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Intelligent Traffic Management through Density Analysis

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ABSTRACT:

In urban areas, traffic system is one of the significant indicators to show the growth and progress of a city and it also influences the quality of life of people living in metropolitan cities. In recent years. there is a significant increase in usage of road vehicles which is becoming challenge for existing transportation system. The currently deployed traffic system is not based on the traffic congestion level land a predefined time is allocated for traffic lights at every road crossing which results in traffic congestion and situation becomes worst in the peak traffic hours. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion. This highlevel traffic congestion contributes to the pollution by the emission of CO 2 and several other pollutants in air. Moreover, it also causes tripling of the fuel consumption and consequently put adverse effects on the economy as well. To address the above problem, this paper presents the development of congestion level based dynamic traffic management system using IoT. It regulates the traffic lights duration based on the real-time congestion level of the traffic measured at the road crossings by using IR sensors. The development of this project is divided in three phases I e simulation and logic development, development of IoT based system and finally hardware implementation. In first phase the simulations are done in Proteus and results are presented in four cases i-e normal routine, low level congestion, medium level congestion and highlevel congestion. In second phase the IoT based system is developed by making the communication link between the end nodes and the gateway over the internet. Finally, the real-time prototype is implemented. In addition to this, we are adding the features like Emergency Vehicle Traffic Clearance i.e Ambulance clearance or VIP Vehicles, Air Pollution detection, Theft Vehicle Identification Feature.

INTRODUCTION

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, sometimes with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices. Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure. In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected. An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular kind of application device. 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 a programming interface, and embedded systems programming is a specialized occupation.

TRAFFIC MOVEMENT & CONGESTION

Traffic congestion occurs when urban transport networks are no longer capable of accommodating the volume of movements that use them, the location of congested areas is determined by the physical transport framework and by the patterns of urban land use and their associated trip-generating activities. Levels of traffic overloading vary in time, with a very well-marked peak during the daily journey-to-work periods.

The intricate nature of these centers makes motorized movements difficult and long-term car parking almost impossible. In developing countries, the problem is particularly acute: Indian and South-East Asian cities often have cores composed of a mesh of narrow streets often accessible only to non-motorized traffic.

The rapid growth in private car ownership and use in western cities in the period since 1950 has rarely been accompanied by a corresponding upgrading of the road network, and these increases

will probably continue into the twenty-first century, further exacerbating the problem. In less-developed countries car ownership in urban areas is in at a much lower level but there is evidence of an increased rate in recent decades, especially in South America and South-East Asia (Rimmer, 1977).

Fig.1Traffic Movement and Congestion

DIFFICULTIES FOR PEDESTRIANS:

Pedestrians form the largest category of traffic accident victims. Attempts to increase their safety have usually failed to deal with the source of the problem (i.e., traffic speed and volume) and instead have concentrated on restricting movement on foot. Needless to says this worsens the pedestrian's environment, making large areas 'off-limits' and forcing walkers to use footbridges and underpasses, which are inadequately cleaned or policed. Additionally, there is obstruction by parked cars and the increasing pollution of the urban environment, with traffic noise and exhaust fumes affecting most directly those on feet.

At a larger scale, there is the problem of access to facilities and activities in the city. The replacement of small scale and localized facilities such as shops and clinics by large-scale superstores and hospitals serving larger catchment areas has put many urban activities beyond the reach of the pedestrian. These greater distances between residences and needed facilities can only be covered by those with motorized transport. Whereas the lack of safe facilities may be the biggest problem for the walker in developing countries, in advanced countries it is the growing inability to reach 'anything' on foot, irrespective of the quality of the walking environment.

It is not easy, safe or healthy to walk on the roads of Indian Cities. Urban planning in the country seems to have failed to accommodate for pedestrian amenities required for a citizen to choose walking as a preferred option to commute. Rapid urbanization and massive industrialization have contributed to taking air pollution in India to alarming levels, which makes walking on roads difficult for citizens. Civic bodies appear to be ineffective in efforts to address the day-to-day problems faced by pedestrians. And society at large doesn't seem to be concerned about the very basic privilege of a citizen to walk on the road with dignity and pride.

Fig.2 Difficulties for pedestrians

DENSITY BASED TRAFFIC SIGNALS:

IR sensors function as the input to the Arduino,
and the LEDs are the output of the Arduino, thereby managing the traffic well. Once the pair of IR sensor detects vehicles on the respective lanes, the receiver of the IR sensor receives data, processes it, and transmits the data to the Arduino controller through its transmitter. The Arduino is programmed and dumped with the codes, as per the requirements and functionality of the traffic control system.

The Arduino thus controls the LED output and clears the traffic at the junction, lane-wise based on the concentration of the vehicles on each lane. The lane with high vehicle density, is prioritized, and will be freed first, by giving green signal to that lane, while all the other lanes remain at halt i.e., the lanes are given a red signal.

AIR POLLUTION MONITORING

The MQ135 sensor can sense NH_3, NO_x, alcohol, Benzene, smoke, CO_2 and some other gases, so it is perfect gas sensor for our Air Quality Monitoring Project. When we will connect it to Arduino then it will sense the gases, and we will get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels, and we need to convert it into PPM. So, for converting the output in PPM, here we have to use a library for MQ135 sensor.

Sensor was giving us value of 90 when there was no gas near it and the safe level of air quality is 350 PPM and it should not exceed 1000 PPM. When it exceeds the limit of 1000 PPM, then it starts cause Headaches, sleepiness and stagnant, stale, stuffy air and if exceeds beyond 2000 PPM then it can cause increased heart rate and many other diseases. We can monitor the data by connecting to thingspeak sever via WI-FI module.

EMERGENCY MODE

In this system, emergency mode is activated by changing switch state to high on transmitter side. When a particular switch gets activated then a signal along with encoded data is transmitted through RF transmitter to the RF receiver installed at central traffic control system nearer to every traffic junction.

After data reception the microcontroller will control signal states for smooth flow of emergency vehicle. So, in emergency mode traffic lights will be controlled by received data.

THEFT VEHICLE DETECTION

Radio Frequency Identification (RFID) system basically consists of three components:

1. radio receiver or tags,
2. radio transmitter or readers, and
3. antenna.

The reader sends radio waves to trigger the RFID tags and gets a signal back from the RFID tag. This signal contains information like a unique identity number, vehicle details, model, manufacturer's name.

Information transmitted from RFID tags received by RFID reader. Information collected by the reader is transmitted through a communication interface to a microcontroller, where useful

information is extracted from that signal. And the microcontroller compares the received vehicle details with theft vehicle details, when details match it gives alert signals.

BLOCK DIAGRAM:

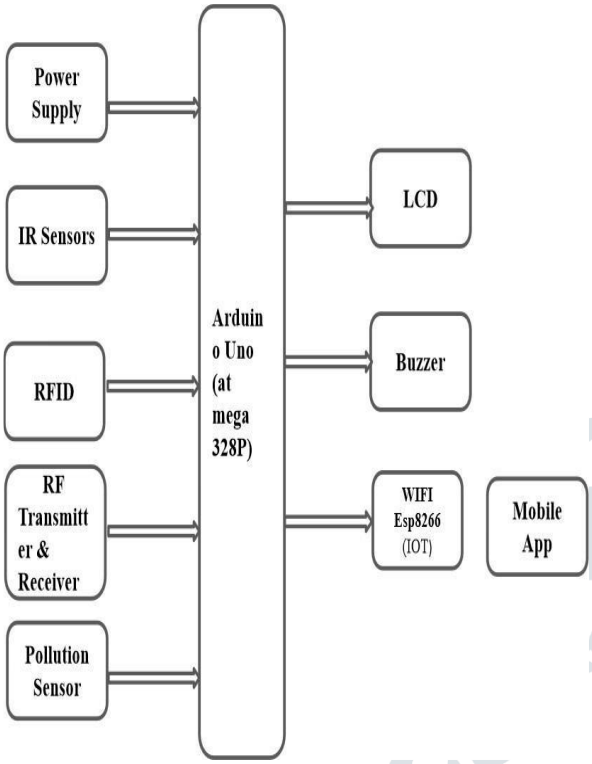


Fig 3: Block Diagram

RESULTS

To show the results of our prototype we need hardware kit and laptop with installed ARDUINO.

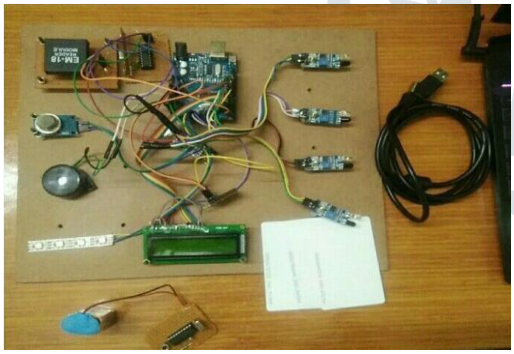


Fig 4: Hardware Kit

Fig 5: ARDUION IDE Software

When we on the power by connecting the Arduino uno with laptop using USB cable, LCD display like "WELCOME " And "SMART & DYNAMIC TRAFFIC SYSTEM"

Fig 6: LCD displays as WELCOME

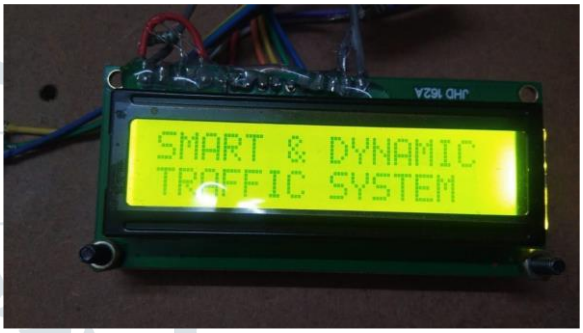


Fig 7: LCD displays as SMART & DYNAMIC TRAFFIC SYSTEM

RESULT FOR EMERGENCY VEHICLE CLEARANCE

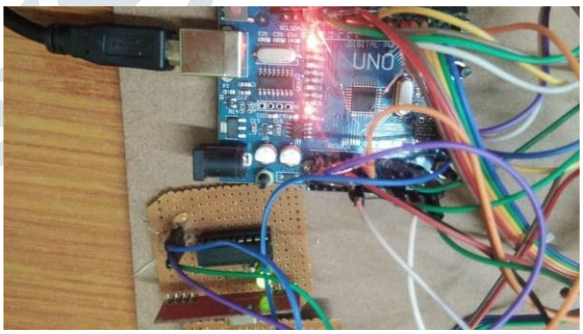


Fig 8: Interfacing of ARDUINO with RF Receiver

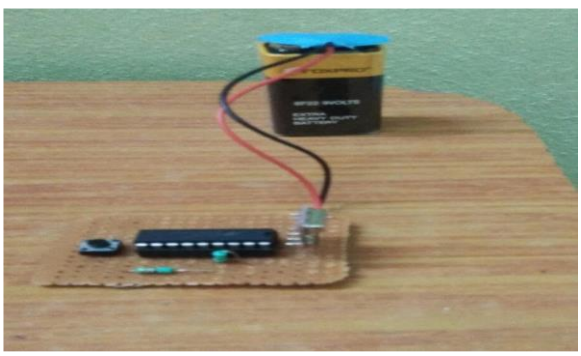


Fig 9 : RF Transmitter

Fig 10: Identification for Emergency vehicle is near -"*"

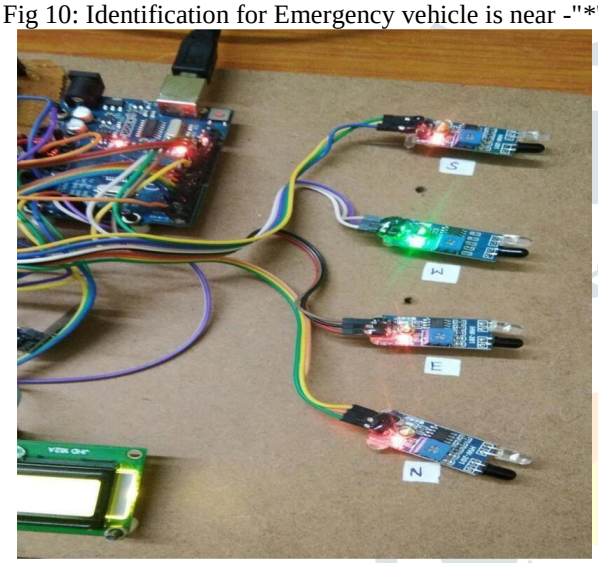


Fig 11: Interfacing ARDUINO with 4 IR Sensors

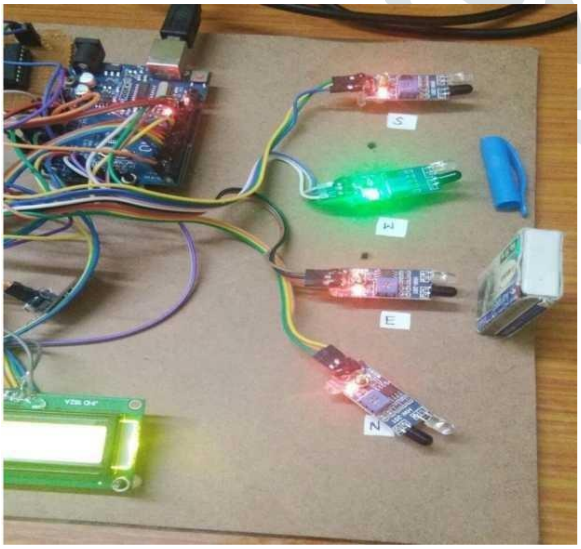


Fig 12: Sensing the density in each direction with IR Sensor

Fig 13: LCD displays Highest Density Direction

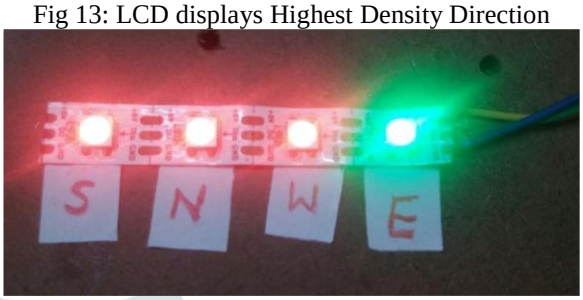


Fig 14: LED displays green at East direction

RESULT FOR DYNAMIC ALLOCATION OF TIME BY USING THINGVIEW APP

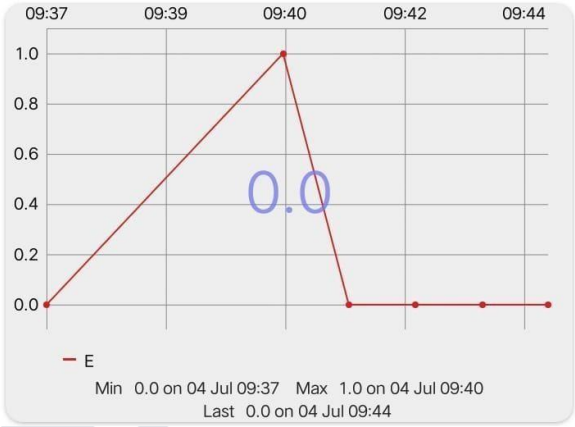


Fig 15: Density report at East Direction

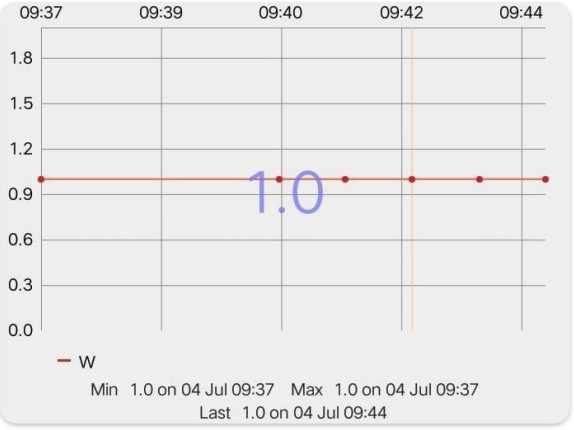


Fig 16: Density report at West Direction

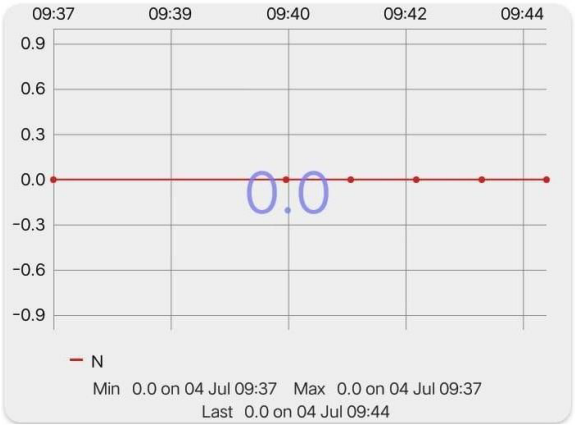


Fig 17: Density report at North Direction

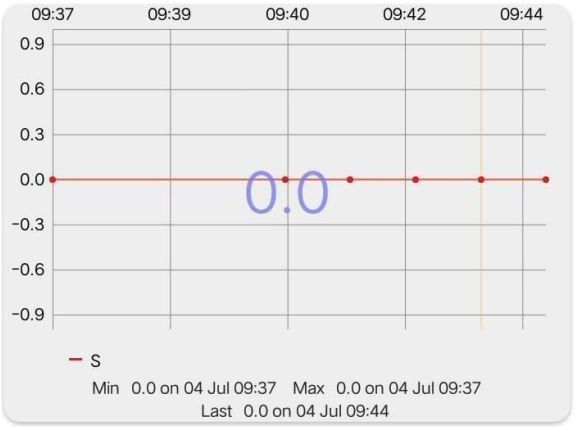


Fig 18: Density report at South Direction

AUTO PARKING

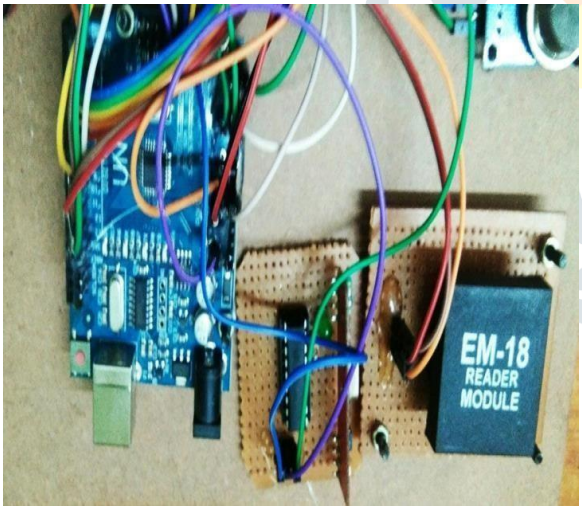
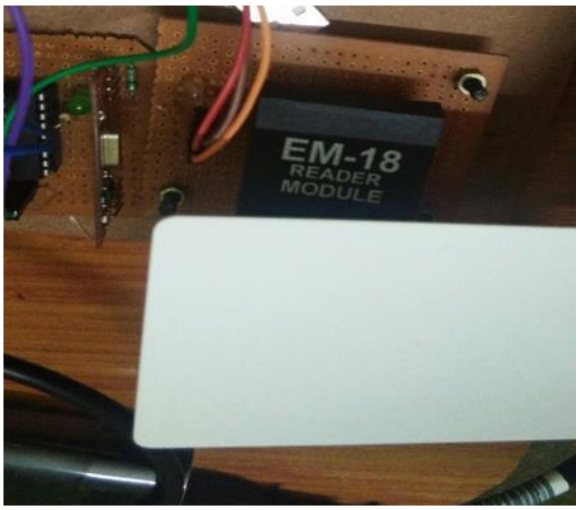


Fig 19: Interfacing ARDUINO with RFID EM Module



AIR POLLUTION DETECTION

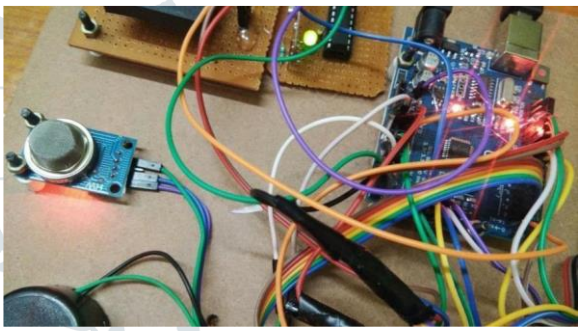


Fig 20: Interfacing of ARDUINO with GAS Sensor

Fig 21: LCD displays amount of Air Pollution Presence

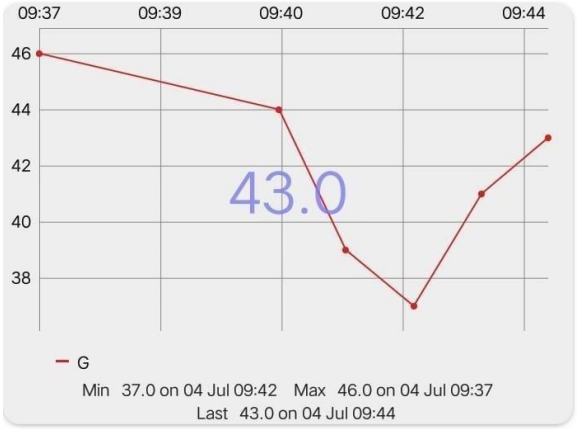


Fig 22: AIR Pollution Report in Thing view app

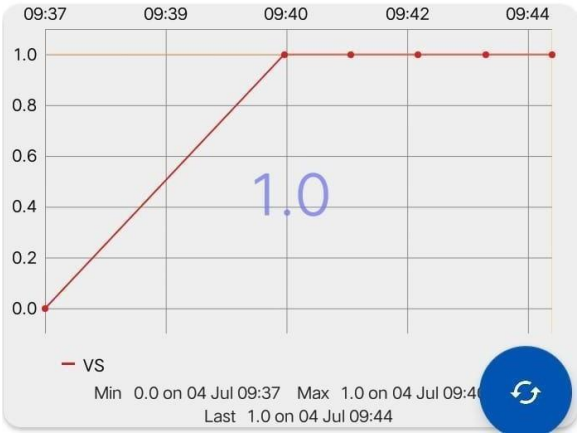


Fig 25: Stolen Vehicle Report in Thing view app

STOLEN VEHICLE IDENTIFICATION

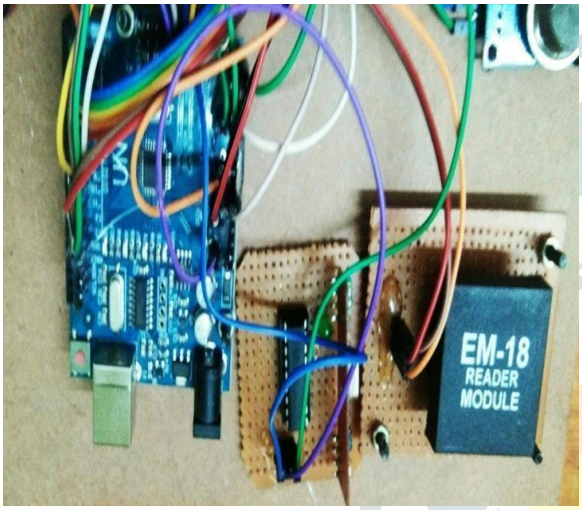


Fig 23: Interfacing ARDUINO with RFID EM Module

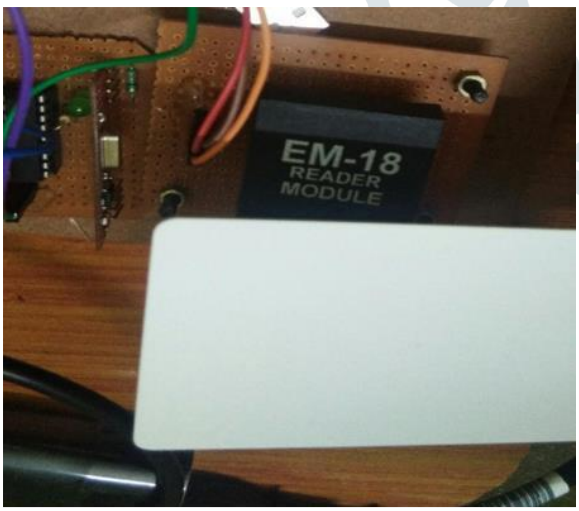


Fig 24: Scanning of RFID Tags

ADVANTAGES

- Comfort for the drivers and pedestrians or other traffic groups
- Conserve time and enhance safety.
- Improve environment quality and saves energy.

CONCLUSION

The Traffic Congestion problem intersection has become more serious of the potential growth of vehicles. In this project, inspired of advanced vehicle technologies we introduce a new approach for real time management the traffic flow based on "Dynamic Time Management Approach". In this regard, when there was more density which shows the direction to move forward.

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