



Prince Mohammad Bin Fahd University
Department of Electrical Engineering

Restaurant Service System (RSS)

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Project Definition

Restaurant service system (RSS) is a solution for ordering food with a delivery robot that will be designed for taking customer orders and delivering the meals prepared from the kitchen.

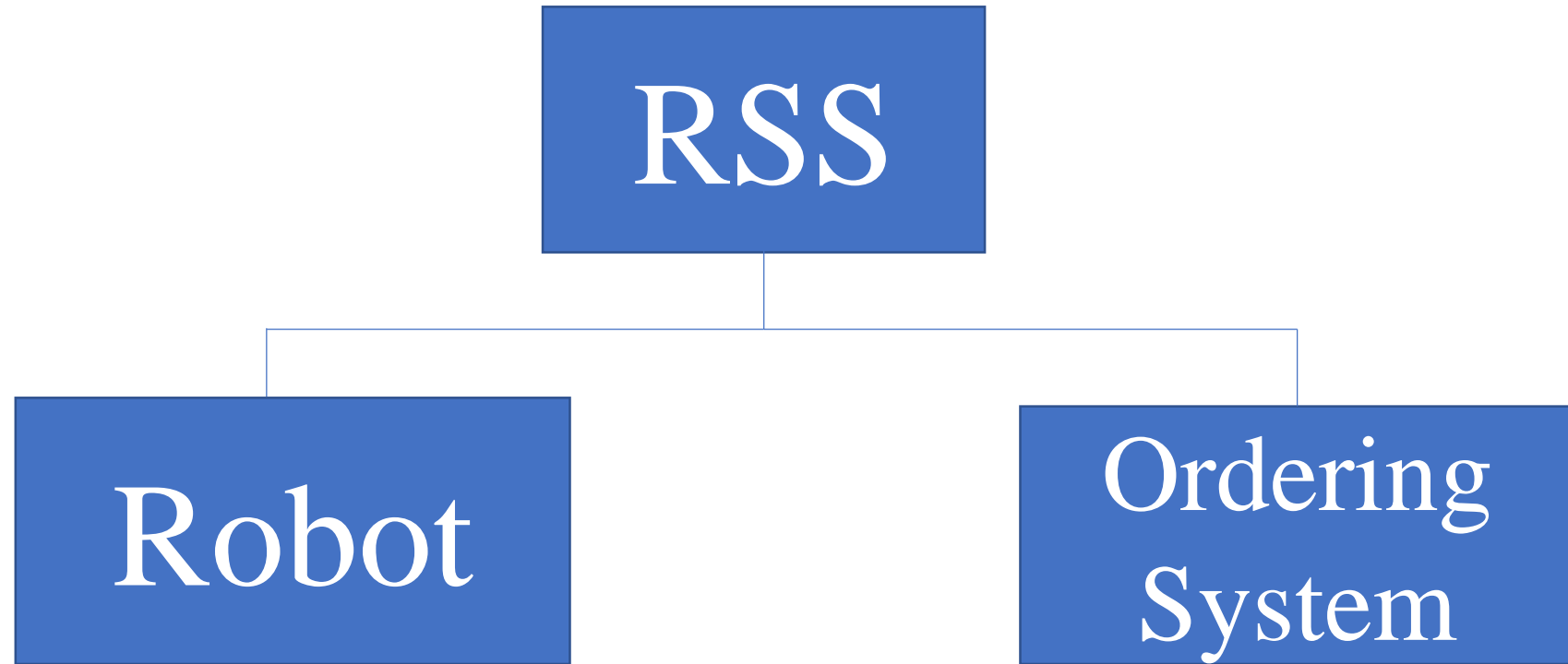
Project Objectives

- Autonomous meal delivery robot that carries the meals from the restaurant kitchen to the designated tables.
- Orders when prepared are dispatched from the restaurant kitchen to the designated tables.
- The orders are made using an android application.

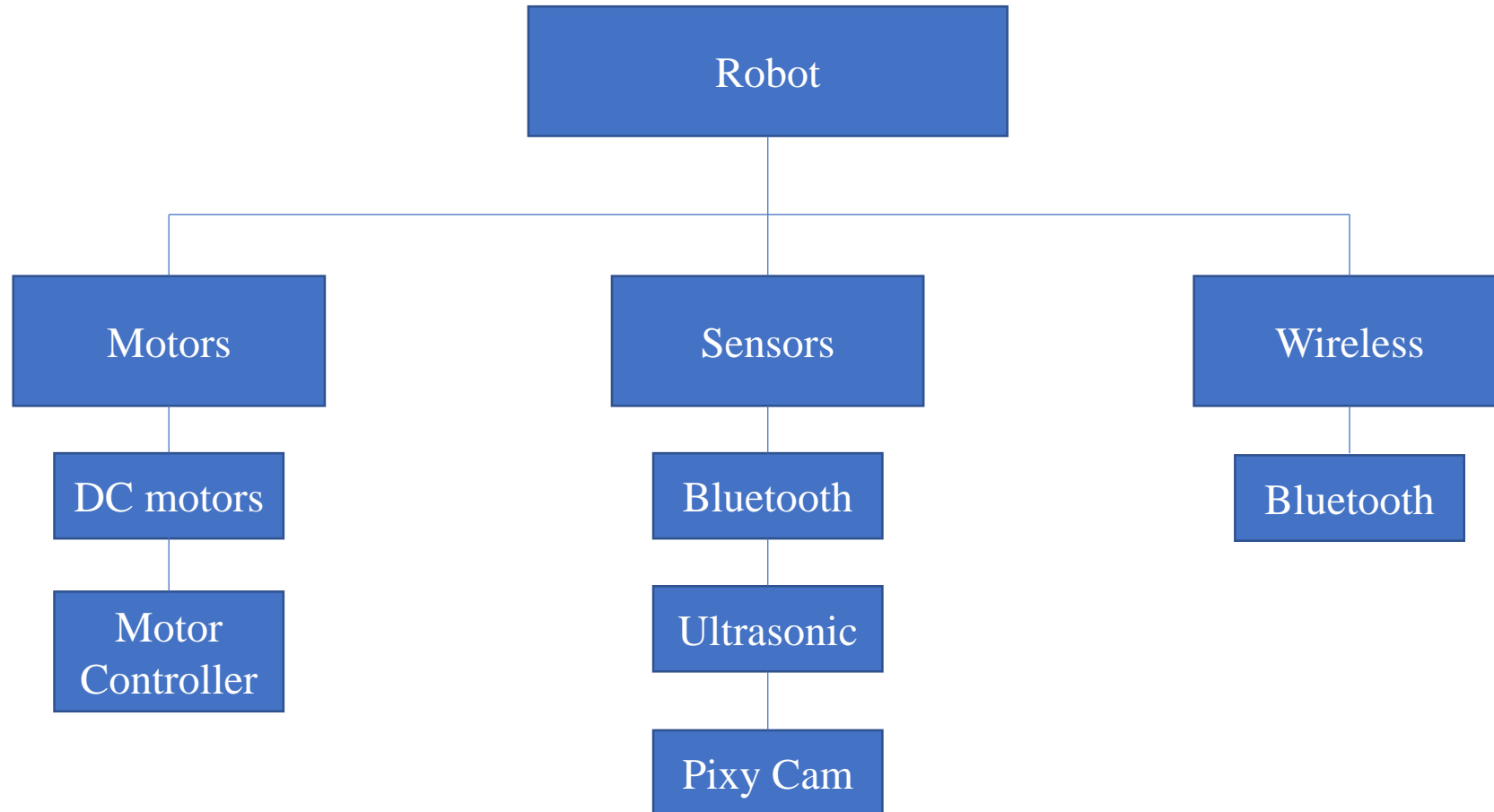
Project Specifications

- Robot stops at the designated table using IR.
- Line detection by Pixy Cam (Red Line).
- Table delivery based on voice command.
- Obstacle avoidance using ultrasonic.
- Robot can return to the kitchen by waving.
- Ordering system (Android app).

Project Architecture



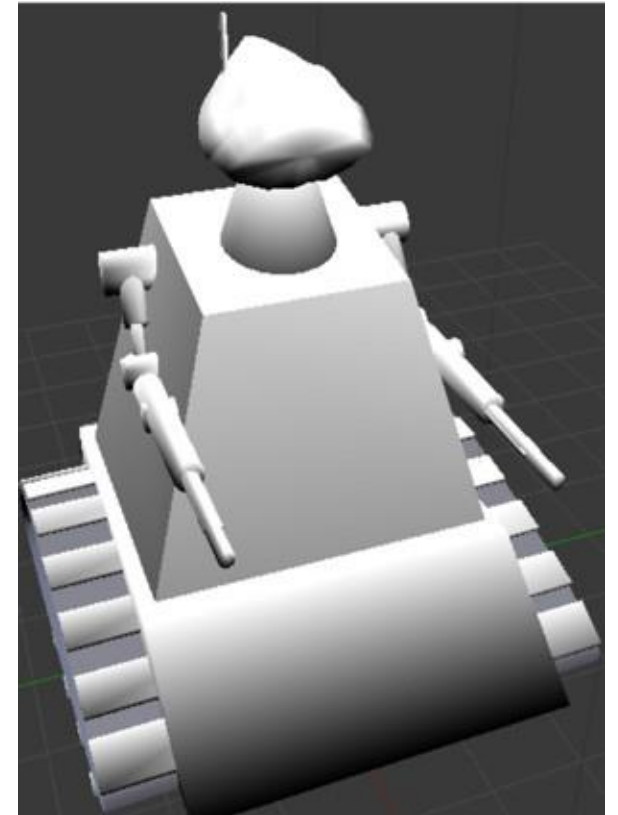
Project Architecture



Similar Projects

An Autonomous Robot for Waiter Service, Department of Electrical and Electronic Engineering, BRAC

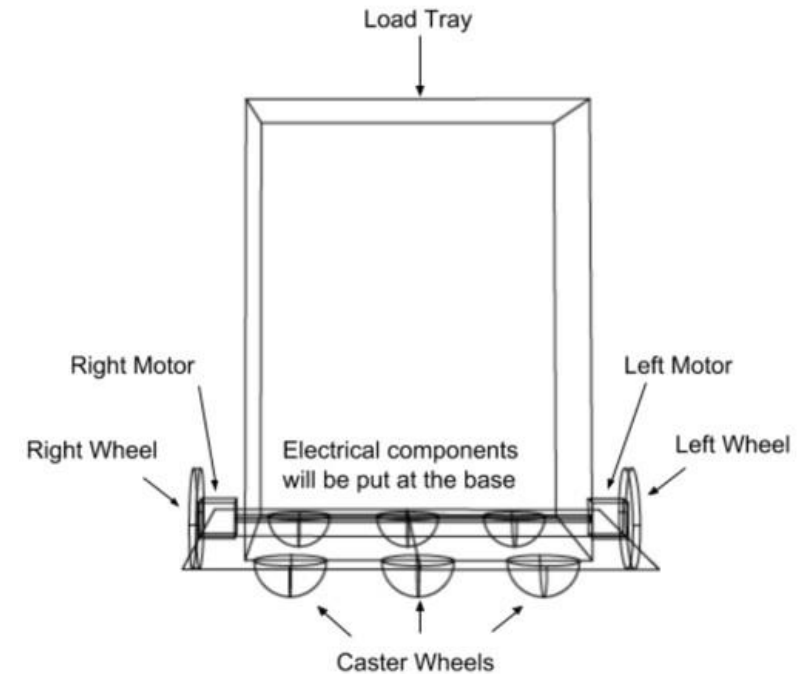
- The Waiter-Bot is an autonomous robot which has the ability to follow a designated path like a pathfinder with the help of IR sensor arrays and reach its intended destination.
- It is an arduino based robotic design implemented to seek out and detect its required destination and perform its deliberate tasks with precision and accuracy.
- The Waiter-Bot consists of simple mechanical design which has simple mechanism with which performing the necessary tasks becomes easier. Due to its design parameters, it also requires less power and draws less current which allows us to work with the robot safely.



Similar Projects

Robot Waiter for Restaurants, JAPANESE UNIVERSITY

- Send information from the kitchen's MCU to the robot's MCU and vice versa.
- Given a destination, the robot is able to calculate and navigate a path to its final destination.
- Kitchen's MCU is able to display the list of tables our robot is serving to on the LED display.



Comparison

Projects	1	2	Our Project
Ordering System			√
IR Sensor	√	√	√
Obstacle Avoidance	√	√	√
Autonomous	√	√	√
Bluetooth			√
Pixy Cam Detection			√

Background

- Cost of hiring is very high.
- Helps existing restaurant staff.
- Has not been implemented in any Saudi restaurant.

Critical Answers: Planning

- Did we verify feasibility of project? The project feasibility is verified as similar projects have been executed by the students.
- Material availability? Most of the components will be available locally but others such as the chassis needs to be ordered from other countries.
- Testing requirements? The required testing can be performed in a small setup however the complete integration has to be done in a restaurant like setup.
- Alternate solutions? Help can be sought from any local restaurant or café.

Project Plan and Execution

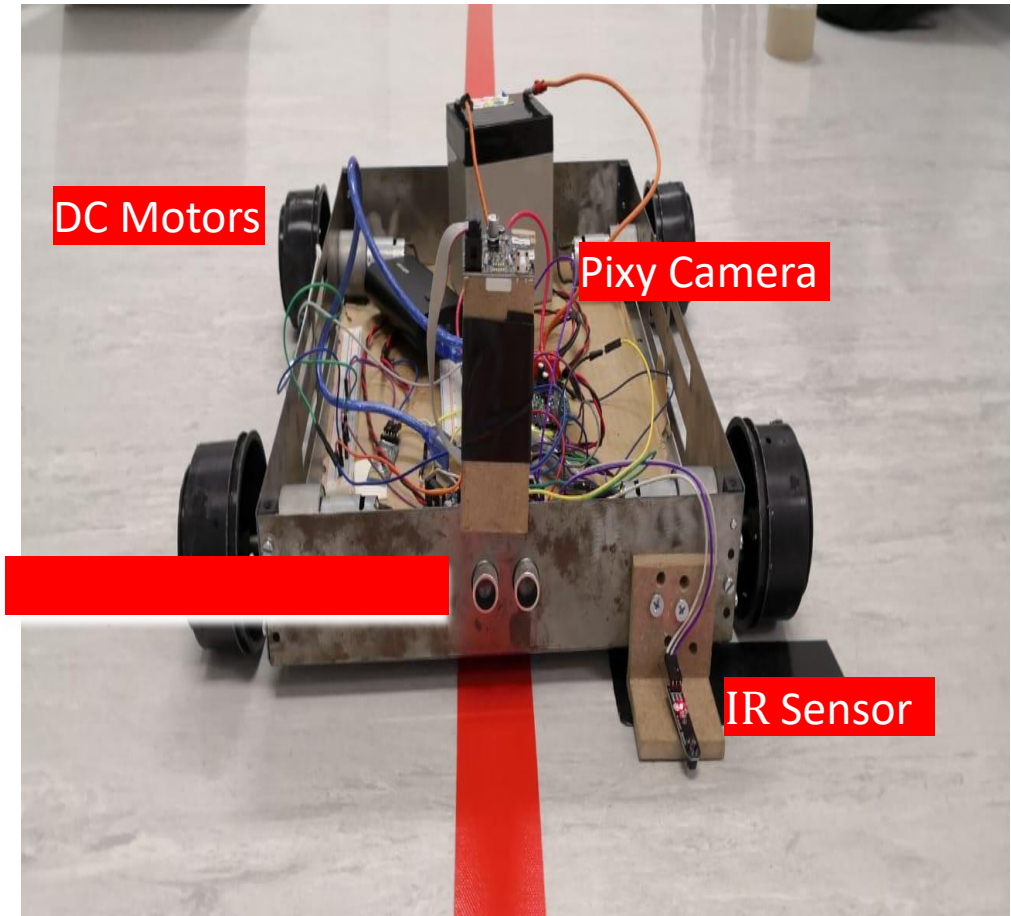
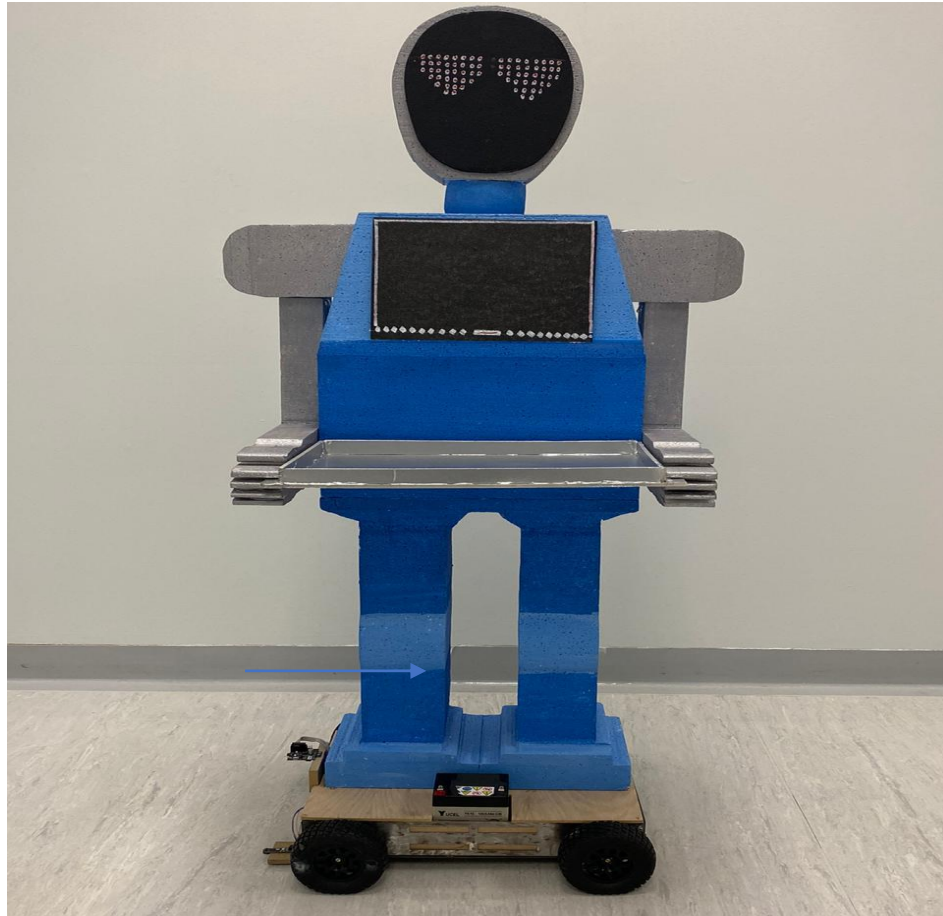
Title: Resturant Service System		Advisor: Dr. Sadiq Alhuwaidi					Design II (ASSE 3)			Fall 2019											
a. Abdullah Almakhaitah 201400610							Project PLAN & Progress														
b. Hamid Bin Hilal 201400673							ProgRpt No. 5														
c. Ahmed Al Turki 201402385							Plan updated (Date): Nov 21, 2019														
d. Ali Al Ali 201402857							Instructor: Dr. Sadiq Alhuwaidi														
e. Abdulrahman Yusuf 201500647							Period Highlight: 6 <input type="text"/> <input type="button" value="↓"/> <input type="button" value="↑"/> <input type="checkbox"/> Actual (beyond plan) <input type="checkbox"/> Plan <input type="checkbox"/> Actual <input type="checkbox"/> Complete (beyond plan)														
ACTIVITY	PLAN	PLAN	Assigned To	ACTUAL	ACTUAL	PERCENT COMPLETE	Periods (Weeks 1-15)														
	TAR	URATIO		START	URATIO		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Prepare plans	1	1	ALL	1	1	100%	█														
Test all systems	2	1	ALL	2	2	100%		█													
Test robot movement	3	1	ALL	3	3	100%			█												
Integrate all systems	4	2	ALL	4	7	100%				█											
Testing integrated system	5	3	b,d,e	5	18	100%					█										
Design robot chassis	6	1	ALL	6	10	100%						█									
Test robot chassis	7	1	ALL	8	11	100%							█								
Initiate Andriod engagment	6	1	d,e	6	4	100%								█							
Prepare midterm presentation	7	1	ALL	7	2	100%									█						
Design ordering system	9	2	d,e	8	10	100%										█					
Test ordering system	9	2	d,e	10	12	100%											█				
Test basic fonictonality for route	8	1	d,e	12	13	100%												█			
Test the entire RSS system	11	1		11	14	100%													█		
Prepapre final report	12	2	a,e	13	14	100%														█	
Prepapre final presentation	12	1	d,e	12	13	100%														█	
Prepare project demo	12	2	ALL	12	15	100%														█	
Submit Rpt/PPT/Brochure ...	14	1	b,e	12	15	100%														█	

Progress Details: ated system is 100% complete and now proceeding to testing the robot system in a route, ordering syst is complet as well, and we show to the doctors	Issues (delay _): Making Better Way Going Back To the Kitchen

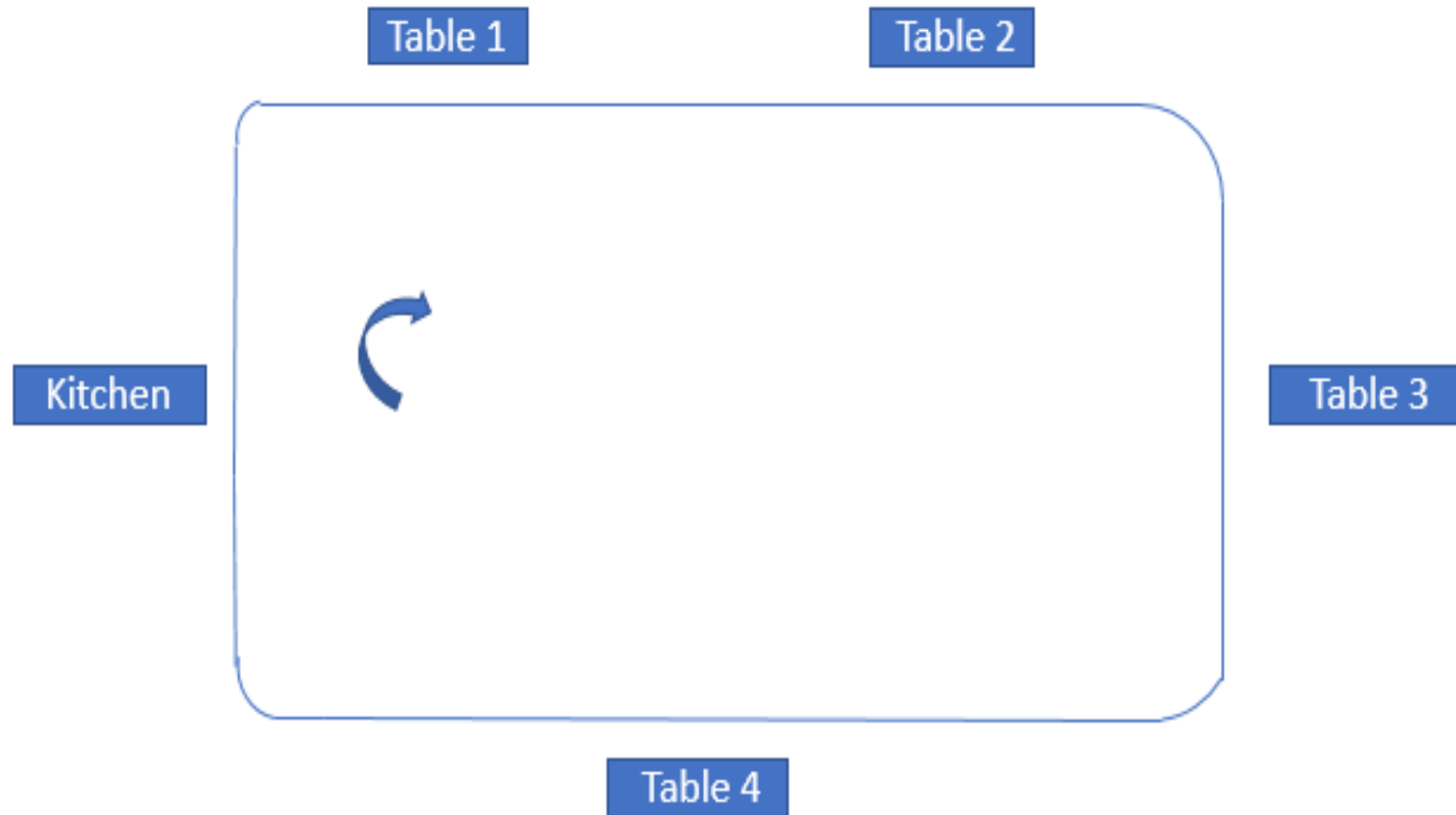
Old Project Design: Structure



New Project Design: Structure



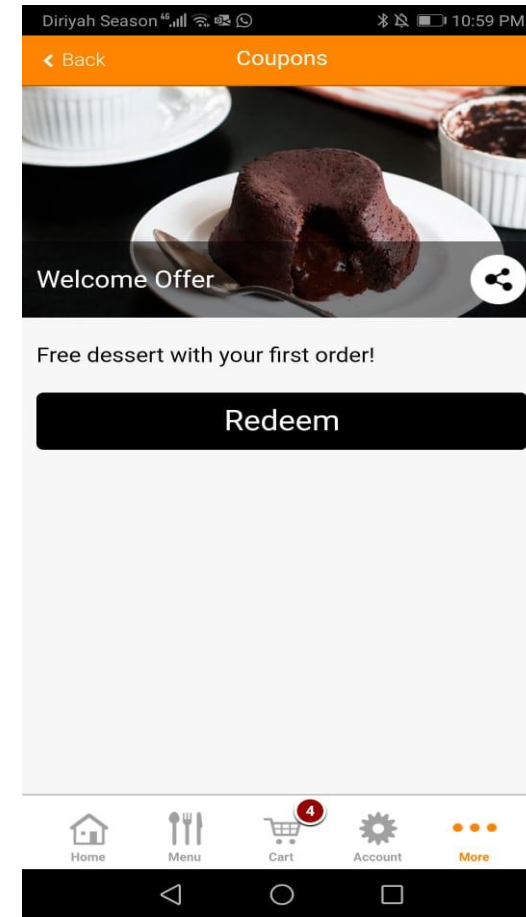
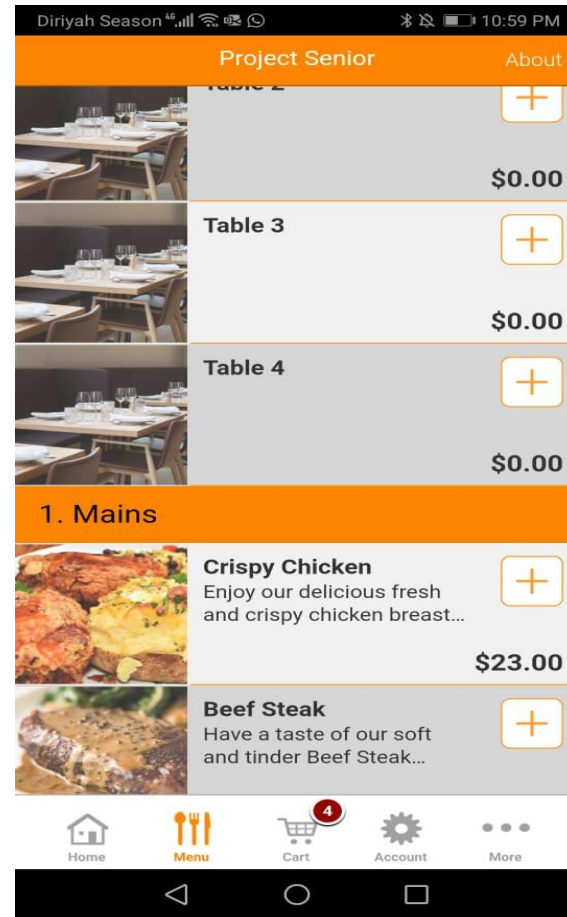
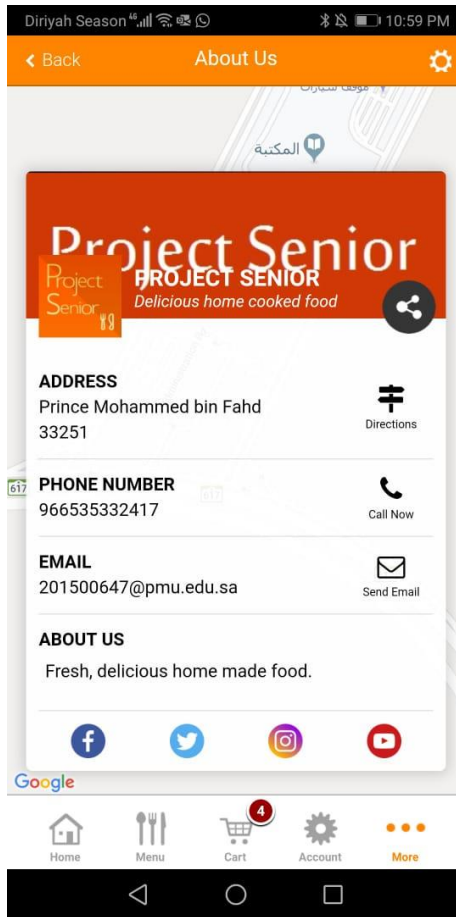
Project Design: Restaurant Layout



Ordering System

- An app designed to take the order from the customers and send it to the restaurant kitchen.
- Wide options for services.
- Designed to maximize customer services (accessible and easy to use).

Ordering System



Component Selections: Motors

- High torque DC geared motor 60 RPM.
- 60 RPM 12 V DC motors with metal gearbox and metal gear.
- 63 mm length and 180 gm weight.
- No load current= 800 mA, Load current= 7.5 A (Max).



Component Selections: IR Sensor

- Size: 3.5 x 1 cm.
- Supply voltage: 5 V DC.
- Detection distance: 10 mm.
- Build-in TCRT5000 Sensor NSOR.
- Applicable to a variety of platforms including Arduino / AVR / ARM/PIC.



Component Selections: Motor Controller

Dual DC Motor Driver (RKI-1341)

- Input voltage: 7 V to 18 V (Max).
- Can take up to 20 A.
- Simple connectivity to IO pins of any MCU.
- Compatible with motors rated up to 18 V.



Component Selections: Bluetooth Chip

HC05/06

- Modules' power supply voltage: 3.3 V to 3.6 V.
- Core module size: 27 mm x 13 mm x 2 mm.
- Working current: matching: 30 ~ 40 mA.
- Communication distance: open 10 m, and under the condition of normal use environment around 8 m.

Bluetooth Module



Component Selections: Pixy Camera

- Processor: NXP LPC4330, 204 MHz, dual core.
- Image sensor: Aptina MT9M114, 1296 x 976 resolution with integrated image flow processor.
- Field of view: 60 degrees horizontal, 40 degrees.
- Vertical dimensions: 1.5" x 1.65" x 0.6".
- Arduino cable, USB cable, and mounting brackets included.
- Supply voltage 5 V , current of 145 mA.



Component Selections: Ultrasonic Sensor

- Supply Voltage: 5 V.
- Maximal range of 400 cm.
- Minimal range of 3 cm.
- Outline dimensions: 43 x 20 x 15 mm.



Reasons for Selections

Component	Reason	Alternative
Motors	High torque, geared	Stepper motor (less torque)
Pixy cam	More accurate and easy to use	IR sensor (less accurate)
Motor controller	High current capacity	L298 N (less current)
Bluetooth chip	Easy to use, cheap and locally available	Bluesmirf sparkfun chip
Battery 12 V	Cheap, easy to replace, reachable	Lithium ion
IR sensor	Giving signal 0 and 1, cheap , easy to use	No alternate chip

Challenges

- Structural stability of the motors.
- Higher torques is required for the motors.
- IR Line following sensors are not ideal.
- The wheels attached to the motor were not stable which causes the IR line following sensors to miss the line.
- We have decided to change the motors of the project.
- We are considering to remove the IR remote receiver and replace it with horizontal lines for stopping in the project.
- We have decided to scrap the IR line following sensors and replace it with an image recognition camera for better detection of the line.
- The customer needs to wave at the robot to have the robot leave back to the kitchen. As a result, a message has to be delivered to the customer to know this information and the procedure to have the customer notify the robot.
- For the suggested restaurant layout, the RSS robot can be enhanced to have it go to table 4, for example, in anticlockwise direction instead of crossing all tables to save the time.

Cost

Item	Cost (SR)
Ultrasonic Sensors	200
Arduino	150
IR sensor	100
Robot Chassis	600
Motor Controller	250
Motors	400
Ordering System App	300
Total	2000

Contributions of Team Members

Task	Ali	Ahmed	Hamid	Abdilrahman	Abdullah
Search and acquire components	30%	10%	20%	20%	20%
Design and Implementation	15%	35%	20%	20%	10%
Research and Problem Solving	25%	25%	10%	20%	20%
Physical Construction	20%	30%	10%	20%	20%
Sensors	10%	20%	30%	10%	30%
Coding and Testing	15%	15%	15%	40%	15%
Reports and Presentations	20%	20%	20%	20%	20%

Improvements

- More efficient motors consume less power.
- Design bigger chassis to carry more plates at the same time.
- Using better microcontroller like Raspberry.
- Change the line following sensor and replace it with the camera.
- Remove the IR remote receiver as it is redundant.
- Work on mapping the restaurant with the triangular approach.
- Let the RSS robot go in both clockwise and anticlockwise directions.

References

- [1] “Restaurant in China Employs Robotic Wait Staff & Chefs,”
- [2] http://www.designnews.com/author.asp?section_id=1386&doc_id=258859&dfpPParams=ind_182,aid_258859&dfpLayout=blog&dfpPParams=ind_182,aid_258859&dfpLayout=blog , Feb 5, 2015
- [3] “Adafruit Industries, Unique & fun DIY electronics and kits,” <http://www.adafruit.com/products/419>, Jan 2, 2005
- [4] “Pololu – ArduinoMega 2560 R3,” <http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/4215/11121094.pdf?sequence=1>