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Sensor Based Smart Parking System

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Abstract:- The Internet of Things(IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. In urban areas, fuel wastage, carbon emission, traffic congestion and air pollution are mainly caused by illegally idling cars or by car drivers trying to find a parking spot. Therefore, finding available parking spots should be a task of utmost importance in daily life. This system proposes an easy but efficient solution of providing motorists with real time information about the availability of vacant spots in parking spaces with the help of a smart-phone application. Drivers can see the available parking spots in real time on a map, and also navigate to the nearest available parking spots using the mobile application. An app which allows drivers to book the parking lot will reduce the time and energy required to find one. This system provides a pathway for making an efficient, low-cost, smart, real-time system. This system also understands the importance of keeping the users data safe as well as protecting the system from any intrusions in a smart parking project and thus takes the required measures to ensure security, privacy, confidentiality and integrity of the users as well as the system.

General Terms:- *Ultrasonic sensor, smart phone application, cryptography.*

Keywords:- *Internet of things, Cyber security.*

I. INTRODUCTION

Today, a major issue any car driver faces is to find an available parking spot for the car and so to tackle this issue we have tried to introduce an efficient solution for parking system based on the nearest location and availability of parking lots. It is taken as an assumption that there is a reserved parking lot for us to operate. This system solves the problem of finding a parking spot for the driver, hence, saving both his time and fuel. Thus, the proposed system is beneficial on both personal as well as global level. The system includes a smart phone application which displays the nearby parking places, allow the driver to book a parking -place and also navigate him to the selected parking space. The system also includes ultrasonic sensors deployed at each parking lot which help in keeping the count of available parking places at that particular parking lot.

- *Need for smart parking system*

To find a parking spot is a time and a fuel consuming process. Studies have revealed that a car is parked for 95% of its life time and is only on the road for rest 5% of time. In a survey conducted by the British National Travel Survey in England, on an average a car was driven for more than 300 hours a year. Now where will a car be parked for these very long hours? It has been found that almost 35% of traffic is caused by drivers wandering around for parking spaces. In 2006, a study in France revealed an estimation that millions of hours were spent every year in France only in searching for parking which resulted in the loss of 700 million euros annually. In 2011, a global parking survey done by IBM states those 22 minutes is spent on average in searching for a parking lot. With these statistics, we can assume that a great portion of global pollution and fuel waste is related to parking issues. Also the convenience provided by the smart parking system will encourage people to start using parking slots on a more regular basis, thus the frequency of vehicles parked on the road shall reduce drastically which in turn shall help in minimizing traffic.

- *Project undertaken*

Parking spaces are sometimes very difficult to find whereas they are very easy to spot during other times. Sometimes the reason behind some parking spaces being over-crowded while others are rarely occupied is the pricing policy. This leads to the need of having a better and efficient parking management and handling system. We believe this is the motivation behind this work. An efficient, cost effective but easy to handle parking management system is the goal that this paper is trying to achieve.

In this system the core language used for programming is JAVA for Android application and RESTful API, MySQL for database and python for programming on the local server (raspberry pie). To implement this system in real time environment, ultrasonic sensors are placed in each parking lot. These sensors will send exact number of used/allocated parking lots so that our application can calculate remaining lots and hence provide an exact count of available slots to the user helping him to reserve a parking spot at nearest location from his intended destination.

II. EXISTING SYSTEMS

[2]For the past two decades, there have been numerous researches and investments in the car parking domain. Some of them had been deployed in practice like Parking Guidance and Information (PGI) systems. PGI systems provide drivers with real time information on parking within controlled areas through variable message signs.

They use deployed sensors mainly on the entrances and exits of parking areas to gather information about total occupancy. Other implementations typically use one sensor per one parking lot which has been seen in commercial shopping malls and in business districts to further utilize

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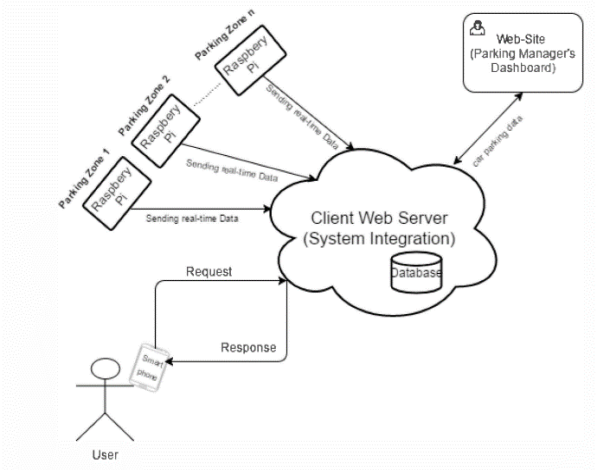
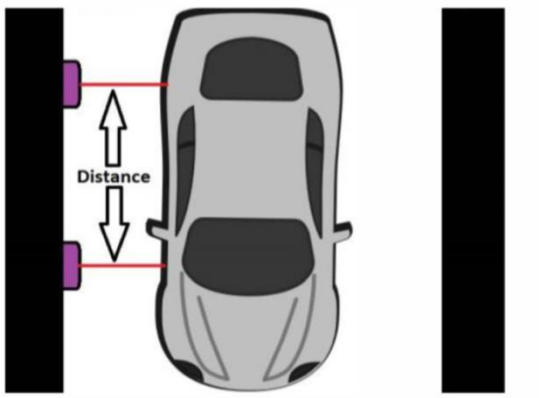
parking spaces and decrease searching time. Most of the researches have focused on how to detect the occupancy state of parking spots. However, those systems still have not solved all the problems.

Sometimes the competition for parking leads to higher traffic congestion where parking is monitored, leaving other parking resources vacant. [1]It is indeed essential to have the data on the occupancy state in parking areas but it is more important to efficiently utilize that data.

Few of the existing parking spaces make use of digital image processing to keep a count of the cars entering and leaving the parking space in order to maintain the number of available slots. However success of this system is dependent on the quality of the cameras used. Also the accuracy of the system will vary depending on the availability of light and weather conditions. Few systems also make use of RFID tags attached to each car to keep a count of parking spaces. However this technology is very expensive as it requires a RFID tag for each vehicle and hence is less suitable for public use. Ultrasonic sensors will provide solution to both these problems as it provides accurate functioning irrespective of light and weather conditions and are also cost effective because only two sensors are needed for each parking space (entrance and exit).

III. PROPOSED SYSTEM ARCHITECTURE





The architecture of the proposed system consists of a single central server to which the various ultrasonic sensors interfaced with a raspberry pi are connected. These ultrasonic sensors are responsible for detection of a car entering and exiting from a parking lot. So, it can be said that the sensor keeps the count at the parking lot where it is deployed. This information is passed on to the central server by the raspberry pi in real time. The sensor used in this system is HC-SR04 which consists of a transmitter and receiver. Its major application is to measure distance. The transmitter sends a sound wave. It reflects from an obstacle and is captured by the receiver. The time required for this process is calculated by multiplying 0.5 of the time with the speed of sound i.e. 330 m/s to get the distance between sensor and the obstacle. In this case, the obstacle is a car. The system assumes that the car waits in front of the sensors for a few seconds so that the sensors are able to detect it. Now, to make sure that only a car is detected, not anything other, there are two sensors deployed at each entrance and exit. The distance between the two sensors is kept so that it is less than the length of the smallest car but large enough not to accommodate anything else. When these both sensors give approximately the same reading of the distance at the same instance, it is considered as a car. This triggers the raspberry pi to signal the central database to change the available count.The central server collects data from all the parking lots and maintains a master availability chart for the user application. Also, the central database is responsible to keep the records of all the users using the application. This data is collected when a user registers to use the application. So, the next time the user logs in, the database should be efficient enough to authorize it almost instantly. The final part of the system is the user application. It is an Android application for the user to book a parking slot of his/her choice. The application obtains all the data from the central database. The user can select a parking lot by navigating through the application. The locations of the parking lots are displayed using Google Maps API. Each time a user books a parking lot, it is treated as a transaction. At the end of a successful transaction, a QR code is generated which needs to be shown at the entrance so as to verify the user identity.

IV. SECURITY ISSUES:

Secure data transfer or communication between the android app(client)and the server as well as the raspberry pie(local server) and the server is the most important security concern. This data includes registration and login information of users, coordinates of the parking space selected by the users, parking count update information, etc. This information is extremely valuable to the user and for the smooth functioning of the smart parking system and hence it is necessary to provide a system which ensures the privacy of the users as well provides confidentiality, security and integrity.

The two most commonly used techniques to provide the security features are Symmetric encryption and Asymmetric encryption algorithms. In symmetric encryption only one key is used to encrypt and decrypt a message. This method is fast and can encrypt large texts of data. However the disadvantage lies in the safe distribution of the key.

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DES, Triple-DES, AES, Blowfish, RC2, RC4 (ARCFOUR), RC5, RC6 are some of the algorithms using symmetric encryption.

In asymmetric encryption technique 2 keys or a key pair is used to implement information security viz .1 public key and 1 private key. Public key is freely available to anyone who wishes to send you a message but the decryption of that data can only be done by private key which only the receiver has. It is comparatively very slow and can encrypt only very small texts of data at a time (128 bytes).RSA, Diffie-Hellman, El Gamal, DSS are examples of Asymmetric Algorithms (aka Public Key Algorithms) using asymmetric algorithms.

After studying both methods it is proposed to use a hybrid solution for encrypting the data between the client and the server. The proposed hybrid solution will not only save the app from intruders, but will also help in improving the goodwill and trust from the end user.

This system also understands the importance of keeping the users data safe as well as protecting the system from any intrusions in a smart parking project and thus takes the required measures to ensure security, privacy, confidentiality and integrity of the users as well as the system.

The restful API will ensure that the client never directly accesses the database stored on the server. Any request by the client is received by the API and similarly any response by the server is sent to the client via the API.

➢ *Securing the MySQL database on the server:*

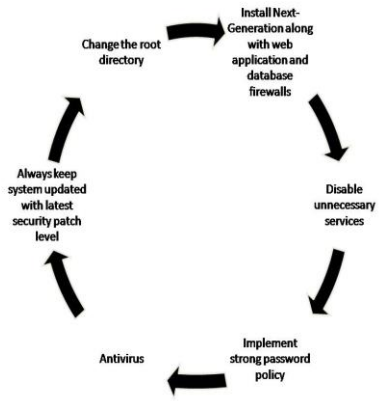
MySQL architecture is based on typical database engine model. It consists of a storage manager, query processing engine, the authentication engine and client connectors at its core. The database structure consist of schema definitions, tables which store the data in an organized form, views which are virtual tables and stored queries to improve performance etc. Database engine is responsible to accept SQL query requests, execute those and provide data back to the querying computer.

Each of the My SQL components mentioned is vulnerable to some risk, if not configured properly. We must remember that the database is a widely and continuously accessible component, which makes it more vulnerable and susceptible to attacks. MySQL security requirements touch all networking layers, and hence need careful design and implementation.

Following are various steps to be carried out post installation on a MySQL server.

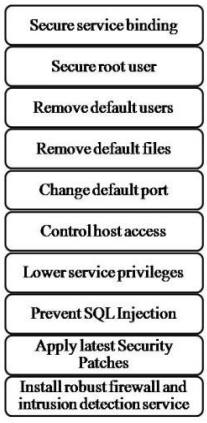
➢ *Harden the operating system*

Following diagram quickly shows the important steps to achieve healthy OS installation



Once the operating system is installed with the above precautions, the database MySQL service should be configured by changing its root directory. This will avoid unnecessary access outside the designated directory, which is essential for ensuring privilege separation for database applications and query engine. Using chown command, user can set up required access rights so that the daemon running in the background can have full control.

Since database servers are an important component of the whole system, multiple measures are to be deployed to ensure security which are enlisted below.



V. GENERAL GUIDELINES FOR MY SQL SECURITY

Since database servers are an important component of the whole system, multiple measures are to be deployed to ensure security. As for MySQL sticking to one authentication method and that too the one provided by MySQL service should be used. When we don't use

operating system based authentication, we automatically keep unauthorized users away, making the access control job easier. As for roles, a minimum set of roles should be created to avoid future confusions, and the roles should be application specific, rather than purpose specific. This helps in keeping track of which user did what, in terms of accessing the resources. Disabling unwanted MySQL database features and services is a good idea too.

In terms of data integrity, using SSL or TLS encryption is useful, especially to avoid packet sniffing of the data flowing between requesting server and the database server. As for data encryption, there are built-in features available for database server, whereby the encryption can be achieved for entire database, or at a granular level such as table or schema. This helps achieving data security without compromising on the server performance.

VI. CONCLUSION

This proposed work of an automated secure smart parking system is simple, economic and provides an effective and a safe solution to the badly managed parking situation today. It is well managed to access and map the status of parking lots from any remote location through an application. Thus, it reduces the unnecessary extra fuel wastage to find the parking slots in any area and also eliminates the wastage of time of drivers to find parking lots in that area. So it reduces time consumption and is cost effective without compromising on user privacy issues.

REFERENCES

[1]. Abhirup Khanna, Rishi Anand 'IOT Based Smart Parking System',International Conference on Internet of Things and Applications, 2016.
[2]. Amir O. Kotb, YaoChun Shen, Xu Zhu, 'iParker - A New Smart Car-Parking System based on Dynamic Resource Allocation and Pricing',IEEE Transactions on Intelligent Transportation Systems, 2016.
[3]. Yanxu Zheng, Sutharshan Rajasgarar, Christopher Leckie 'Parking availability prediction for sensor-enabled car parks in smart cities', IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2015.
[4]. Luca Mainetti, Luigi Patrono, Maria Laura Stefanizzi, Roberto Vergallo 'A smart parking system based on IOT protocols and emerging enabling technologies', IEEE 2nd World Forum on Internet of Things (WF-IoT), 2015.
[5]. Juan Rico, Juan Sancho, Bruno Cendon, Miguel Camus 'Parking easier using context information of the Smart City' 27th International Conference on Advanced Information Networking and Applications Workshops (WAINA), 2013.
[6]. Zhanlin Ji, Ivan Ganchev, Mairtin O'Droma and Xueji Zhang 'A cloud based Intelligent Car Parking service for Smart Cities', XXXIth URSI General Assembly and Scientific Symposium (URSI GASS), 2014.
[7]. Nastaran Reza Nazar Zadeh, Jennifer C. Dela 'Smart Urban Parking Detection System', 6th IEEE International Conference on Control System, Computing and Engineering (ICCSCE), 2016.