Abstract— As the volume of traffic on highways and roadways continues to grow at a greater rate than our roads can accommodate the effect of traffic congestion will become an ever increasing burden on city infrastructure. One solution is an adaptive system using real-time signal control to optimize signal timings and minimize delays. A large number and variety of ATCS(Adaptive Traffic Control Systems) have been developed and researched using different control methods and structure to reduce travel times and congestion.

Sydney Coordinated Adaptive Traffic System (SCATS), is one such system in which it gathers data on traffic flows in real-time at each intersection. Data is fed via the traffic controller to a central computer. The computer makes incremental adjustments to traffic signal timings based on minute by minute changes in traffic flow at each intersection. It helps to allocate maximum green time for vehicles thus reducing delay. It is implemented using ATMEGA 328 controller which is cheap in cost. In order to improve efficiency, an automatic speed controlling of vehicles was also done prior to this, which helps to avoid traffic congestion, accidents and fuel usage of vehicles.

Keywords— Adaptive Traffic Control, Advanced Virtual Risc (AVR), IDE (Integrated Development Environment), Radio Frequency (RF), Sydney Coordinated Adaptive Traffic System(SCATS).

I. INTRODUCTION

The increase in urbanization and traffic congestion create an urgent need to operate our transportation systems with maximum efficiency. One of the most cost-effective measures for dealing with this problem is traffic signal control. Traffic Signal Control is a system for synchronizing the timing of any number of traffic signals in an area, with the aim of reducing stops and overall vehicle delay or maximizing throughput. It provides control, surveillance, and maintenance functions i.e. control of traffic by adjusting and coordinating traffic signals at intersections, surveillance by monitoring traffic conditions with vehicle detectors and cameras; and maintenance of equipment by monitoring for equipment failures. These functions allow a traffic management agency to service traffic demand, share traffic status with other agencies and operate and maintain the traffic signal control system. Traffic signal control varies in complexity, from simple systems that use historical data to set fixed timing plans.

As an advanced traffic management system, adaptive traffic control systems (ATCSs) have been developed to address real-time demand variability and adjust signal timings in real time [1]. Poor traffic signal timing contributes to traffic congestion and delay. Their major benefits include changing control parameters responding to fluctuating demands or changing traffic conditions to reduce delays and increase system effectiveness. Although ATCSs have been used since the early 1980s and at least 25 ATCSs have been deployed in the United States, their operational benefits may not be clearly identified and widely understood [2]. Various ATCSs have been developed and deployed, such as SCOOT, SCATS, OPAC, PRODYN, RHODES, and UTOPIA, to name a few. They have different adaptive signal control strategies with varying capabilities [3]. SCATS [1], which is an intelligent transportation system developed in Sydney, Australia, is one of the broadly utilized traffic control systems for urban signalized traffic [2-7]. As an ATCS, SCATS self-calibrates and automatically adjusts to changing traffic patterns over time, providing potentials to reduce stops and delay over standard time-of-day operation [8].

Here scats are implemented with AVR microcontroller at mega 328. Infra red sensors is provided for detecting the vehicles i.e. for measuring the traffic density. It is implemented in a four way traffic system i.e. considering vehicles coming from north, south, east, west. In addition to traffic density here also considering the pedestrian checking too in all directions. The Arduino integrated development environment (IDE) is a cross platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. Data is fed from microcontroller to management computer. In this system management computer focuses on data collection i.e. vehicle density, status of pedestrian. It is implemented using matlab software. PC is interfaced with microcontroller using RS232 cable.

The objective of the paper is to control the speed of vehicle, vehicle speed in order to improve traffic congestion.
If vehicle density coming from north direction is more then through RF transceiver it will send information regarding this, accordingly the fuel will cut off thus reducing speed[10].

II. RELATED WORK

Vehicular traffic in cities today has reached an unprecedented level. In such a scenario, traffic jams at major junctions are common place. It is often seen that the current system of fixed time sequenced signal lights cannot adapt to the changing traffic. Very often even though there is barely any traffic on the road, the green signal is given for an extended period of time. Besides leading to a waste of time, this exacerbates the traffic congestion. There is a direct need for a smart system that can adjust the timings of these lights based on the traffic present on the road. Adaptive traffic control is a traffic management strategy. Traffic timing changes, or adapts, based on actual traffic demand. This is accomplished using an adaptive traffic control system consisting of both hardware and software. It will improve travel time reliability by progressively moving vehicles through green lights. It will reduce congestion by creating smoother flow. Adaptive traffic control systems (ATCSs) have been developed to address real time demand variability and adjust signal timings in real time. Various ATCSs have been developed and deployed, such as SCOOT, SCATS, OPAC, PRODYN, RHODES, and UTOPIA, to name a few [9]. They have different adaptive signal control strategies with varying capabilities.

UTOPIA (Urban Traffic Optimization by Integrated Automation) is an adaptive traffic signal control system which determines and acts upon optimum management strategies for the regulation of urban traffic. It was implemented in 1984 at Italy. It is Optimized Policies for Adaptive Control which is a fully adaptive, proactive, and distributed real time traffic control system implemented in 1989 at USA. Here the means of communication media is fibers. The detectors used are the magnetic loops. OPAC is a distributed real time traffic signal control system. Real-time Hierarchical Optimizing Distributed Effective System which was implemented in 1998 at Finland. Three level hierarchies dynamic-programming (DP) based algorithm. RHODES uses three level hierarchy for characterizing and managing traffic. It explicitly predicts traffic at these levels utilizing detector and other sensor information. SCOOT is adaptive traffic control system which coordinates the operation of all the traffic signals in an area to give good progression to vehicles through the network.

Whilst coordinating all the signals, it responds intelligently and continuously as traffic flow changes and fluctuates throughout the day. It removes the dependence of less sophisticated systems on signal plans, which have to be expensively updated.

Sydney Coordinated Adaptive Traffic System which is world’s leading traffic control system, implemented in Australia at 2010. SCATS gathers data on traffic flows in real-time at each intersection. Data is fed via the traffic controller to a central computer. The computer makes incremental adjustments to traffic signal timings based on minute by minute changes in traffic flow at each intersection. As an ATCS, SCATS self-calibrates and automatically adjusts to changing traffic patterns over time, providing potentials to reduce stops and delay over standard time-of-day operation.

III. SCATS ARCHITECTURE

![Fig.1. Scats Architecture](image-url)

Scats gathers data on traffic flows in real time at each intersection. Data is fed via traffic controller to a central computer. The computer makes incremental adjustments to traffic signal timings based on minute by minute changes in traffic flow at each intersection[11].
A. Block Diagram

It shows the main controller atmega 328, and port expander IC, which is used for extra input output connections. IR sensors are used for detecting the amount of traffic. If any vehicle coming from north, then from IR sensor signals are send to controller and it provide access to any directions, i.e., south east west and north. Depending on the vehicle density timer value will set accordingly. If the density is more timer value will be 5sec and if the density decreases timer value decreases accordingly. For pedestrian checking LDR is placed in all directions. For pedestrians the timer value will be 5 sec allotted. The programming is done such a way that, if pedestrian is detected and traffic density is less then priority will be assigned to the pedestrian checking.

IV. PROPOSED DESIGN

Fig.3. Proposed hardware scheme (controller unit)

Fig.4. Proposed hardware scheme (vehicle unit)
In the proposed design, microcontroller is interfaced with Vehicle Speed Sensor, Microcontroller Unit and the wireless module. In transmitter section microcontroller loads the frames in to the wireless module and switches the wireless module periodically between the transmission state[10]. Microcontroller in the receiver section receives the frame from the wireless module. Later microcontroller processes this frame and imposes the speed.

In the modified circuit diagram shown in the circuit diagram (b), there are four buttons provided, in order to detect the vehicles coming from directions; east, west, north, south. If the vehicle is coming from north direction, we have to manually push the button in order to indicate that it is coming from north direction. Similar is in the case in all directions. If the traffic density is higher, through rf data modem, it will send those information as data frames and automatically adjusts to that limited speed and it will be displayed on lcd. In practical cases, fuel injection will be cut and according to this speed decreases. When traffic density becomes normal, it will automatically switches to normal speed. The central management computer will give details regarding the traffic and will be display the details in the command window. Here the details regarding vehicles coming from east, west, north, south as well as pedestrian check across all other directions are checked and displayed. This data can be saved and retrieved at any time.

IV. RESULT

Arduino, PROTEUS and MATLAB are the softwares used for the simulation.

In this figure, if pedestrian are detected in south east direction, then leds(green) placed in south and east direction will be on and thus allowing the pedestrians to go in these directions.

In this figure, vehicle coming from east direction comes with normal speed. The vehicle density in the east direction is comparatively less. Why lcd displays as normal speed. The motor shown in this figure will rotate in normal rpm. Similarly for all directions buttons are provided, ie for west direction, north direction and south direction.

In this figure, vehicle coming from east direction comes with limited speed. The vehicle density in the east direction is more. Why lcd displays as limited speed. The motor shown in this figure will rotate in limited rpm. ie rpm will be less. Similarly for all directions buttons are provided, ie for west direction, north direction and south direction.
In this figure command window is displayed. In this pedestrian is detected at east. Therefore it gives the value high for pedestrian east detection. All other values in all the directions west, north and south remain as zero. Vehicles are not detected, so it remains as zero. Pedestrians at north, south east and west will remain as zero. It is indicated in the pedestrian_east, pedestrian_west, pedestrian_north and pedestrian_south. Since the pedestrian is detected in east direction pedestrian east is assigned as 1.

V. CONCLUSION

The objective of the paper is to design and implement a highly efficient method of adaptive traffic control system. SCATS system maximizes the use of any road network. It is recognized as a worldwide market leader in intelligent transport system.

About 34,350 intersections in over 154 cities in 25 countries use this system. By adding this modification helps us to avoid road accidents, increases in travel time, reducing stops and delays, travel time increases, reduces traffic congestion, improve fuel efficiency.

REFERENCES