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Abstract:

Drivers searching for parking are estimated to be responsible for about 30% of traffic congestion in cities. Historically, cities, businesses, and property developers have tried to match parking supply to growing demand for parking spaces. It has become clear, though, that simply creating more parking spaces is not sufficient to address the problem of congestion. New approaches using smart parking systems look to provide a more balanced view of parking that better manages the relationship between supply and demand. Smart parking can be defined as the use of advanced technologies for the efficient operation, monitoring, and management of parking within an urban mobility strategy. The global market for smart parking systems reached $93.5 million, with the United States representing 46% market share, and offering a strong growth opportunity for companies offering services in the United States and overseas. A number of technologies provide the basis for smart parking solutions, including vehicle sensors, wireless communications, and data analytics. Smart parking is also made viable by innovation in areas such as smartphone apps for customer services, mobile payments, and in-car navigation systems. At the heart of the smart parking concept is the ability to access, collect, analyze, disseminate, and act on information on parking usage. Increasingly, this information is provided in real-time from intelligent devices that enable both parking managers and drivers to optimize the use of parking capacity.

Smart System:

Smart system is the function of sensing any situation via a sensor, process of the sensor data by analyzing the situation through a programming algorithm and make adaptive decision based on the available data.

Smart Car Parking System:

Smart parking system is a vehicle parking system that uses sensors in each parking space to detect the presence or absence of a vehicle in that space and helps the drivers finding a vacant parking spot. Smart parking is one of the most adopted and quickest developing smart city solutions over the world. Smart Parking includes the use of low-cost sensors, real-time data, and applications that enable users to monitor available and unavailable parking spots.

Advantages:

Smart parking system provides a lot of advantages such as:

- Time saving - By driving fewer kilometers when in search of parking space, one can save valuable time which can be spent on work, fun or hobbies.
- Reduced pollution – Searching for parking burns around one million barrels of oil a day. An optimal parking solution will significantly decrease driving time, thus lowering the amount of daily vehicle emissions and ultimately reducing the global environmental footprint.

- Optimized parking – Users find the best spot available, saving time, resources and effort. The parking lot fills up efficiently and space can be utilized properly by commercial and corporate entities.

- Reduced traffic – Traffic flow increases as fewer cars are required to drive around in search of an open parking space.

- Decreased Management Costs – More automation and less manual activity saves on labor cost and resource exhaustion.

- Increased Safety – Parking lot employees and security guards contain real-time lot data that can help prevent parking violations and suspicious activity. License plate recognition cameras can gather pertinent footage. Also, decreased spot-searching traffic on the streets can reduce accidents caused by the distraction of searching for parking.

Hardware & Software We Used:

- **LDR:** **Light-dependent resistor (LDR)** is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuit.

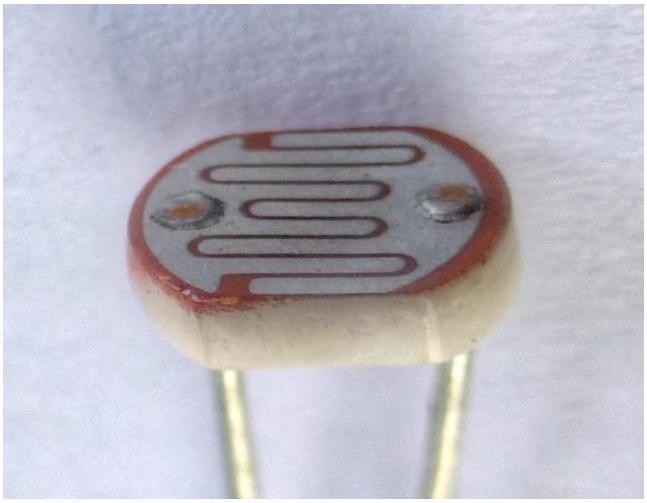


Figure1: Light dependent resistor

- **Microcontroller:**

Microcontroller is used to convert the light signal from the LDR done on the PC to observe the values send by LDR. The proposed microcontroller used in the project is the commercial well-known Arduino MEGA board. An Arduino is a single-board microcontroller and a software suite for programming. It is designed for an Atmel AVR processor and features on-board I/O support. Arduino Mega microcontroller board is based on the ATmega1280. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller.

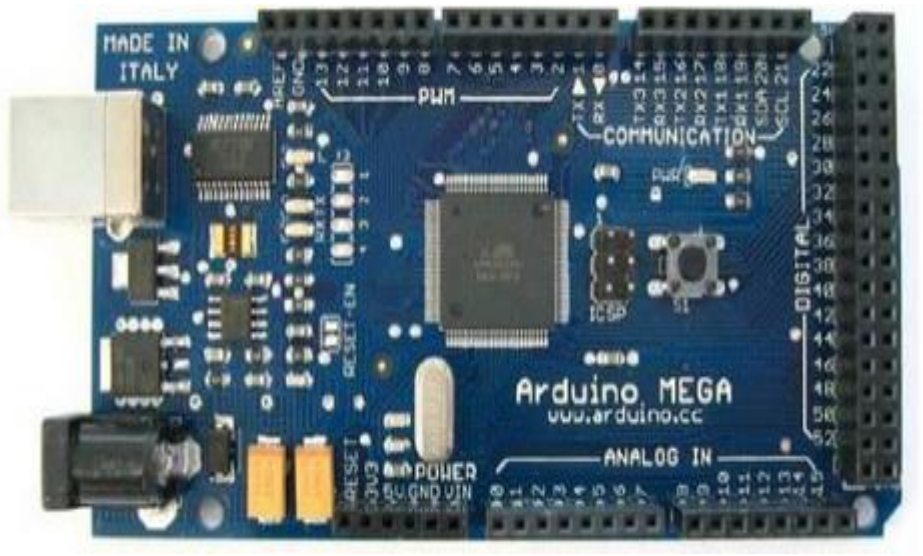


Figure: A typical Arduino MEGA microcontroller

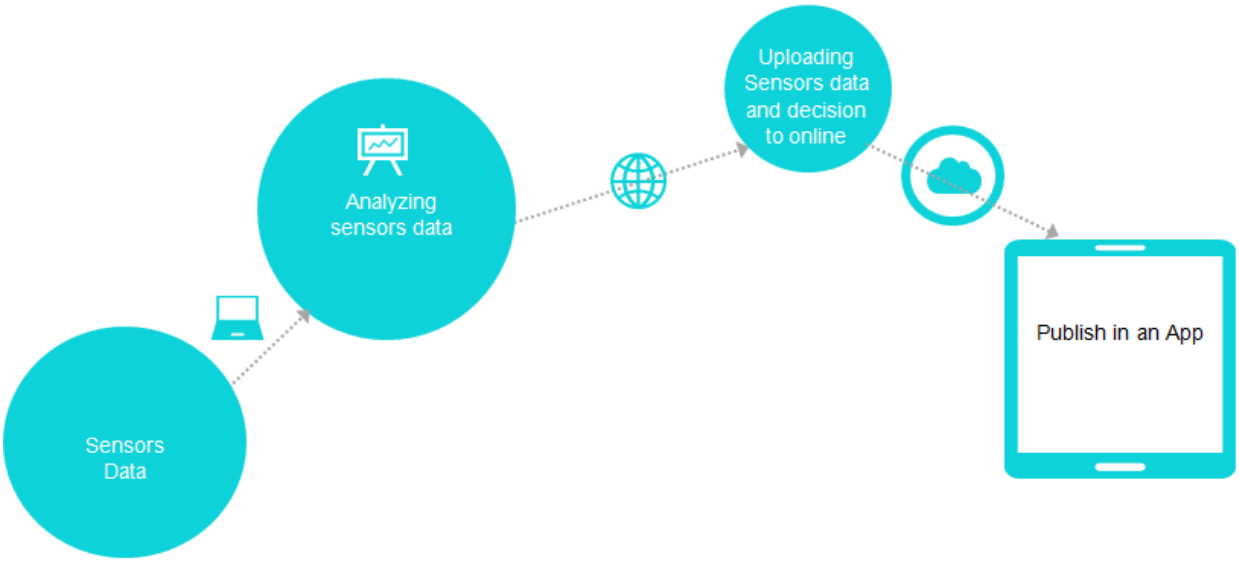
Arduino IDE: The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards.

Google Spreadsheet:

Google Sheets is a spreadsheet program included as part of a free, web-based software office suite offered by Google within its Google Drive service. The service also includes Google Docs and Google Slides , a word processor and presentation program respectively. Google Sheets is available as a web application, mobile app for Android, iOS, Windows, BlackBerry, and as a desktop application on Google's ChromeOS. The app is compatible with Microsoft Excel file formats. The app allows users to create and edit files online while collaborating with other users in real-time. Edits are tracked by user with a revision history presenting changes. An editor's position is highlighted with an editor-specific color and cursor and a permissions system regulates what users can do. Updates have introduced features using machine learning, including "Explore", offering answers based on natural language questions in a spreadsheet.

Working Procedure:

The project was done according to the following sequence:



- In this project, we used LDR (light detecting resistor) sensor to take analog data.
- We constructed a mini garage on a wood sheet and attached the LDR (Light detecting resistor) sensors on the slots of the mini garage.

Figure 1:Mini-garage having empty slots.

Figure 2:Mini-garagewith parked cars.

- We constructed necessary circuit diagram on the bread board and connected the Arduino board with the circuit properly to take the analog data and send them to the spread sheet.The circuit diagram is as follow:

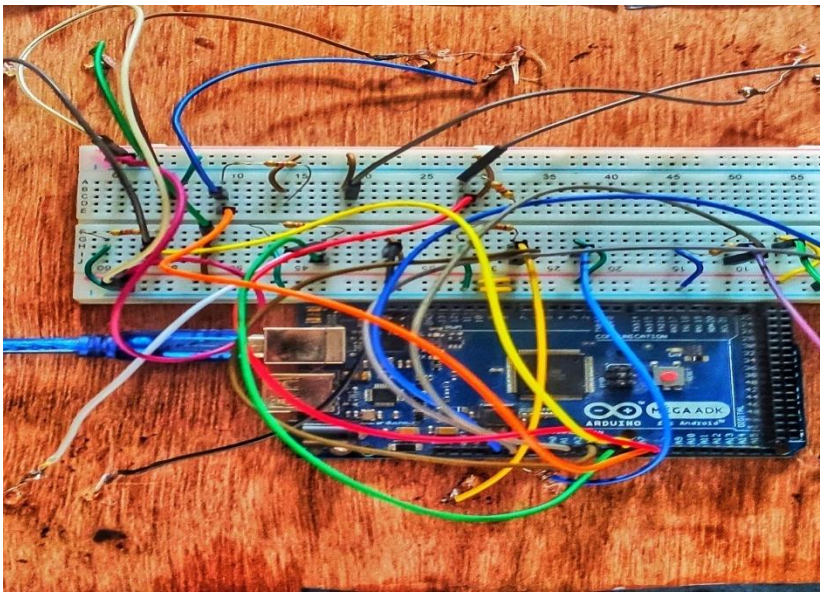


Figure 3:Original circuit diagarm.

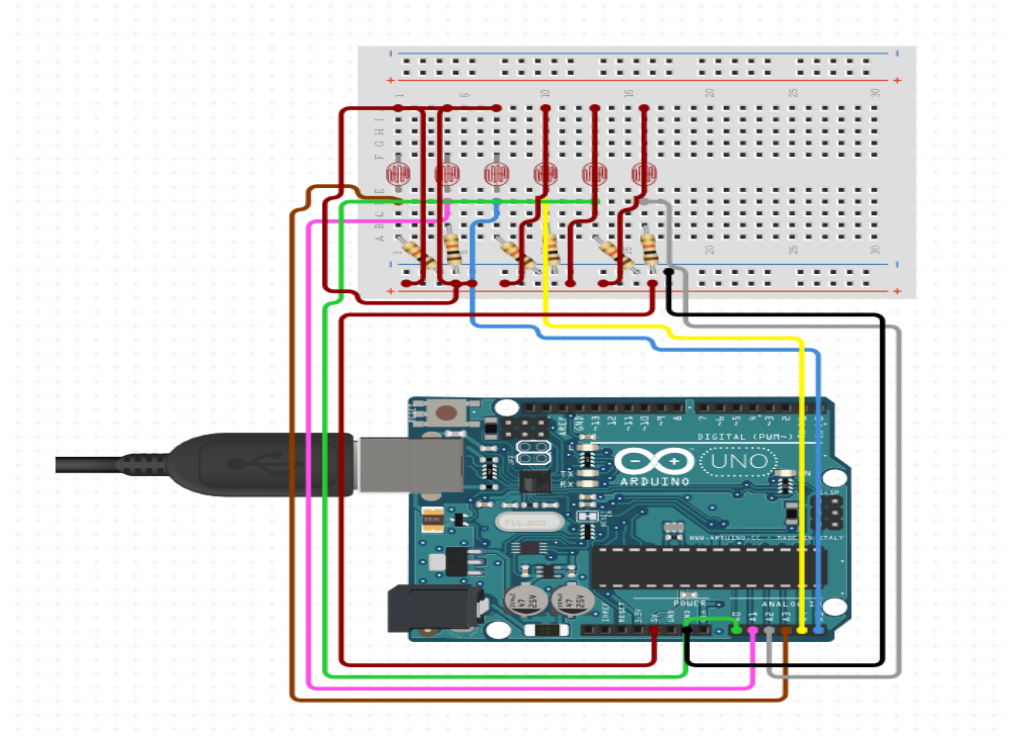
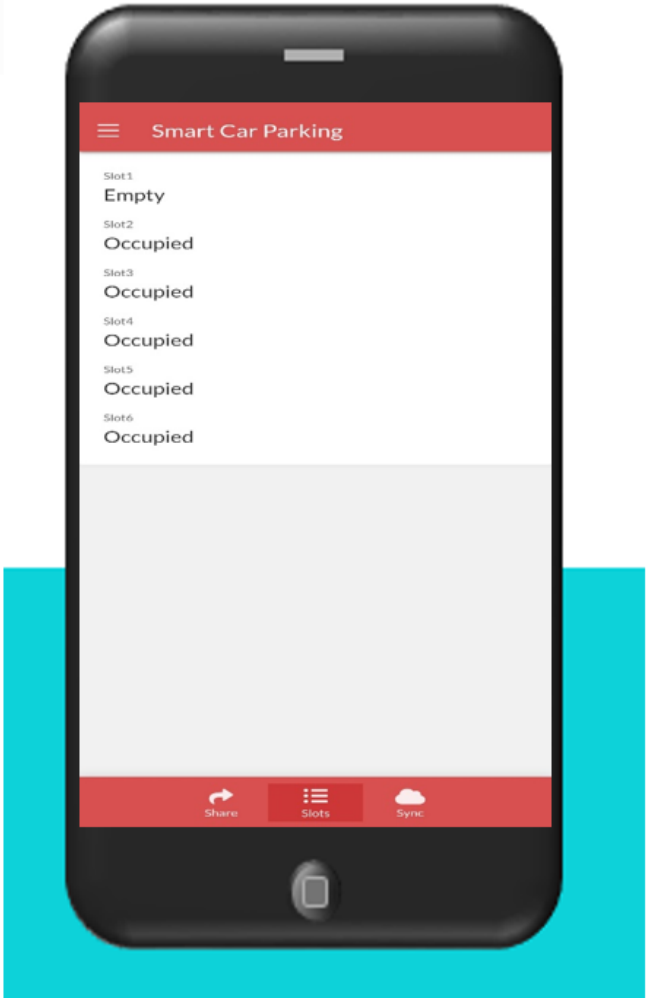


Figure 4:Circuit diagram using protious.

- Observing the data sheet values at empty slot condition and non-empty slot condition, we defined a threshold value corresponding to each slot.
- After defining the threshold value, we got digital data from analog LDR data. If the analog value is above the threshold value it means binary one and below the threshold value means binary zero. We send these binary bits to the Google sheet.
- A software is connected with the Google sheet which shows that whether the slot is empty or not on the basis of digital values. Anyone using this app can know whether any slot of the garage is empty or not.



Future Implementation:

- Adding weight sensors: Although we have done our project using light sensor, one can do the same tusk using weight sensor. Weight sensor is a type of transducer, specifically a *force* transducer. They convert a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized.
- Include parking map to the software: In future, the parking map can be included to the software that the drivers can find the parking place easily.
- All the parking area are included in a single software: All the parking place of a city can be included in a single software so that the user of the software can find all the parking places on the map and can decide which one is the nearest to him.
- Add the software to the automated driving: An automated driving system is a complex combinations of various components that can be defined as systems where perception, decision making, and operation of the automobile are performed by electronics and machinery instead of a human driver. In future, Smart parking system software can be installed into that kind of automated driving car, which will lead the car to the parking place automatically.
- Making the app available for all operating system: The app is now only for android platform mobile devices. We are planning to expand this available all other operating platforms such as iOS, Windows, HarmonyOS etc

Limitations:

There are some limitations that we cannot solve through our project.

Firstly, we used light sensor to take analog data, this system accuracy depends on the intensity of light. In case of low light condition, the values may not be as expected consequently threshold decisions will be difficult to give and the app will show unexpected result.

Moreover, we developed the app for only android operating system, not for iOS, Windows and other operating system.

Another limitation to mention, the app updates its value after 5 sec later after every action.

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