# EVALUATION ANALYSIS OF AUTOMATIC DUAL ROLLED TRANSMISSION ASSEMBLY THROUGH EMBEDDED SYSTEM (MICROCONTROLLER)

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**ABSTRACT**

*This study entitles the development and shifting mechanism of a design applied on automobile clutch and introduced to making the transmission process easier and less destructible for the diver using embedded system. The current transmission systems available are partially mechanically controlled and costs higher and not suitable for small displacement engines, hence the need for dual rolled transmission assembly through embedded system (microcontroller). The components used for the system development were: Speed Sensor, Sensor mounting, Relays, Relay driver unit, Ignition coil, Dc motor Oscillator, Battery, and Microcontroller. The system was tested and was reliable, making the driving easier and efficient with small dimensions, cost-effective and little maintenance cost. It also attributes to improving the shifting of the gear process suitable to control and implement for the clutch featured bikes. Based on the gear shifting technique, the microcontroller selects the transmission gear as per the speed of the vehicle without any human interference, which can also be used in 5 and 6 speed versions by altering few changes in the program. The system was successfully developed and tested. The head light control was designed that dims and dips for any vehicles that comes in opposite direction with high beam. It acts as a safety feature installed to avoid accidents caused by high beam lights with blinding effect on drivers from the opposite direction.*

**Keywords:** Automatic Transmission assembly, Embedded System, Digital Speedometer, Inductive Proximity Sensor, Microcontroller AT89s52.

## 1 INTRODUCTION

This work aims at the development of controller for automatic transmission assembly with a predetermined number of gearshifts that transmits the gears automatically base on speed limit. Gearshifts in automatic transmissions involves a change in the power flow path as in [1] parts 1 & 2 through the transmission with some major advantages 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. Low maintenance cost in which these savings become more significant. As in the past. In this our present research, the automatic transmission was developed and be-clutch featured which can be applied effectively and efficiently in a clutch featured bikes with suitable control techniques. The ultimate goal of our art in the article is to transmit the gears without the human interference and to attain efficient, safe and easy driving in cost effective way. Microcontroller unlike the ordinary systems (hydraulic or electrical systems) [1] is used as the heart of the system which handles all the sub devices as listed in section 2.1 connected across it, block diagram Figure 1. Atmel 89s52 microcontroller was used so as to detect the coming vehicle [2], so also easy to transmit power like the gearless transmission [3].

Under normal condition, the dual rolled assembly transmission has an improved working condition greater than that of [4] having just slightly around 43.2% aggregate.

# 2 MATERIALS AND METHOD

## 2.1 Materials

The available materials obtained in our workshop used in developing the effort less transmission assembly comprised of the followings: Speed Sensor, Sensor mounting, Relays, Relay driver unit, Ignition coil, Dc motor, Oscillator, Battery, Microcontroller.

## 2.2 Method

## 2.3 Automation

This is the control system used to control the process to replacing the human operators' effort. It is a step beyond mechanization, where human operators are provided with the physical requirements of work. Automation was applied primarily to attain the 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.

## 2.4 Types of Transmissions

### *2.4.1 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 by which 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 as described by [1].

### *2.4.2 Automatic Transmission*

As discussed in [1], an automatic transmission is a 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.

### *2.4.3 Advantages of Automatic Transmission*

Easier to drive in stop-and-go traffic and available in most new modern cars with the following transmission benefits: Simply easier to use and. Fuel efficient.

### *2.4.4 Embedded System*

All embedded system uses either a microprocessor (or) microcontroller [6]. 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. As stated in [6], an embedded system is some combinations 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. It's 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 [6].

### *2.4.5 Block Diagram Description*

The presented project is aimed to perform operations such as automatic gear transmission, automatic headlight control, and digital speedometer as described in [1]. 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 and presented in Figure 1, 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.

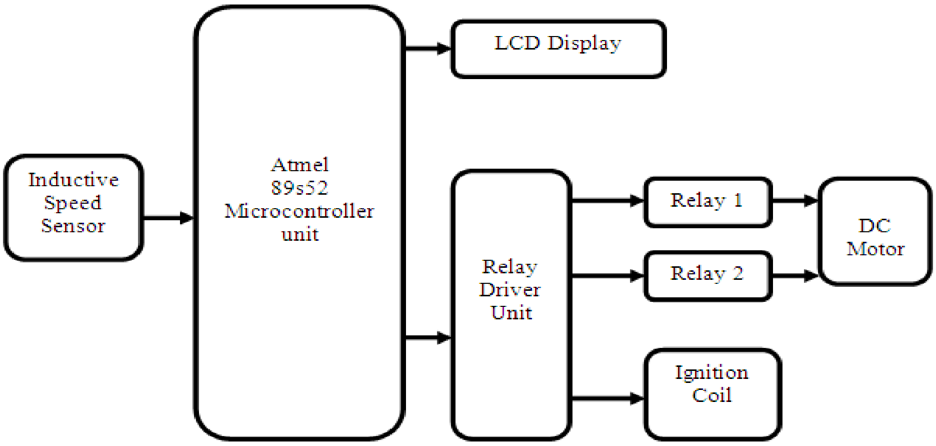


Figure 1. Block Diagram of Automatic gear transmission in Two Wheelers Using Embedded System

## 3 HARDWARE DESCRIPTION

### 3.1 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 [1]. The sensor consists of a ferrite core, an oscillator, a trigger-signal level detector and an output circuit. Figure 2 presents the oscillator that 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

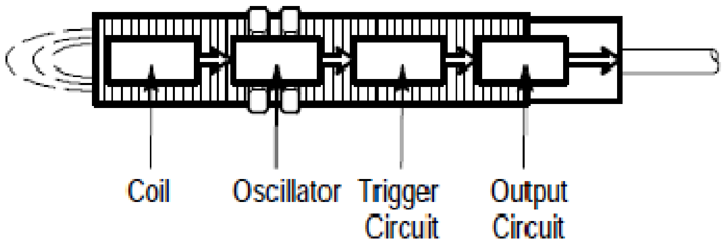


Figure 2. Inductive proximity pickup

Figure 3 describes the detector circuit recognizes a specific change in amplitude and generates a signal which will turn the solid state-output "ON" or "OFF" for gear change as the speed changes unlike the one presented [1]. 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 and circuit oscillation at very low rotational speed. 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.

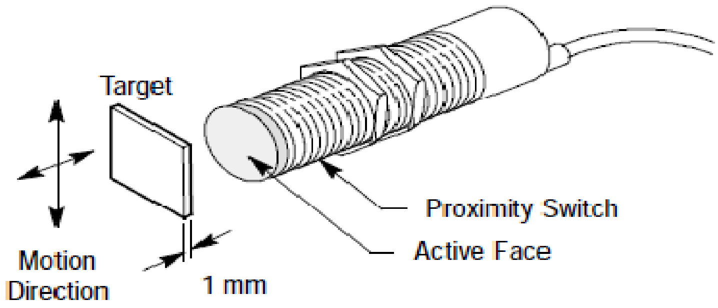


Figure 3. Sensor mounting

### 3.2 Microcontroller

Microcontrollers are microprocessors with peripheral devices and memory embedded in a single chip used in almost all modern-day appliances produced in millions [7], and the most popular microcontroller architecture is Atmel 89s52. There are many numbers of IC manufacturers offering microcontrollers based on this architecture. Atmel is one of them. The microcontroller 89s52 from Atmel was chosen for this work.

### 3.3 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) [7]. 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. The **AT89S52** used has the following Features: 8K bytes of in-System, reprogrammable flash memory, 256 x 8-bit internal RAM, 32 programmable I/O lines, tree 16-bit timer/counters, eight interrupt sources, programmable serial channel and low-power idle and power-down modes.

### 3.4 Oscillator Characteristics

Oscillator is a tuned electronic circuit used to generate a continues output waveform [8], in which XTAL1 and XTAL2 are the input and output respectively of an inverting amplifier configured for use as an on-chip oscillator shown in Figure 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 as driven, as indicated 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 should be observed.

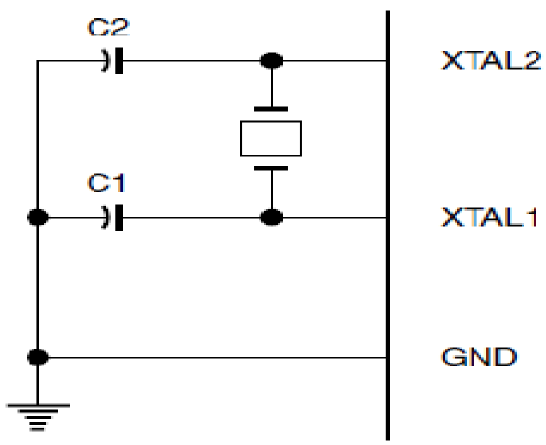


Figure 4. Oscillator connection

### 3.5 Liquid Crystal Display

The liquid crystal display (LCD) is a flat panel display, electronic visual display, or video a 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 consisting of 14 pins.

### 3.6 Relay Driver Unit

Relays are devices which allow low power circuits to switch a relatively high current and voltage ON/OFF [9]. 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, Figure 5. The Figure shows the basic relay driver circuit. The NPN transistor BC547 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.

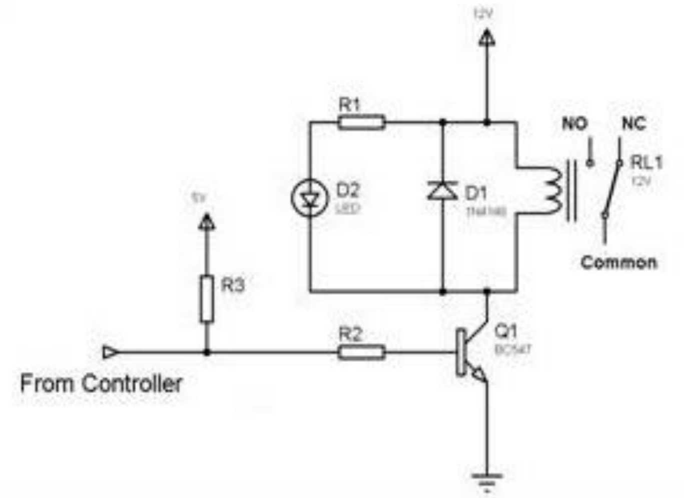


Figure 5. Relay Driver Unit

### 3.7 Relays

Relays comes in various configurations for their switch contacts, as well as different DC voltages for to operate their coil [9]. 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 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.

### 3.8 DC Motor

DC motor convert direct current (DC) electrical energy into mechanical energy through magnetic field and of two basic parts [10]. 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.

### 3.9 Photo Detectors

The MRD500 photodiode used in this work is a p-intrinsic-n (PIN) silicon diode operated in reverse bias as described by [10]. 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.

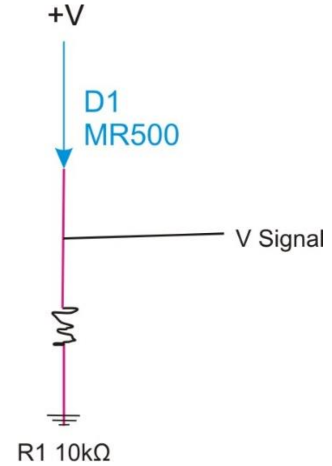


Figure 6. Photo Detector Circuit

### 3.10 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 5volt output, while the 7812 produces 12 volts). The 78xx.

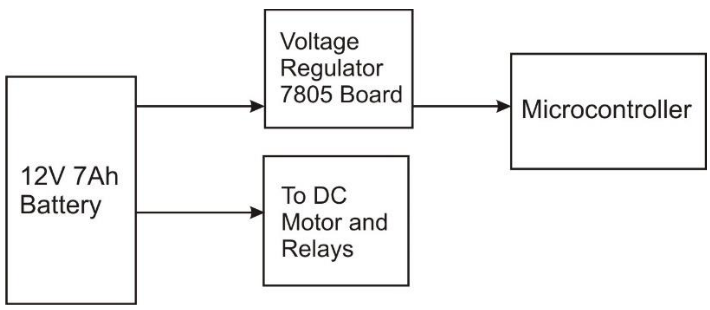


Figure 7. Block Diagram of Power Supply Unit

## 4 Overall Circuit of the system

Figure 8 presents the complete circuit diagram of the automatic dual rolled transmission assembly through embedded system (microcontroller) comprising of the Speed Sensor, Sensor mounting, Relays, Relay driver unit, Ignition coil, Dc motor, Oscillator and the battery.

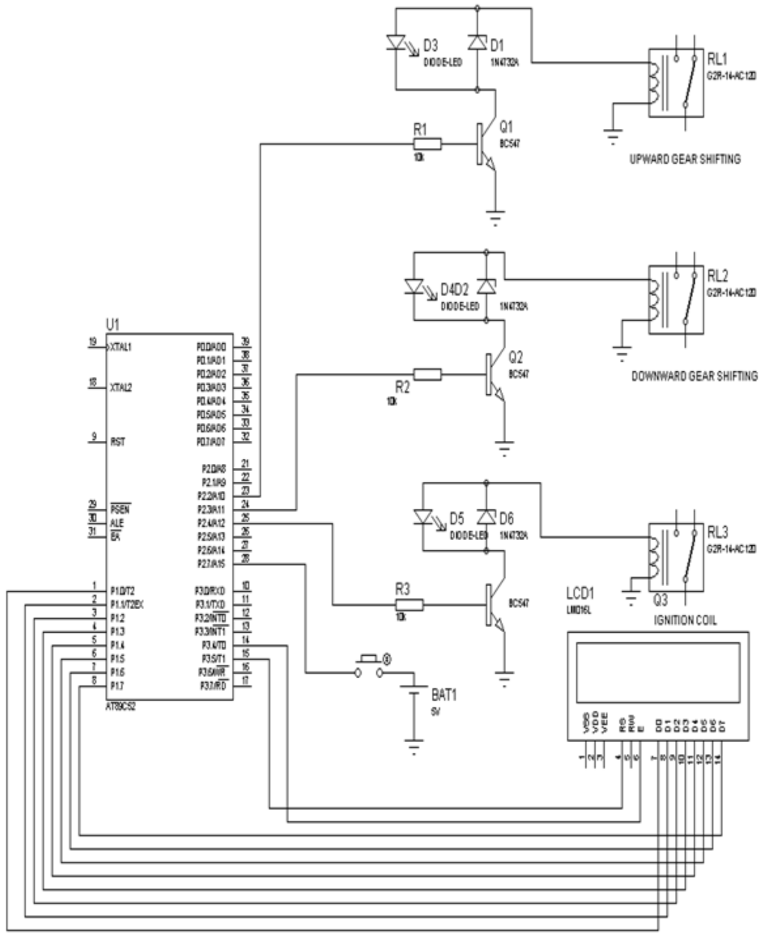


Figure 8. Overall Circuit

## 4.1 DC Motor Connections

Figure 9 shows the DC Motor Connections.

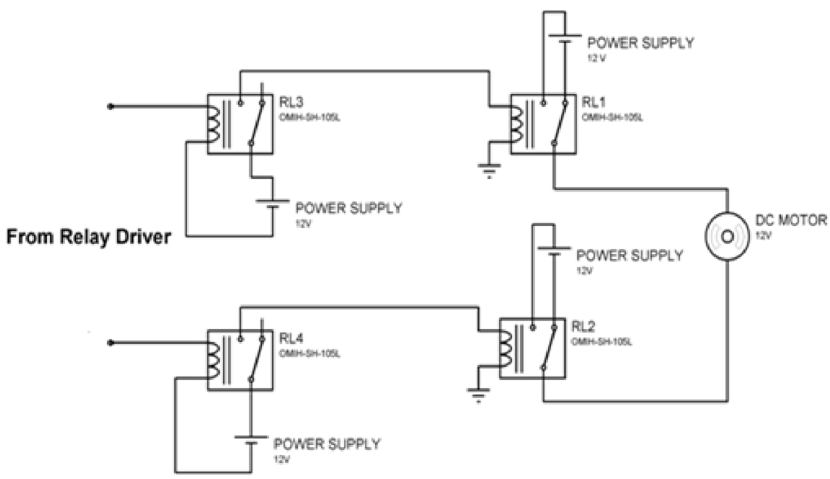


Figure 9. DC Motor Connections

## 4.2 DC Motor Connections

Relay specification: Relays 1 and 2 – 12V, 25A Relays 3 and 4 – 12V, 5A. The relays 1 and 2 through the microcontroller respectively as presented by [9]. 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 downward.

### 4.3 Photo Detector Circuit

MR500 is used as a sensor to detect the light intensity which is silicon photodiode as presented in [10]. 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. 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.

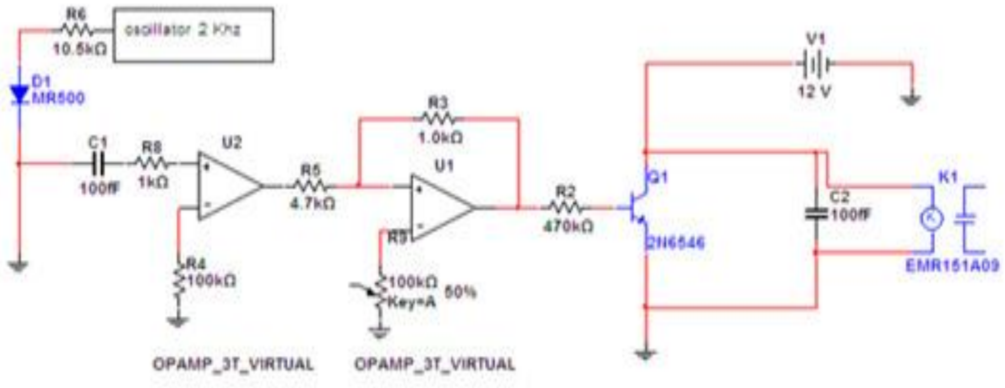


Figure 10. Photo detector circuit

### 4.4 Microcontroller Board

The complete system comprised of the following components: Microcontroller board Figure 12, the motor mounting Figure 13, DC motor mounting figure 14, and the Inductive sped sensor Figure 14, that enables the gear shifts.

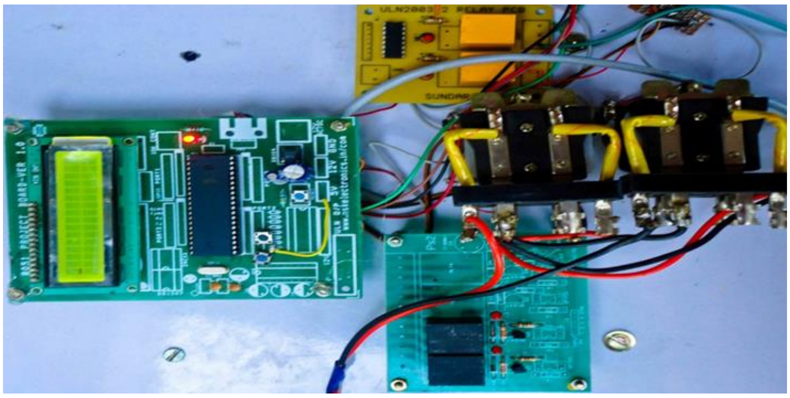

Figure.11. Microcontroller board

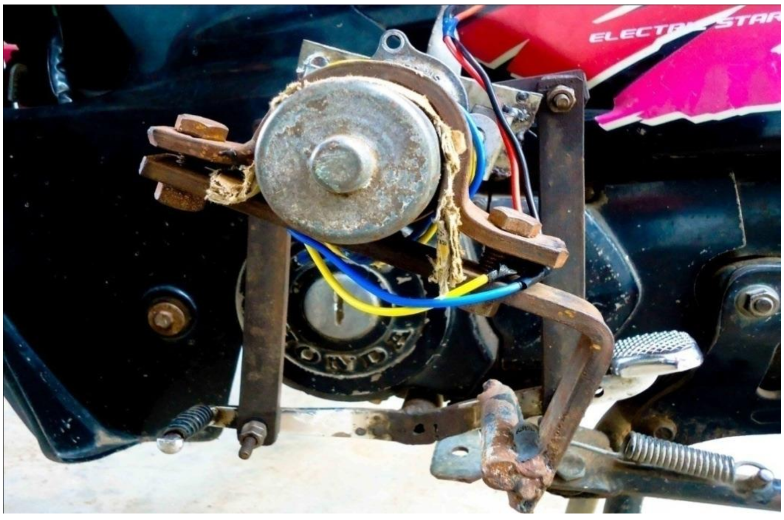

Figure 12. DC motor mounting

Figure 13. Inductive speed sensor mounting

## 5 RESULTS AND DISCUSSIONS

Table 1 presents the Inductive speed sensor output pulses of the system. The sensor produces pulses when it crosses the metal target fixed in the wheel. The sets of the gear patterns are decided by the pulses obtained from the sensor and are tabulated below. Based on the output results, the system was evaluated and was reliable, making the driving easier and efficient with small dimensions. It also attributes to improving the shifting of the gear process suitable to control and implement for the clutch featured bikes. So also, on the gear shifting technique, the microcontroller selects the transmission gear as per the speed of the vehicle without any human interference, hence the system was successfully developed.

Table 1. Obtained Output

| Sensor Pulses | Speed (Km/Hr) | Gear Position |
|---|---|---|
| 1 | Less than 5 | Gear 1 |
| 2 | 5 | |
| 3 | 15 | Gear 2 |
| 5 | 20 | |
| 7 | 25 | Gear 3 |
| 9 | 30 | |
| 11 | 35 | |
| 13 | 40 | Gear 4 |
| 15 | 45 | |
| 17 | 50 | |

## 6 CONCLUSIONS

The work presents the development and implementation of automatic transmissions for bikes, which suggests the gaps in existing research particularly regarding cost reduction, sustainability, and efficiency improvement in delivering bikes productions. The motivation also to implementing the idea in clutch featured bikes with a suitable clutch control. The automatic transmission can also be 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 making the driving process easier and fuel-efficient driving could be achieved.

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