

Review on Parking Management by using Integration of WSN, RFID and IOT

¹D. Sreekanth, ²G. Uganya

¹UG student, Department of ECE, Saveetha School of Engineering

²Assistant Professor, Department of ECE, Saveetha School of Engineering

¹dsrikanthchoudary143@gmail.com, ²uganyaeece@gmail.com

Article Info

Volume 82

Page Number: 10826 - 10838

Publication Issue:

January-February 2020

Abstract

Nowadays, finding a stable Car parking is a major issue in modern congested cities of today. The rapid climb in population has led to substantial traffic bottlenecks in recent transportation systems. Nowadays, finding a secure parking zone in modern cities deemed as very hard and time-consuming task. Thus, Smart Parking System (SPS) deemed inevitable option to solve those issues and build a comprehensive smart transportation system. The increasing wide variety of cars on the road alongside the mismanagement of available parking IOT results in the parking related issues additionally as increased site visitors jam in city areas. Toward this end, this work aims to analyse a secure and smart parking solutions for monitoring, controlling and management of vehicles based on Wireless Sensor Network (WSN), Radio Frequency Identification (RFID), Ado Network, and Internet of Things (IoT). Thus, Smart Parking System (SPS) deemed inevitable option to clear up those troubles and construct a comprehensives mart transportation system. Toward this work objective to layout a secure and smart parking monitoring, controlling and control answers supported the blending of Wireless Sensor Network (WSN recurrence Identification (RFID), Adios Network, and Internet of Things (IoT). Considering digital secure-ty issues in IoT condition, we receive a light-weight crypto-photo set of decides that meets IoT gadget necessities in time span of computational charge and vitality utilization. Haze registering has been followed to strategy and control touchy realities inside the sting of the system and quicken response time for any emery-association situation. The model gives ongoing in-arrangement to distinguishing stopping burdens and reservation, e-installment answers for alleviate congested road, stopping control streamlining and finish client appreciate while keeping client protection and security.

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 19 February 2020

Keywords: Parking Management, smart cities, IOT, RFID and WSN

1. Introduction

The idea of smart parking was introduced to solve the problem of parking space and parking management in megacities. With the increasing number of vehicles, parking has become a serious issue for the people. Today in many cities it's become almost impossible

and quite expensive to create new parking areas for the vehicles as they need almost reached its full occupancy. Improper use of parking areas results in congestion for drivers or those that are seeking the parking therein particular area. It's been observed around 28 -45% of traffic jam is due to unavailability

of parking at an appropriate time. It's been observed that a driver usually spends nearly about 80 million hours to look for an ideal parking squeeze France yearly. Increasing traffic in urban cities causes more pollution that even causes various body diseases.

Recent promising and emerging technologies such as; IoT, WSN, and RFID open the trend to hunt out solutions of plenty of complicated issues in secure SPS. It provides reasonable operation cost, strong reliability, availability, efficiency, and prove that they're not barely technically possible but also economically feasible. Therefore, those tiny devices (sensors) are expected to play a crucial and essential part to any suggested solutions. Toward this end, exploiting recent technologies to make and elegance parking lots is taken under consideration with appropriate security issues. Here, detecting, monitoring and controlling are considered because the key solution that provides real-time information about available parking lots.

Finding a parking lot in urban cities has been deemed as time-consuming task and it may lead many problems such as fuel consuming, air pollution, driver frustrates and traffic congestion. As users are more preferring to use their private cars for transporting and parking nearest to their destinations by utilizing their smart devices, Google map, and GPS which may lead to more congestions and traffic deterioration. To support and solve this issue SPS has been suggested and implemented. generally, SPS ask the tactic of utilizing recent technologies to provide real-time monitoring, controlling and management for parking lots status which may be either vacancy or occupied. Also, it's going to include many facilities like guidelines and e-payment solutions which support to optimize operations, boost productivity and save in resources and costs.

1. Determine parking lots status regarding vacancy\occupied using inexpensive and efficient WSN.
2. Adopt RFID to identify vehicle registration numbers (cars plates numbers) and its relevant information such as; parking zone Number, parking period, parking fee and assigned password for security purpose.
3. Improve a finest cyber security model for devices generated data exchange and store.
4. Enhance the security mechanism to prevent cars stolen. Adopt fog computing concept to accelerate sensitive processing and manipulating within the sting of the network

2. Related Works

Khaoula et al. proposed [1] conduct a survey on smart parking system. A theoretical comparison between modern smart parking technologies has been presented as an example the advantage and disadvantage of the

proposed model. Finally, as a future trend, expert system and Multi-Agent system are suggested as an optimal solution for smart parking system.

Amit et al. Proposed In [2] authors aim to remedy the holdup, parking issue, and toll collection. Regarding holdup, the shortest path routing algorithm called Dijkstra has been proposed to route the vehicle with rock bottom density path supported information collected from Smart holdup system STCCS Smart Parking Allotment System SPAS; and Smart Parking Allocation Centre (SPAC) are collecting parking information by adopting optical character recognition which reads the vehicle number using Automatic Number Plates Recognition (ANPR) where WSN has been utilized to determined parking lots status which is either occupied or vacant. To calculate parking fee a wise Toll collection system STTCS has been proposed. To understand the optimal goals for the proposed models (STCCS, SPAC, and STTCS) different arties need to participate and cooperate with one another.

Al-Fuqaha et al. proposed figuring out the concept of the Internet of Things (IoT) [3]. A developing wide variety of physical objects are being connected to the web at an unprecedented price deciding the concept of the web of Things. Basic examples of such objects include thermostats and HVAC (Heating, Ventilation, and Air Conditioning) tracking and manage systems that enable smart homes.

Gupta et al. proposed Smart Parking System by leveraging Internet of Things [4]. The speed at which number of vehicles are increasing greatly beats that at which new parking places are made available. This works a solution of Smart Parking System by leveraging Internet of Things technology. The status of each parking squeeze the parking enclosure is indicated by wireless technology using ultrasonic sensors. Pre-booking of the parking slot is additionally possible through the app developed. The intention of presenting this paper and also implementing the system is to help reduce the worsening traffic and parking issues faced in cities.

Prasadetal. proposed [5] ration card which among the foremost important documents in India. The card is especially used for purchasing subsidized foodstuffs and fuel. It's utilized in identification process while making passports, PAN card, Aadhar cards and acts as an address proof for citizens of India. It also provides reference to government database. This card distribution system has many drawbacks like inaccurate quantity of products, manual work, low processing speed, large waiting time, and redundant data. Repeatedly shopkeepers also enjoy forgery by providing ration under false names, within the names of ineligible people, dead people, and duplicate names from other areas.

Kumar et al. proposed RFID and GSM based parking system [6]. In this work, an answer is provided for preventing theft of auto from parking using RFID and GSM technology. There's an enormous amount of reduction in transaction cost with frequency identification

technology in automation. Software and LED lights. This technique is employed for controlling GSM kit, operating barriers and glowing LEDs in several cases.

Faraud et al. discussed a study which is used to utilize this wireless [7] knowledge with a sensible application to undo the security problem of vehicles within the organization. The foremost components of this system are RFID interrogators, RFID labels, GSM kit to inform authenticated member through SMS, barrier to manage check-ins and check-outs, LED lights with alarm to make security personnel alert and software to manage this system. The check-in and check-out of any vehicle is controlled with the use of RFID readers and RFID tags.

Z. Pala et al. proposed [8] incident of auto stealing is becoming commonplace lately and thus there is a requirement for secure systems for preventing vehicle theft. If members of any organization do not feel safe for his or her parked vehicles, then it's getting to become a distraction for them and affect their work. During this paper we propose a secure smart parking system using GSM and RFID technology. Some work has been exhausted the planet of smart parking using RFID technology.

Poojaa et al. [9] introduced a secure parking management system WSN. The proposed model consists of; parking lot vacancy monitoring model, parking lot reservation model and security model. To figure out parking lot status, a WSN has been utilized; short message services are adopted for parking reservation purpose. Finally, for the security purpose and to protect cars from thefts and stop illegal access a predefined password has been adopted.

P. V. Patel et al. [10] aimed to tag each parking slots with RFID reader ultrasonic sensors to figure out parking status regarding vacancy occupied and send it to the routing gateway through RF communication. Edge sensors nodes are connected as adhoc network.

Malekloo et al. proposed a conceptual hybrid-parking model [11]. The rapid boom in population has led to big traffic bottlenecks in latest transportation structures. This not only causes widespread pollution, and waste in time and energy, but also signifies the problem of the auto park scarcity. Within the age of Internet of Things (IoT) and smart city ecosystems, smart parking and relevant innovative solutions are necessary toward greater sustainable future cities. Smart parking with the assistance of sensors embedded in automobiles and city infrastructures can alleviate the deadlocks in parking problems and supply the simplest better of services and income to citizens. We also define open research problems within the contemporary nation of smart parking structures and propose a conceptual hybrid-parking model.

Li et al. proposed a UAV-assisted architecture to detect the status (occupied vacant) of parking spaces in parking lots. We use a totally unique generative model, GAN (Generative Adversarial Network), to automatically

detect the locations of parking spaces and predict their occupancy states. The performance of our vision-based scheme is evaluated employing a documented PKLot dataset [12]. The result shows that our scheme achieves a high detection and prediction result. Additionally, we also propose a totally unique algorithm to manage the navigation of these UAVs so as that they're going to collaboratively cover the whole parking lot using limited battery resources that they have and also avoid obstacles like trees, occlusions while flying. Within the near future, we hope to research the robustness of our design using tougher parking lot and street parking images that contain obstacles e.g. trees, occlusions along the flight paths of collaborative UAVs.

Valipour et al. proposed [13] running on a mobile device or an online browser. A user can submit his/her requests to the server to question the database regarding where the vacant parking spaces are immediately. This work is analogous to the one proposed in by Valipour.

Ramaswamy et al. proposed [14] burning fossil fuels by the medium of transportation contributes 1/3 of portion in increasing greenhouse gas and resulting in raise surface temperate. Commuters in and round the developed cities faces difficulties find parking zone thanks to lack of notification process and autonomous parking systems. This causes commuters to require multiple rounds trips to urge the parking slot which causes burning additional fuel and ultimately producing excessive CO₂ emission. This paper describes solution to smart parking system using Internet of Things (IoT) to override parking hazards and explains how does it helps to attenuate emitting greenhouse gases. IoT enables smart parking system using the system of interconnected Raspberry Pi, Distance Sensor, Pi Camera devices together. This hardware reacts to at least one another collects data and transmits to cloud storage.

Praveen et al. The purpose of Praveen et al. [15] work is to propose a design of a smart car parking system supported NB-IoT commanded by a software application that instructs the amount of cars to be parked on assigned parking zone by automating the parking and unparking of the car with the assistance of features of an internet site or application. In current times, the concept of clever town and synthetic intelligence has considerably increased first-rate popularity. With the sunrise of Internet of things, the implementation of clever city is formed almost achievable. Continual experiments are made inside the area of IoT in order to enhance the reliability of city infrastructure, NB-IoT was developed by 3GPP standard. The use of various modern techniques like artificial intelligence, augmented reality, wireless sensor based, GPS based, vehicle communication based by using either Arduino or raspberry pi board can reduce parking issues practically. But the term smart car parking aims at low cost, wide area coverage, low power consumption, high connectivity and everyone these features are provided by NB-IoT.

Vishwanath et al. [16] To realize this goal, there's growing interest within the capabilities of the rising Internet of Things (IoT), that allows a good range of physical objects and environments to be monitored in fine detail by low-cost, low-power sensing and communication technologies. This paper proposes a

practical Parking Management System supported wireless sensor network era that offers advanced options like far off parking observation, automated guidance, and parking reservation mechanism. Table.1 summarizes the existing solutions related to smart parking management.

Table 1: Works Analysis

S. No	Author	Year	Reference paper	Summary
01	Khaoula	2016	[1]	A theoretical comparison between modern smart parking application
02	Al-Fuqaha	2015	[3]	Figuring out the concept of the Internet of Things (IoT)
03	Fraud	2017	[7]	The most components of this system are RFID interrogators, RFID labels, GSM kit to inform authenticated member through SMS, barrier to regulate check-ins and check-outs,
04	Gupta	2018	[4]	Pre-booking of the parking slot is moreover possible Complete the app advanced.
05	A.Poojaa	2017	[9]	To work out parking zone status, a WSN has been used short message services are accepted for parking booking determination.
06	Patel	2017	[10]	Superiority instruments nodes are connected as Ado network.
07	Z. Pala et	2017	[8]	Some work has been applied out the ecosphere of smart parking using RFID knowledge
08	Amit	2016	[2]	To calculate parking fee a sensible Toll collection system (STTCS) has been suggested
09	Li, X., Chuah	2017	[12]	Unique algorithm to manage the navigation of these UAVs so as that they're going to collaboratively cover the whole parking lot using limited battery resources that they have and also avoid obstacles like trees, constrictions while hovering
10	S. Valipour	2016	[13]	Consecutively on a traveling method or an internet browser
11	Ramaswamy	2016	[14]	This causes commuters to need multiple round strips to urge the parking slot which causes burning additional fuel and ultimately producing excessive CO2emission.
12	Praveen,	2019	[15]	NB-IoT was developed by 3GPP standard. The use of various modern techniques like AI, augmented reality, wireless sensor based, GPS based, vehicle communication based by using either Arduino or raspberry pi board can reduce parking issues practically .

Block Diagram

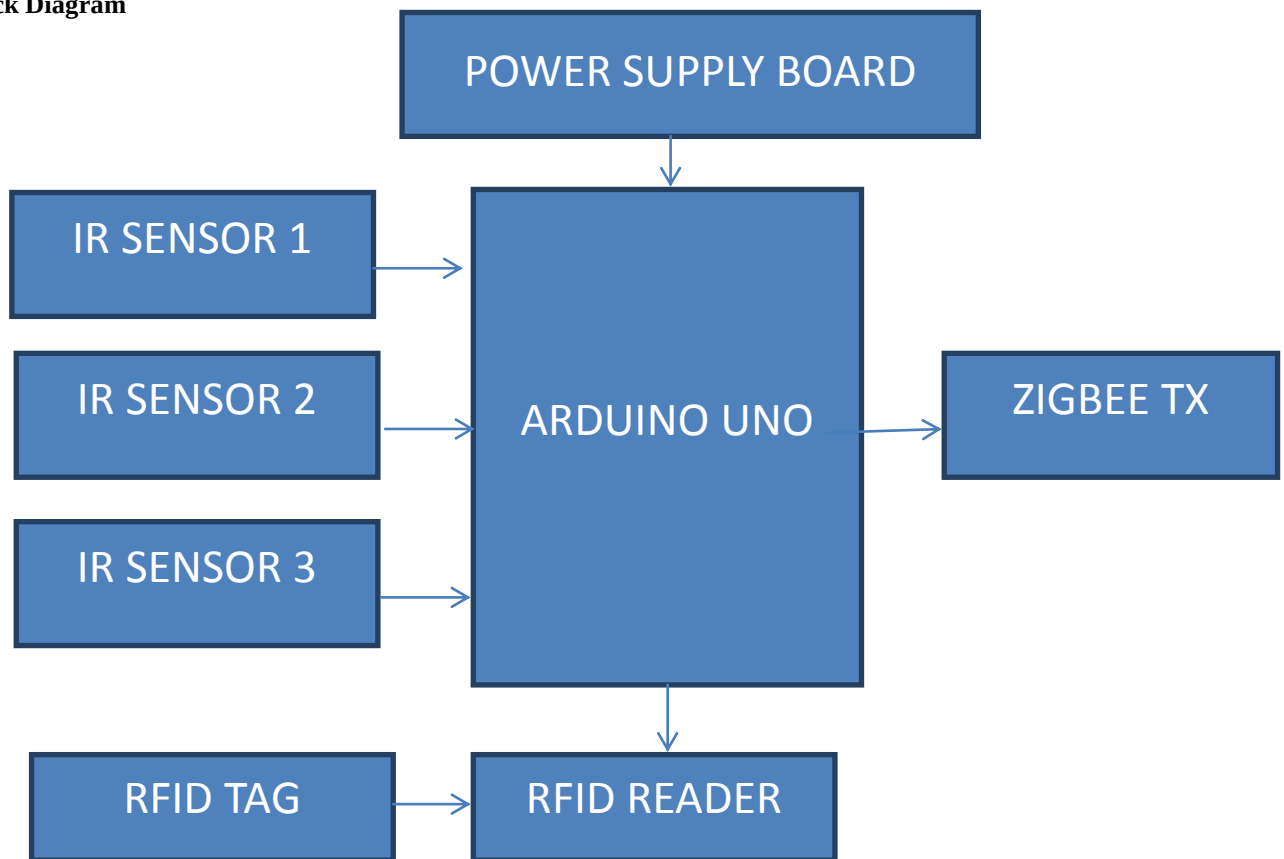


Figure 1: Block Diagram

3. Hardware Components

- ARDUINOUNO
- IR SENSOR
- RFID READER
- MOTOR
- WIFI MODULE
- RFID CARDS

3.1 Arduino Uno (ATMEGA328)



Figure 2: Arduino Uno (ATMEGA328)

- This is that the new Arduino Uno R3. Additionally to all or any the features of the previous board, the Uno now uses an ATmega16U2 rather than the 8U2 found on the Uno (or the FTDI found on previous generations).
- No drivers needed for Linux or Mac (inf file for Windows is required and included within the Arduino IDE), and therefore the ability to possess the Uno show

up as a keyboard, mouse, joystick, etc.

- Additionally, there are two new pins placed near the RESET pin.

3.2 IR Sensor

- Using an easy ADC on any microcontroller will allow variable readings to be collected from the detector.
- The emitter is driven up to 50mA with a current limiting resistor like any LED device. The detect may be a NPN transistor that's biased by incoming IR light.
- An infrared sensor is a device that emits and/or detects infrared so as to sense some aspect of its surroundings.
- Infrared sensors can measure the warmth of an object, also as detect motion. Many of those soar test of sensors only measure infrared, instead of emitting it



Figure 3: IR Sensor

3.3 Node MCU

- MCU stands for Microcontroller Unit - which really means it's a computer on one chip. A microcontroller contains one or more CPUs (processor cores) alongside memory and programmable input/output peripherals. They're wont to automate engine control, implantable medical devices, remote controls, office machines, appliances, power tools, toys etc.



Figure 4: Node MCU

3.4 RFID Reader EM18



Figure 5: RFID Reader EM18

- Radio frequency documentation (RFID) has been used in a number of practical applications, such as improving supply chain organization, following everyday pets, retrieving office structures, and hurtling up toll collection on roads.
- A RFID Reader may be a device that uses radio-frequency waves to wirelessly transfer data between itself and a RFID tag/label so as to spot, categorize and track assets. We feature RFID readers from the highest brands, including Alien, Imping, Motorola, Intermec, TSL, and Zebra. Call us for a free consultation on a RFID tracking solution or to assist you discover the proper RFID Reader to satisfy the stress of your business.

3.5 DC Motor

- Easy to use low cost motor for robotics presentation. Nut for increasing motor firmly on body/framework of

robot. Inside threaded hole on shaft for straightforward mounting of wheels by using fastens.

- A DC motor-powered is any of a category of rotational electrical machineries that converts DC electrical dynamism into mechanical dynamism.
- The commonest types believe the forces produced by magnetic fields.
- Nearly all kinds of DC motors have some inside appliance, either electromechanical or electronic; to sporadically change the way of current in chunk of the motor.



Figure 6: DC Motor

3.6 RFLD Cards



Figure 7: RFLD Cards

4. Proposed System

1. To beat all the problems mentioned above, we'd like an efficient parking system
2. In advanced parking system, IR sensors are getting to be placed at each parking slot to sense vehicle and obstacle.
3. Sensor values are getting to be displayed on display at entry gate.
4. Once car need to entry in parking, immediately notification will send to the mobile that car has been parked at particular position.
5. All the required components are of fantastic quality like IR sensor is used which may sense any obstacle also.
6. Power supply is required to run the whole system. Power backup should be there to provide 24X24 power supply.

7. In our project we have 3 IR sensors that is used to detect the availability of the vehicles in 3 different slots.
8. That is IR sensor 1 is used to detect the vehicle in Slot 1 and IR sensor 2 is used to detect the vehicle in slot 2 and the IR sensor 3 is used to detect the vehicle in slot 3.
9. All the sensor conditions is uploaded to IOT module continuously.
10. Thus, the user can identify the free slot and occupied slot clearly with the help of mobile link.
11. This system requires internet that is used to display the status of slots.
12. To increase the security purpose the RFID tag is provided. Once the tag is verified the gate pass will be provided.

1. Figures: The more the information, the better it's to form the proper decision. Knowing what to urge from the grocery while you're out, without having to see on your own, not only saves time but is convenient also.
2. Tracking: The computers keep a track both on the standard and therefore the viability of things reception. Also, you'll never run out of anything once you need it at the last moment.
3. Time: the quantity of your time saved in monitoring and therefore the number of trips done otherwise would be tremendous.
4. Money: The financial aspect is that the best advantage. This technology could replace humans who are responsible of monitoring and maintaining supplies. Show in the figure below:

Smart parking system using IOT

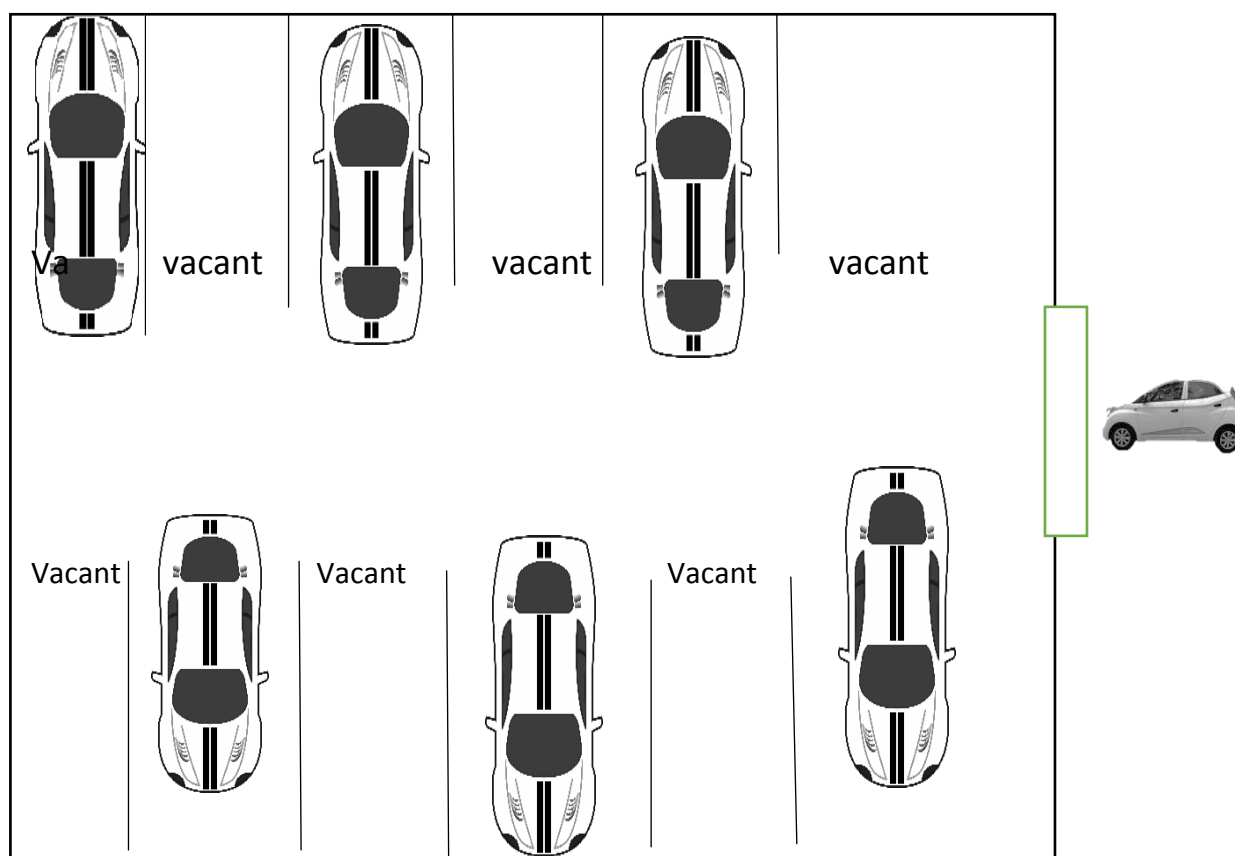


Figure 8: smart parking system IOT

Wireless Sensor Networks

WSN is a bi-directional wirelessly connected network of sensors in a multi-hop fashion, built from several nodes scattered in a sensor field each connected to one or several sensors which can collect the object specific data such as temperature, humidity, speed etc. and then pass on to the processing equipment. The sensing nodes communicate in multi-hop. Each sensor is a transceiver

having an antenna, a micro-controller and an interfacing circuit for the sensors as a communication, actuation and sensing unit respectively along with a source of power which could be both battery or any energy harvesting technology. However, has proposed an additional unit for saving the data, named as Memory Unit which could also be a part of the sensing node. A typical sensing node is shown in the figure below:

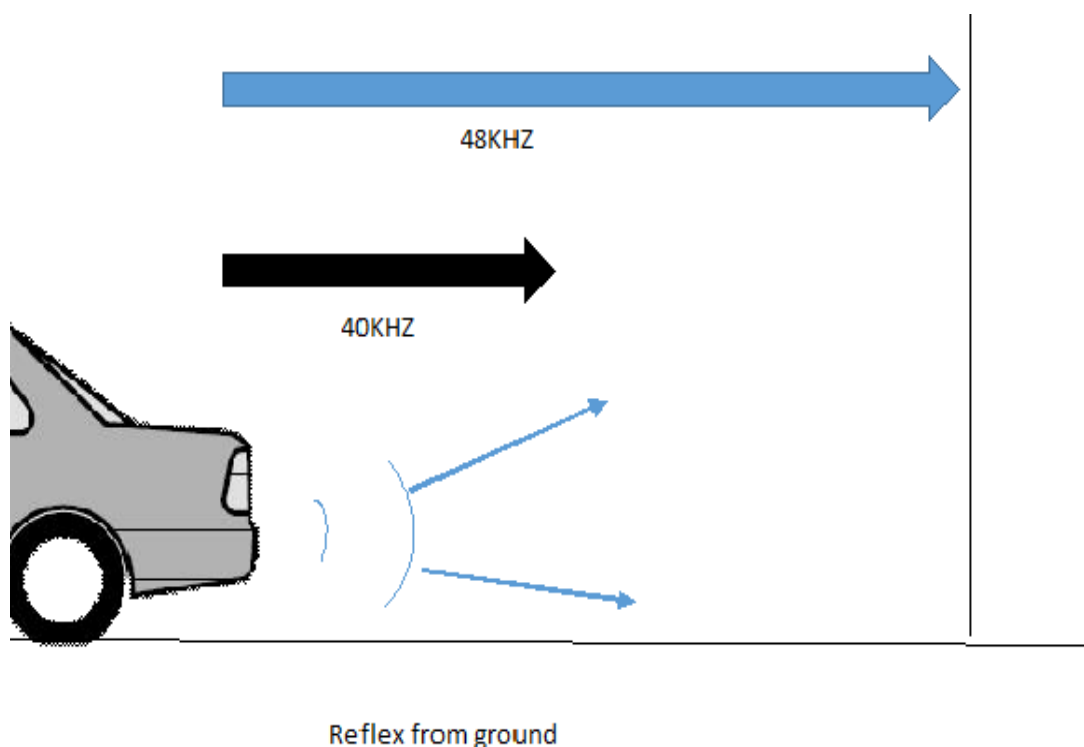


Figure 9: Smart parking system using for WSN

Radio Frequency Identification Technology

RFID system contains 3 mechanisms in mixtures: a transceiver (source/headset) and feeler are generally combined as an RFID reader. A transponder (transmitter/responder) and antenna are blended to shape an RFID tag an RFID tag is examine whilst the reader emits a radio wave that activates the transponder, which sends records returned to the transceiver.

A regular RFID machine constitutes 3 main additives as mentioned below.

1. An loop Projection
2. A transceiver with-decoder
3. A transponder Radio frequency

Which is by microelectronic means automatic to contain unique information? There are two kinds of transponders, which correlate to the two major kinds of RFID tags. Active transponder contains a battery that periodically transmits signals. Passive transponders do not have any energy source of their own, relying on the energy given off by the reader for the power to reply. Passive tag is thus cheaper. There are plenty of uses of this technology around us. You will find that you simply are already carrying and employing a RFID - Read vehicle ID Y is that the vehicle registered? N Read member ID Read Vehicle Information DATABAS E Store Check-in information.

1. Sweeping the Gate

2. Close the Gate N is that the ID Present-day N ID is of the Party? N Send a text memo to the recorded mobile number ID same as that connected to Car

3. don't sweeping the Gate

4. Ring security fright Fig.3Check-in development of parking place Check-in point label, or may be some. RFID has increased gigantic devotion due to its facility to trace stirring items. With the growth and modification in knowledge, more ubiquitous and offensive uses of RFID tags are inside the offing.

A. RFID Booklover: - booklover is employed to read the label info at the time of registration or register.

B. Open-end credit with integral RFID tag: - this characterizes membership of the group for the user. It is of two types

- a. Stable ID card
- b. Caller ID card

C. Car Tag: - this is often the vehicle tag in connotation with user open-end recognition.

D. Database: - it'll contain all the private information of the user, the associated vehicle information also because the current information of movement of the vehicles in organization.

Originally admin will register the user and user will get a sensible card with unique RFID id then followers will register their vehicle within the humanity. Firms also can register their vehicle at the time of entry himself.

Recording Process

- Step 1. For members of the group
- Step 2. Ask members of the group to record their vehicle.
- Step 3. Confer RFID vehicle label like RFID open-end credit on to the vehicle.
- Step 4. List mobile number on which member needs the updates.
- Step 5. Give brief overview about the organization for the

visitors

- Step 6. Ask visitor to register their vehicle.
- Step 7. Attach RFID vehicle tag like RFID open-end credit on to the vehicle.
- Step 8. Register mobile number on which visitor needs the updates.
- Step 9. Give brief overview about the system.

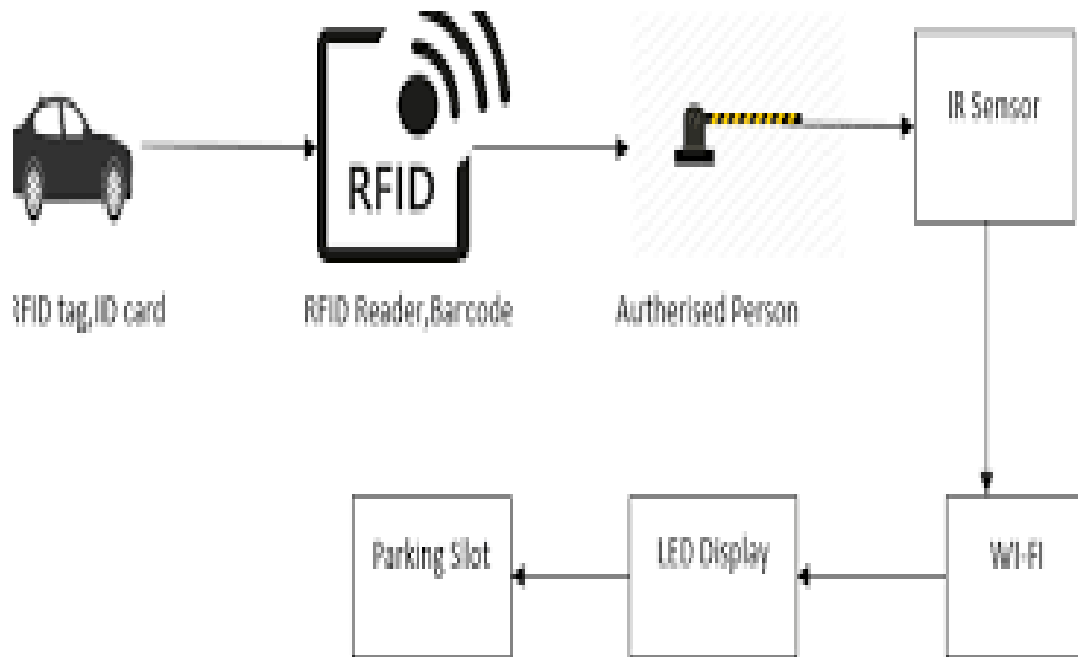


Figure 10: Radio Frequency Identification Technology

Recent Issues in Smart Car parks System

After making your phones and houses “smart”, many companies are innovating with smart car Parking Solutions. What percentage times have you ever struggled to seek out a parking spot in your office block or at an event? It’s a standard and a few problems that wasn’t addressed till now but is being talked tons this year.

Innovative and excellent parking solutions are the primary and important step within the right direction. Many megacities like Beijing, I. a., Dubai, San Francisco, and nay are piloting new and trending parking solutions. These smart parking lot systems work on low-power sensors and smart meters to trace the occupancy or availability of parking spots.

Registration Point

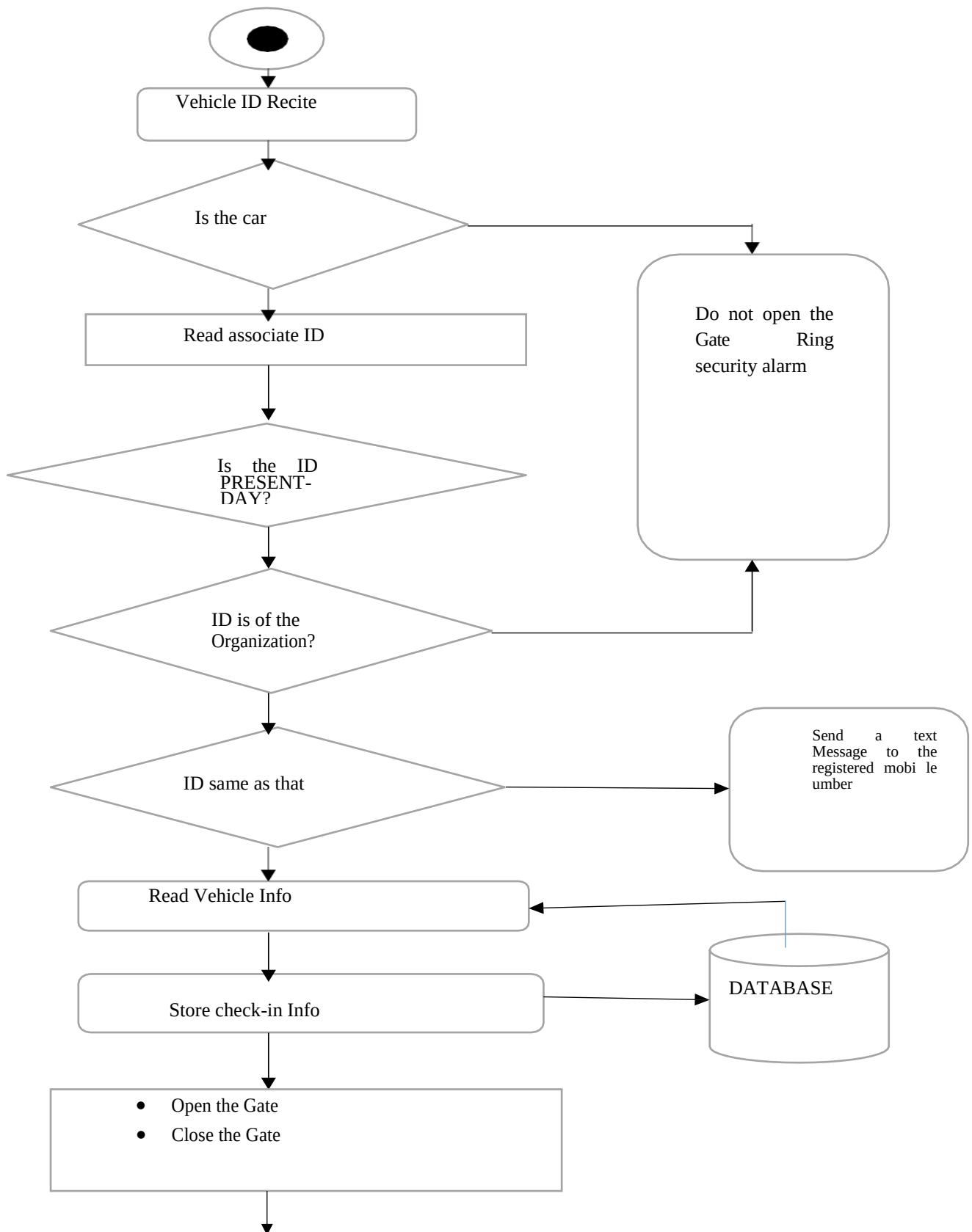


Figure 11: Registration Point of Smart Car parks System

If the check-out vehicle could also be a visitor vehicle then system will strictly confirm the visitor id should be same because the associated vehicle id and after

successful check-out, security will collect the visitor revolving credit also because the vehicle tag pasted on the vehicle. Show within the figure below.

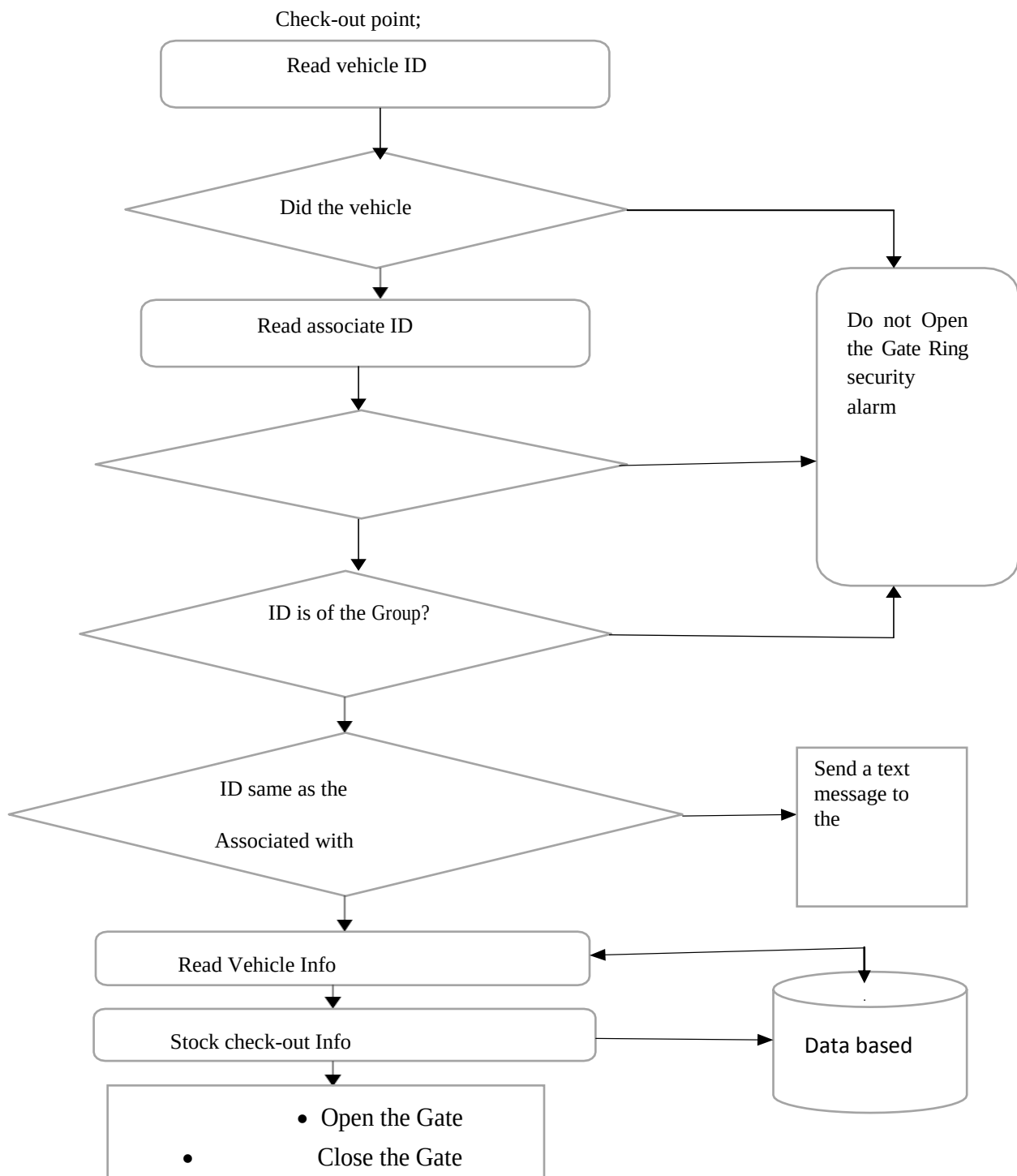


Figure 12: Check out Point of Vehicle Parking

Below are planned the probabilities or circumstances which may happen in world application of this smart car parks system:

1) Authorized user check- in: - this is often the monotonous case when the authorized user is doing check in and inspect of his vehicle.

2) Other member's check-in: -This is that the case when an employee is carrying another employee's vehicle.

3) Vehicle not registered: -In this case the worker or the opposite member is trying to urge a vehicle in, which isn't registered with the organization.

4) Not a member of organization: -In this case the person trying to urge the vehicle in or out isn't an employee of the organization.

5) Provide vehicle ID first: - during this case RFID reader reads the worker ID first or user provides his ID first while the limitation of this application is that it will read the vehicle ID first.

6) Already fetched Vehicle ID: - This case means the RFID reader reads the vehicle ID again instead of reading the worker ID.

7) MISS: -This case takes place when the reader misses to read the vehicle ID and employee ID thanks to distance restraint.

The application was tested for varying distances of the RFID reader from the vehicle. The distances chosen were 30cm, 70 cm and 1 m and for each distance the

appliance was tested 60 times. The next graphs were obtained which show the quantity of various cases under which check-in was successful or unsuccessful.

5. Result

A new model supported the blending of WSN, RFID, Adhoc network, and IoT for smart parking system are going to be tested and implemented efficiently. Additionally, it'll adopt new promising and emerging technologies such as; fog computing, NFC and HCE for quick and adequate accident report, e-payment solutions and access control. Optimized parking time, reduced holdup and pollution, will increase safety, enhance the user experience, and supply a comprehensive view to style and build a wise transportation.

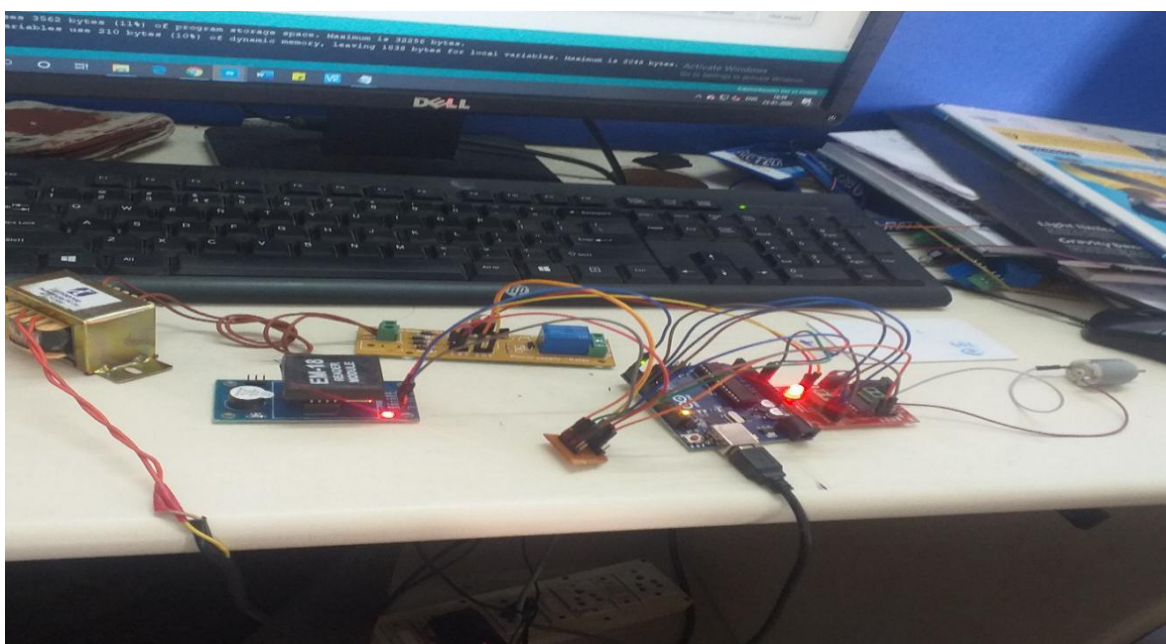


Figure13: New model of WSN, RFID, Adhoc network and IoT for smart parking system

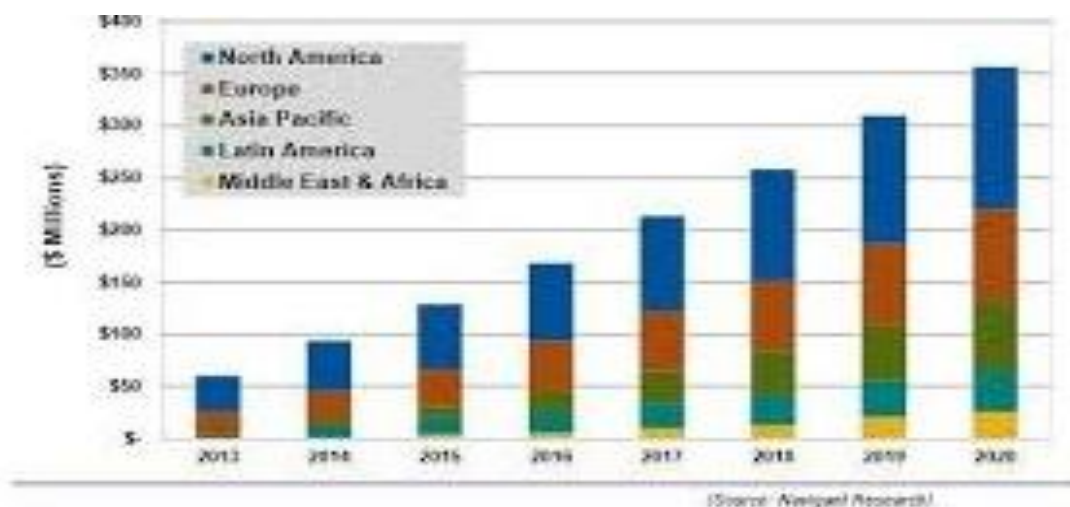


Figure 14: Bar Graph representation of Smart Car Parking

6. Conclusion

A completely unique smart parking monitoring, controlling and management solution supported the blending of RFID, WSN, Adhoc network, and IoT has been introduced. Although cyber security and privacy in SPS haven't been well explored analytically. As most of the presented papers if not all consider providing real-time parking slots status, reservation, and sufficient payment methods while not considering cyber security issues within SPS. By studying foggy developments, we explore the thanks to enhance the processing of the smart parking facilities securely and efficiently. Through the proposed model we aim to provide a comprehensive view of the traffic status which allows us to hunt out the parking lots status. In future work, we aim to measure the computational cost and energy consumption of smart parking for each WSN and IoT devices from the initialization stage to the last word stage. Also, to compute the interference issue with RFID. Supported this measurement, we'll evaluate and perform the enhancement and management of smart parking solutions to understand high throughput and low latency while preserving low Fig.3. The proposed Secure and Smart Parking System model 105 computational cost and energy consumption. As aforementioned, the proposed model also aims proactively support in reporting stolen and reported cars to the traffic agencies and support fatherly to make a totally unique smart and comprehensive transportation management system.

References

- [1] Hassoune, Khaoula, Wafaa Dachry, Fouad Moutaouakkil, and Hicham Medromi. "Smart parking systems: A survey." In *Intelligent Systems: Theories and Applications (SITA)*, 2016 11th International Conference on, pp.1-6. IEEE, 2016.
- [2] Roy, Amit, Juned Siddique, Angshudhara Data, Pripyat Poddar, Gaurav Ganguly, and Aritra Bhattacharjee. "Smart traffic & parking management using IoT." In *Information Technology, Electronics and Mobile Communication Conference (IEMCON)*, 2016 IEEE 7th Annual, pp. 1-3. IEEE, 2016.
- [3] Al-Fuqaha A, Guizani M, Mohammadi M, Aledhari M, Ayyash M (2015) Internet of things: a survey on enabling technologies, protocols, and applications. *IEEE Commun Surv Tutor*17(4):2347–2376
- [4] Gupta R, Pradhan S, Haridas A, Karia DC (2018) Cloud based smart parking system. In: 2018 second international conference on inventive communication and computational technologies (ICICCT). IEEE, pp 341–345
- [5] Prasad, A., Ghenge, A., Zende, S., Mishra, S., Gadakh, P.: Smart ration card using RFID, biometrics and SMS gateway. In: *Proceedings of the International Conference on Inventive Communication and Computational Technology (ICICCT)*, 1517
- [6] Kumar, L., Khan, M.H., Umar, M.S.: Smart parking system using RFID and GSM technology. *IMPACT*-1517
- [7] RFID Takes a Swing at Ticket Fraud, *RFID Journal*, December 2017,
- [8] Z. Pala and N. Inanc, "Smart Parking Applications Using RFID Technology," *Proc. of 1st Annual RFID Eurasia*, pp. 1 – 3, September 2017.
- [9] A. Poojaa, M. Glory, M. Glory, P. Nathiya, R. Ramya and E.T. Sivasrinee. "WSN Based Secure Vehicle Parking Management and Reservation System." *National Conference on Research Advances in Communication, Computation, Electrical Science and Structures (NCRACCESS-2015)*.
- [10] P. V. Patel and B. Kadhiwala, "Broadcasting techniques for route discovery in mobile Adhocnetwork—A survey," *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)*, New Delhi, 2016, pp.671-674.
- [11] Al-Turjman, F., & Malekloo, A. (2019). Smart Parking in IoT-enabled Cities: A Survey. *Sustainable Cities and Society*, 101608. doi: 10.1016/j.scs.2019.101608
- [12] Li, X., Chuah, M. C., & Bhattacharya, S. (2017). UAV assisted smart parking solution. *2017 International Conference on Unmanned Aircraft Systems (ICUAS)*.doi:10.1109/icuas.2017.7991353
- [13] S. Valipour, M. Siam, E. Stroulia, and M. Jagersand, "Parking stall vacancy indicator system based on deep convolutional neural networks," *arXiv preprint arXiv:1606.09367*, 2016.
- [14] Ramaswamy, P. (2016). IoT smart parking system for reducing green house gas emission. *2016 International Conference on Recent Trends in Information Technology*.
- [15] Praveen, M., & Harini, V. (2019). NB-IOT based smart car parking system. *2019 International Conference on Smart Structures and Systems (ICSSS)*.doi:10.1109/icsss.2019.8882847
- [16] Vishwanath Y , Aishwarya D Kuchall " Survey paper on Smart Parking System based on Internet of Things ", *IJRTER*-2016,.