الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري

Arab Academy for Science, Technology & Maritime Transport

SMART PARKING SYSTEM

Course: CC415 – Data Acquisition Systems

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1. Summary :

The Smart Parking System project is designed to address the challenges faced by urban areas in managing parking spaces efficiently. By leveraging advanced technologies such as sensors, real-time data analysis, and mobile applications, the proposed system will optimize parking space utilization, improve traffic flow, enhance customer convenience, and enable effective parking management.

In densely populated cities, the scarcity of parking spaces has become a significant concern. Finding a parking spot has become a frustrating and time-consuming task. The Smart Parking System seeks to alleviate this issue by providing real-time information about available parking spaces. By utilizing sensors installed in parking lots, the system can detect the occupancy status and transmit the data to a central management system.

In conclusion, the Smart Parking System project offers a comprehensive and technologically advanced solution to the challenges faced by urban areas in managing parking spaces. By optimizing parking space utilization, enhancing customer convenience, and enabling effective parking management, this system has the potential to significantly transform the parking experience in cities, making it more efficient and hassle-free for drivers and authorities alike. The budget needed for a proposal for this project would range between 2800 – 3000 EGP.

2. Introduction:

The Smart Parking project aims to create a smart, electricity-saving parking lot to make the parking process easier. We believe that the successful implementation of the Smart Parking System will have a significant positive impact on urban mobility, customer experience, and parking facility management.

3. Needs/Problems:

Finding available parking spaces in crowded cities has always been a time-consuming and frustrating task for drivers, leading to traffic congestion, wasted fuel, and increased pollution. Traditional parking management systems lack real-time information and effective utilization of parking spaces, resulting in inefficient space allocation and revenue losses for parking operators.

4. Goals and Objectives:

a. **Improve Parking Efficiency**: The primary goal of implementing a smart parking system is to optimize parking space utilization and enhance efficiency. This includes reducing the time taken to find an available parking spot, minimizing traffic congestion caused by drivers searching for parking, and maximizing the utilization of parking spaces throughout the city.

b. **Enhance User Experience**: The objective is to provide a seamless and convenient parking experience for drivers by including real-time information on available parking spaces.

c. **Reduce Traffic Congestion and Environmental Impact**: A key objective is to minimize traffic congestion and its associated environmental impact caused by drivers circling in search of parking. By providing accurate real-time information and guidance, the smart parking system aims to streamline parking processes, reduce unnecessary traffic movements, and lower carbon emissions.

5. Procedures/Scope of Work

a. Planning Phase:
- Create a project plan and timeline for execution.
- Identify required components and create an initial budget.
- Divide work among team members.

b. System Design and Development:
- Divide project into separate systems (lighting - gate and Bluetooth module - fire alarm – parking slots – LCD and available slots)
- Divide systems to milestones over 4 weeks.

c. Deliverables:
- Follow project plan to submit project milestones at the specified deadline.
- After finishing all milestones create a functional prototype

d. Documentation and Presentation:
- Prepare detailed documentation that outlines the technical specifications, design considerations, and testing results of the smart parking prototype.

- Develop a compelling presentation highlighting the key features, benefits, and potential applications of the smart parking concept.

6. Timetable

	Description of Work	Start-End Dates
Phase One: Planning	• Create a project plan and timeline for execution. • Identify required components and create an initial budget. • Divide work among team members.	Weeks from 8 to 9
Phase Two: Execution	• **Week 10:** - Parking slots: - Ultrasonic sensor and RGB LED that represent status are present at each parking slot. - Parking lighting system: PIR, LDR and LEDS to light up the parking. • **Week 11:** - Parking fire system: - Flame sensor module with buzzer and LED. - Progress of parking gate: Ultrasonic sensors at the gate. Servomotor to open the gate. • **Week 12:** - Parking gate: Bluetooth module to voice command the gate. • **Week 13:** - Parking gate: LCD display to show the count of available slots in the parking	Weeks from 10 to 13
Phase Three: Testing and Closing	• Testing of each system • Creating the prototype • Documentation and Presentation	Week 14

7. Budget

Component	Quantity	Price/pc
Bluetooth Module (HC-05)	1	130.00 EGP
Flame sensor module	1	35.00 EGP
Photo-resistor LDR Light Sensor Module	1	30.00 EGP
PIR Sensor SR501	1	45.00 EGP
PIR HC-SR501 Bracket	1	10.00 EGP
Ultrasonic Sensor Module HY-SRF05	6	65.00 EGP
Buzzer 5V	1	7.00 EGP
Micro Servo MG90S	1	90.00 EGP
LED	9	2.00 EGP
Arduino Uno	3	250.00 EGP
Arduino Nano shield	3	60.00 EGP
Wires 10 Cm "Female To Female Pins"	60	0.75 EGP
LCD 2x16	1	65.00 EGP
Prototype	1100 EGP	
Total	2895 EGP	

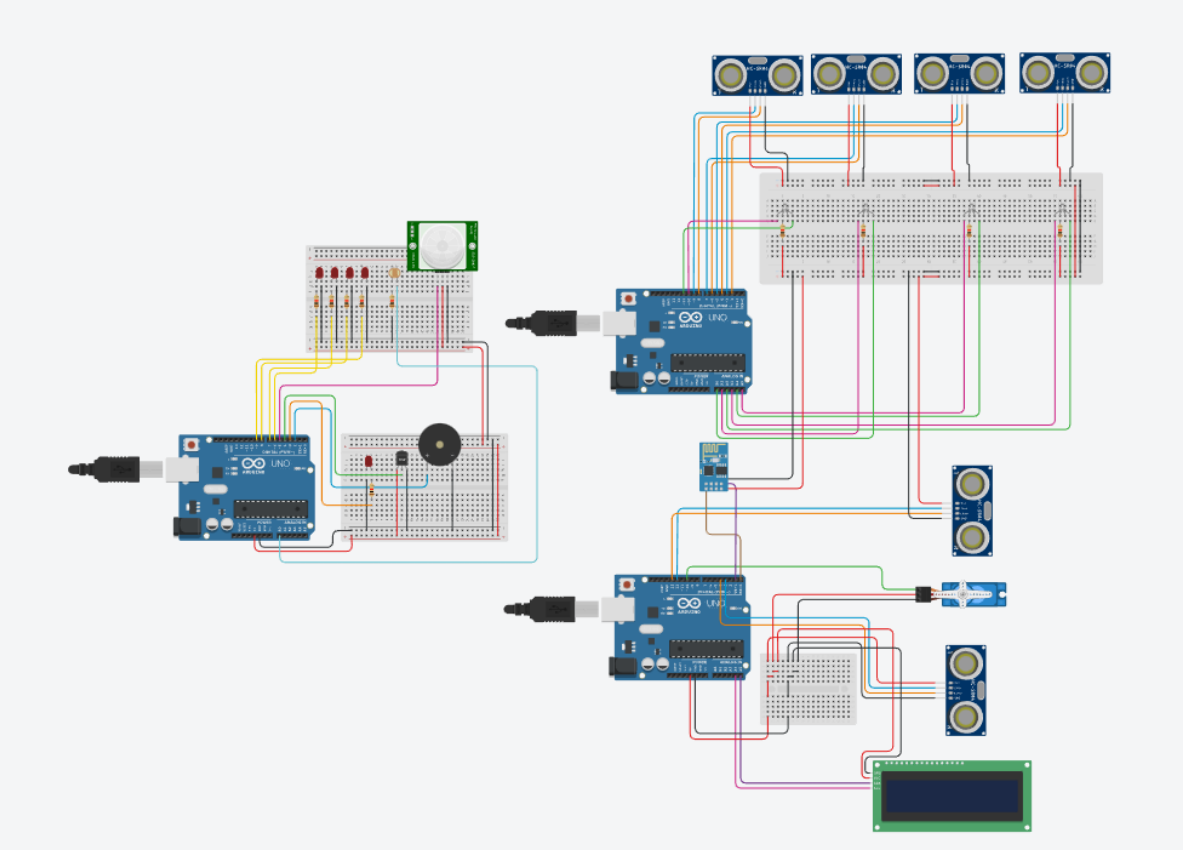
8. Key Personnel

- **Project Manager**: The project manager oversees the entire project and is responsible for its successful execution. They coordinate with various stakeholders, manage resources, monitor progress, and ensure timely completion of tasks.
- **Technical Architect:** The technical architect is responsible for designing the overall architecture of the smart parking system. They determine the technology stack, infrastructure requirements, and system integration aspects.
- **Software Developers/Engineers:** These professionals are responsible for developing the software components of the smart parking system. They work on coding, programming, and testing the system to ensure its functionality and reliability.

- **Sensor Installation Team:** This team comprises technicians and experts who are responsible for installing and maintaining the sensors in parking lots and on-street parking spaces. They ensure the accurate functioning of the sensor infrastructure.
- **Marketing and Communications Specialist**: This individual is responsible for promoting the smart parking system, raising awareness among potential users, and creating effective marketing strategies. They may also handle communication with stakeholders, partners, and the public.
- **Operations and Maintenance Team**: This team takes care of the ongoing operations and maintenance of the smart parking system. They monitor the system, handle technical issues, perform updates and upgrades, and ensure the system runs smoothly.

9. Evaluation

Circuit Design



Code Snippets:

Opening/Closing of gate: if the empty spaces range from 1 to 4 and a car is detected at the first ultrasonic before the voice-controlled gate at a certain threshold, then the Bluetooth module will start taking a reading , the user's voice is converted to a string and placed in string variable "voice" if voice string is equal to open then the servomotor opens the gate and the voice string is reset. Once the second ultrasonic after the gate detects that the car is leaving it then the gate will be closed by the servomotor.

```
if ( Indistance >= 2 && Indistance < 5) //car is near the
{
  if (Serial.available()>0)  //take bluetooth module readi
  {
  Serial.flush();
  voice=Serial.readString();
  Serial.print(voice+'\n');
  }
  if (voice=="open" || voice== "Open")
  {
  digitalWrite(led,HIGH);
  gate.write(90);
  flagin=1;
  voice="";
  }
  voice="";
}

if (Outdistance >= 2 && Outdistance < 5 && flagin==1)
  flagout=1;


else if (flagin ==1 && flagout ==1)
{
  delay (100);
  gate.write(0); //gate closes
  emptyspaces--;
  digitalWrite(led,LOW);
  flagin =0;
  flagout=0;
}
```

Adjusting the state of the RGB LED. In the case of detecting an object in the threshold's range, this means that the parking space is occupied, so the LED turns red. Otherwise, the space is empty and the LED lights green.

```
if (distance1>0 && distance1<=threshold)
{
  flag1 = 1;
  digitalWrite(greenpin1,LOW);
  digitalWrite(redpin1,HIGH);
}

else if (distance1==0)
{
  if (flag1==1){
    digitalWrite(greenpin1,LOW);
    digitalWrite(redpin1,HIGH);}

  else if (flag1 ==0)
    {digitalWrite(greenpin1,HIGH);
    digitalWrite(redpin1,LOW);
    }

}
else
{
  flag1 =0;
   digitalWrite(greenpin1,HIGH);
  digitalWrite(redpin1,LOW);

}
```

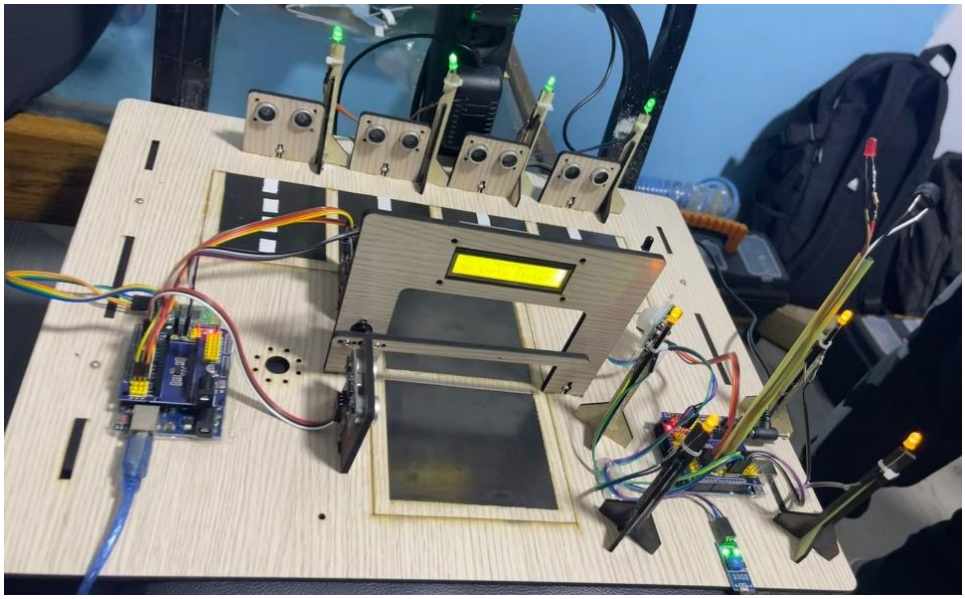
The functioning of the LCD: if the empty spaces are from 1 to 4 then the LCD will be displaying the number of empty spaces, otherwise if the empty spaces are 0 then the LCD will be displaying "Sorry, No available slots!"

```
if (emptyspaces >=1 && emptyspaces<=4)
{
  lcd.clear();
  lcd.setCursor(4,0);       /* Set cursor to column 0 row 0 */
  lcd.print("Welcome!");        /* Print data on display */
  lcd.setCursor(0,1);
  lcd.print("Empty Slots: ");
  lcd.print(emptyspaces);
}

else if (emptyspaces == 0)
{
  lcd.clear();
  lcd.setCursor(5,0);
  lcd.print("Sorry!");
  lcd.setCursor(0,1);
  lcd.print("No Empty Slots!");
}
```

This is a fire system, where the flame sensor would read, if the analog reading based on the surroundings was less than 1000 in this case there will be a flame detected and a LED turn red, and the buzzer goes off. Otherwise, there is no fire.

```
flame_detected = analogRead(flame_sensor);

Serial.println(flame_detected);

if (flame_detected < 1000)

{

  Serial.println("Flame detected...! take action immediately.");

  digitalWrite(buzzer, HIGH);

  digitalWrite(LED, HIGH);

}

else

{
  Serial.println("No flame detected. stay cool");

  digitalWrite(buzzer, LOW);

  digitalWrite(LED, LOW);
}
```

Prototype:

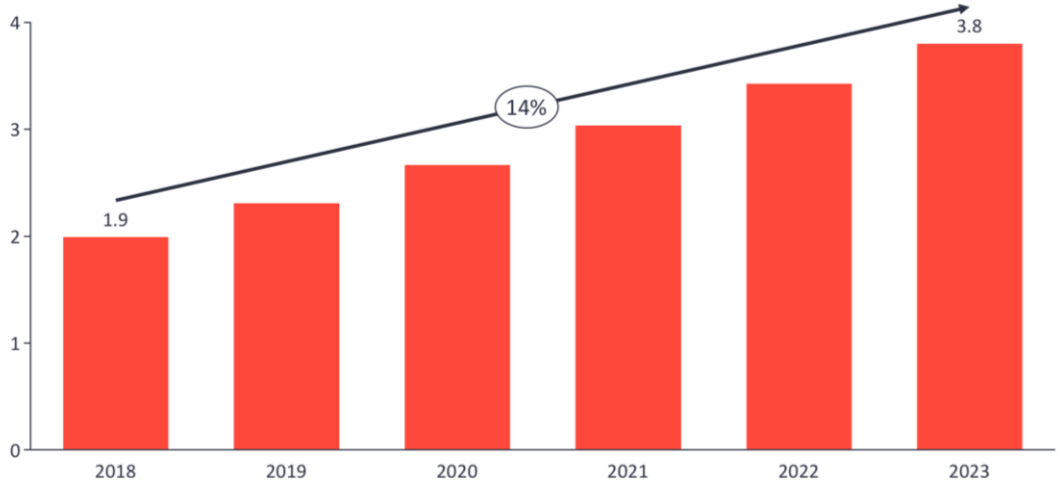


10. Next Steps:

a. Technical Refinement: Conduct further testing and debugging to address any technical issues or limitations identified during the project. Enhance the reliability, efficiency, and scalability of the prototype.
b. Mobile application and database: create a data base that is connected to a mobile application that allows user to check all available parking slots to save time.
c. Camera-based Vehicle Recognition: Implement advanced camera recognition technology to accurately capture and record the entry and exit of vehicles within the parking facility. This functionality aims to streamline the payment process by automatically calculating the duration of each vehicle's stay, enabling more accurate and efficient billing for customers.
d. Business Planning: Develop a comprehensive business plan that outlines the value proposition, target market, revenue model, and marketing strategies for commercializing the smart parking system. Determine the scalability and feasibility of turning the prototype into a market-ready product.
e. Market Research: Conduct market research to understand the demand for smart parking solutions in various industries and target markets. Identify potential customers, competitors, and market trends to inform your next steps.
f. Manufacturing and Production: Once the prototype is refined and validated, initiate the manufacturing and production processes to create market-ready units of the smart parking system. Ensure quality control and compliance with relevant industry standards.

11. Appendix

1- Global Spending – Smart Parking Market (billion US$) - Worldwide



2- Research Paper:

- Baros, J., Martinek, R., Jaros, R., Danys, L., & Soustek, L. (2019). Development of application for control of SMART parking lot. IFAC-PapersOnLine, 52(27), 19–26. https://doi.org/10.1016/j.ifacol.2019.12.726
- https://robosavvy.co.uk/ir-sensor-vs-ultrasonic-sensor-what-is-the-difference