Intelligent Parking Management System

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Abstract

The Intelligent Parking Management System is a system that is highly automated and reliable without the necessity of large man-power to control parking. We look forward to acquiring a secured parking spot in a very short time before heading out towards our destination in order to reduce the hassle of driving around looking for a parking spot by implementing a sensor-based automated system and displaying the parking status information to help in efficient parking.

Keywords: Automation, Parking System, Sensor

1. Introduction

A parking space is a location that is designated for parking, either paved or unpaved.It is usually a space delineated by road surface markings. The automobile fits inside the space, either by parallel parking, perpendicular parking or angled parking.Depending on the location of the parking space, there can be regulations regarding the time allowed to park and a fee paid to use the parking space. When the demand for spaces exceeds supply, vehicles may park onto the sidewalk, grass verges and other places which were not designed for the purpose. In a Multi-storeyed parking, the driver needs to

know about the availability of parking and has to be guided to the particular parking space.

The focus is mainly on reducing the manpower required to monitor the parking in. Normally we can see in the multiplexes, theatres, marriage halls, etc, a considerable amount of manpower is required to coordinate the parking process. In cities the majority of parking spaces is controlled by manpower. Surprisingly hardly any data on usage of these spaces is available. This is changing rapidly. Parking data from sensors are considered a prominent part of that. With information from parking sensors, it is easy to guide visitors quickly to available parking spaces.

The Intelligent Parking Management System (IPMS) addresses these problems. IPMS is an Automated Sensor-based system which gives details regarding availability of parking lots for the given parking layout. Sensor networks are a natural candidate for car park management systems, because they allow status to be monitored very accurately for each parking space, if desired. Wireless sensor networks have the advantage that they can be deployed in existing car-parks without having to install new cabling for network and electricity to reach each sensing device.

The system setup consists of IR proximity sensors placed appropriately in the parking lots. These sensors sense the presence or absence of the vehicle. These sensors are connected to a Micro-controller Unit which transmits the information to the server via a wireless connection .The data is stored in a database and dynamically accessed to map the parking availability on to a Web Interface which is displayed on LCD screens. These LCD screens will be placed at strategic locations in the parking layout for the people to park

their vehicles accordingly.

This project will reduce the manpower to a certain extent and make it easy for drivers to park their cars on their own. An increment of this system will be a Smart booking system that provides customers an easy way of reserving a parking space online. It overcomes the problem of traffic in parking.

2. Related Works

Prediction of parking space availability in real time [1] is a proposed system that allows customers to select a parking facility according to their preferences, rapidly park their vehicle without searching for a free stall, and pay their reservation in advance avoiding queues, interact with in-vehicle navigation systems and provide users with information in real time such as capacity, parking fee, and current parking utilization. These systems assist drivers with their trip planning in searching and waiting for vacant parking stalls while mitigating driver frustration, and decreasing queues at parking entrances, the amount of miles traveled per vehicle, and average trip time, traffic congestion, energy consumption, and air pollution

Determining the availability of parking spaces [2] is a system for determining and communication the availability of parking spaces. The system includes an Optical adapted to Scan a plurality of the Parking spaces and to produce scan data for the parking spaces scanned.This invention relates generally to managing parking spaces, and more particularly, to determining and broadcasting the availability of vehicle parking spaces. Motorists often become frustrated While searching for an available parking space. The frus-

tration increases as the searching continues, because random searching does not assure the motorist an on-street or facility parking space Within a fixed amount of time. Systems to determine and communicate the availability of parking spaces could lead to more efficient use of existing parking facilities in crowded city centers.

Detection and remote notification of vehicle parking space availability data [3] is a system for Providing timely and efficient notification of vehicle parking space availability and locations of vehicle parking spaces to motorists or other network users. Local detector devices sense the presence or absence Of a vehicle in a Particular parking Space and Communicate space identification and status information to a computer network. The present invention relates to a method and apparatus for communicating space availability data and more particularly to a method and apparatus for sensing the presence or absence of vehicles in particular parking spaces and communicating parking space location and status information.

Predictive analytics: parking prediction using sensors and gps [4] is a system thus takes care to relieve traffic congestion by making parking easier and efficient. Due to planned parking the entire road can be available exclusively for moving vehicles. Technology like GPS, Infra-red and RFID will thus be deployed to develop an easy, quick and efficient parking system. RFID sensor detects the vehicle occupying the parking, it can log where exactly the vehicle in parked, including the floor and number of parking, for example, P1/ Lot-86. The system explained in this paper will have the ability to compute sense and interact with the physical environment in detail, leading to generation of huge amounts of data

Parking availability prediction for sensor-enabled car parks in smart cities [5] is a proposal which with the use of sensors and gps and previous experiences and predicting the parking congestion in future and also notifying registered users regarding the availability. on and utilities, more aware, interactive and efficient. The realization of the Smart City is now becoming possible with the emergence of the Internet of Things (IoT), which radically evolves the current Internet into a network of interconnected objects, such as sensors, parking meters, energy measuring devices and actuators [12]. These networked devices have the ability to compute, sense and interact with their surroundings in fine spatial and temporal detail, and generate a vast amount of data

Finding available parking spaces made easy [6]is a system for predicting the number of available parking spaces in a parking lot. The parking lot is modeled by a continuous-time Markov chain. The parking lot regularly communicates the number of occupied spaces, capacity, arrival and parking rate through a vehicular network. The navigation system in the vehicle has to compute from these data the probability of an available parking space upon arrival.

Smart parking solutions for urban areas [7]is a survey on the needs of drivers from parking infrastructures from a smart services perspective. As smart parking systems are becoming a necessity in today's urban areas, we discuss the latest trends in parking availability monitoring, parking reservation and dynamic pricing schemes.

3. Detailed Design

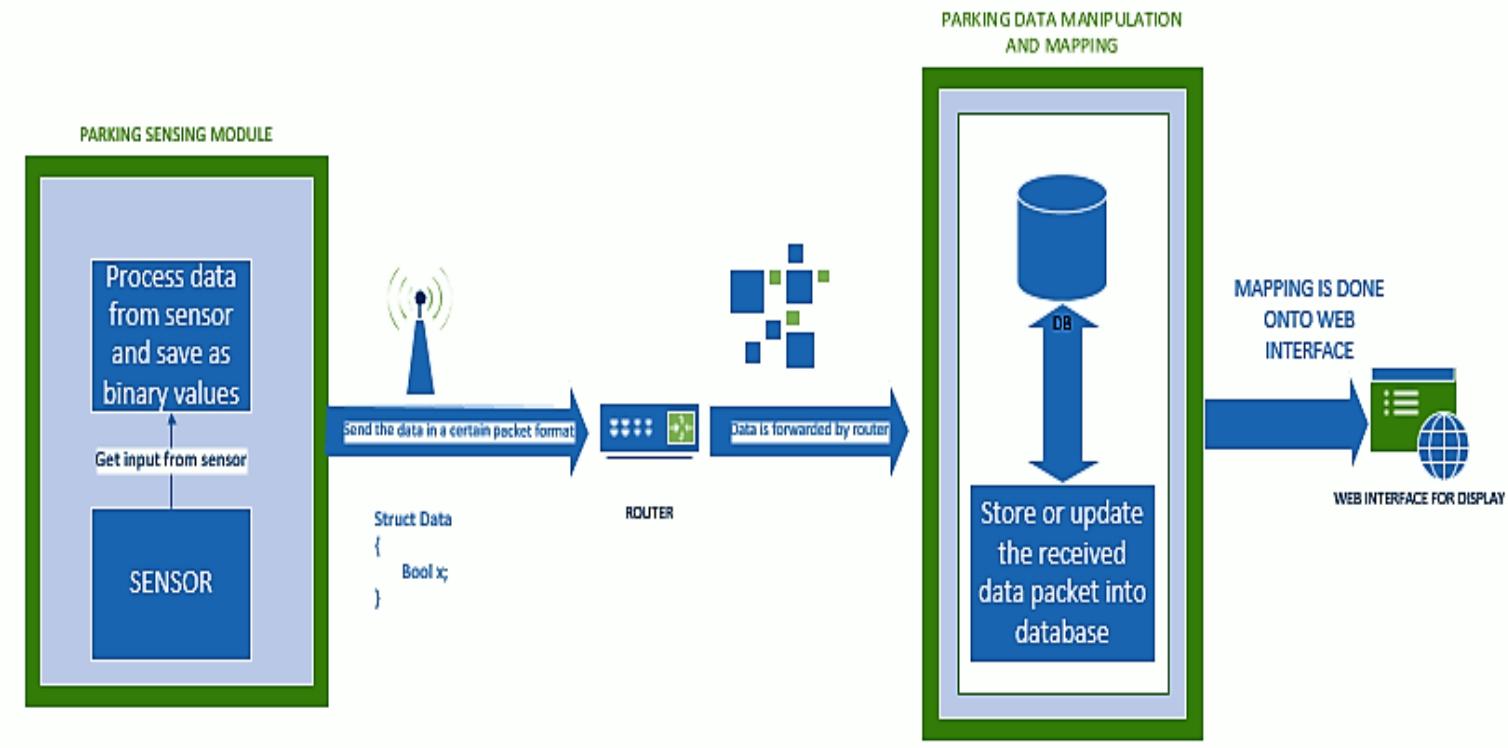

Figure 1: System Architecture

The above figure 1 is a depiction of the architecture of the system. The blocks represent the various modules and the arrows represent the flow of data across the various modules.

The sensor is connected to the Microcontroller Unit. THe MCU processes the input from the sensor with respect to the availability of the car in the parking lot. Then this data is packeted and transmitted wirelessly to the server where it stores the obtained data into the database. This wireless transmission occurs with the help of a router which forwards the packet to

the server. The server retrieves the data dynamically at regular intervals and the availability of the parking lot is mapped onto a Web GUI which displays the availability status for the currently monitored parking layout.

The system has two main modules. One is the **Parking Sensing Subsystem** and the other one is the **Data Manipulating and Mapping Subsystem**

The following contains the state transition model for the hardware, followed by the description of the two modules.

3.1. State Model of the hardware

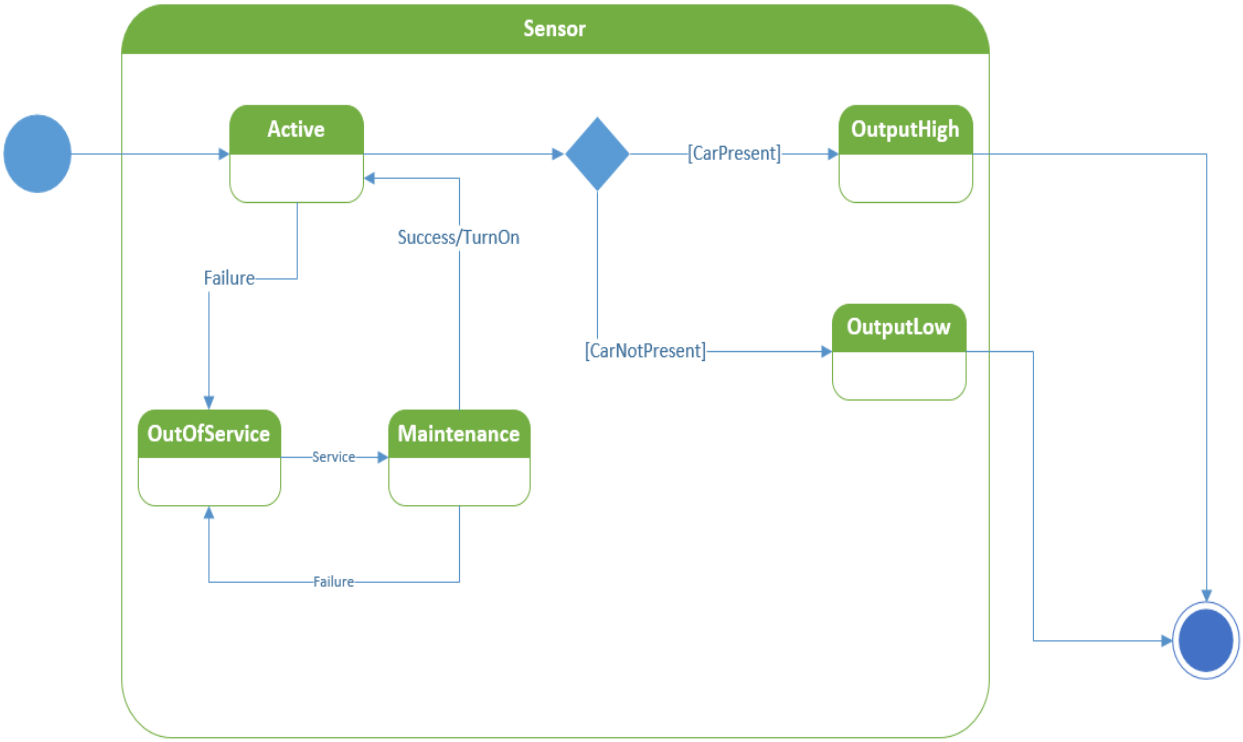

Figure 2: State transition diagram for Sensor

Figure 2 represents the state transition diagram for the sensor. When the sensor is active its job is the sense the presence of a car in the parking lot. If the car is present, the sensor goes to ActiveHigh State, else, it goes to ActiveLow State. If the sensor goes out of order it is repaired back to active state.

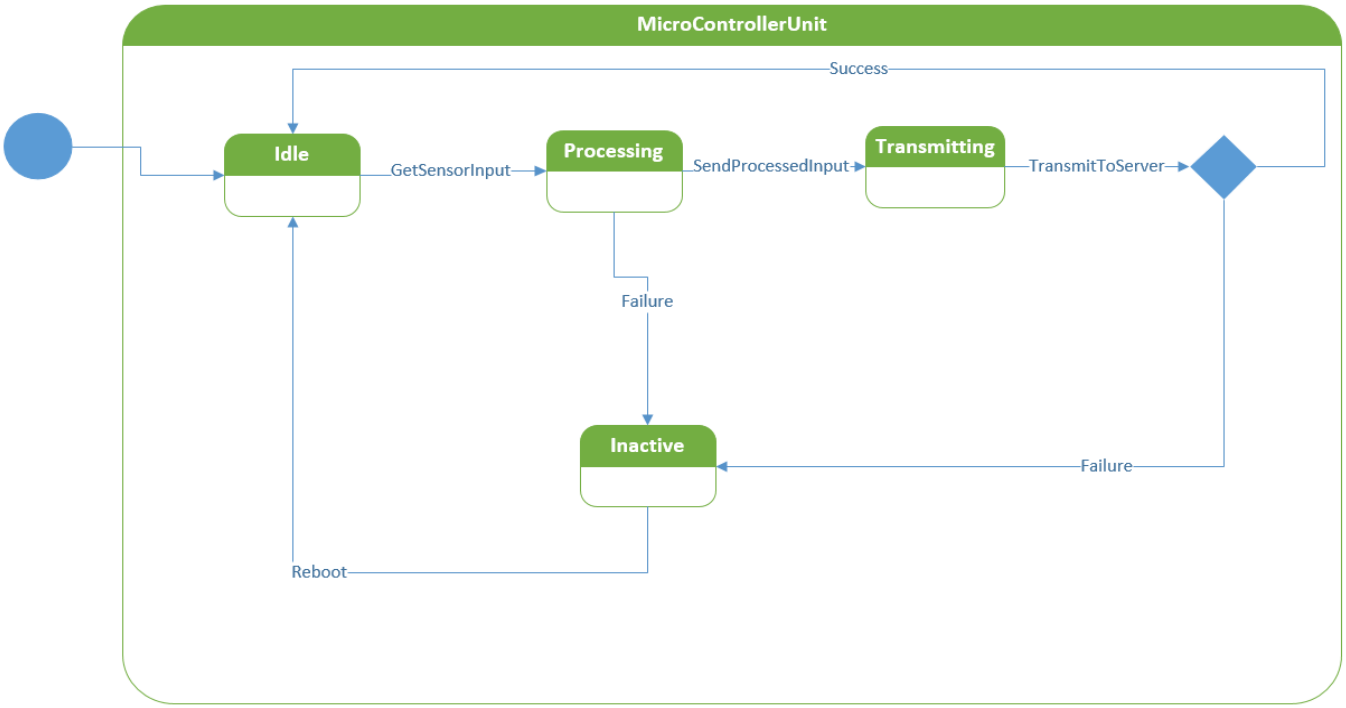

Figure 3: State transition diagram for MCU

Figure 3 represents the state transition diagram for Micro-Controller Unit. The MCU goes from Idle state to Processing state if it receives an input from the sensor. After processing is done, it transmits the data to the server. If there is a problem in processing or transmitting, the MCU goes to inactive state. It is then rebooted to its idle state to resume processing.

3.2. Parking Sensing Subsystem

The role of the parking sensing module is to detect the presence of a car in the parking lot where the sensor is installed. The type of sensor used is an **Infrared (IR) Line sensor**. The sensor is connected to the Micro-Controller Unit.If there is no car present in the parking lot, then the IR sensor is in **LOW state** (Binary 0). If a car is present in the parking lot, then the sensor is in **HIGH state**(Binary 1). This data is stored in the form of binary values.

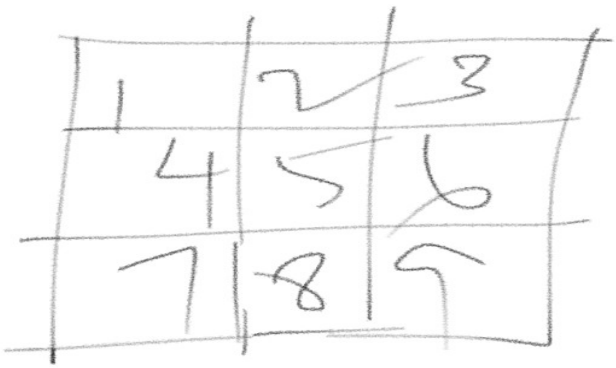

Figure 4: An arbitrary example of a parking lot having id 1 to 9

Let us consider Figure 4 which shows a parking layout in the form of a 3x3 board (9 parking lots). This layout helps to explain the working of the system in a simple and understandable manner.The data obtained from the sensor is processed by the MCU.

The structure for receiving the data is

```
struct sensorData
{
int id;
    bool s;
};
```

At each parking lot 2 sensors are strategically placed so that the car is in the sensor's range even if the alignment of the car is not perfect. Let these sensors be s1 and s2. Each sensor has an unique id. The following table represents the logic of the sensor I/O.

S1	**S2**	**Action**
0	0	Car not present
0	1	Error Condition
1	0	Error Condition
1	1	Car is present

Table 1: Sensor I/O

Table 1 shows the sensor input logic and the correspondingly performed action. When s1=0, s2=1 or s1=1, s2=0, it means that an error condition has been encountered. The error can be due to improper parking of the car or due to obstruction by some other object.

Following is the algorithm used for handling errors due to other objects or improper parking of the vehicle.

```
while(true)
{
value=ambientIR-objectIR;
    distance+=value;
}
If(distance< d)
then invalid object
```

Here the **ambientIR** contains the distance value when no object is present. **objectIR** is the distance calculation if an object is present. If the difference between. If this **distance** is less than a specified value, then the object is not a car.

Now an AND operation is performed between **SensorData** of two sensors of a particular parking lot. The resulting boolean value is stored in a separate structure.

```
struct sensorData
{
int parking_lot_id;
    bool x;
};
```

Here **x** is the variable that stores the value after the AND operation. The structure also contains a variable that holds the parking lot id. After packet-

ing the data, a TCP connection is established with the server.Then the data is transmitted wirelessly to the server.

3.3. Data Manipulation and Mapping subsystem

This module, on receiving data from the MCU, stores it in the database. Then a web GUI is designed and the data retrieved from the database and is mapped onto the web GUI accordingly. This is web GUI is displayed in LCD screens for the user's accessibility. If the data retrieved is 0, then parking space is occupied. If it is 1, the parking space is available.

4. References

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