KGiSL INSTITUTE OF TECHNOLOGY

(Approved By AICTE, New Delhi, Affiliate to Anna University

Recognized by UGC, Accredited by NBA(IT)

265, KGISL Campus, Thudiyalur Road, Saravanampatti, Coimbatore-641035.)

DEPARTMENT OF
ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

NAAN MUDHALVAN - INTERNET OF THINGS

SMART PARKING

NAME: Aswitha.R

REG NO: 711721243014

NM ID: au711721243014

TEAM MENTOR: Mr. Mohankumar M

TEAM EVALUATOR: Ms. Akilandeeshwari M

Phase 5: Project Documentation & Submission

Problem Statement:

Our challenge is to develop a smart parking solution using IoT technology. We aim to monitor real-time parking space occupancy, offer dynamic parking guidance to users, and seamlessly integrate these features into a mobile app. The ultimate goal is to enhance the efficiency and convenience of public parking services, alleviating the common difficulties of finding available parking spaces in urban areas.

Project Overview

1. Objectives

- **Define the purpose of the project:** Creating a real-time parking availability system using IoT sensors, Raspberry Pi, and a mobile app.
- **Describe the primary goals:** Enhancing parking management, providing real-time information to users, and improving the parking experience.

2. IoT Sensor Setup

Ultrasonic Sensors

Model: HC-SR04

Purpose: Detection of vehicle presence within specific parking spaces.

Installation: Mounted above each parking spot for accurate detection.

Specifications: Operating voltage 5V, operating current 15mA.

PIR Motion Sensors

Model: HC-SR501

Purpose: Detection of general movement in the parking area.

Installation: Positioned at key locations to monitor general occupancy.

Specifications: Operating voltage 5V, standby current <50μA, detection range up to 7 meters.

3. Raspberry Pi Integration

Configuration and Setup:

The Raspberry Pi serves as the central processing unit for the real-time parking availability system. The following steps outline the configuration and setup process:

Hardware Configuration

Raspberry Pi Model: Raspberry Pi 4 Model B

Operating System: Raspbian Buster

Connectivity: Connected to local Wi-Fi network

Power Supply: 5V, 3A power adapter

Software Installation

Installed Raspbian Buster OS on a 32GB microSD card following official Raspberry Pi documentation.

Configured the Wi-Fi connection through the terminal using raspi-config.

Enabled SSH for remote access and interfacing.

4. Integration with IoT Sensors

The Raspberry Pi was integrated with the following IoT sensors to capture and process parking space occupancy data:

Ultrasonic Sensors

Utilized HC-SR04 Ultrasonic Distance Sensor for detecting vehicle presence in parking spaces.

Connection Diagram:

VCC pin connected to Pin 2 (5V)

GND pin connected to Pin 6 (Ground)

Trigger pin connected to GPIO Pin 23

Echo pin connected to GPIO Pin 24

PIR Motion Sensors

Used HC-SR501 PIR Motion Sensor for detecting movement in specific zones of the parking lot.

Connection Diagram:

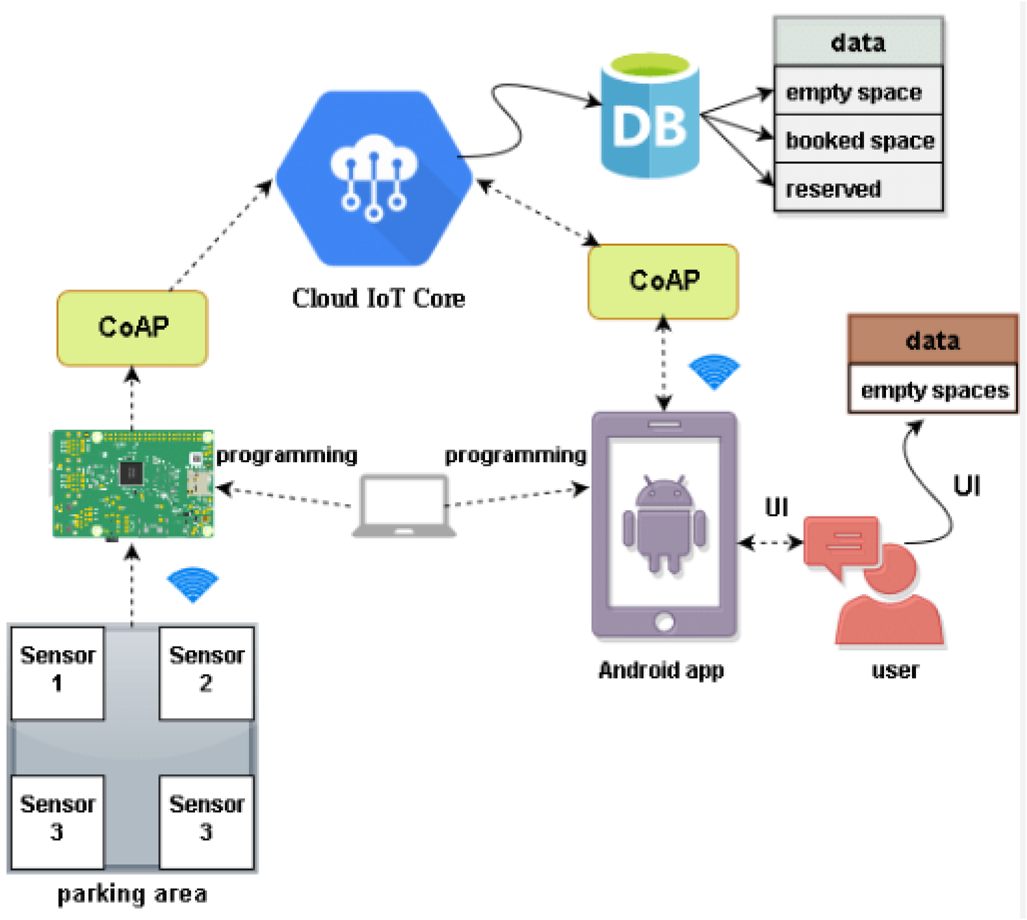
VCC pin connected to Pin 4 (5V)

GND pin connected to Pin 9 (Ground)

Signal pin connected to GPIO Pin 17

Data Processing and Storage

Python scripts were developed to interact with the sensors and process the data on the Raspberry Pi. These scripts analyzed sensor inputs and updated the parking availability status in real-time. The data was stored locally in JSON format and also transmitted to the cloud for remote access.



5. Mobile App Development

Mobile Platform

Android OS for wider compatibility.

Programming Language: Java using Android Studio.

Features

Real-time Parking Updates

Display available parking spaces to users in real-time.

Navigation to the nearest available parking spot.

User Interface Design

Intuitive interface for ease of use.

Screens with parking availability status and navigation options.

Visual Representations

Include screenshots or mock-ups of the mobile app's interface, highlighting various features and functionalities.

6. Code Implementation

Raspberry Pi Code:

Python scripts to process sensor data and update parking availability status.

Details on data collection, processing, and storage methods.

Code:

```
import time

import RPi.GPIO as GPIO

import time

import os,sys

from urllib.parse import urlparse

import paho.mqtt.client as paho

GPIO.setmode(GPIO.BOARD)

GPIO.setwarnings(False)


&#39;&#39;&#39;

define pin for lcd

&#39;&#39;&#39;

# Timing constants

E_PULSE = 0.0005

E_DELAY = 0.0005

delay = 1
```

```
# Define GPIO to LCD mapping
LCD_RS = 7
LCD_E = 11
LCD_D4 = 12
LCD_D5 = 13
LCD_D6 = 15
LCD_D7 = 16
slot1_Sensor = 29
slot2_Sensor = 31
GPIO.setup(LCD_E, GPIO.OUT) # E
GPIO.setup(LCD_RS, GPIO.OUT) # RS
GPIO.setup(LCD_D4, GPIO.OUT) # DB4
GPIO.setup(LCD_D5, GPIO.OUT) # DB5
GPIO.setup(LCD_D6, GPIO.OUT) # DB6
GPIO.setup(LCD_D7, GPIO.OUT) # DB7

GPIO.setup(slot1_Sensor, GPIO.IN)
GPIO.setup(slot2_Sensor, GPIO.IN)
# Define some device constants
LCD_WIDTH = 16 # Maximum characters per line
LCD_CHR = True
LCD_CMD = False
LCD_LINE_1 = 0x80 # LCD RAM address for the 1st line
LCD_LINE_2 = 0xC0 # LCD RAM address for the 2nd line
LCD_LINE_3 = 0x90# LCD RAM address for the 3nd line

def on_connect(self, mosq, obj, rc):
```

```
self.subscribe(&quot;Fan&quot;, 0)


def on_publish(mosq, obj, mid):
print(&quot;mid: &quot; + str(mid))


mqttc = paho.Client() # object declaration
# Assign event callbacks
mqttc.on_connect = on_connect
mqttc.on_publish = on_publish


url_str = os.environ.get(&#39;CLOUDMQTT_URL&#39;,
&#39;tcp://broker.emqx.io:1883&#39;)
url = urlparse(url_str)
mqttc.connect(url.hostname, url.port)


&#39;&#39;&#39;
Function Name :lcd_init()
Function Description : this function is used to initialized lcd by
sending the different commands
&#39;&#39;&#39;
def lcd_init():
# Initialise display
lcd_byte(0x33,LCD_CMD) # 110011 Initialise
lcd_byte(0x32,LCD_CMD) # 110010 Initialise


lcd_byte(0x06,LCD_CMD) # 000110 Cursor move direction
lcd_byte(0x0C,LCD_CMD) # 001100 Display On,Cursor Off, Blink Off
lcd_byte(0x28,LCD_CMD) # 101000 Data length, number of lines, font size
lcd_byte(0x01,LCD_CMD) # 000001 Clear display
time.sleep(E_DELAY)
&#39;&#39;&#39;
Function Name :lcd_byte(bits ,mode)
Fuction Name :the main purpose of this function to convert the byte data into bit and send to lcd port
&#39;&#39;&#39;
def lcd_byte(bits, mode):
# Send byte to data pins
# bits = data
# mode = True for character
# False for command

GPIO.output(LCD_RS, mode) # RS

# High bits
GPIO.output(LCD_D4, False)
GPIO.output(LCD_D5, False)
GPIO.output(LCD_D6, False)
GPIO.output(LCD_D7, False)
if bits&amp;0x10==0x10:
GPIO.output(LCD_D4, True)
if bits&amp;0x20==0x20:
GPIO.output(LCD_D5, True)
if bits&amp;0x40==0x40:
```

```
GPIO.output(LCD_D6, True)

if bits&amp;0x80==0x80:

GPIO.output(LCD_D7, True)


# Toggle &#39;Enable&#39; pin

lcd_toggle_enable()


# Low bits

GPIO.output(LCD_D4, False)

GPIO.output(LCD_D5, False)

GPIO.output(LCD_D6, False)

GPIO.output(LCD_D7, False)

if bits&amp;0x01==0x01:

GPIO.output(LCD_D4, True)

if bits&amp;0x02==0x02:

GPIO.output(LCD_D5, True)

if bits&amp;0x04==0x04:

GPIO.output(LCD_D6, True)

if bits&amp;0x08==0x08:

GPIO.output(LCD_D7, True)


# Toggle &#39;Enable&#39; pin

lcd_toggle_enable()

&#39;&#39;&#39;

Function Name : lcd_toggle_enable()

Function Description:basically this is used to toggle Enable pin

&#39;&#39;&#39;
```

```
def lcd_toggle_enable():
# Toggle enable
time.sleep(E_DELAY)
GPIO.output(LCD_E, True)
time.sleep(E_PULSE)
GPIO.output(LCD_E, False)
time.sleep(E_DELAY)
&#39;&#39;&#39;
Function Name :lcd_string(message,line)
Function Description :print the data on lcd
&#39;&#39;&#39;
def lcd_string(message,line):
# Send string to display

message = message.ljust(LCD_WIDTH,&quot; &quot;)

lcd_byte(line, LCD_CMD)

for i in range(LCD_WIDTH):
lcd_byte(ord(message[i]),LCD_CHR)

lcd_init()
lcd_string(&quot;welcome &quot;,LCD_LINE_1)
time.sleep(0.5)
lcd_string(&quot;Car Parking &quot;,LCD_LINE_1)
lcd_string(&quot;System &quot;,LCD_LINE_2)
time.sleep(0.5)
```

```
lcd_byte(0x01,LCD_CMD) # 000001 Clear display
# Define delay between readings
delay = 5

while 1:
# Print out results
rc = mqttc.loop()
slot1_status = GPIO.input(slot1_Sensor)
time.sleep(0.2)
slot2_status = GPIO.input(slot2_Sensor)
time.sleep(0.2)
if (slot1_status == False):
lcd_string(&quot;Slot1 Parked &quot;,LCD_LINE_1)
mqttc.publish(&quot;slot1&quot;,&quot;1&quot;)
time.sleep(0.2)
else:
lcd_string(&quot;Slot1 Free &quot;,LCD_LINE_1)
mqttc.publish(&quot;slot1&quot;,&quot;0&quot;)
time.sleep(0.2)

if (slot2_status == False):
lcd_string(&quot;Slot2 Parked &quot;,LCD_LINE_2)
mqttc.publish(&quot;slot2&quot;,&quot;1&quot;)
time.sleep(0.2)
else:

lcd_string(&quot;Slot2 Free &quot;,LCD_LINE_2)
```

```
mqttc.publish(&quot;slot2&quot;,&quot;0&quot;)
time.sleep(0.2)
```

Mobile App Code:

Java code snippets for real-time data updates and user interactions.

Highlighting key functionalities and data display mechanisms.

Code:

```
var createError = require(&#39;http-errors&#39;);
var express = require(&#39;express&#39;);
var path = require(&#39;path&#39;);
var cookieParser = require(&#39;cookie-parser&#39;);
var logger = require(&#39;morgan&#39;);
var methodoverride = require(&#39;method-override&#39;);
var hbs = require(&#39;hbs&#39;);
var session = require(&#39;express-session&#39;);

var connection = require(&#39;./models&#39;);
var indexRouter = require(&#39;./routes/index&#39;);
var usersRouter = require(&#39;./routes/users&#39;);
var carsRouter = require(&#39;./routes/cars&#39;);
var app = express();
// view engine setup
app.set(&#39;views&#39;, path.join(__dirname, &#39;views&#39;));
app.set(&#39;view engine&#39;, &#39;hbs&#39;);
// Helpers hbs
hbs.registerHelper(&#39;equals&#39;, (val1, val2, options) =&gt; {
return val1 == val2 ? options.fn(this) : options.inverse(this);
```

```
});
app.use(session({
secret: &#39;parkingsystem&#39;,
}));
app.use(logger(&#39;dev&#39;));
app.use(express.json());
app.use(express.urlencoded({ extended: false }));
app.use(cookieParser());
app.use(methodoverride((req, res, next) =&gt; {
if(req.body &amp;&amp; typeof req.body == &#39;object&#39; &amp;&amp; req.body._method) {
var method = req.body._method;
delete req.body._method;
return method;
}
}));

app.use(express.static(path.join(__dirname, &#39;public&#39;)));


app.use(&#39;/&#39;, indexRouter);
app.use(&#39;/users&#39;, usersRouter);
app.use(&#39;/cars&#39;, carsRouter);
// catch 404 and forward to error handler
app.use(function(req, res, next) {
next(createError(404));
});
// error handler
app.use(function(err, req, res, next) {
```

```
// set locals, only providing error in development

res.locals.message = err.message;

res.locals.error = req.app.get(&#39;env&#39;) === &#39;development&#39; ? err : {};

// render the error page

res.status(err.status || 500);

res.render(&#39;error&#39;);

});

module.exports = app;
```

```
{

&quot;name&quot;: &quot;parking&quot;,

&quot;version&quot;: &quot;0.0.0&quot;,

&quot;lockfileVersion&quot;: 1,

&quot;requires&quot;: true,

&quot;dependencies&quot;: {

&quot;accepts&quot;: {


&quot;version&quot;: &quot;1.3.5&quot;,

&quot;resolved&quot;: &quot;https://registry.npmjs.org/accepts/-/accepts-1.3.5.tgz&quot;,

&quot;integrity&quot;: &quot;sha1-63d99gEXI6OxTopywIBcjoZ0a9I=&quot;,

&quot;requires&quot;: {

&quot;mime-types&quot;: &quot;2.1.19&quot;,

&quot;negotiator&quot;: &quot;0.6.1&quot;

}

},

&quot;align-text&quot;: {

&quot;version&quot;: &quot;0.1.4&quot;,

&quot;resolved&quot;: &quot;https://registry.npmjs.org/align-text/-/align-text-
```

```
0.1.4.tgz&quot;,
&quot;integrity&quot;: &quot;sha1-DNkKVhCT810KmSVsIrcGlDP60Rc=&quot;,
&quot;requires&quot;: {
&quot;kind-of&quot;: &quot;3.2.2&quot;,
&quot;longest&quot;: &quot;1.0.1&quot;,
&quot;repeat-string&quot;: &quot;1.6.1&quot;
}
}
{
&quot;name&quot;: &quot;parking&quot;,
&quot;version&quot;: &quot;0.0.0&quot;,
&quot;private&quot;: true,
&quot;scripts&quot;: {
&quot;start&quot;: &quot;node ./bin/www&quot;
},
&quot;dependencies&quot;: {

&quot;cookie-parser&quot;: &quot;~1.4.3&quot;,
&quot;debug&quot;: &quot;~2.6.9&quot;,
&quot;express&quot;: &quot;~4.16.0&quot;,
&quot;express-session&quot;: &quot;^1.15.6&quot;,
&quot;hbs&quot;: &quot;~4.0.1&quot;,
&quot;http-errors&quot;: &quot;~1.6.2&quot;,
&quot;method-override&quot;: &quot;^3.0.0&quot;,
&quot;mongoose&quot;: &quot;^5.2.4&quot;,
&quot;morgan&quot;: &quot;~1.9.0&quot;
}
```

```
}
var Car = require(&#39;./../models/car&#39;);
exports.find = (req, res) =&gt; {
Car.find({}, (err, cars) =&gt; {
if(err) {
return;
}
res.render(&#39;cars_list&#39;, {
cars: cars
});
});
}
exports.new = (req, res) =&gt; {
res.render(&#39;cars_new&#39;);
}
exports.create = (req, res) =&gt; {

Car.create(req.body, (err, car) =&gt; {
if(err) {
return;
}
res.redirect(&#39;/cars&#39;);
});
}
exports.edit = (req, res) =&gt; {
Car.findById(req.params.id, (err, car) =&gt; {
if(err) {
```

```
return;
}
res.render(&#39;cars_edit&#39;, {
car: car
});
});
}
exports.update = (req, res) =&gt; {
Car.update({
_id: req.params.id
}, req.body, (err, car) =&gt; {
if(err) {
return;
}
res.redirect(&#39;/cars&#39;);
});

}
exports.remove = (req, res) =&gt; {
Car.remove({
_id: req.params.id
}, (err) =&gt; {
if(err) {
return;
}
res.redirect(&#39;/cars&#39;);
});
```

```
}
exports.index = (req, res) =&gt; {
res.render(&#39;index&#39;, {
user: req.session.user
});
}
var User = require(&#39;./../models/users&#39;);
exports.login = (req, res) =&gt; {
res.render(&#39;login&#39;);
}
exports.signin = (req, res) =&gt; {
User.findOne({
username: req.body.username,
password: req.body.password
}, (err, user) =&gt; {
if(err) {

return;
}
req.session.user = {
username: user.username
}
res.redirect(&#39;/&#39;);
});
}
exports.register = (req, res) =&gt; {
res.render(&#39;register&#39;);
```

}

exports.create = (req, res) =&gt; {

User.create(req.body, (err, user) =&gt; {

if(err) {

return;

}

res.redirect(&#39;/users/login&#39;);

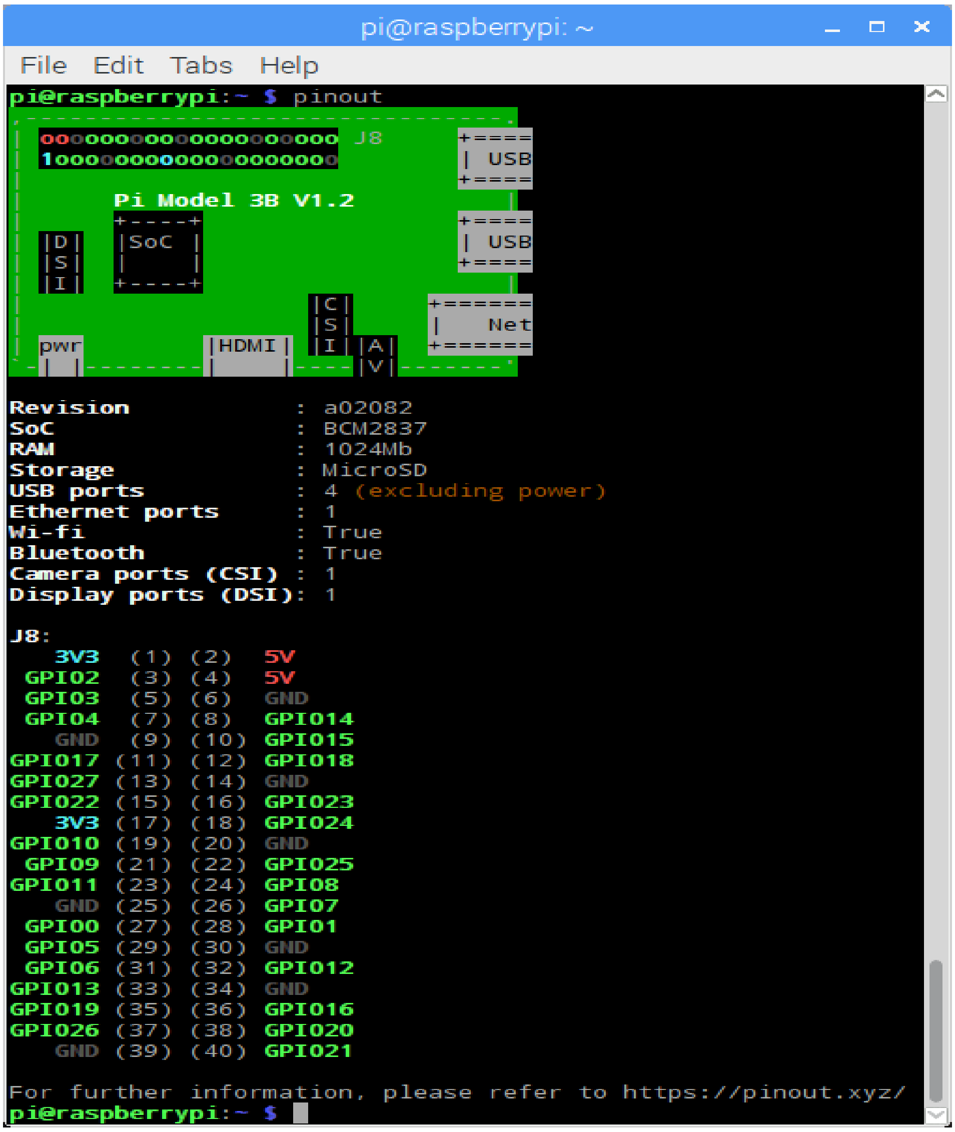
});

}

7. System Integration

Data Flow Diagram

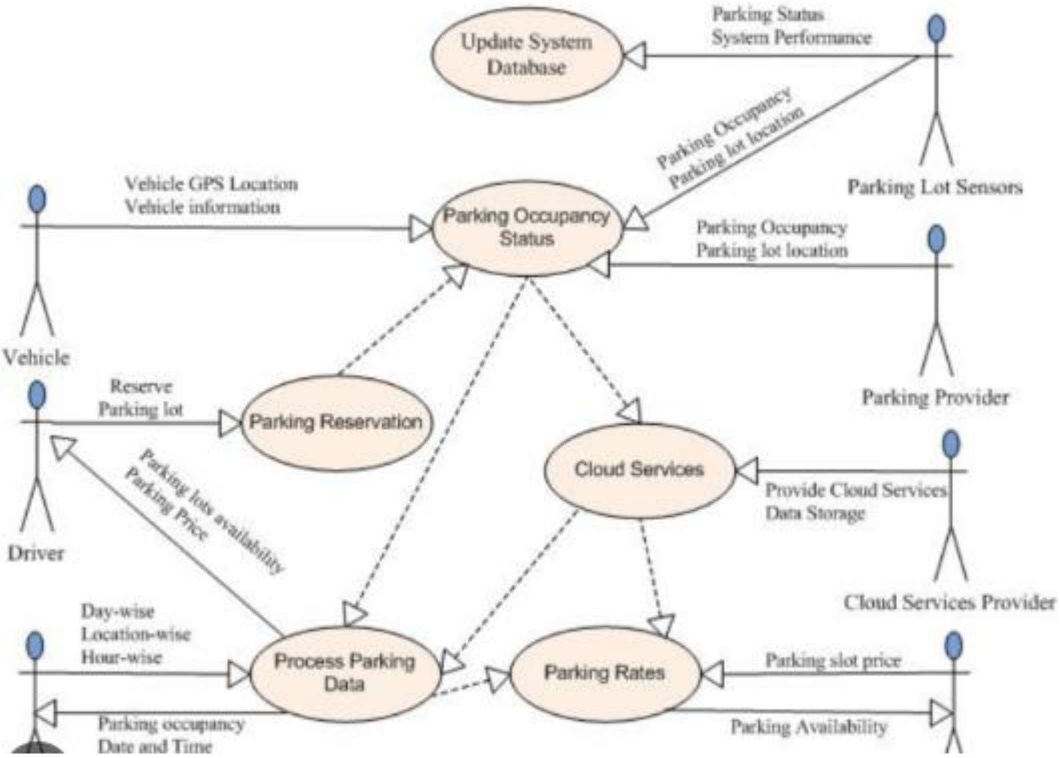
flow of data from IoT sensors to the Raspberry Pi and subsequently to the mobile app.



```
pi@raspberrypi:~ $ pinout
,--------------------------------.
| oooooooooooooooooooo J8     +====
| 1ooooooooooooooooooo        | USB
|                             +====
|      Pi Model 3B V1.2          |
|      +----+                 +====
| |D|  |SoC |                 | USB
| |S|  |    |                 +====
| |I|  +----+                    |
|                   |C|     +======
|                   |S|     |   Net
| pwr        |HDMI| |I||A|  +======
`-| |--------|    |----|V|-------'

Revision           : a02082
SoC                : BCM2837
RAM                : 1024Mb
Storage            : MicroSD
USB ports          : 4 (excluding power)
Ethernet ports     : 1
Wi-fi              : True
Bluetooth          : True
Camera ports (CSI) : 1
Display ports (DSI): 1

J8:
   3V3  (1) (2)  5V
 GPIO2  (3) (4)  5V
 GPIO3  (5) (6)  GND
 GPIO4  (7) (8)  GPIO14
   GND  (9) (10) GPIO15
GPIO17 (11) (12) GPIO18
GPIO27 (13) (14) GND
GPIO22 (15) (16) GPIO23
   3V3 (17) (18) GPIO24
GPIO10 (19) (20) GND
 GPIO9 (21) (22) GPIO25
GPIO11 (23) (24) GPIO8
   GND (25) (26) GPIO7
 GPIO0 (27) (28) GPIO1
 GPIO5 (29) (30) GND
 GPIO6 (31) (32) GPIO12
GPIO13 (33) (34) GND
GPIO19 (35) (36) GPIO16
GPIO26 (37) (38) GPIO20
   GND (39) (40) GPIO21

For further information, please refer to https://pinout.xyz/
pi@raspberrypi:~ $
```

Real-Time Functionalities

the real-time synchronization of parking availability status occurs across the entire system.



8. Benefits of the Real-Time Parking System

Improved Driver Experience

Reduced search time for parking spaces.

Convenience of accessing real-time parking availability updates.

Alleviating Parking Issues

Optimizing parking space utilization.

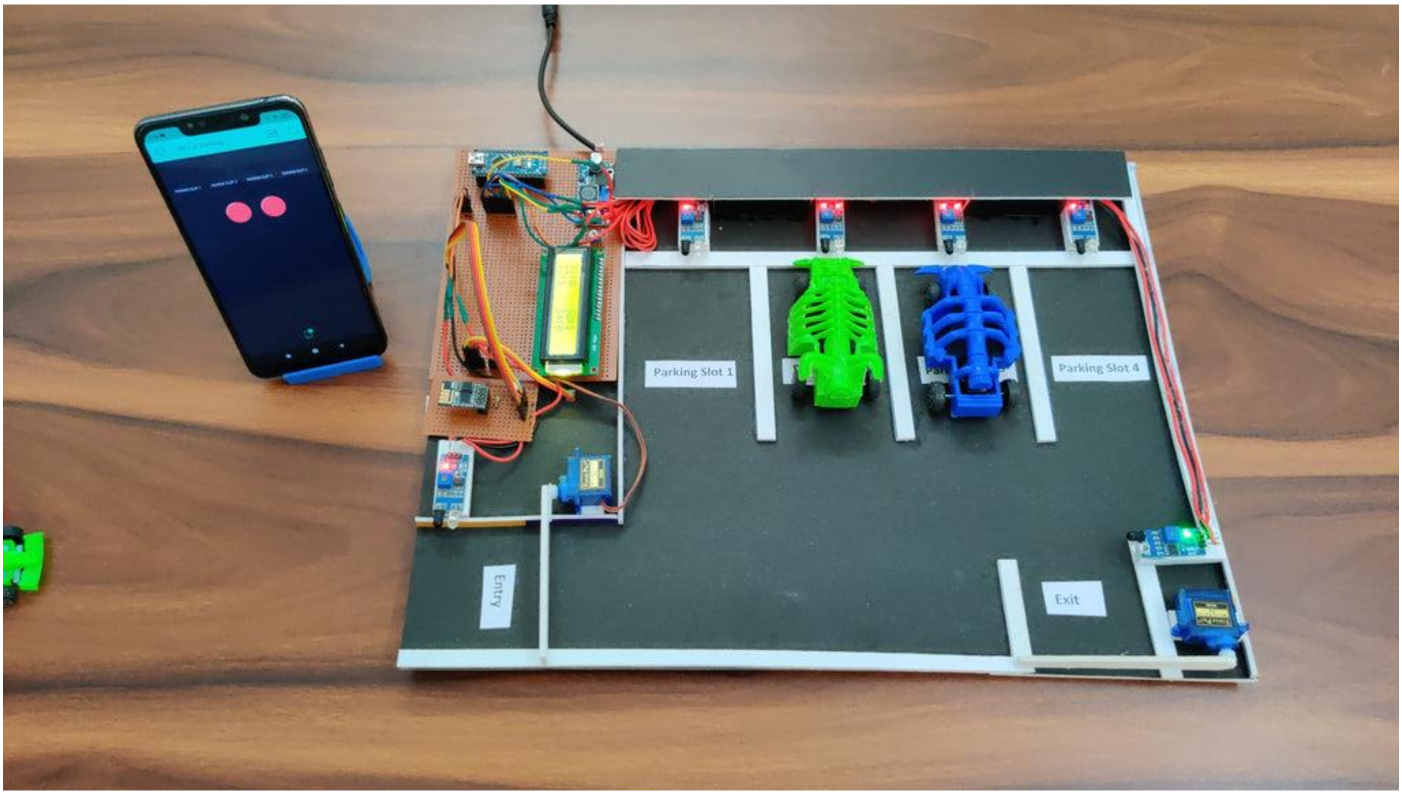
Contributing to reduced congestion and traffic in urban areas.

Data Flow Diagram:

Createing a diagram illustrating the flow of data from sensors to the Raspberry Pi and the mobile app.

Real-Time Functionality

Explain how real-time data synchronization occurs between the sensors, Raspberry Pi, and the mobile app.



CONCLUSION:

In conclusion, building a smart parking system using IoT sensors and Raspberry Pi integration is a valuable project that offers solutions to urban parking challenges