

SMART PARKING SYSTEM USING NODEMCU (ESP8266)

GROUP 39

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BACKGROUND OF SMART PARKING SYSTEM

WITH RAPID URBANIZATION AND THE INCREASING NUMBER OF VEHICLES, FINDING AVAILABLE PARKING SPACES IN CITIES HAS BECOME A MAJOR CHALLENGE. CONVENTIONAL PARKING SYSTEMS LEAD TO CONGESTION, WASTED FUEL, TIME, AND INCREASED CARBON EMISSIONS DUE TO VEHICLES IDLING IN SEARCH OF PARKING. TO ADDRESS THESE ISSUES,

SMART PARKING SYSTEMS HAVE EMERGED AS AN INNOVATIVE SOLUTION USING TECHNOLOGIES LIKE IOT (INTERNET OF THINGS), SENSORS, CLOUD PLATFORMS (E.G., FIREBASE), AND MOBILE APPLICATIONS.

SMART PARKING SYSTEMS TYPICALLY USE IR SENSORS, MICROCONTROLLERS (LIKE ESP32), AND REAL-TIME DATABASES TO DETECT VEHICLE PRESENCE, MONITOR OCCUPANCY, AND COMMUNICATE THIS INFORMATION TO USERS. THESE SYSTEMS CAN BE DEPLOYED IN SHOPPING MALLS, AIRPORTS, SMART CITIES, UNIVERSITIES, AND RESIDENTIAL COMPLEXES TO IMPROVE PARKING EFFICIENCY.

LIST OF COMPONENTS

SOFTWARE COMPONENTS

- FIREBASE - REAL-TIME DATABASE AND CLOUD SERVER
- ANDROID STUDIO - FOR MOBILE APPLICATION FOR USER INTERFACE
- ARDUINO IDE - FOR CONNECTING ESP8266 WITH SENSORS AND FIREBASE

HARDWARE COMPONENTS

- 5 INFRARED SENSORS
- 1 SERVO MOTOR
- 2 ESP8266
- 5 LEDs
- BREADBOARD
- CONNECTING WIRES

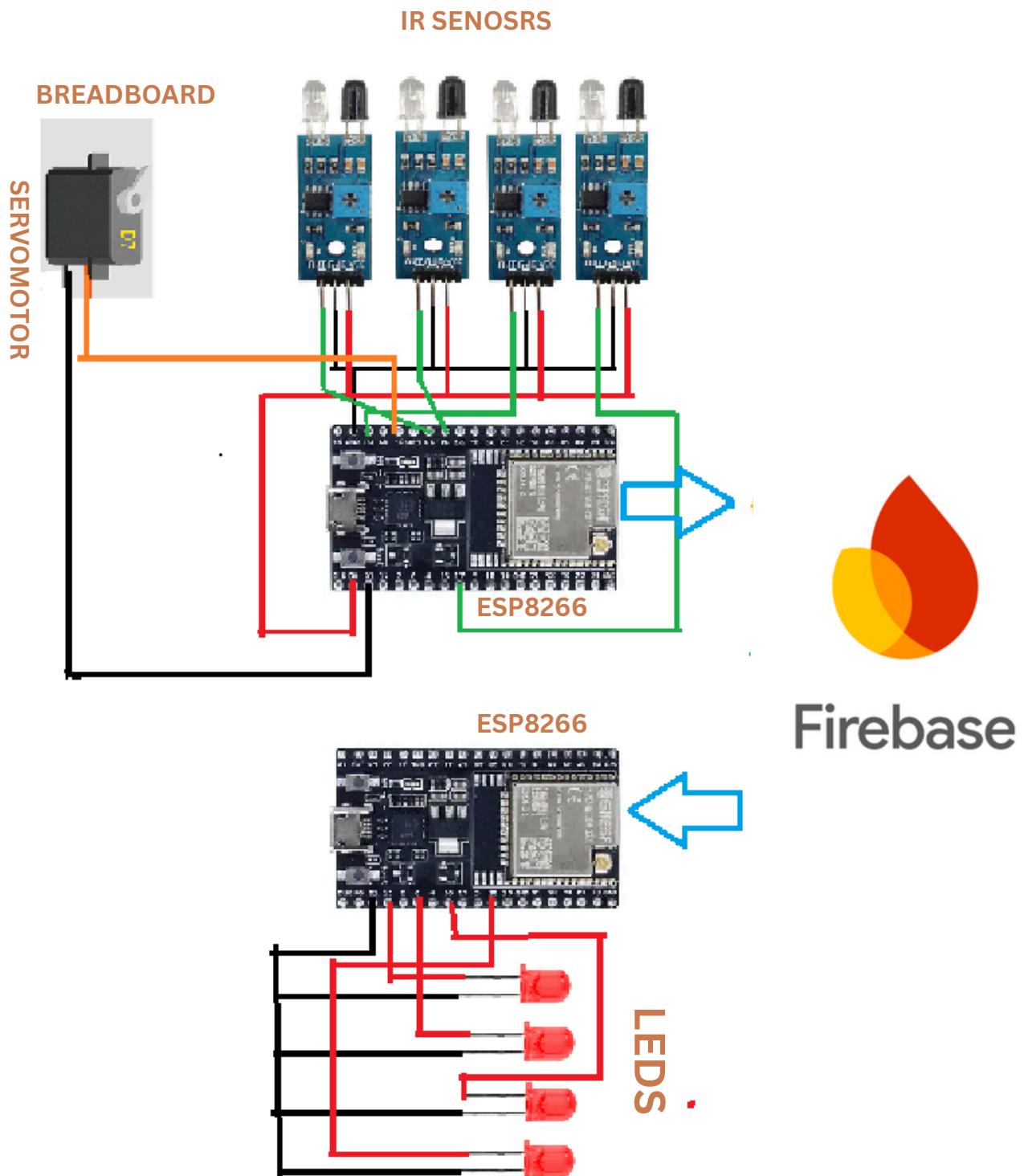
COMMUNICATION PROTOCOLS

THE NODE-MCU, WITH ITS BUILT-IN WIFI MODULE, ENABLES DATA TRANSMISSION TO A CLOUD BASED PLATFORM FOR STORING AND PROCESSING PARKING DATA ENSURING REAL-TIME UPDATES AND ACCESSIBILITY

GITHUB LINK OF OUR PROJECT :

https://github.com/Kaltroniz/Smart_Parking_System

CIRCUIT DIAGRAM



CHALLENGES FACED DURING THE PROJECT AND HOW THEY WERE ADDRESSED

CHALLENGES FACED

- LED INDICATORS FOR EACH TIME SLOT SOMETIMES FAILED TO MATCH THE REAL-TIME STATUS SHOWN IN THE APP DUE TO COMMUNICATION LAGS AND LOGIC ERRORS
- HARDWARE LIMITATION: WE HAD ONLY ONE ESP8266 MICROCONTROLLER, AND IT DIDN'T HAVE ENOUGH GPIO PINS IN ORDER TO CONNECT THE LEDs AND IT DOES NOT BEAR THAT MUCH LOAD ALTOGETHER
- WE NEED SECURE AND EFFICIENT METHOD WHICH ALLOWS ONLY THE USERS WHO HAVE ALREADY BOOKED A SLOT CAN ENTER IN PARKING AREA, WE HAVE OPTIONS LIKE USING RFID CARDS OR SECURITY GUARDS BUT THEY COST TOO MUCH AND ALSO THESE WERE SLOWER FOR SMART BASED SYSTEM

THEIR SOLUTIONS

- FOR THAT PROBLEM WE IMPLEMENTED A FEEDBACK LOOP IN OUR ESP8266 CODE SO AS TO UPDATE THE LEDs BASED ON THE LATEST DATA FROM FIREBASE
- TO OVERCOME THIS WE INTEGRATED A SECOND ESP8266 WITH IT AND CONNECTED IT TO THE SAME FIREBASE REAL-TIME DATABASE. SO THIS WAY WE ARE ABLE TO SHARE THE TOTAL LOAD BETWEEN TWO MICROCONTROLLERS, HERE ONE HANDLING THE IR SENSORS AND SERVO MOTORS AND ANOTHER ONE HANDLING THE SYNCHRONIZATION BETWEEN BOTH MICROCONTROLLERS AS WELL AS LEDs
- ON DISCUSSING, WE DECIDED TO USE QR CODE BASED ENTRY. WHEN USERS BOOK A SLOT, THEY CAN ONLY ENTER THE PARKING SLOT AFTER SCANNING THE QR WHICH IS PLACED AT ENTRY GATE OF PARKING AREA, QR SCANNER READS THE CODE, AND VERIFIES THE BOOKING FROM FIREBASE AND WITH THE HELP OF THE SERVO MOTOR THE GATE IS OPENED IF THERE IS A BOOKING. THIS METHOD IS FASTER AND COST-FRIENDLY FOR OUR SMART PARKING SYSTEM

- CLOUD SERVER SELECTION: INITIALLY WE THOUGHT THAT WE COULD CREATE OUR OWN CLOUD-BASED SERVER USING VARIOUS ONLINE PLATFORMS. BUT THE MOST RELIABLE OPTIONS ARE PAID, WHICH WAS NOT FEASIBLE FOR OUR PROJECT DUE TO BUDGET CONSTRAINTS
- AFTER SOME RESEARCH AND ANALYSIS WE CHOSE FIREBASE AS OUR CLOUD SERVER BECAUSE FIREBASE PROVIDES US WITH ALL THE FEATURES WE NEED - SUCH AS, REALTIME DATABASE, USER AUTHENTICATION AND IT IS FEASIBLE TO SYNC OUR APP WITH ESP8266(VIA ARDUINO IDE) AS WELL. THE MOST IMPORTANT THING IS THAT IT OFFERS ALL THESE FEATURES WITHOUT ANY PAID SUBSCRIPTION WHICH IS PERFECTLY MATCHES WITH OUR GOAL

CONTRIBUTION :

TAMAJEET BISWAS

CONNECT AND TEST IR SENSORS WITH NODEMCU FOR VEHICLE DETECTION, ENSURE CORRECT SIGNALS FOR PARKING SLOT STATUS, ALSO INTEGRATE SERVO MOTORS, AND LEDs INTO A CIRCUIT AND DEBUG FALSE DETECTIONS OR CONNECTION ISSUES

VIVEK C.K.

DEVELOP A BASIC BACKEND API TO HANDLE PARKING DATA AND WRITE SCRIPTS TO RECIEVE, PROCESS AND STORE DATA FROM FIREBASE ALSO IMPLEMENT AN AUTHENTICATION SYSTEM TO RESTRICT ACCESS TO AUTHORIZED USERS AND ENSURE SMOOTH DATA

VEKARIYA PRITKUMAR

PROGRAM SERVO MOTORS FOR GATE CONTROL BASED ON PARKING STATUS, INTEGRATED LEDs AND TEST MANUAL AND AUTOMATED SENSOR RESPONSES, ALSO ENSURE HOW THE HARDWARE PART LOOK LIKE

YANU GUPTA

DESIGN A BASIC UI FOR THE MOBILE APP AND IMPLEMENT DATA FETCHING FROM FIREBASE CLOUD TO DISPLAY AVAILABLE/OCCUPIED PARKING SLOTS AND INTEGRATE REAL-TIME DATA BASE TO PARKING SLOT STATUS UPDATE

VAASUDEV E

ESTABLISH WI-FI CONNECTION AND DATA TRANSMISSION BETWEEN NODEMCU AND THE FIREBASE CLOUD, SETUP FIREBASE AND VERIFY CORRECT PARKING STATUS UPDATES, ALSO ENSURE STABLE REAL-TIME UPDATES