# A METHODOLOGY FOR SIGNAL TIMING ESTIMATION BASED ON LOW FREQUENCY FLOATING CAR DATA: ANALYSIS OF NEEDED SAMPLE SIZES AND INFLUENCING FACTORS

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**Abstract:**The objective of this paper is to demonstrate the feasibility of estimating traffic signal phase and timing from statistical patterns in low-frequency vehicular probe data. We use a public feed of bus location and velocity data in the city of San Francisco, CA, USA, as an example data source. We show that it is possible to estimate, fairly accurately, cycle times and the duration of reds for fixed-time traffic lights traversed by buses using a few days' worth of aggregated bus data. When made available on an open server, such information about the traffic signals' phase and timing can be valuable in enabling new fuel efficiency and safety functionalities in connected vehicles. Velocity advisory systems can use the estimated timing plan to calculate velocity trajectories that reduce idling time at red signals and therefore improve fuel efficiency and lower emissions. Advanced engine management strategies can shut down the engine in anticipation of a long idling interval at red. Intersection collision avoidance and active safety systems could also benefit from the prediction. In this paper, we have demonstrated the feasibility of estimating timing of fixed-time traffic lights by observing statistical patterns in sparse probe vehicle data feeds.

***Keywords:*** *Micro controller (LPC2148), Hardware traffic signal Circuit Design, GSM MODEM, RFID READER.*

## I. INTRODUCTION

In an ideal situation in which the state of a light's timing and phasing is known, the speed could be adjusted for a timely arrival at green [2]. One can expect considerable fuel savings in city driving with such predictive cruise control algorithms, as shown in [2] and [3]. When idling at red becomes unavoidable, knowledge of remaining red time can determine if an engine shutdown is worthwhile. A collision warning system can benefit from the light timing information and warn against potential signal violations [4]. Future navigation systems that have access to the timing plan of traffic lights can find arterial routes with less idling delay [5] and can also provide more accurate estimates of trip time. The main technical challenge to deploying such in-vehicle functionalities is in reliable estimation and prediction of signal phase and timing (SPAT). Uncertainties arising from clock drift of fixed-time signals, various timing plan of actuated traffic signals, and traffic queues render this a challenging and open endedproblem. Direct access to signal timing plans and real time state of the light is prohibitively difficult due to hundredsof local and federal entities that manage the more than 330,000 traffic lights across the United States alone [6]. Even when such access is granted, much effort and time must be spent on structuring information from various municipalities in standard and uniform formats. The more recent emphasis on dedicated short range communication technology for communicating the state of traffic signals to nearby vehicles has safety benefits but requires heavy infrastructure investments and even then is limited by its short communication range.

## II. HARDWARE SYSTEM

**Micro controller:** This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

**ARM7TDMI:** ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer(CISC) designs.

**Liquid-crystal display** (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

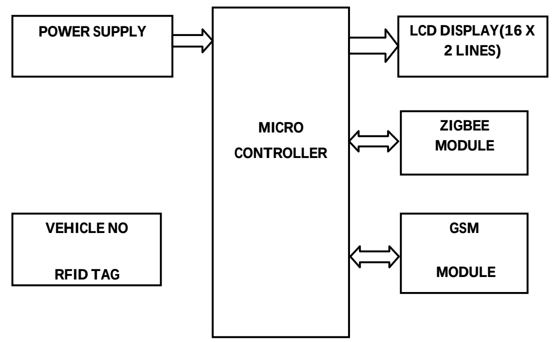


Fig 1: Vehicle Section

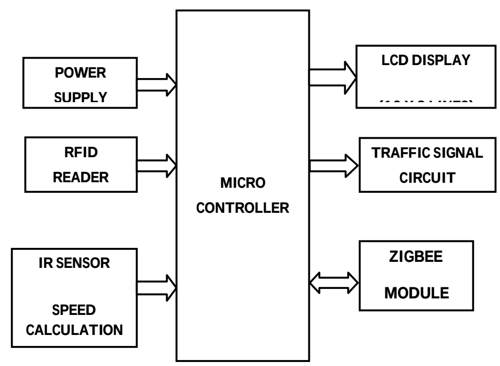


Fig 2: Control Section

## III. Board hardware system features

**IR Transmitter and Receiver:**

Transmitter and receiver are incorporated in a single housing. The modulated infrared light of the transmitter strikes the object to be detected and is reflected in a diffuse way. Part of the reflected light strikes the receiver and starts the switching operation.

The two states – i.e. reflection received or no reflection – are used to determine the presence or absence of an object in the sensing range.

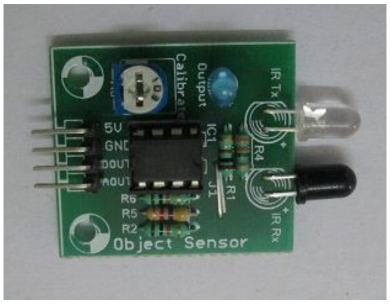


Fig 3: IR sensor

This system safely detects all objects that have sufficient reflection. For objects with a very bad degree of reflection (matt black rough surfaces) the use of diffuse reflection sensors for short ranges or with background suppression isrecommended.

**GSM:**

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service.

The network is structured into a number of discrete sections:

- Base Station Subsystem – the base stations and their controllers explained
- Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"
- GPRS Core Network – the optional part which allows packet-based Internet connections
- Operations support system (OSS) – network maintenance

SM was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is vulnerable to different class of attacks, each of them aiming a different part of the network.

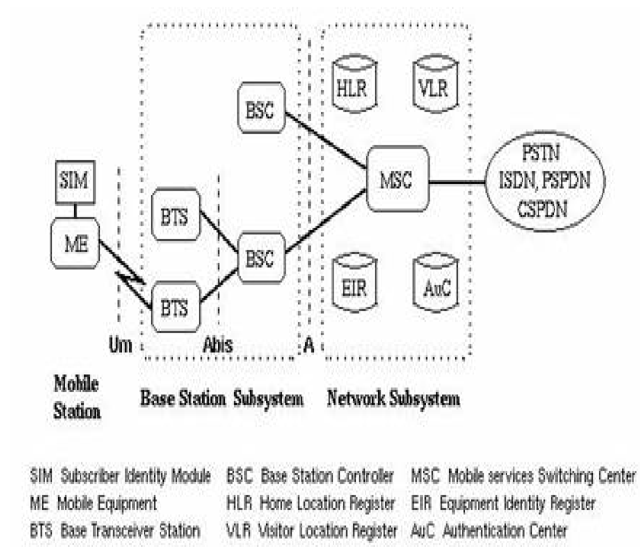


Fig 4: GSM Architecture

**ZIGBEE:**

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this caseis ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The X-

Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device.

Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

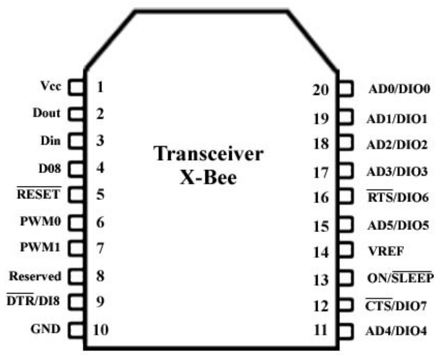


Fig 5: Zigbee Pin Diagram

**RFID:**

Radio Frequency Identification (RFID) is a silicon chip-based transponder that communicates via radio waves. Radio Frequency Identification is a technology which uses tags as a component in an integrated supply chain solution set that will evolve over the next several years. RFID tags contain a chip which holds an electronic product code (EPC) number that points to additional data detailing the contents of the package. Readers identify the EPC numbers at a distance, without line-of-sight scanning or involving physical contact. Middleware can perform initial filtering on data from the readers. Applications are evolving to comply with shipping products to automatically processing transactions based on RFID technologyRFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to Communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.


Fig 6: RFID Reader

Tags are classified into two types based on operating power supply fed to it.

1. Active Tags
2. Passive Tags

**Active Tags**: These tags have integrated batteries for powering the chip. Active Tags are powered by batteries and either have to be recharged, have their batteries replaced or be disposed of when the batteries fail.

**Passive Tags**: Passive tags are the tags that do not have batteries and have indefinite life expectancies.

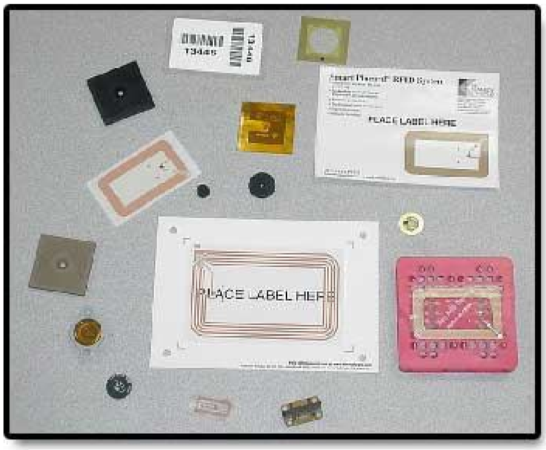

Fig 7: Different types of tags

## IV. CONCLUSION

In this paper, we have demonstrated the feasibility of estimating timing of fixed-time traffic lights by observing statistical patterns in sparse probe vehicle data feeds. By this project, we can know the distance and time to take from one place to other place. We can save fuel by knowing how much time to wait. The start of greens is cyclically mapped using the estimated cycle time of the traffic light. In addition, the change in signal offset during schedule change is accounted for in this process. The estimated values for the start of greens are then compared with the actual ground readings of the start of greens.

## V. EXPEREMENTAL RESULTS

An experimental setup with traffic signals and control station is communicating with GPRS. And the experimental results are taken and added.

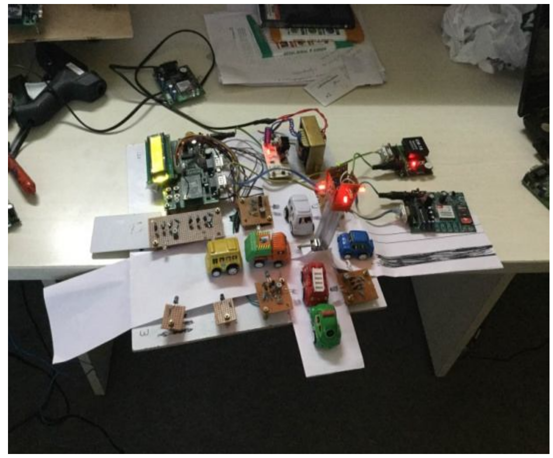

Fig 8: Hardware Implementation

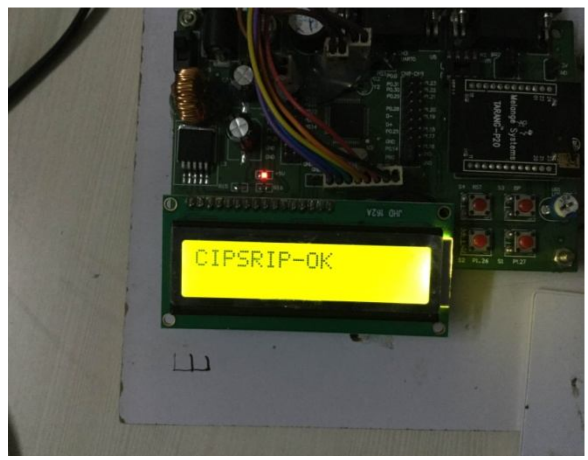


Fig 9: Commnands For GPRS

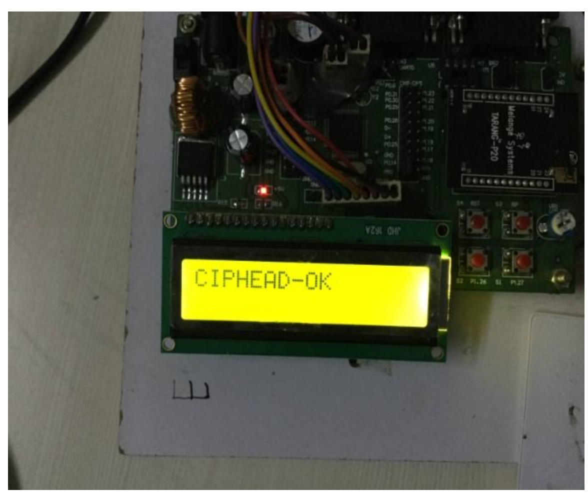


Fig 10: Commnands For GPRS


Fig 11: Output Results

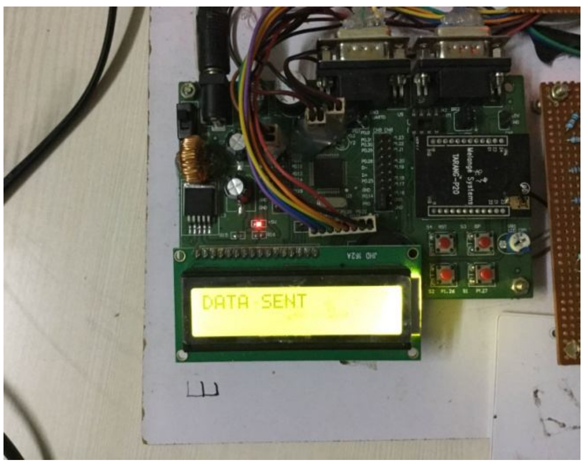


Fig12: Output Results

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