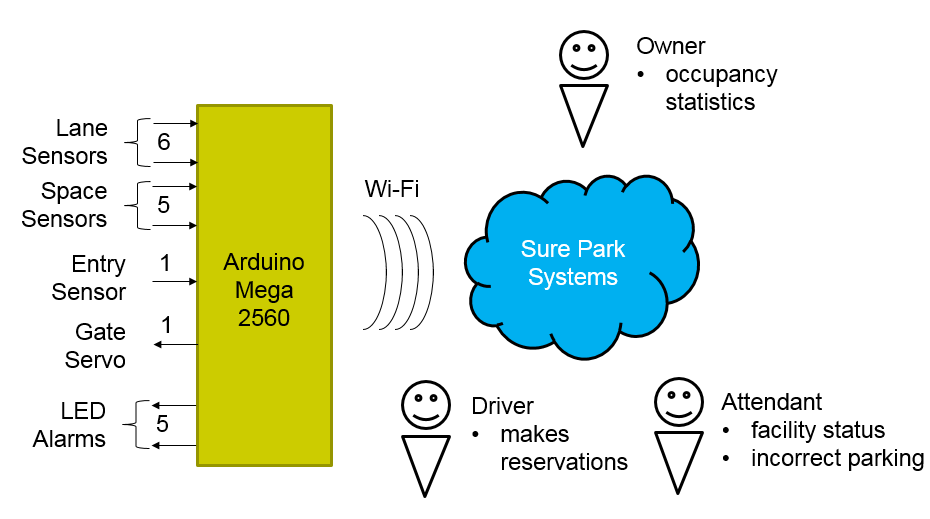
1. **Introduction**

Key business goals for the system are to create:

* A system/infrastructure that enables users to reserve parking spaces using a laptop or phone.
* Enables a parking attendant to monitor the parking facility
* A system that can be reused and scaled for another parking facility (garage or lot)
* Provide owner with facility usage data to initially include average usage, peak usage hours, revenue and must be extensible for adding more analysis algorithms

****

1. **Project Context**

**2.1) Market Context**

|  |  |
| --- | --- |
| **Stakeholders** | Garage owner, GTPS, Attendant, drivers, team members, team mentor, Smart phone company, App market, Credit card company, System installer, Project Manager |
| **Quality** | Reduce driver frustration, more efficiently utilize the space, reducing liabilities, reducing operating costs for owner |
| **Functional expectations** | H/W control and reservation parking space, monitoring and managing parking facility |
| **Product packaging** | H/W devices, Server, Network device, DB, user manual and S/W. |

**2.2) Organizational Context**

|  |  |
| --- | --- |
| **Structure** | The development team has 5 members.  Namjin Lee, he is FW engineer. |
| **Culture** | Customer oriented. Our team name is “Infinite Challenge”. It means that we have an “Infinite” passion and we love “Challenges”. |

**2.3) Business Context**

|  |  |
| --- | --- |
| **Strategies** | We will focus on the successful deployment of the initial system. And then we will extend markets into global. |
| **Internal and external providers** | H/W parts company, Server provider |
| **Cost obligations and assets** | PC, Server, Development expense |
| **Profit model** | Maintenance fee/every month, Installation fee. |
| **Competition** | Other development team. |
| **Future direction** | GTPS would like to scale the system to include larger parking lots and garages and, if the solution is successful for them, market the system to other garage owners around the world. |

**2.4) Technical Context**

|  |  |
| --- | --- |
| **Languages** | JAVA, C, C++, Scratch |
| **Tools** | Eclipse, Arduino IDE, JDK |
| **Operating system and hardware platform** | Arduino, Windows, Mac OSX |
| **Implementation frameworks** | Arduino |

1. **High Level Functional Requirement**

|  |  |  |
| --- | --- | --- |
| **ID** | **Functional Requirement** | **Description** |
| FR01 | The system shall detect cars in parking space. | Arduino H/W control |
| FR02 | The system shall detect when cars are parked incorrectly (straddling parking slot lanes). If a car straddle parking slot lanes, the system shall blink LED. And the system shall inform it to attendant in 2 minutes. |
| FR03 | The system shall open and close an entry gate. |
| FR04 | The system shall detect when cars arrive at the gate. |
| FR05 | The system shall allow drivers to reserve parking spaces.  Reservations will be made via mobile app, laptop, or desktop app for drivers. | Reservation system for drivers |
| FR06 | For reservation, drivers must sign up the system. So that the system can prevent from unauthorized users. |
| FR07 | The system shall provide available parking slot information to drivers. |
| FR08 | Drivers shall provide a license plate (identifying information), the day and time they would like to park, and credit card information (payment information). |
| FR09 | The system shall return confirmation information to driver if reservation is success. |
| FR10 | The system shall check confirmation information and verify the deriver's information and reservation. | When drivers come up an entry gate. Checking system. |
| FR11 | The system shall configure "grace period". | Operating a "grace period" |
| FR12 | If a customer does not show up at the start of their reservation time, the system will be held for a "grace period". |
| FR13 | If the customer doesn't show up with in grace period, the system will expire that reservation. So that customers lose their reservation. | No-show process |
| FR14 | The system shall calculate the hour for parking and it will charge on their credit card. | Charge system |
| FR15 | The system will show which parking spots are open or not. | Monitoring system for attendant |
| FR16 | The system will show how long a car has occupied a particular parking spot. |
| FR17 | The system will notify the attendant if a driver parks other spot, and it will reallocate the parking spaces. |
| FR18 | The system will notify the attendant after 2 minutes if a car crosses the lanes and LED is blinking. |
| FR19 | The system will show facility usage and revenue.  The facility usage include average occupancy, peak usage hours, parking slot statistics. | Management system for owner |
| FR20 | The system shall extend analysis algorithms or applications without disrupting operations. | Management system for owner  Extend system |
| FR21 | The system shall provide login system for preventing unauthorized users. | System security |
| FR22 | The system should not allow anyone to view facility data (reservations, credit cards, etc.) without owner. |
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1. **Use Case Scenario**

**4.1) UC01** Reserve parking spaces

|  |  |
| --- | --- |
| **ID: UC01** | **Description** |
| **Title** | (FR05 ~ FR09) Reserve parking spaces |
| **Stakeholders** | Drivers who want to reserve parking spaces. |
| **Preconditions** | Drivers must satisfied FR06 |
| **Primary use case flow of events** | 1) The Sure-Park system allows authorized drivers to reserve parking system.  2) The system shows available parking space to drivers.  3) If available parking space is exist, drivers input a license plate, the day and time they would like to park and credit card information.  4) If all information is ok, the system returns confirmation information to drivers. |
| **Post conditions** | A Deriver can park a car in parking space. |
| **Alternate use case** | 2a) No available parking space  1) The system close reservation step.  4a) Some items are invalid  1) The system display what item is problem.  2) Repeat steps 3-4 until done. |

**4.2) UC02** Show up and parking scenario

|  |  |
| --- | --- |
| **ID: UC02** | **Description** |
| **Title** | (FR05-FR09) Show up and parking scenario |
| **Stakeholders** | Drivers who reserve parking space. Attendants who check reservation. |
| **Preconditions** | UC01 |
| **Primary use case flow of events** | 1. A driver come at the gate. 2. The system detects presence of a car at the gate. 3. A driver provides confirmation information to system. 4. The system verifies driver’s information and confirms the reservation. 5. The system gives a driver a unique alpha-numeric identifier.   (A unique alpha-numeric identifier can be a parking spot like ‘A’ to ‘E’?)   1. The system lifts the entry gate and allows the driver to enter the facility. 2. A driver parks a car at the designated parking spot. |
| **Post conditions** | The system can charge parking fee. |
| **Alternate use case** | 4a) Invalid confirmation information,   1. The system is not allow the driver to enter the garage.   7a) A driver parked a car at other spot,   1. The system will notify the attendant and it will reallocate the parking spaces. |

**4.3) UC03 ‘**No show scenario and grace period’

|  |  |
| --- | --- |
| **ID: UC03** | **Description** |
| **Title** | (FR11-FR13) No show scenario and grace period |
| **Stakeholders** | Drivers who reserve parking space. |
| **Preconditions** | UC01 |
| **Primary use case flow of events** | 1) If a driver does not show up at the start of their reservation time, the parking spot will be held for a “grace period” after the start of the reservation.  2) If a driver doesn’t show up within the grace period, the parking spot is released. Drivers are not charged for “no-show”, but they lose their reservation. |
| **Post conditions** | The system can charge parking fee. |
| **Alternate use case** | 1a) If a driver shows up at the garage  1) process UC02 scenario  2a) If a driver show up within the grace period,  1) process UC02 scenario |

**4.4) UC04 ‘**Get out the garage and charge scenario’

|  |  |
| --- | --- |
| **ID: UC04** | **Description** |
| **Title** | (FR14) Get out the garage and charge scenario |
| **Stakeholders** | Drivers who reserve parking space. Attendants who check reservation. |
| **Preconditions** | UC02 |
| **Primary use case flow of events** | 1. A driver gets out of the parking lot. 2. The system detects getting out of the parking lot. 3. The system calculates the parking fee and charges it automatically on driver’s credit card. 4. The system updates the parking status and the parking lot makes free. |
| **Post conditions** | None. |
| **Alternate use case** | None. |

**4.5) UC05 ‘**Wrong parking scenario’

|  |  |
| --- | --- |
| **ID: UC05** | **Description** |
| **Title** | (FR01, FR02, FR18) Wrong parking scenario |
| **Stakeholders** | Attendant, Drivers who is parking their car. |
| **Preconditions** | Drivers get in the garage. |
| **Primary use case flow of events** | 1) When drivers tries to park a car, they may cross the line, occupying 2 parking spaces.  3) The system detects that they cross the line, occupying 2 parking spaces.  4) The system blinks a visual indicator(LED) at the parking spot.  5) A car breaks the lane keeping systems in the garage for 2 minutes.  6) The system notifies the parking attendant.  7) The attendant notify to the driver that car breaks the lane keeping systems.  8) The driver parks again.  9) The system and attendant repeats step 2-8 until the driver parked 1 parking space.  10) The driver parked correctly. |
| **Post conditions** | None. |
| **Alternate use case** | None. |

**4.3) UC06 ‘**Monitoring scenario’

|  |  |
| --- | --- |
| **ID: UC06** | **Description** |
| **Title** | (FR15, FR16) Monitoring scenario for attendants. |
| **Stakeholders** | Attendants |
| **Preconditions** | Attendants must satisfied FR06 |
| **Primary use case flow of events** | 1) Attendants logins to parking system.  2) Attendants selects monitoring menu.  3) The system shows which parking spots are open and which are occupied. Also, it will show how long a car has occupied a particular parking spot. |
| **Post conditions** | None. |
| **Alternate use case** | None. |

**4.3) UC07 ‘**Management scenario’

|  |  |
| --- | --- |
| **ID: UC07** | **Description** |
| **Title** | (FR19) Management scenario for owner |
| **Stakeholders** | Owner |
| **Preconditions** | Owner must satisfied FR06 |
| **Primary use case flow of events** | 1) Owner logins parking system.  2) Owner selects management menu which shows parking statistics and revenue.  3) The system shows which basic statistics on facility usage to include average  occupancy, peak usage hours, parking slot statistics (e g. how much time cars were parked in parking slots) and revenue. |
| **Post conditions** | None. |
| **Alternate use case** | None. |

1. **Quality Attribute**

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **Quality Attribute** | **Priority** | **Description** |
| QA01 | Modifiability | 9 | Installer should complete to setup and test new facility controller in an hour. |
| QA02 | Availability | 1 | Facility controller experiences a catastrophic hardware failure. In this case, Sure Park system’s software detects the fault and notify attendants in 30 seconds. |
| QA03 | Security | 9 | Users log-in the system and get the permission to access the authorized data and information. The unauthorized user tries to access the data and information which are permitted only attendant and owner. The system prevents all unauthorized access. |
| QA04 | Extensibility | 3 | Developer wants to add new algorithm application to Sure Park software. The system need to be updated without disrupting operations. New algorithm can be implemented and tested within 1 week. |
| QA05 | Performance | 3 | When driver wants to get empty parking slot, system must do that in 5 sec. |
| QA06 | Usability | 1 | The owner wants to check basic statistics on facility usages. The owner can show statistic report in 3 step after login. |
| QA07 | Interoperability | 9 | When driver enter and go out parking garage, facility controller and Sure park system must communicate without communication loss. |

1. **Quality Attribute Scenario**

**6.1) QA01**

|  |  |
| --- | --- |
| **Title** | Scale out to other parking facilities |
| **ID** | QA01 |
| **Quality Attribute** | Scalability |
| **Scenario** | Installer should complete to setup and test new facility controller in an hour. |
| **Source of stimulus** | Installer |
| **Stimulus** | Installer wants to new facility controller in parking garage. |
| **Artifact** | The System |
| **Environment** | New owner wants to install new system or existing owner wants to extend system. |
| **Response** | New facility controller will be installed and running test completely |
| **Response measure** | 1 hour for installing and running testing. |

**6.2) QA02**

|  |  |
| --- | --- |
| **Title** | Detect malfunction of the facility controller |
| **ID** | QA02 |
| **Quality Attribute** | Availability |
| **Scenario** | Facility controller experiences a catastrophic hardware failure. In this case, Sure Park system’s software detects the fault and notify attendants in 30 seconds. |
| **Source of stimulus** | Facility controller (Arduino) |
| **Stimulus** | Facility controller which composes of a microcontroller and a Wi-Fi module experiences a catastrophic hardware failure. |
| **Artifact** | Facility controller software and Sure Park system’s software |
| **Environment** | During normal operation |
| **Response** | The hardware fault is detected, the system logs the fault and notifies attendants. |
| **Response measure** | The system should notify attendants of the fault in 30 seconds. |

**6.3) QA03**

|  |  |
| --- | --- |
| **Title** | Protect data and information from unauthorized access |
| **ID** | QA03 |
| **Quality Attribute** | Security |
| **Scenario** | Users log in the system and get the permission to access the authorized data and information. The unauthorized user tries to access the data and information which are permitted only attendant and owner. The system prevents all unauthorized access. |
| **Source of stimulus** | Unauthorized user, unauthorized system |
| **Stimulus** | Unauthorized attempt to display data and access system service. |
| **Artifact** | The system |
| **Environment** | Normal operation (run time) |
| **Response** | The data and information are protected from unauthorized access. |
| **Response measure** | How many unauthorized accesses are protected? 100% |

**6.4) QA04**

|  |  |
| --- | --- |
| **Title** | Add more analysis algorithms or analysis applications |
| **ID** | QA04 |
| **Quality Attribute** | Extensibility |
| **Scenario** | Developer wants to add new algorithm application to Sure Park software. The system need to be updated without disrupting operations. New algorithm can be implemented and tested within 1 week. |
| **Source of stimulus** | Developers |
| **Stimulus** | Add new algorithm to the system |
| **Artifact** | Sure Park system’s software |
| **Environment** | Normal operation (run time) |
| **Response** | New algorithm should be added without disrupting operations. |
| **Response measure** | New algorithm can be implemented and tested within 1 week. |

**6.5) QA05**

|  |  |
| --- | --- |
| **Title** | Retrieve an available parking slot ASAP. |
| **ID** | QA05 |
| **Quality Attribute** | Performance |
| **Scenario** | When driver wants to get empty parking slot, system must do that in 5 sec. |
| **Source of stimulus** | Driver |
| **Stimulus** | Request reservation. |
| **Artifact** | Sure Park system |
| **Environment** | Normal operation (run time) |
| **Response** | Retrieve about parking slot status. |
| **Response measure** | The system must return parking slot status in 5 sec. |

**6.6) QA06**

|  |  |
| --- | --- |
| **Title** | Have basic statistics on facility usage. |
| **ID** | QA06 |
| **Quality Attribute** | Usability |
| **Scenario** | The owner wants to check basic statistics on facility usages. The owner can show statistic report in 3 step after login. |
| **Source of stimulus** | Owner |
| **Stimulus** | Check statistics on facility usage. |
| **Artifact** | Sure Park system |
| **Environment** | Normal operation (Run time) |
| **Response** | Display basic statistics |
| **Response measure** | Statistics report can be show in 3 steps after owner log in. |

**6.7) QA07**

|  |  |
| --- | --- |
| **Title** | Communicate with between facility controller and sure park system. |
| **ID** | QA07 |
| **Quality Attribute** | Interoperability |
| **Scenario** | When driver enter and go out parking garage, facility controller and Sure park system must communicate without communication loss. |
| **Source of stimulus** | Facility controller and Sure park system |
| **Stimulus** | Exchange the updated status or commands. |
| **Artifact** | Facility controller and Sure park system |
| **Environment** | Normal operation (run time) |
| **Response** | Communication success. |
| **Response measure** | Communication success rate : 100%(100 times communication try and 100 times success.) |

1. **Quality Attribute Utility**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Quality Attribute** | **Description** | **Difficulty** | **Priority** |
| QA01 | Scalability | Scale out to other parking facilities | 9 | 9 |
| QA02 | Availability | Detect malfunction of the facility controller | 3 | 1 |
| QA03 | Security | Protect data and information from unauthorized access | 3 | 9 |
| QA04 | Extensibility | Add more analysis algorithms or analysis applications | 3 | 3 |
| QA05 | Performance | Retrieve an available parking slot ASAP. | 1 | 3 |
| QA06 | Usability | Have basic statistics on facility usage. | 1 | 1 |
| QA07 | Interoperability | Communicate with between facility controller and sure park system. | 9 | 9 |

1. **Business Constraint**

|  |  |  |
| --- | --- | --- |
| **ID** | **Business Constraint** | **Description** |
| BC01 | Reducing complain | GTPS wants to reduce driver frustration when customers find an available parking slots and reserve them. |
| BC02 | Increasing profits | More efficiently utilize the space in the parking facilities. |
| BC03 | Reducing liabilities | Reduce traffic congestion and the chance for accidents inside the parking facilities. |
| BC04 | Reducing operating costs | More efficiently utilize personnel and reduce the number of employee. |
| BC05 | Applying other garage | GTPS would like to market the system to other garage owners around the world. |
| BC06 | Delivery | The system should be delivered in 5 weeks. |
| BC07 | Availability of workforce | The team is consists of 5 members. Java expert is only 1 person. |

1. **Technical Constraint**

|  |  |  |
| --- | --- | --- |
| **ID** | **Technical Constraint** | **Description** |
| TC01 | H/W System | Wi-Fi enabled Arduino(mega 2560)  - Flash Memory: 256KB of which 8KB used by bootloader  - SRAM: 8KB  - EEPROM: 4KB  - Clock Speed: 16MHz |
| TC02 | Programming language | For development Arduino: C/C++  For server and application: Java |
| TC03 | Network | Wi-Fi  Wi-Fi configuration |
|  |  |  |
|  |  |  |

**Q&A**

1. The document says, the system will return confirmation information when a driver reserve parking space. And system also give a driver "parking space identifier" when a driver show up an entry gate after reservation. "**confirmation information**" and "**parking space information**" can be same? Or it's just our decision?
2. Can a driver select a special parking spot? For example, parking spots are available with A,B and E. At this time, can a driver choice “A” parking spot?
3. How can we catch up when driver go out of garage? Attendant or IR Detector sensor?
4. Could you tell me “reallocation” scenario in detail?