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Chandkheda, Ahmedabad



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A Report On:-

SMART PARKING MANAGEMENT SYSTEM

Under subject of

DESIGN ENGINEERING – II A(2150001)

B. E. III, Semester – V

(Computer Engineering)

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Academic year
(2020-21)

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Acknowledgment

The efforts we took in the completion of this project would not be fulfilled without the support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them.

We hereby take the opportunity to express our deep sense of gratitude to all faculty members of “**COMPUTER ENGINEERING DEPARTMENT OF C.K.P.C.E.T.**” for their valuable guidance, constant stimulation and unforgettable support. We are highly indebted to our internal guide Dr. AMI T.CHOKSI for her guidance and constant supervision as well as for providing necessary information regarding the project because of which we are able to complete the project and would also thank our DIC PROF. NEELAM SURTI for motivating us throughout the project.

We are obliged to staff members of our department for the valuable information provided by them in their respective fields. We are grateful for their cooperation during the period of our assignment.

Abstract

In the recent, the concept of smart city has gained appreciation. One of the important considerations of being a smart city is the Smart Parking facility. Finding a particular space to park our vehicle becomes an annoying issue. Besides, number of vehicles in like manner rapidly grows once every day. It has been seen that the drivers struggle to find a halting extent without thinking about where parking space is open. The request for the parking space prompts to develop the traffic congestion and excess consumption of fuel. To create a optimize solution for the crisis, many technologies evolved but it didn't benefit all varying with expense, efficiency, power, accuracy and other factors. In this review, we created a prototype of a novel smart parking framework for an urban domain in light of reservation utilizing Internet of Things (IoT) by using Arduino Uno. Initially, our research gives a brief overview of the concept of smart parking system and the need for IoT devices to be integrated with cloud. By highlighting the key features of our work we have then described the convenience and benefits. Towards the end of the paper, we prove with artifacts that the prototype based on smart parking system using IoT finds a solution to the traffic congestion and ease the way to get a parking slot.

- **Keywords:** Smart Parking; Internet of Things (IoT); ARDUINO UNO.

1. Introduction

1.1 What is Design Thinking?

- Internet of Things (IOT) is used to communicate with the devices. By using this devices could be controlled or monitored through the internet, IOT acts as a platform to store data from the remote locations. IOT consists of web enabled devices that collects the data from the surrounding environments using processors, sensors and other communication devices. The device could be monitored and tracked using computers connected through internet
- There are different types of car parking system available to reduce the time and the traffic congestion. The types used in day to day life are by using cameras, parking space is detected and the camera is fixed at the parking area pillars then another method is by using laser beams it detects the corner and target parking position. Then another method is by using Light Detection and Ranging sensors.
- With the latest proliferation of the vehicle availability finding the parking place availability is more difficult. Car parking is a main problem because of increasing in the vehicle number. Searching of a parking place around the cities is the routine work.
- In the smart parking system the parking space information is available at the real time. It consists of real time data collection, low cost sensors and mobile phone enabled systems.
- The proposed smart parking system is implemented using mobile application and the system helps the user to know the parking space availability.
- The user can able to interact with the system by installing car parking application on their mobile phones.
- In this paper Infrared sensor is used in every parking slot. The basic principle of Infrared sensor is the waves emitted by the transducer is reflected back from the object and received by the transducer. Therefore by using this sensor the user can able to understand whether the parking slot is occupied or not.
- The Infrared sensor is connected with the Arduino board. The obtained details are send to the server.

1.2 Project importance

The importance of smart parking is:

1. Accurately sense and predict spot/vehicle occupancy in real-time.
2. Guides residents and visitors to available parking spot.
3. Optimize Parking Space Usage.
4. Simplifies the parking experience and adds value for parking stakeholders, such as merchants and drivers.
5. Helps the free flow of traffic in the city leveraging IoT technology.
6. Enables intelligent decisions using data, including real-time status applications and historical analytics reports.
7. Smart Parking plays an important role in creating better urban environment by reducing the emission of CO₂ and other pollutants.
8. Smart Parking enables better and real time monitoring and managing of available parking space which results in significant revenue generation.
9. Provides tools to optimize workforce management.
10. Speed / quick Parking By RFID Reader to decrease waiting time of vehicles from Queue.
11. Provides Online booking facility through smart Phone application OR Website.

2. Canvases

2.1 AEIOU Summary framework

AEIOU is an investigative tool to help interpret observations gathered by ethnographic practices in the field. It is an Observation tool. Its two primary functions are to code data, and to develop building blocks of models that will ultimately address the objectives and issues of a client.

1) ACTIVITIES :

General Impressions :

In this activity section , we will take a look on the activities performed by us to develop the project. activities done like:

Element Features :

- Sensors Selection
- Chip Selection
- Building user device
- Centralized server management
- Display device management
- Programming Language selection for project SET-UP

2) ENVIRONMENT :

General Impressions :

In this we discuss that in which environmental conditions our users are and usage of our product and implementation of our product to be done. The environment like:

Element Features :

- Noise Pollution
- Traffic
- Noisy Atmosphere
- Air Pollution
- Hotels / Shopping / Malls / Airport / Cinemas Places

3) INTERACTION :

General impressions :

Interaction generally means a conversation or exchange of any information between individuals. Here we have to summaries the interactions which our users have during performance of activity. In our case interaction of users with each other shown below:

Elements Features :

- Engineer ~ Engineer
- Engineer ~ Technicians
- Engineer ~ Manager / Administrator
- Engineer ~ Employees / Workers
- Project Owners ~ Engineer
- Technicians ~ Workers
- Engineer ~ Employees Different Department

4) OBJECT :

General Impressions :

This section includes the objects which users use during their activities or during some work. In our case we spotted many objects like:

Elements Features :

- Centralized Server
- ARDUINO UNO
- Jumper Wires
- Web server
- Cameras / Sensors [IR / Ultrasonic]
- Display Devices [LED / COMPUTERS]

5) USERS :

General Impressions :

This section includes the people who are using objects in order to perform their activities. They are called users. users like:

Element features :

- Manager / Administrator
- Drivers / Customers [Peoples]
- Project Owners
- Technicians
- Workers / Security Guards
- Security Department
- Customer Dealing Department
- Billing Department

AEIOU Summary framework

Activities :

SENSOR
SELECTION

CHIP
SELECTION

BUILDING USER
DEVICE [WEB-
APPLICATION]

CENTERLIZED
SERVER
MANAGEMENT

DISPLAY DEVICE
MANAGEMENT

PROGRAMMING
LANGUAGE
SELECTION FOR
PROJECT SET-UP

Environment:

NOISE POLLUTION

TRAFFIC

AIR POLLUTION

NOISY
ATMOSPHERE

HOTELS / SHOPPING
CENTERS / MALLS
/ AIRPORT / CINEMAS
PLACES

Interactions:

ENGINEER TO
ENGINEER

ENGINEER TO
TECHNICIAN

ENGINEERS TO MANAGER
/ ADMINISTRATOR

ENGINEERS TO
WORKERS / EMPLOYEES

PROJECT OWNER TO
ENGINEERS

TECHNICIANS TO
WORKERS

ENGINEERS TO EMPLOYEE
OF
DIFFERENT DEPARTMENT

Objects:

CENTERLIZED
SERVER

ARDUINO UNO
CHIP

JUMPER WIRES

WEB SERVER

CAMERAS / SENSORS
[IR / ULTRASONIC]

DISPLAY DEVICE
[LED / COMPUTERS]

Users :

ADMINISTRATOR /
MANAGER

MICRO-CONTROLLER

DRIVERS / CUSTOMERS
[PEOPLES]

PROJECT OWNER

TECHNICIANS

WORKERS / SECURITY
GUARDS

SECURITY
DEPARTMENT

CUSTOMER DEALING
DEPARTMENT

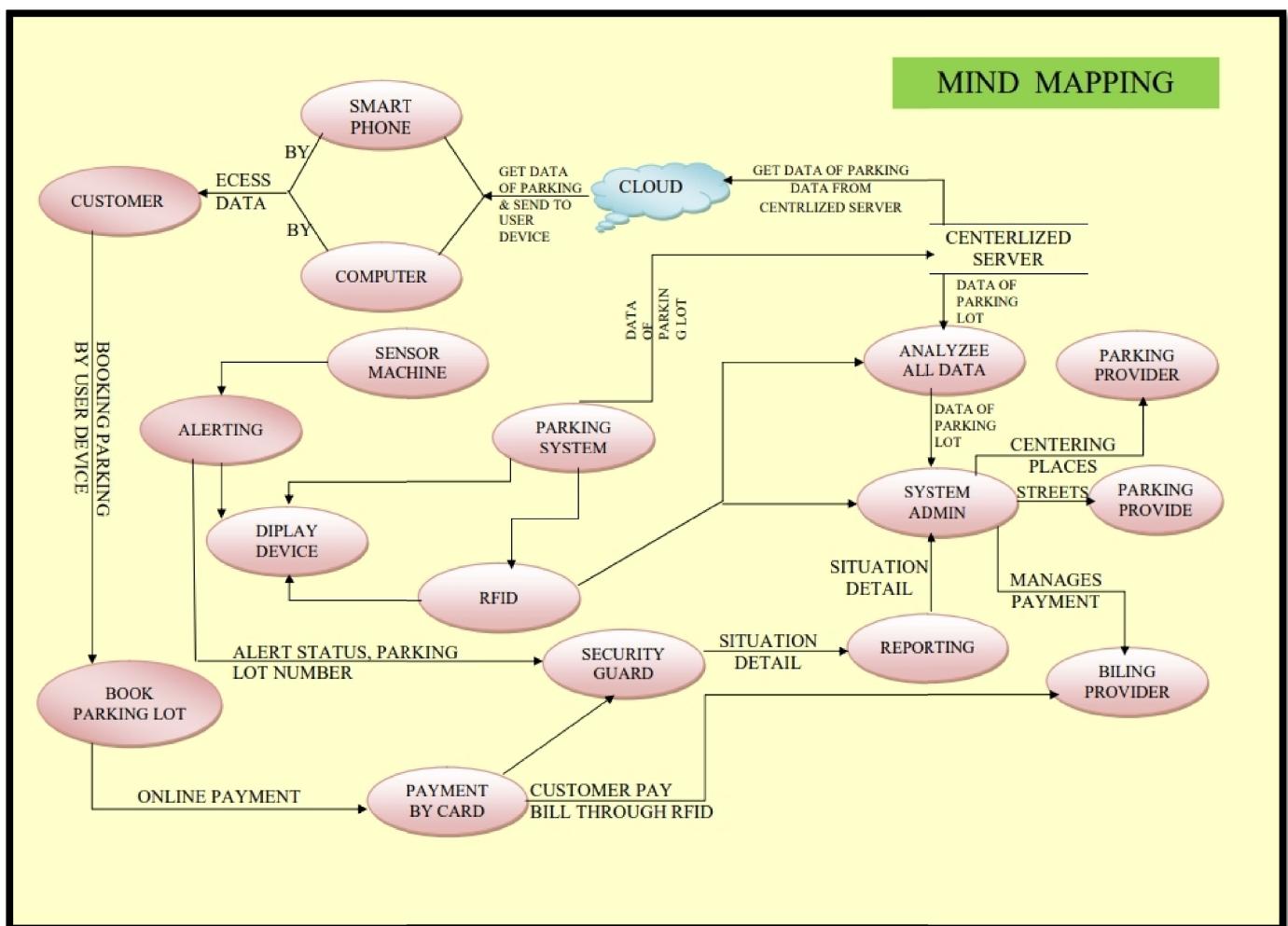
BILING
DEPARTMENT

Aliou
16/3/19

AEIOU Summary		Group ID: Domain name	Date:	Version
Environment:	NOISE POLLUTION AIR POLLUTION NOISY ATMOSPHERE	Interactions:	ENGINEER TO TECHNICIAN ENGINEERS TO MANAGER / ADMINISTRATOR ENGINEERS TO EMPLOYEES / PROJECT OWNER TECHNICIANS TO WORKERS	SMART PARKING MANAGEMENT SYSTEM ARDUINO UNO CHIP CENTERIZED SERVER ARDUINO UNO CHIP CAMERAS / SENSORS [IR / ULTRASONIC] DISPLAY DEVICE [LED / COMPUTERS] WEB SERVER
Activities:	SENSOR SELECTION BUILDING USER DEVICE WEB APPLICATION CENTRALIZED SERVER MANAGEMENT DISPLAY DEVICE MANAGEMENT	Objects:	DRIVERS / CUSTOMERS [Peoples] TECHNICIANS WORKERS / SECURITY GUARDS	CENTERIZED SERVER ARDUINO UNO CHIP CENTERIZED SERVER ARDUINO UNO CHIP CAMERAS / SENSORS [IR / ULTRASONIC] DISPLAY DEVICE [LED / COMPUTERS] WEB SERVER
	CHIP SELECTION PROGRAMMING LANGUAGE SELECTION FOR PROJECT SET-UP	Users:	ADMINISTRATOR / MANAGER PROTECT OWNER CUSTOMER DEALING DEPARTMENT	1.8.2.43.4 19/9/2019 DE-IIA
	BILLING DEPARTMENT			16/3/19 <i>(Signature)</i>

2.2 Mind Mapping (Data analysis)

Mind mapping refers to a technique that designers and engineers use to express and generate ideas. All that mind mapping really is, however, is a way to get all of the ideas in your head down onto paper. There is no right or wrong way to mind map. It is simply a visual representation of the thoughts in your head, and it often looks like organized chaos.



2.3 Empathy Mapping Canvas

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment.

1) USER:

- Manager / Administrator
- Drivers / Customers [Peoples]
- Technicians
- Security Department
- Customer Dealing Department
- Billing Department

It includes the person who develop our product and use it. They are the main domain area and people of interest whom we are targeting.

2) STAKEHOLDERS:

This term basically means a person with an interest or concern in something especially in business, this was the definition according to business. But here stockholders can be defined as a person who takes care of the users or guide the users

- Drivers / Customers [Peoples]
- Manager / Administrator
- Technicians
- Project Owners
- Engineers

3) ACTIVITIES:

Activities centered design is an approach to interaction design, which does not focus on the goals and preferences of the users but on the activity a user would perform with the given piece of the technology . Activities can be defined as action taken by the user to achieve a goal.

- Sensors Selection
- Chip Selection
- Building user device
- Centralized server management
- Display device management
- Programming Language selection for project SET-UP

4) STORY BORDING:

➤ HAPPY:

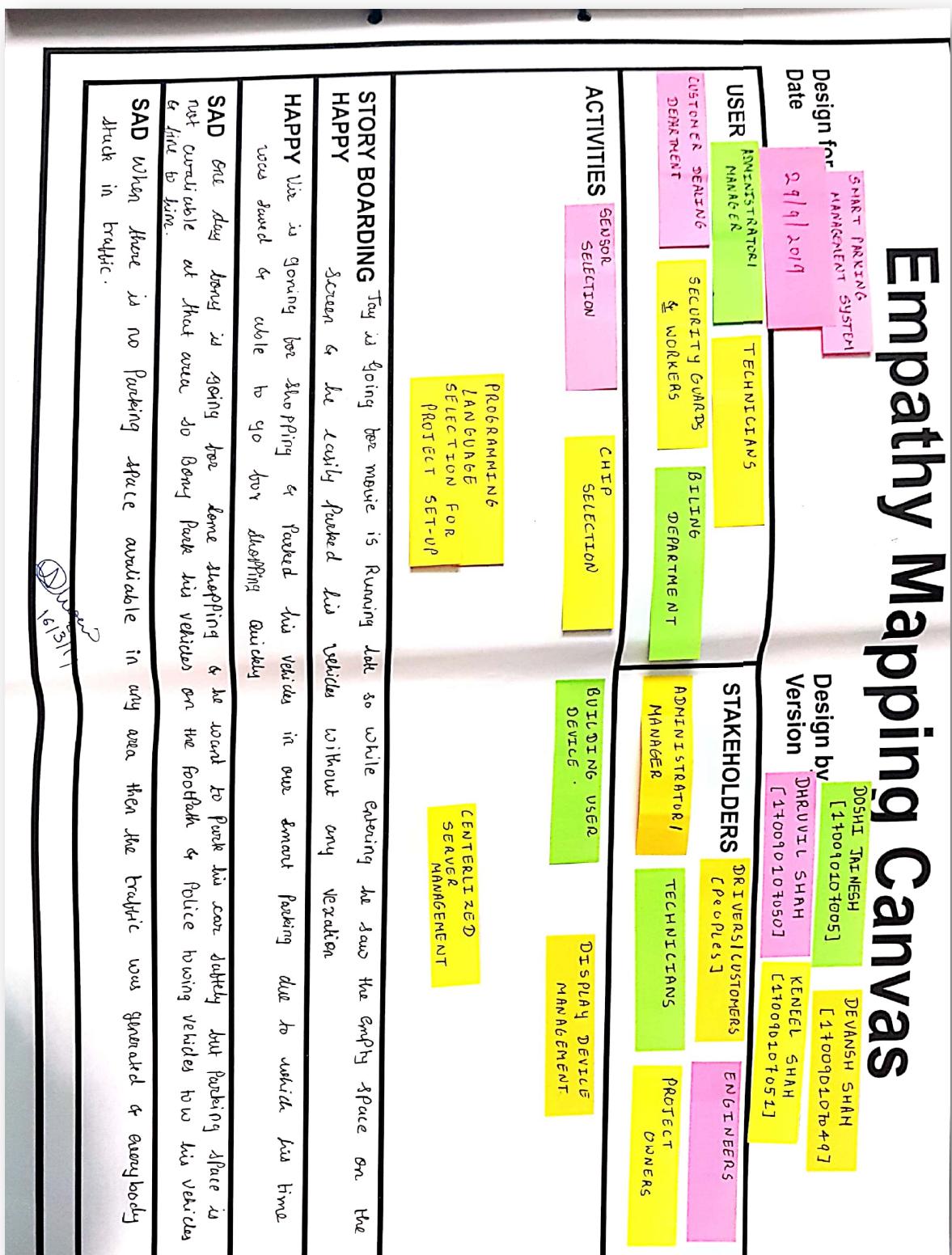
1. Jay is going for movie and running late so when he enter the smart parking he saw empty parking space on the screen and was easily able to parked his vehicle without any vexation.
2. Vir is going for shopping and he parked his vehicle in smart parking due to which his time was saved and was able to go for shopping quickly.

➤ **SAD:**

1. One day Bony is going for some shopping and unable to find free parking spot so in hurry he parked his vehicle on road due to which his car got towed by traffic police for creating traffic by blocking road and parking inappropriately.
2. when there is no parking space available the traffic gets generated and everyone gets stuck in traffic so that causes them delay in work.

Empathy Mapping Canvas

Empathy Mapping Canvas



2.4 Ideation Canvas section in section

Ideation means creating innovating ideas. Hence this canvas represents the development of ideas and solutions for the problem identified. It also specifies where the idea will be useful.

1) PEOPLE:

As in the Empathy Mapping We found many users so now we have to limit the users and select limited people only for our product. So we developed this project for Peoples/users like

- Manager / Administrator
- Project Owners
- Technicians
- Workers / Security Guards
- Security Department
- Customer Dealing Department
- Billing Department

2) ACTIVITIES:

Activities are almost same as that of the empathy mapping canvas difference is that Now only main activities are targeted. So now we are restricting everything and lead towards activities like

- Sensors Selection
- Chip Selection
- Building user device[web application]
- Centralized server management
- Display device management

- Programming Language selection for project SET-UP

3) SITUATION/CONTEXT/LOCATION:

Situation means in what condition our product can be used. context means in reference to what while location means the place where our product is going to be used.

- Noise Pollution
- Air pollution
- Traffic
- Noisy Atmosphere
- Hotels / Shopping / Malls / Airport / Cinemas Places

4) PROPS:

The solution of the ideation canvas helps in

- Sensors: Fully sensors based parking
- Display Device: Shows Availability of parking slots on LED
- Computers: Alerts visitors for availability of parking space or not
- Centralized Server: Storing parking current situation and billing information

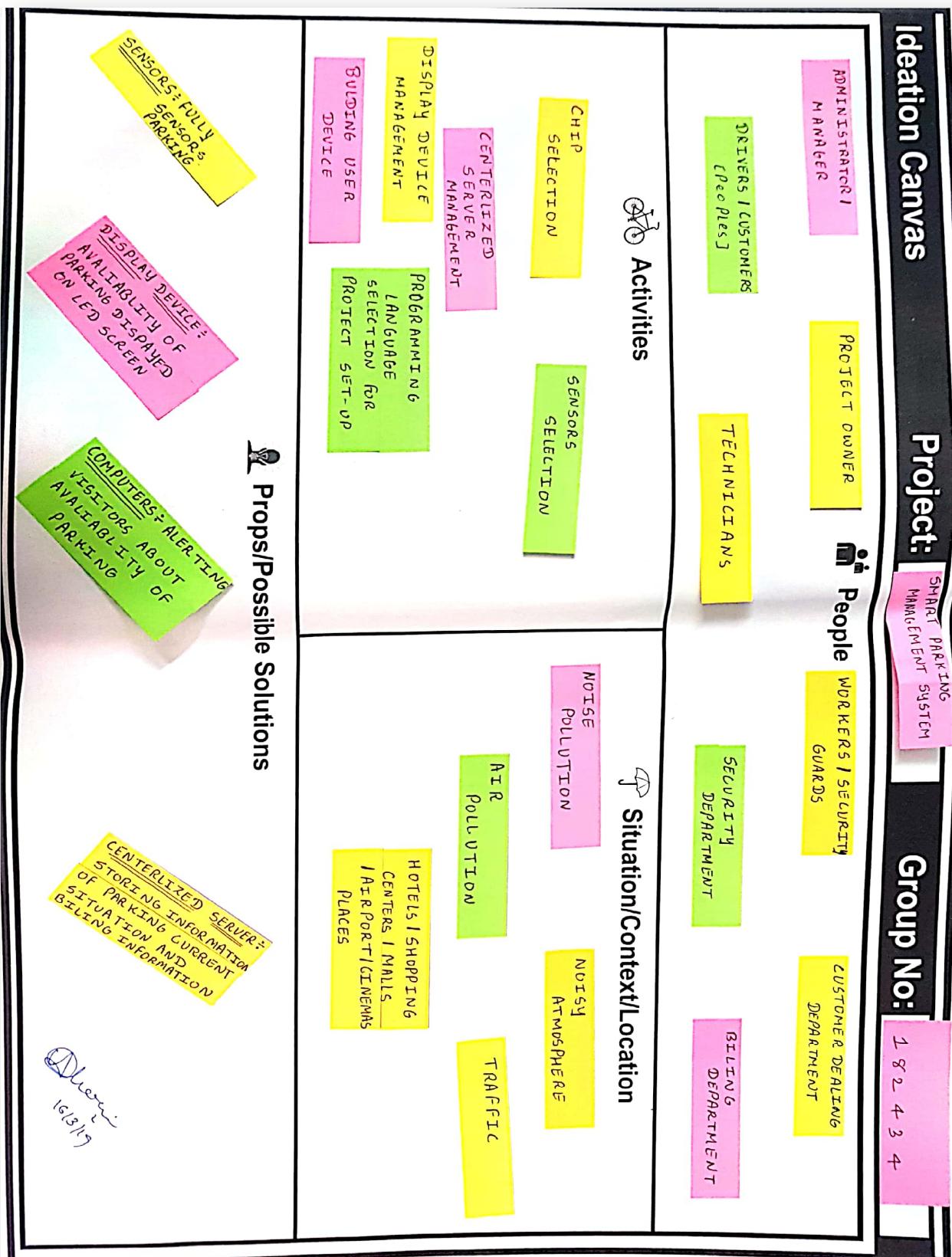
Ideation Canvas

Project:

SMART PARKING
MANAGEMENT SYSTEM

Group No:

1 8 2 4 3 4



Props/Possible Solutions

CENTERIZED SERVER:
STORING CURRENT
SITUATION AND
BILLING INFORMATION

16/3/19
Kiran

2.5 Product Development Canvas

In this section we are supposed to work on our concept in little detail. In ‘purpose’ , we mentioned the purpose of developing this application.

1) PURPOSE:

We have made SMART PARKING FOR METROPOLITAIN CITIES by considering purpose and that is given below:

"SMART PARKING" is fully based on sensors device that helps visitors to gives direction towards the free parking slots and alerts also for availability of parking or not on computer so visitors time not get wasted in finding free lots in full parking and decrease waiting in parking queues.

2) PRODUCT EXPENSE:

MATERIALS	COST	LINKS
ARDUINO UNO CHIP	400 Rs	https://www.amazon.in/gp/product/B015C7SC5U/ref=ppx_yo_dt_b_asin_imagine_05_s00?ie=UTF8&psc=1
IR SENSORS (X5)	250 Rs	https://www.amazon.in/gp/product/B07N4MSC2Q/ref=ppx_yo_dt_b_asin_imagine_02_s00?ie=UTF8&psc=1
SERVO MOTORS (X2)	150 Rs	https://www.amazon.in/gp/product/B00MTFFAE0/ref=ppx_yo_dt_b_asin_imagine_05_s00?ie=UTF8&psc=1
JUMPER WIRES [Male-Male, Female-Female, Male-Female] each (X20)	151 Rs	https://www.amazon.in/gp/product/B0711JDRPV/ref=ppx_yo_dt_b_asin_imagine_07_s00?ie=UTF8&psc=1
LCD DISPLAY	175 Rs	https://www.amazon.in/gp/product/B00XT53R10/ref=ppx_yo_dt_b_asin_imagine_05_s01?ie=UTF8&psc=1
BREAD BOARD	90 RS	GANDHI ELECTRONICS, SURAT
LED LIGHTS	20 RS	GANDHI ELECTRONICS, SURAT

Approx cost of our prototype is 1250 RS, If more IR Sensors/Led Lights/Jumper wires are bought than cost will be increase

3) PRODUCT FUNCTION:

The main function of our project is as follows

- 1.Gives direction towards free parking spots.
- 2.Alerts on full parking
- 3.check availability for parking space.
- 4.Recieves Signal when parking i full

4) PRODUCT FEATURES:

Features means apart from the function what it extra features. So our product has additional features such as:

- It is environmental friendly nothing will be harmed to environment by our project.
- Minimum electricity usage
- It is small in size.
- Easy maintenance.

5) COMPONENTS:

- Centralized Server
- ARDUINO UNO
- Wifi module for ARDUINO UNO
- Display Devices [LED / COMPUTERS]
- Cameras / Sensors [IR / Ultrasonic]
- Jumper Wires

6) CUSTOMER REVALIDATION:

- Quick Parking
- Quick Easy Payment
- Queue & Waiting problem will be solved

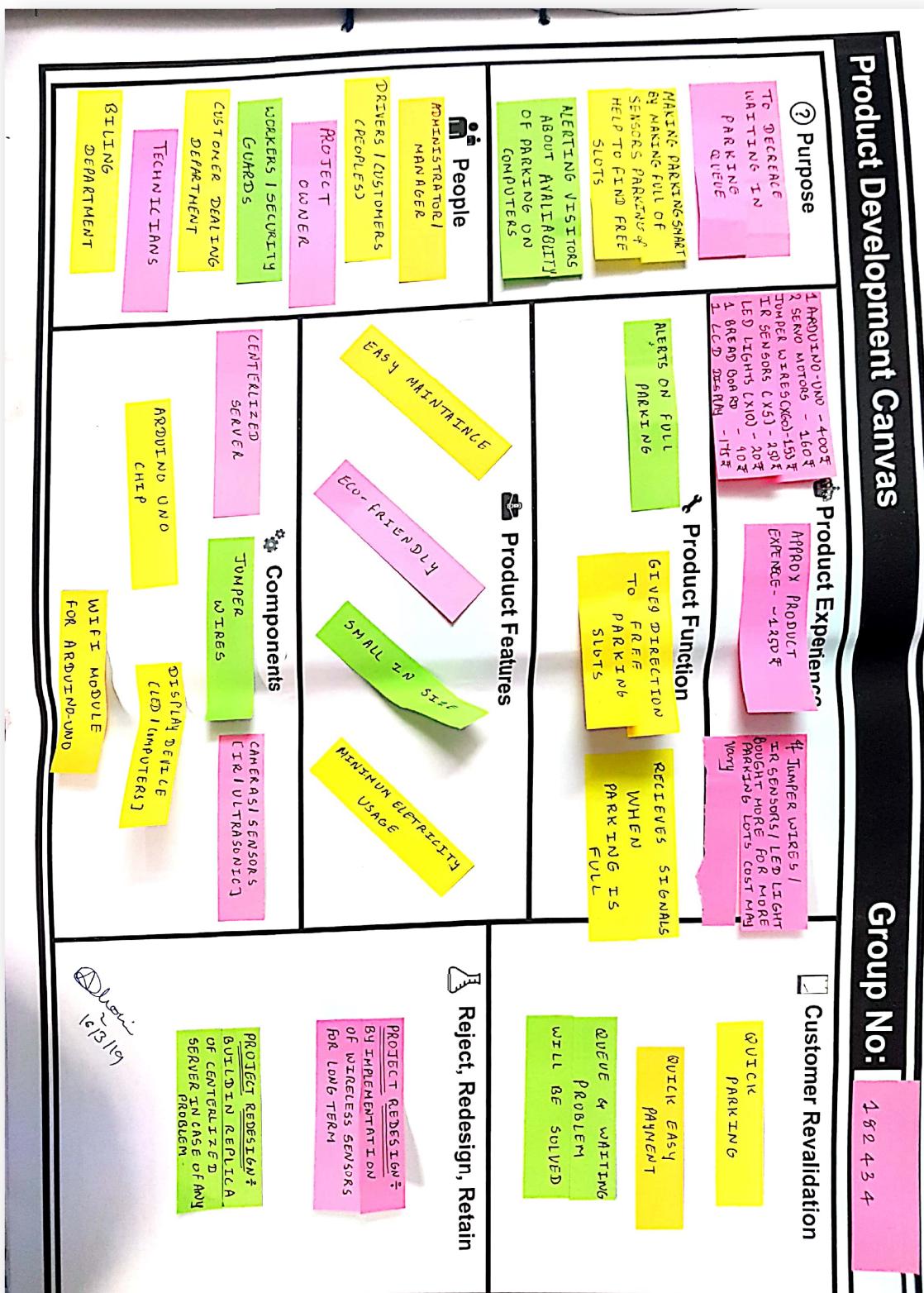
7) Reject, Redesign, Retain

- **Project Redesign :-** By implementation of wireless sensors for long term
- **Project Redesign :-** Building Replica of centralized server in case of any problem

Product

Development

Canvas



2.6 Learning Needs Matrix(LNM)

There are in total 4 quadrants as a part of learning needs Matrix(LMN). Currently our group has made LMN of the 4th semester DE – 2B (Stage 1)

Purpose / Product Concept

Making parking full of sensors to find free available slots and alerting visitors about availability of parking on computers and to decrease waiting by quick billing through RFID

Quadrant 1 : Theories/ Methods/ Application process involved / Mathematical Requirement

Stage 1:

- In this we had discussed the basic aim or purpose of our topic Smart parking system which implemented on basis of **IOT BASED APPLICATION**

Stage 2:

- We had basic knowledge of IR SENSORS
- We had basic knowledge of Arduino Uno chip.

Quadrant 2 : Applicable Standards and design specifications / principles and experiments

This include application standards and design specifications of our Smart parking system by :-

Stage 1:

- 1. ARDUINO UNO:-** On which project implemented.
- 2.Centerized Server:-**To store each activity of parking and payment.

Stage 2:

- 1.Control Circuit design.

Quadrant 3 : Software / Tools /Simulation Methods / Skills :

It includes the software reference and language which will be used for the application like:-

Stage 1:

- 1. Arduino Uno “C” Language**
- 2. Basic DATABASE Management**

Stage 2:

- 1. Overall Stimulation**
- 2. Learn basics of Arduino Uno “C” Language**

Quadrant 4 :

Component materials and Strength criteria (exploration – varieties / testing requirements) are:-

Stage 1:

- 1. Display Devices[LED / COMPUTERS]**
- 2. IR Sensors [IR / Ultrasonic]**
- 3. Jumper Wires**

Stage 2:

- 1. Testing of Control Circuit**

Learning Needs Matrix(LNM)

Learnings Need Matrix		Group ID : 1 8 2 4 3 4	Date : 29/9/2019
		Theories/Methods/Application Process Involved/ Mathematical Requirement	Applicable Standards and design specifications/ Principles & Experiments
		During BE IV / Stage III	
		KNOWLEDGE OF IR SENSORS	
		IOT BASED APPLICATION	
	Purpose / Product	MAKING PARKING FLOOR SEAMLESSLY FINDING FREE PARKING SLOTS & ALERTING VISITORS ABOUT AVAILABILITY OF PARKING ON COMPUTER & TO DECREASE WAITING TIME	CENTRALIZED SERVER TO STORE EACH ACTIVITY OF PARKING & PAYMENT
	OVERALL SIMULATION	ARDUINO UNO "C" Language	DISPLAY DEVICE [LED / COMPUTER]
	LEARN BASIC OF ARDUINO AND "C" LANGUAGE	IR SENSORS	CONTROL CIRCUIT DESIGN
	JUMPER WIRES	TEST ING OF CONTROL CIRCUIT	
Software/ Tools/ Simulation Methods/ Skill		Component materials & Strength criteria (exploration - varieties/ testing requirements)	

3. Feedback Analysis with users

Problems:

Inappropriate parking cause heavy traffic

slow billing counter which creates long queue for parking.

No direction for finding free parking lots.

Feedback:

- We met the Security guard and explain our project to him on which he gave his feedback that if this project is implemented then parking of vehicles will take less time.
- We met the visitors and their families and explained them our project and took their feedback that if this project got implemented then queue of parking vehicles will be reduced and they can quickly go for their purpose they came.

4. Prior Art Search

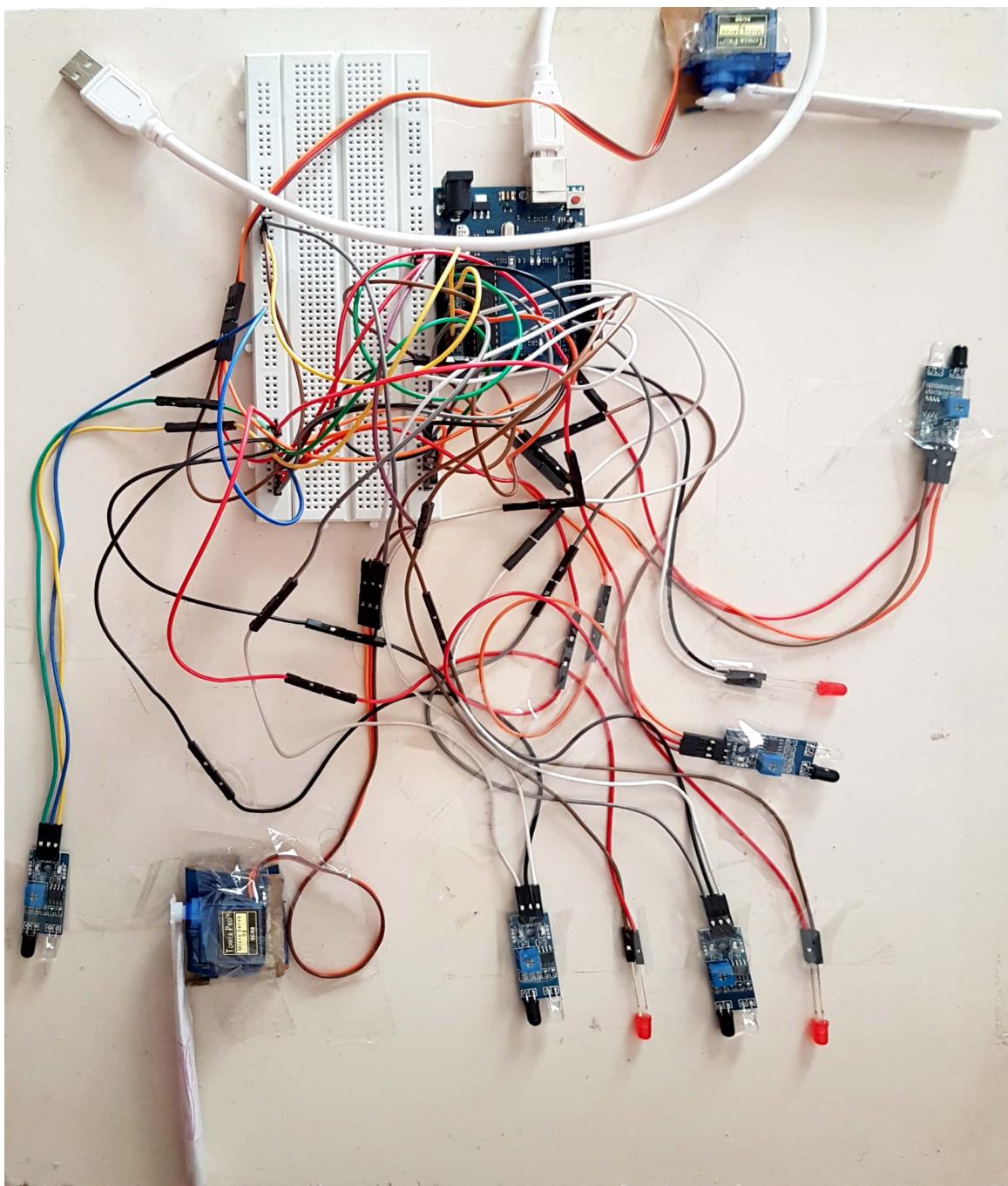
Secondary Art Search

Project Name	Author's	Outcomes-Conclusions
A new “Smart Parking” System Infrastructure and Implementation	Yanfeng Geng, Christos G. Cassandras	They have proposed a “smart parking” system that exploits technologies for parking space availability detection and for driver localization and which allocates optimal parking spots to drivers instead of only supplying guidance to them. They have described the system infrastructure and basic “smart parking” procedure. They studied the main requirements to implement such a system and provided the necessary solutions. A pilot implementation project has been carried out in a garage at Boston University
A Survey of Intelligent Car Parking System	Faheem S.A.Mahmud G.M.Khan M.Rahman H.Zafar	In this paper, various systems that provide intelligent parking services are discussed. These systems can counter the parking problems that arise due to the unavailability of a reliable, efficient and modern Parking system. The use of different modern techniques such as Expert Systems, wireless sensor based, fuzzy based, GPS based, Vehicular communication based and Vision based can reduce the parking related issues. Such system can help the economic, social and safety based aspects of the society. It also helps in preserving the environment, fuel and time. The economic analysis can help us find the feasible project so that we can have a better parking system without making the economy suffer. Future work should be done for integrating different technologies together in order to achieve a system which is the most efficient, reliable, secure and inexpensive. The economic analysis should be done both quantitatively and qualitatively. After the economic analysis is done, then the project can be finalized.
Smart Car Parking Management System Using IoT	Aniket Gupta*, Sujata Kulkarni*, Vaibhavi Jathar, Ved Sharma, Naman Jain	Smart parking facilitates the problems of urban livability, transportation mobility and environment sustainability. Smart Parking technology is used for enhancing the productivity levels and the service levels in operations. It also benefits in terms of lowering operating costs and increases revenues and facility value . Proposed system has developed from traditional servicing channels like toll-booth and parking attendants. It involves the use of Ultrasonic sensor, Arduino Uno, ESP8266-01 WiFi Module, Cloud server. The Internet of Things integrates the hardware, software and network connectivity that enable objects to be sensed and remotely controlled across existing network. Such integration allows users to monitor available and unavailable parking spots that lead to improved efficiency, accuracy and economic benefit.

5. Rough Prototype Model

Rough Prototype/Dirty Mock up/Conceptual Plan/Layout

Rough prototype is the rough physical appearance of the project. It describes about how the product will actually look when we use it. Here we provided actual prototype of our project.

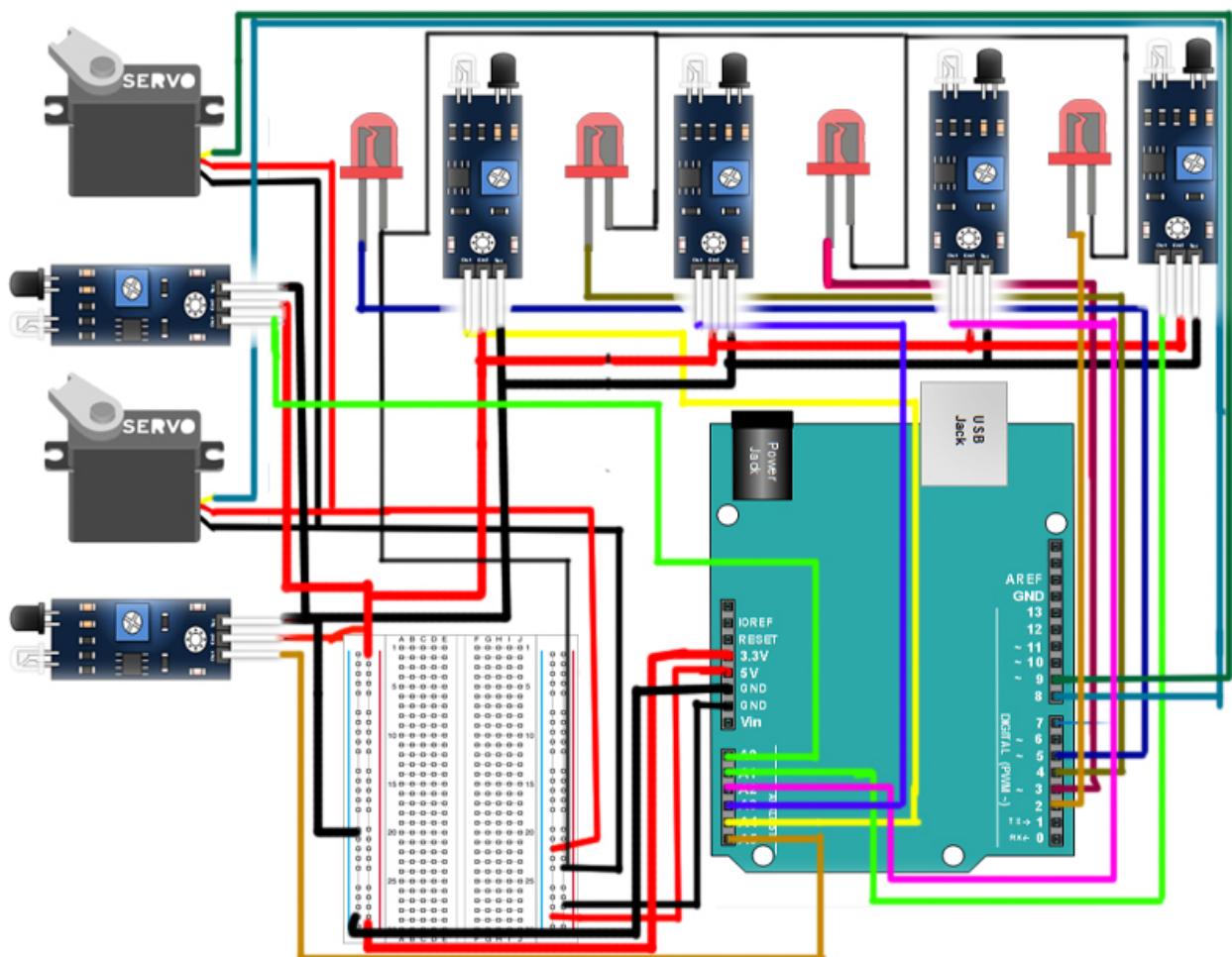


Prototype Working Explanation

Smart Parking uses sensing devices such as IR/Ultrasonic sensors which are installed in pavements to determine occupancy of the parking lot. More and more robust sensing systems are being built to analyze and transmit the information to the database in real time.

The system increases the availability of parking with the use of sensors. It prevents the drivers from spending too much time searching for a parking space. Internet of Things wireless sensors detect the vacant parking spaces and transmit the data to help the drivers get an idea about the vacant spaces for parking through LED lights if all Lot is occupied than entrance gate will not open and if any one lot get free again than entrance gate will start to open again.

PROTOTYPE CIRCUIT DIAGRAM



6. Summary

The automated parking system using **IoT** that can be developed & implemented in covered parks, open parks and also street side parking. The smart parking system will have a cloud service provider that provides cloud storage to store information about the parking status in the slots. There will be a centralized server which stores the information about the number of parking slots, availability status and also the parking time.

The functionalities of the components of automated parking system project are as follows,

Major steps involved:

1. The IR sensors should be placed in the appropriate places to clearly cover all the parking slots
2. The parking slots should be appropriately numbered to mark them on the system
3. These marked points will act as the control points and will be integrated as slots in the cloud
4. Then the setting will be saved and the microcontroller will be programmed to display the data online accordingly

Programming language: Arduino Programming (C++)

Kit required to develop Automatic Smart Parking System using IoT:

- Arduino UNO
- display device
- IR Sensor

Technologies you will learn by working on Automatic Smart Parking System using IoT:

- IOT
- Arduino UNO
- Arduino Programming (C++)

References

- **EMPLOYEES and WORKERS OF MALL**

- <https://www.sciencedirect.com/science/article/pii/S1877042812043042>
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- <http://article.sciencepublishinggroup.com/pdf/10.11648.j.ajset.20170204.13.pdf>
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