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Original Article

Assistance to Traffic for Transportable Multipurpose

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Abstract: *In India in 2019, 82,781 accidents occurred as a result of various traffic regulations. Numerous of such collisions were caused by bad road conditions, infractions of the law, etc. This kind of traffic accidents are a common hazard for employees in construction projects that focus on roads. There are several solutions to this problem. One of them is to utilize a portable traffic light to control traffic in areas without traffic lights when roads are being constructed or while traffic lights are out. By controlling traffic, whether it be cars or people walking, a portable wireless traffic-control signal system reduces risk. On the market, there are several portable traffic lights. Our objective is to create a multifunctional traffic light that is both affordable and portable. This device will take the place of the personnel who risk their safety to stand in the middle of the highways to direct traffic. By building the system more cheaply, more individuals will be able to purchase and utilise it.*

Keywords: *Portable traffic light system, Arduino Nano Microcontroller, RF Module, Solar panel.*

I. INTRODUCTION

The first traffic signal was created in 1912. They are signalling tools used to manage traffic flow at places like road intersections, pedestrian crossings, railway connections, and rail lines. The Volume The whole signal system consists of three different coloured lights: green, which permits you to go in the assigned direction, yellow, which warns you to prepare for a brief halt, and red, which prevents traffic from moving ahead.

Indian highways need strict traffic management, which is done by the traffic police at the major intersections in the city using the standard traffic signals. However, in cases like broken traffic lights and emergency checks at checkpoints, public employees are required to stand in the middle of the road and control the flow of traffic, which puts them at extremely high risk for accidents and exposure to air pollution. Additionally, traffic is brought on by the building of new roads, the use of flyovers and bypass highways, the creation of rings, and the restoration of existing roads. Road work might occur anywhere. As a consequence, traffic has to be carefully watched over and managed. Flagmen are often employed to regulate and watch over traffic movement. Utilizing manpower comes at a hefty price. Because training sessions are expensive, the bulk of paid flagmen are not properly trained. The flagman may encounter several perils while the route is being built. Additionally, there is an increased likelihood that the flagman, employees, and even other road users may be involved in an accident during road construction. Road work may take place throughout the night or sometimes during the day, depending on the weather. Therefore, deploying flagmen is improper, especially at night. To avoid traffic jams and accidents in certain areas, traffic must be regulated during specific times. There is a temporary traffic control device that is portable and has both automated and manual operating options. The conventional kind of portable traffic assistance is bulkier, has trouble getting about, is expensive, and requires a lot of time to move.

In order to reduce the chance of public employees getting hurt, it is proposed in this paper to design and develop a cost-effective, portable, easily transportable, multipurpose traffic assist that can be used at checkpoints during emergencies, during road and bridge construction, and during traffic light failures. The device will be RF-controlled. The Multipurpose portable traffic assist will provide a great solution for the above mentioned problems since it is remote controlled and the public worker can regulate the traffic from a safe distance. Furthermore, the unit is modular and compact, light, detachable, and portable, it can be readily transported to any site on a two-wheeler and set up and programmed for use by a single person. All these features are being done at low cost, we have eliminated yellow light since it's only being used in situations where yellow light is not required.

II. RELATED WORKS

The invention consists of a wireless portable traffic management signal system that may be utilised to safely control both pedestrian and vehicular traffic. It has a base, a vertical support that can be raised or lowered, and a display module for t ext or pictures. The system has a remote control feature that enables administrators to manage it from a secure location away from traffic.

They have developed a temporary portable traffic control device that can run both automatically and manually. The device is set up and configured for usage by one person, is modular, tiny, and light enough to be transported in a police, emergency, or other vehicle. At many road crossings, the flow of cars is monitored and managed by traffic light control systems. Aligning several traffic signal systems at nearby intersections requires consideration of a number of factors, including the issue of junctions is challenging. They suggest a system based on a PIC microcontroller that performs dynamic time slots with various levels and uses infrared sensors to assess traffic density. Additionally, a portable controller device is designed to address theissue of emergency vehicles becoming stuck on jam-packed roadways.

A technical and economical analysis of the installation of a photovoltaic (PV)-powered LED (light-emitting diode) system to be utilised as traffic lights in a significant bogota avenue was done. Traditional traffic signals and the new LED system were contrasted, with design and financial considerations taken into account. Traditional traffic lights, LED traffic lights, a stand-alone PV-powered LED system near to support (SALED), and a stand-alone PV-powered contemporary traffic light were all investigated (SAMTL).

The analysis concludes that LED traffic lights are the best solution in our particular situation since they use 88 percent less energy than conventional systems and need less maintenance after three years. A mobile traffic control system intended for usage along a section of road when the regular flow of traffic has to be changed for a number of reasons. The system consists of two radio-controlled signal display units with lamps that may be mounted at each end of a length of road. The operators control the devices using a handheld remote transmitter. A temporary portable traffic control device having an electrical control circuit, a horizontal boom that can be folded into a vertical position, and the ability to operate both automatically and manually. [8] A roadwork Safety unit is linked to a conventional trailer lighting connection and fastened to the receiver hitch of a vehicle. The carrier also houses a standard light unit with a telescopically extendable red light and flashing warning light.

A portable wireless traffic light system is built using a microcontroller and wireless ZigBee. This system is equipped with motion and infrared sensors that detect and count the number of cars in order to prevent collisions. A mobile traffic control device that may be used to regulate traffic. The portable traffic assistance system has a remote control, a signal head with an LED display, and a microprocessor. A base unit with a power supply box and a signal head are joined together. This box offers LED lights and the CPU both need energy. The height of the portable traffic assistance device may be changed.

III. PROPOSED SYSTEM

The major goals of the suggested approach are to make the traffic lights lighter, more transportable, and less expensive. There are numerous portable traffic lights on the market, and many of them need to be transported in a different heavy-duty vehicle. However, in emergency scenarios such as road, bridge, and flyover construction, sudden failure of traffic lights, and at checkpoints, our technology may be simply carried utilising a two-wheeler. Due to its ability to be controlled by radio frequency modules, this system aids in the reduction of labour requirements and takes into account the protection of public employees from airborne contaminants. There are four main building pieces that make up the proposed multipurpose portable traffic assist design architecture. Power supply unit, controlling unit, RF unit, and lighting unit make up this group. The power supply unit is made up of two batteries: a 12V battery for the system's control unit and a 9V battery for the traffic lights. A battery level indicator circuit may be used to determine the battery's condition. We utilise a solar panel that can be installed on top of the traffic assistance system to recharge the battery. The system's controlling component, which is in charge of both the manual and automated modes of operation, is the Arduino NANO. The RF unit, which is used to manually operate the system, is made up of an RF transmitter and receiver. In order to activate automated mode, we utilise a two-position switch. The automated mode is then managed using a three-position switch dependent on the volume of traffic. The three- position switch's low mode is employed in areas with low traffic density, neutral mode in areas with medium traffic density, and high mode in areas with high traffic density. High intensity LED lights that can provide significant illumination in daytime make up the lighting unit. The Multipurpose Portable Traffic Assist's components are selected for their ability to accomplish the goal, cost effectiveness, compactness, and quality. The diagram below depicts the system architecture.

Due to the cost-effective design of the Multipurpose Portable Traffic Light, we disregarded the yellow signal on our traffic light. This method will mostly be used when a temporary traffic signal is necessary. Therefore, ignoring the yellow signal saves money and makes the gadget smaller and lighter overall. A camera tripod stand that is the appropriate height is utilised for the traffi c light stand since it is portable and reasonably priced. The traffic light's lights have to be powerful enough to provide enough lighting throughout the day. Our system's LED lights provide a sufficient level of lighting while still being reasonably priced.

IV. DESIGN AND IMPLEMENTATION

A. Arduino Nano

The ATmega328 processor powers the tiny microcontroller known as the Arduino Nano. The Arduino Nano uses UART TTL(5V) serial connection. It is functionally similar to the Arduino Duemilanove but comes in a different form factor. The size of this specific microcontroller is one of the primary factors in its selection. It may be readily customised using the Arduino Software integrated development environment (IDE), a free online resource. A computer, another Arduino, or other microcontrollers may all be communicated with using the Arduino Nano's many communication features. C and C++ are the programming languages used to setup this microcontroller. This microcontroller may be powered by either a 9 V battery or a type-B micro-USB connection. The microcontroller's 27th external pin may also provide it.

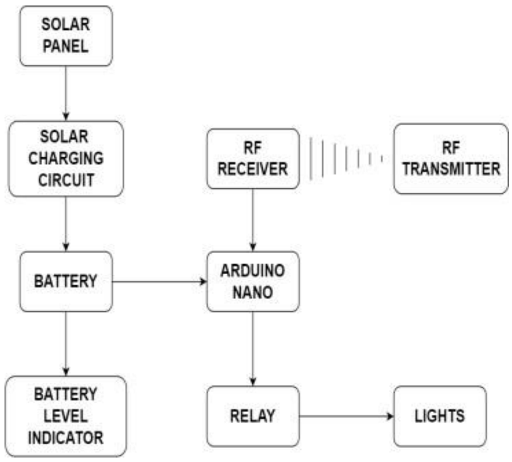


Figure 1: Block Diagram

32kb of internal RAM are available on the ATmega328. The instructions digitalwrite() and digitalread() may be used to set its 14 digital pins. The digital pins' working voltage is 5V, and they have a maximum current capacity of 40mA. The 8 analogue pins of the Arduino Nano are typically powered by 5 volts. With the exception of pins 6 and 7, all analogue pins may be utilised as digital pins. The tiny Arduino Nano board has the same connections and features as the larger Arduino Uno board.

Figure 2: Arduino Board

The Arduino platform itself is renowned for its capacity to manage automation in a functioning system. It may be quickly linked to computers and set up using a variety of software programmes, including Mac, Windows, and Linux. Additionally, in the event that the system fails, it is simple to debug. Due to its suitability for our needs, we decided to use the Arduino nano as the project's controller.

B. RF Module:

There are several methods to send a signal wirelessly, however employing an RF transmission module is the best option for sending the signal outside. The RF module is a comprehensive wireless communication system since it includes a transmitter and a receiver module. The RF module uses radio frequency to communicate, as the name would imply. An RF module is just two devices interacting through radio frequency, to put it simply. From 30 kHz to 300 GHz, the frequency range varies.

The proper frequency range is chosen based on the use scenario. Here, we employ a 433 MHz module for our use case. Because traffic lights are employed outside in our case, RF transmission is particularly useful in resolving communication issues. To avoid having frontline personnel present on the field, a wireless communication system was used. This addresses the issue of accidents, health problems, physical strain, etc. that frontline employees experience. While there are many other RF modules on the market, we are utilising one that is already built and features a remote-style transmitter and a standard receiver for our system. There are four buttons on the remote. By assigning each button to a different channel of the traffic assistance system, the task is made simpler.

The RF module we used for our traffic assistance system is R02A. This RF module's receiver circuit features eight external connectors. The power supply is connected to the 5V pin, and the GND terminal serves as the negative end of the power supply. The receiver's data output is sent to the 4 data pins: D0, D1, D2, and D3. Each of these data ports has a 5V output voltage and is a digital pin. The antenna's pin, known as the ANT, is regarded as the receiver's eighth pin.

Figure 3: RF Transmitter & Receiver

C. Relay

In order to manage the main supply, relays are nothing more than electromagnetic switches. In this instance, the power supply for the traffic lights is managed by the relay. Relays come in a variety of designs and varieties. We are employing a four channel relay module for this traffic assist since the traffic light in our case has four channels. The four channel relay is setup using four 5V relays and a few more parts. As a result, connecting to and configuring the four channel relay with microprocessors or sensors is more versatile.

Each block is shared by two relays, and the relay is split into two blocks. Six screw-type terminals, six in each block, make it simpler to connect the wires. The four relays on the module are rated for 5V, thus when there is about 5V across the coil, the relay turns on. Each relay's contacts are marked on the body with the specifications for 250VAC, 30VDC, and 10A in each instance. The switching transistors serve as a buffer between the low-current inputs and the high-current relay coils in relay systems. They boost the input signal in order to drive the coils and turn on the relays.

Figure 4: Relay

Given that the coils represent an inductive load when the relay is switched off, the freewheeling diodes avoid voltage spikes across the transistors. When the coil of each relay is activated, the indicator LEDs flash, signaling that the relay is active. The optocouplers provide an extra barrier of isolation between the inputs and the load being switched.

D. Lighting Unit

Lights play a crucial role in traffic signals. Therefore, choosing the right illumination is crucial. When it comes to traffic lights, the throw and brightness should be quite strong. Since LEDs are more efficient in every way than their predecessors, Halogen and Incandescent bulbs, they are employed in conventional traffic signals.

LEDs offer a greater lighting range and use less electricity. We will only utilise the technology in our traffic assist when temporary help is needed to control the flow of traffic. Therefore, we have decided to use angel-shaped fog lights as traffic signals. Angel lights are often employed as fog-clearing lights in automobiles.

Angel lights were chosen for our system primarily because they are affordable, energy-efficient, and provide a respectable spectrum of lighting. Because it is only utilised temporarily in our system, the lighting is somewhat impaired, thus we chose to cover the illuminating range for the first few cars. Traffic can be controlled if we halt the first few cars, which will cause all the others to stop as well. The lighting range of our angel light is around 100 metres. The four channel relay on the microcontroller makes it simple to configure this angle light.

Figure 5: Lights

E. Power Supply Unit

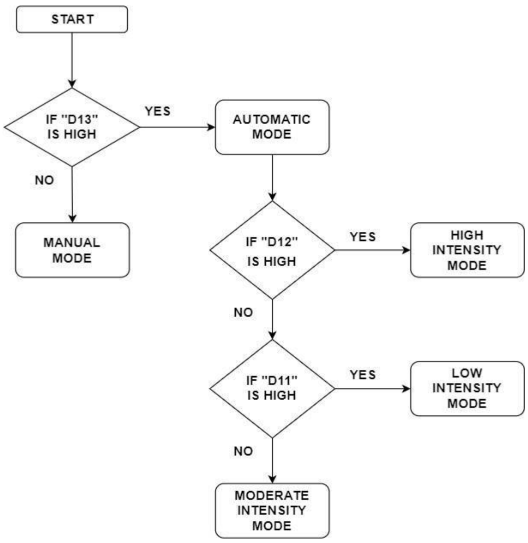
Any electrical equipment has to be powered in order to work. Therefore, selecting a power supply is essential to every electrically powered system. In our situation, picking a power source should be acceptable. The standby time of the power supply is one of the characteristics that is necessary for a power supply in our system. The standby period varies depending on the power supply's capacity. The standby time increases with battery capacity. The battery we selected has a capacity of 2600mAh since our system is intended to be small in size. This results in a standby period of around one hour.

Actually, our system uses two different power supply. The microcontroller is in one, while the LED is in the other. The primary power source, which has a capacity of 2600mAh, provides the LED with its working voltage of 12V. The 9V battery supplies the microcontroller's working voltage, which ranges from around 5V to 9V. The microprocessor itself supplies power to the RF receiver and the relay (Output voltage of the digital pins in the microcontroller is 5V). Because the power supply unit is rechargeable, the system may be recharged while not in use. In our system, the power source is also simply replaceable, making it simple to swap them out for a new battery with a full capacity as necessary.

Figure 6: Battery

F. Flow Chart

An Arduino Nano microcontroller serves as the system's controller. Typically, the Arduino is used to execute the main loop indefinitely. The system's flow chart consists of a single loop where input into a pin modifies the system modes. By default, the system operates in manual mode since the input on digital pin D13 is low. When the digital pin's input is increased, the system switches from manual to automated mode and vice versa. When the system enters automated mode, it will look for any inputs on digital pins D11 and D12. Each traffic cycle's time is determined by these digital pins, which are designated in three different modes. three modes: one for heavy traffic, one for light traffic, and one for very light traffic. The low intensity option is activated when the digital pin 11 is set to high. Additionally, the high intensity mode activates when the digital in 12 is set to high. The moderate intensity mode is activated if both digital pins are set to low (the default setting).



The graphic below shows the system's flow chart.

Figure 7: Flow Chart for Automatic Mode

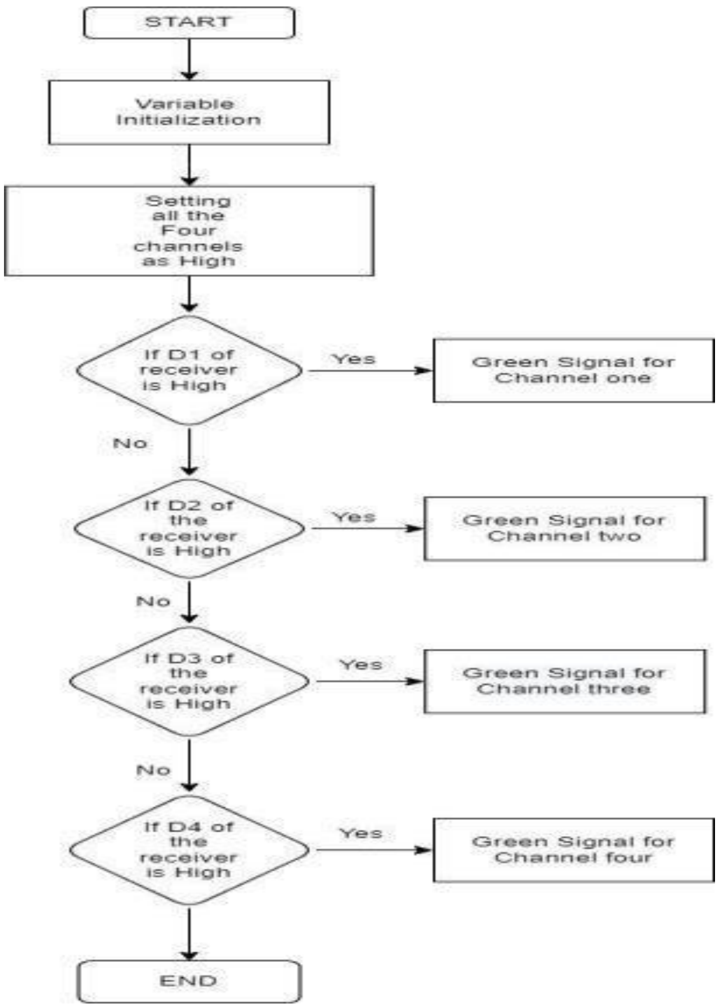


Figure 8: Flow Chart for Manual Mode

V. RESULTS AND DISCUSSION

The final findings were produced in a manner that was identical to the flow charts. Figures 7 and 8 demonstrate how the whole system functions. The system's controlling component, which is in charge of both the manual and automated modes of operation, is the Arduino NANO. The RF unit, which is used to manually operate the system, is made up of an RF transmitter and receiver. We use a two-position switch to go into automatic mode. The automated mode is then managed using a three-position switch dependent on the volume of traffic. The three-position switch's low mode is employed in areas with low traffic density, neutral mode in areas with medium traffic density, and high mode in areas with high traffic density. Both conventional charging and a solar panel that may be installed on top of the traffic assistance system are used to recharge batteries.

Figure 9: Proposed System Prototype

A. Circuit Diagram

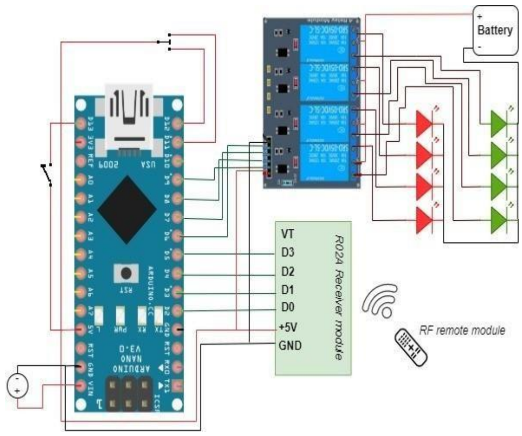


Figure 10: Hardware Wiring Diagram

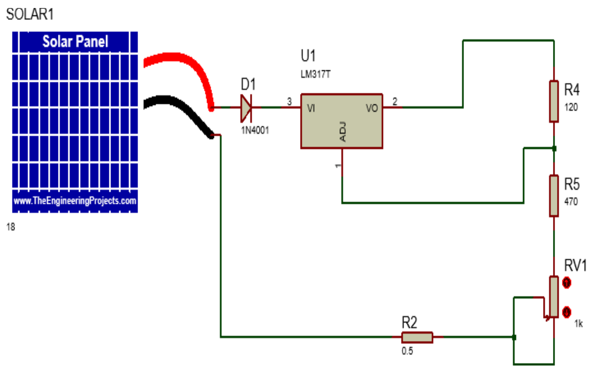


Figure 11: Solar Charging Circuit

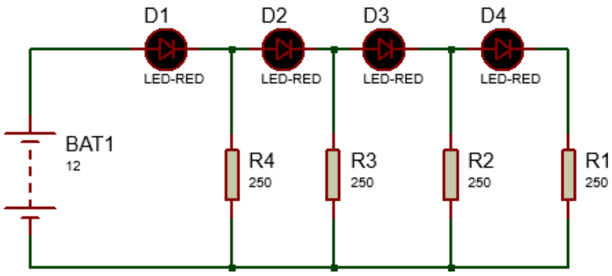


Figure 12: Battery Level Indicator Circuit

B. Calculation for Battery Level Indicator

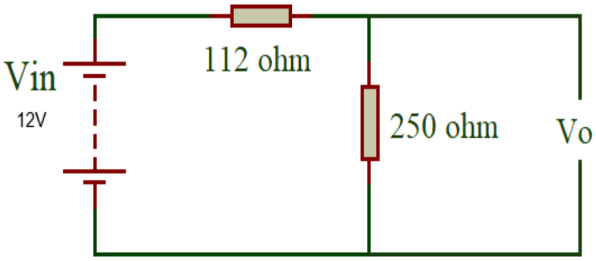


Figure 13: Calculation of Battery Level

Indicator$V_O = V_i * R_2 / R_1 + R_2 V_O = 12 * 250 / 250+112$

$V_O = 8.2$

Table 1: Battery Level Indicator Calculation

S. No	Voltage Drop across each Divider	Battery voltage to glow LED	LED	Battery Percentage
1	8.2	3.8	1	30 %
2	5.6	6.4	2	50 %
3	3.9	8.2	3	70 %
4	2.6	9.4	4	80 %

VI. CONCLUSION

The suggested system is a portable traffic assistance system that aids in managing traffic conditions on highways, bridges, flyover projects, checkpoints, as well as when traffic signals are out. An Arduino nano microcontroller, a 4-channel relay module, an RF transmitter, a receiver, and high-luminosity LEDs make up the system. Traffic police have been removed thanks to the suggested approach, which also helps to prevent worker accidents, air pollution, etc. Due to our traffic light's portability, it can be rapidly brought to the location and the traffic may be cleared without difficulty. Because the suggested approach is economical, it may be used by both the government and commercial manufacturers to develop a dependable system that will be put to the best possible use.

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