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Predictive Inter and Intra Parking System

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Abstract: ***Time has become a rare commodity and often takes the back seat in reality. Everyone in life need to park some time for their well being but there are trying times, where they spend their prime time for parking. In crowded cities in specific places like Mumbai, Delhi, Kolkata, Chennai and in other Asian cities this is magnified to many fold. Conventional technologies involved lot of Manual overhead and upcoming IOT based technologies are coming good on this aspect. Typical time spent on looking for parking space averages out to be 5.9 minutes, totaling to 90.5 hours in other words four days lost over the year. Anything done to improve on this front would make a huge difference to the human community***

Keywords: Sensor, Analytical Engine. Processor, Report Tool

I. INTRODUCTION

The time spent to park a vehicle is often considered to be a Sunk investment and could be put to best use by investing on latest IOT technologies. IOT Technologies typically employ a Sensor, Database/Knowledge base, Data Analytics Engine, Processing, and Reporting Block as Modules to accomplish this task. Conventional models are Reactive ones with much focus on reporting the current status alone. The Reactive model takes the current parking availability status, Analyze, Process and Report on the Availability. On the other hand coming up with a proposal for a Predictive Intuitive model would be more of Proactive and is worth trying by all means. The Predictive model works based on the current availability based, Past Data, Patterns and runs through an Analytics Model and Generates Report and Repositize. Both the outcome of Reactive and Predictive model could be streamed to Navigation applications like Google Maps or Waze for Better use.

Parking Models in turn again can be Intra Parking or Inter Parking Models. Intra Parking Models focuses on the parking management for any given premises. While the Inter Parking is spread across parking spaces. Intra Parking is limited to only a specific parking lot and hence private in nature. Inter Parking Model will be much of a Cloud based one Nexus with each and every Private Parking Lots. It could be vest visualized by looking at the Intra Parking model based Private Parking Lot as Private Network and the Inter Parking Model based public parking Infrastructure as the Internet. Every country GDP is much dependent on its Infrastructure like Roads, Civic facilities, and on and on that also includes Parking Lots.

Hence the Parking Management in all due respect needs its right kind of attention. Parking Management in current trend could be best implemented using IOT devices. IOT Framework placed in each parking Premises can talk to each other, exchange Information on the Parking availability, Traffic in its periphery and share the current parking space availability, projected parking space in the future time.

Holistic solution would be to integrate the Parking Management with the Task Management framework of every individual or a Firm. Applications can be built to suggest users with options to get their pending task like shopping and other pending chores to be accomplished in the interim time before the parking time slot arrives.

II.LITERATURE SURVEY

Rico et al. [1] and zheng et al. [2] used an algorithm to schedule the online problem of a parking system into an offline problem. Second, they set up a mathematical model describing the offline problem as a linear problem. Third, they designed an algorithm to solve this linear problem. Finally,they evaluated the algorithm using experimental simulations of the system. The experimental results indicated timely and efficient performance. However, these papers do not mention the resource reservation mechanism (all parking requirements are derived immediately and are placed in the queue), the mechanism for assessing the resources system, the mechanism to guide vehicles to the parking space, the mechanism for handling situations when the request for service is denied and do not calculate the average waiting time and average total time that each vehicle spends on the system.

Trusiewicz et al. [11] utilized Unstructured Supplementary Service Data communication medium between diverse and parking reservation system. Although it is not free to utilize USSD for the vast majority of system administrators, it is as yet a shabby and reliable technology to adopt in parking reservations. Inaba et al. [12] used RFID labels to store and refresh the reservations status and they talked about the contrast between continuous and share-time reservations where the distinction between them is that in share-time reservations, drivers must utilize the administration in a referred to passage and leave time period as they share the asset time.

Though continuously reservations, they are permitted to stop for boundless interim of time for being free on different drivers. Wang et al. [13] had presented a model for a circulated framework at which there is one focal processor which accumulates the reservation asks for and diverts them to the important neighborhood processors.

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Their framework uses Blue-tooth and WiFi to detect the occupancy states inside parking lots, and inform the drivers with accessible spaces as needs be.

III.TYPICAL AND NEXT GEN SYSTEMS

The model aims at achieving the smart parking by using the various components like Sensor & Preprocessor Module, DBMS, Analytical Engine, Processor/Renderer Unit and Navigator/NAV. The model involves various objects like driver, user interface and Analytical engine. The various components are explained as follows:

A.SENSOR & Pre-Processor MODULE:

Typical Sensor Module for Parking framework would comprise of Sensors, CODEC and Processors connected to DBMS. Sensors could be Infrared, Passive Infrared (PIR) and Ultrasonic Sensors to detect the free slots in the Parking lot. A typical ultrasonic sensor is remotely networked with a Pre Processor which could be a low priced microcontroller. The Sensors could be a motion sensor that shares the presence or absence of a vehicle to the Pre-Processor as raw data. The Pre-Processor in terms does some very basic data handling and forward to the DBMS to create, modify or delete any record. CODEC will come handy in order to make the Data formats compatible across Sensors, Processors and DB.

B.DBMS:

It stores the records of the vehicle that Enters and Leaves the premises. It has the parking availability or occupancy. Also can hold the details of the vehicle registration number of the parked vehicles currently and historically. It acts as an information base that could be shared to the Billboard to let everybody know about the parking occupancy. The data could be shared remotely to APPS through cloud networking. The data could be shared to the vehicles that enters, approaches or crosses the premises. It also could be shared for consumers to view in the Internet from any part of the world.

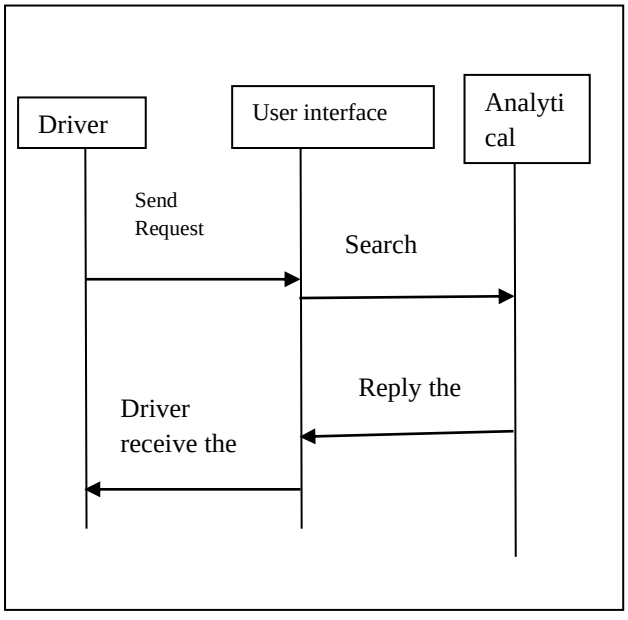

Fig 1: Interaction Diagram for Smart Parking

C. Analytical Engine:

Analytical engine will be of much use for the Predictive model in order to predict the Parking availability based on the past parking occupancy, traffic and other Demographic factors. It plays a major role in predicting the different kind of patterns from the available knowledge base. It helps to predict the different type of parking customer arrival time, their usage time and departure time based on past data. It can take Time of the Day, Vehicle Size, Season, Regional preference, Terrain, Weather, etc apart from the History to predict the occupancy and availability. It also helps in Pricing for the parking based on the above parameters.

D. Processor/Renderer Unit:

For the Intra Parking facility, it would be much of Rendering the data onto the Billboard or to a Console (Mobile/Desktop/Laptop). The Rendered data could be parking availability along with its Location like Floor, Bay, etc…

For the Inter parking the data need to be forwarded to the other nearby parking stations. This could be achieved by using the Processing Unity implemented using typical devices like Raspberry pi which is a processor on chip. This would transmit the Parking details to the nearby station over Wireless/Microwave/Wired/IP communications.

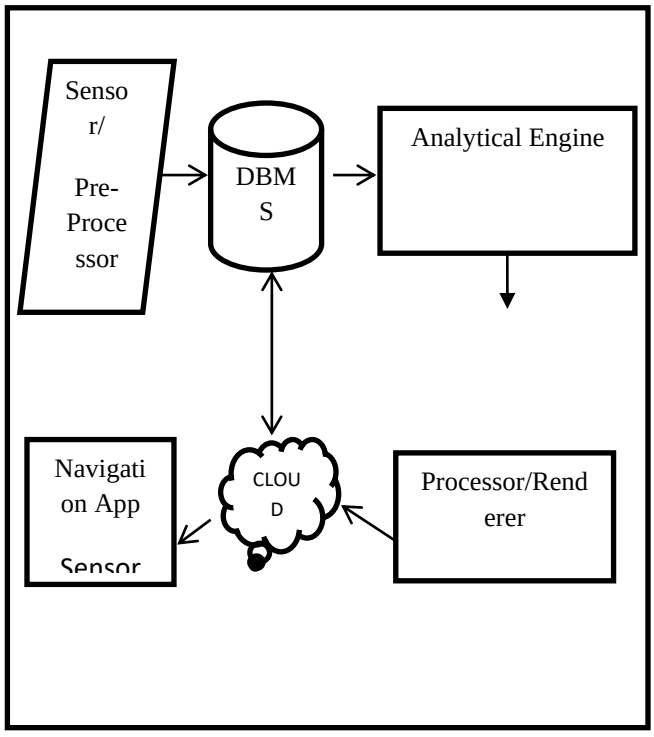

Fig 2: Flow diagram for INTRA Smart Parking

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E. Navigation application:

The data from the Processor/Renderer can be streamed to the Navigation application to ease the task of locating the parking position for the vehicle in need. The data could be relayed to typical navigation applications like Google Maps, Waze and which could be utilized by the end consumers to plan their parking.

The usage could be more customized by adding the predictive analysis part to it with inclusion of cloud services offering analytical capabilities. This would help any user to plan their day inclusive of trivial but time taking task like parking. Also the Navigation devices can make use of predictive capabilities to plan the day interleaved with various other personal tasks of users.

Clustering is grouping of similar objects. Centroid is chosen for each parking lot and according to the sensor output, distance between the centroid and vehicle are calculated based on the time of request.

If the centroid of the parking lot is c1,c2,c3 then the distance measurement must be calculated for each object with various parameters with the centroid

$$D(I,C1) = \sqrt{(xi - C1)^2 + (yi - C1)^2} \quad (1)$$

$$D(I,C2) = \sqrt{(xi - C2)^2 + (yi - C2)^2} \quad (2)$$

$$D(I,C3) = \sqrt{(xi - C3)^2 + (yi - C3)^2} \quad (3)$$

The Centroid which is near to the object is chosen and based clustering methodology is combined with first come first serve. The priority of the vehicle is also calculated based on the number of times usage of the particular lot.

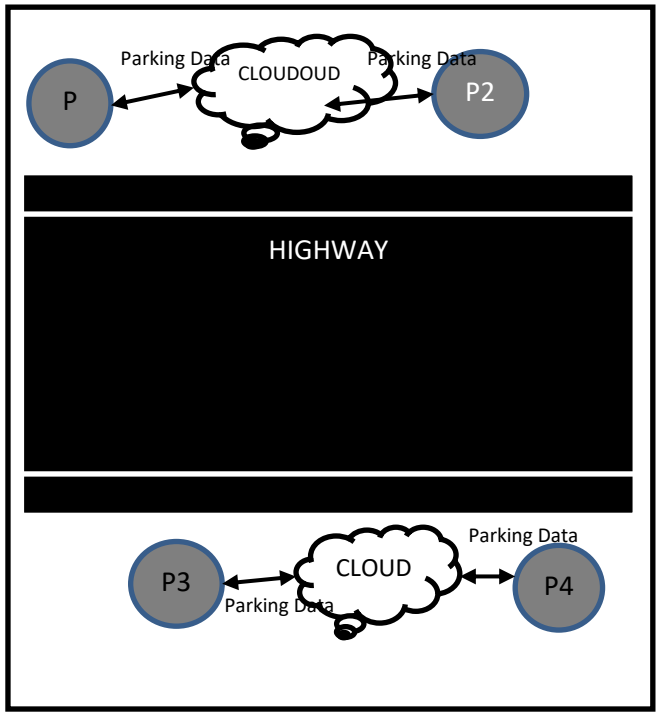

Fig 3 INTER Smart Parking

Typical Protocol to achieve the Intra Parking would be
Step 1: Sensor checks for the Parking Availability
Step 2: Sensor pushes raw data to Pre-Processor
Step 3: Pre-Processor does data processing and sends Instructions to DBMS
Step 4: DBMS will Create/Delete/Modify based on the Instruction from Pre-Processor.
Step 5: Analytical Engine will Process the data to Depict or Predict the parking data and sends to the Processor/Renderer
Step 6: Processor/Renderer will convert the data to a template that is consumable by the end user like Display board, Navigation System etc…
Step 7: Processor/Renderer provides Payment option to User to Pay the Parking fee through Cash and through other Digital Currency options
Step 8: Processor Renderer also hosts the data to cloud which could be used by other Parking Lot Management System or Navigation Systems to make Parking recommendations to clients.

The above protocol can decrease the processing time of smart parking in terms of identification of traffic congested area, tracking the free slot area, reserving the free slot area and allocating it to the clients in an efficient manner.

The Physical Component used for smart parking are Lora Wireless Magnetic Parking Sensor, Raspberry Pi 3,Model B , Intel I7 processor, Wifi router, GPS Sensor, GSM, UPS. Every country GDP is much dependent on its Infrastructure like Roads, Civic facilities, and on and on that also includes Parking Lots. Hence the Parking Management in all due respect needs its right kind of attention. Parking Management in current trend could be best implemented using IOT devices. IOT Framework placed in each parking Premises can talk to each other, exchange Information on the Parking availability, Traffic in its periphery and share the current parking space availability, projected parking space in the future time.

IV. CONCLUSION

Dreaming a Smart City has been on the Anvil for many generations and IoT has all the potential to make it happen. The Twenty First century is a time to stop dreaming and bring things to reality. The idea of Intra and Inter parking could be extended for Ships, Airbase, etc… and IoT will accelerate the same. We are sure that this chapter has tried its best to attempt on making the learner as a torch bearer by being aware of various parking models such that this could be carried forward to the community and next generations.

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