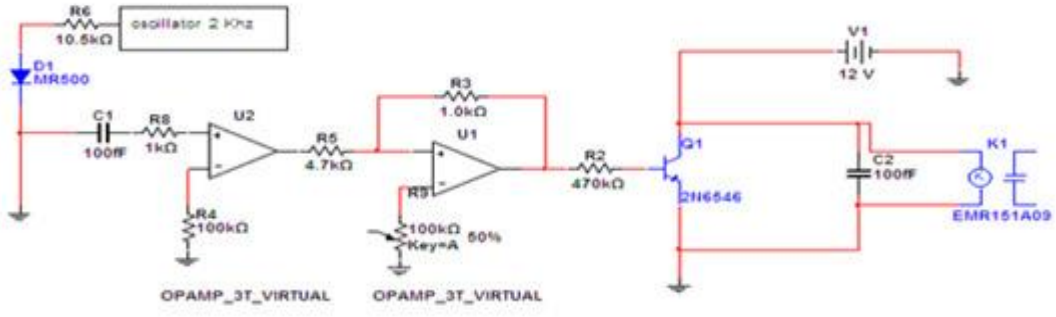

Fig.11: Photo detector circuit

The output of the current to voltage amplifier is connected to the relay through the relay driver unit which operates the functionality of the headlight.

3.4 Project Snapshots

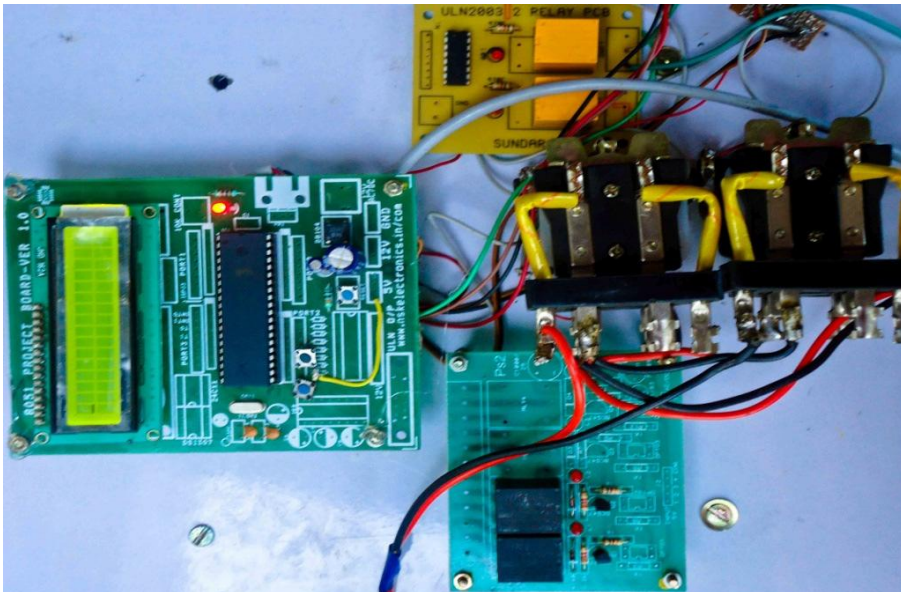

Fig.12: Microcontroller board

Fig.13: DC motor mounting

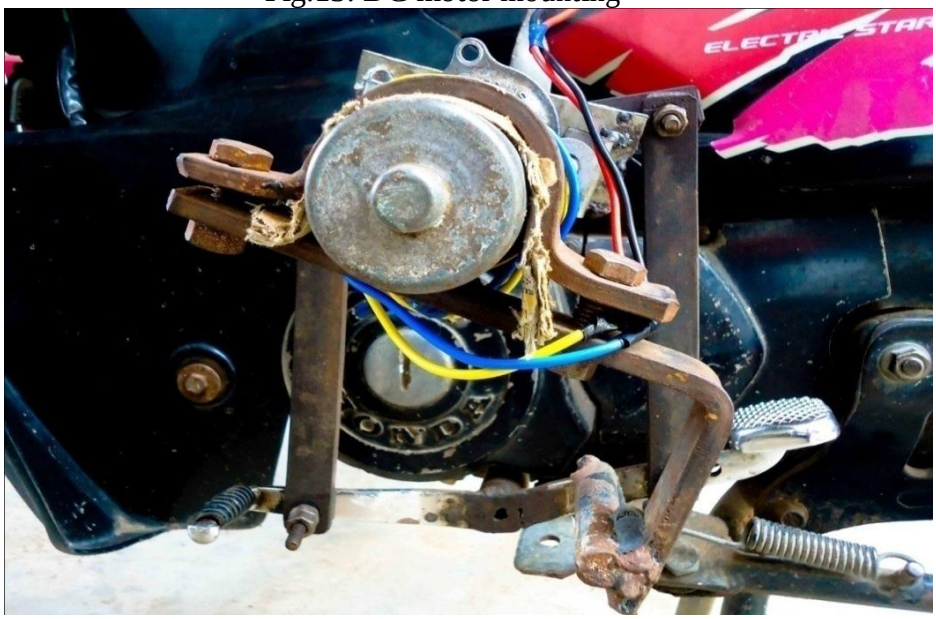

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Fig. 14: Inductive speed sensor mounting

4. RESULTS ANALYSIS

The Inductive speed sensor output pulses decide the output of the system. The sensor produces pulses when it crosses the metal target fixed in the wheel. The sets of gear pattern is decided by the pulses obtained from the sensor and they are tabulated below,

Table 1: Obtained Output

Sensor pulses	Speed (Km/hr)	Gear position
1	Less than 5	Gear 1
2 3	5 15	Gear 2
5 7	20 25	Gear 3
9 11 13 15 17	30 35 40 45 50	Gear 4

5. CONCLUSION

The project presented has involved the development and implementation of automatic transmissions for bikes. The motivation of this work is to implement this idea in clutch featured bikes with a suitable clutch control. The automatic transmission can be also used in 5 and 6 speed versions by altering few changes in the program. According to the achieved results the mechanism done is reliable if it is installed in bikes. Using the simplest microcontroller and the required hardware enables to convert the old traditional semi automatic gear transmission mechanism to a fully automated one. The application of this mechanism leads to make the driving process easier and fuel efficient driving can be achieved.

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