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Wireless Sensor Network for Car Space Display Unit

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***Abstract*— In recent times, there has been renewed effort to solve problems of traffic disorder, congestion and unauthorized parking of cars in the parking area of busy business premises. The trend in solution to this environmental menace has evolved from the approach of human intervention by traffic and security agents to automatic/electronic assisted processes. The latter was applied in this work. It was achieved by deploying an electronic space display unit to indicate; 1, the available empty parking slots on a particular level of the three storey parking area. 2, to automatically update the information on an LCD about the parking area should there be a change in the vehicular movement within the area. 3, to indicate when the parking area is full in capacity inorder to avoid further entry of vehicles and any form of congestion. To achieve this work, simulation was performed using C++ program in proteus 8.5 professional workbench. The vehicular movement made within the parking area was detected and the numerical values were displayed on the LCD. The counting operation was achieved by the microcontroller. It counts by incrementing 1 (for entrance) and decrement 1 (for exit) on each level for a specified capacity. This paper therefore, explores ways of ensuring orderly parking of vehicles in a busy parking area, and also ensures drivers locate unoccupied parking slots when in the car park. It further counts automatically, the number of vehicles entering and leaving the car park without human intervention. This work when implemented will ensure that traffic management authorities understand patterns and trends of ensuring good traffic system in busy business environment.**

***Index Terms*— Microcontroller, Embedded System, Switches, Car Park Occupancy, Simulation.**

I. INTRODUCTION

The anomalies and chaos created in parking areas of busy business centers has been a major concern in recent time. This problem is as a result of lack of updated and available information on the parking capacity and available slots in these areas. This has become alarming due to the massive population recorded in cities. Since cars are the dominant mode of transportation, there is need to plan the activities of motorist in these areas to mitigate the extent to which traffic congestion issues occur. This paper therefore describes the Design and Simulation of an Electronic Space Display Unit for a three-Storey Car Park of a densely populated business area. The most widespread solution to this problem is to adopt high level of manpower utilization to handle such traffic issues. The latter is prone to having defaulters who will go against laid down rules and end up not solving the intended problem. However; introducing the use of electronic systems is worthwhile. This will help to mitigate the difficulty in searching for vacant slots during peak shopping period, improve traffic flow, reduce cost associated with man power involvement/other forms of network decongestion system and finally save time to ensure good delivery of goods and services.

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II. REVIEW OF RELATED WORKS

Divers' technology has been adopted to ensure motorist find parking slots, locate and retrieve their vehicles with ease and less human interventions to better today's life. This is pronounced in today's smart cities to explore the ability to indentify things in an unfamiliar environment [1-2]

In [3], the use of gate arm counters and induction loop detectors at the entrance and exit of car parks to grant access and take inventory of cars entering and leaving the parking area was implemented. Galadanci et al [4] designed and simulated an automobile control system using up/down Decade counters to grant access and display full on maximum storage. In Bong et al [5], an integrated approach for design of car park occupancy information system (COINS) using image processing algorithm to process and relate information. This information is transmitted via wired or wireless approach to system panels located at strategic positions in the area. The limitation of adopting the image processing technique rather sensor based technique lies on the fact that, the former is not expected to perform under low image luminance except other sources of light is made available. The principle of electromagnetic induction can also be applied to detect metal at the entry and exit point of a car park [6], this method only aims at eliminating manual interventions and inconsistencies in counting and detecting vehicles. In [7], car park systems were designed with capacity control of which the park entrance is closed once the space is fully occupied. Its limitation involves the inability of motorist to indentify vacant slots once the space is created rather than prevent vehicles in the entire area. Pradhran et al [8], designed and developed automated parking slot using embedded system, wireless (Xbee) and sensors. This process is limited by the collision problem from multiple tags transmitting simultaneously while implementing RFID technology. This hinders fast identification of cards. However, with the advent of RFID technology a more advanced implementation using wireless sensor technology was also deployed for intelligent parking management system [9-11]. Although this approach has high level of cost implications, it is also possible to have unauthorized devices read and change data on tags.

In this work, the wireless sensor network was adopted. This choice was initiated with the aim of overcoming long

and complicated wiring associated with wired sensors networks, cost implications and long distances involved in the wiring process.

III. METHODOLOGY

The methodology adopted in this work involves the design and software programming aspects. The design required the use of switches, sensors and microcontrollers. The Program was written in C++ language. The C++ was complied in HEX File and embedded in the Integrated Development Environment (IDE) of the microcontroller (ATmega328, Arduino). Components needed were selected from Proteus 8 Professional, which is the work bench. Figure 1 shows the block diagram of Design and Simulation of Electronic Space Display for three-Storey Car Park.

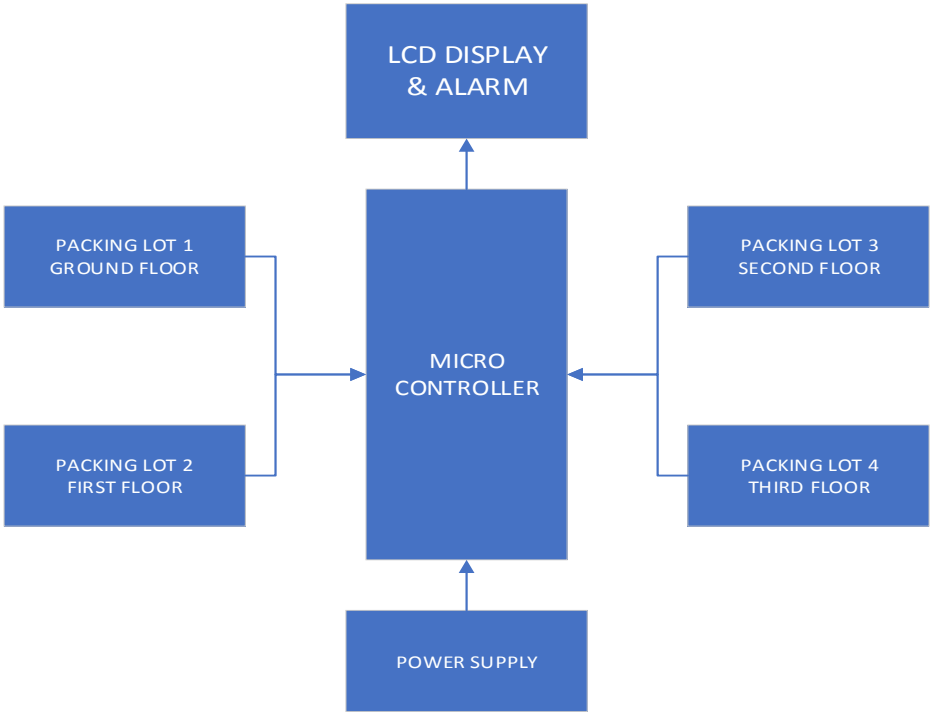

Fig. 1: Block Diagram of the Electronic Space Display for three-Storey Car Park

The entire build up of the system consist of seven building blocks which are: the microcontroller, the power supply unit, display unit which is a 20x4 LCD, alarm (buzzer), and the other four block representing the four packing space (CP A, CP B, CP C and CP D). The alarm (buzzer) is triggered when the car park is full.

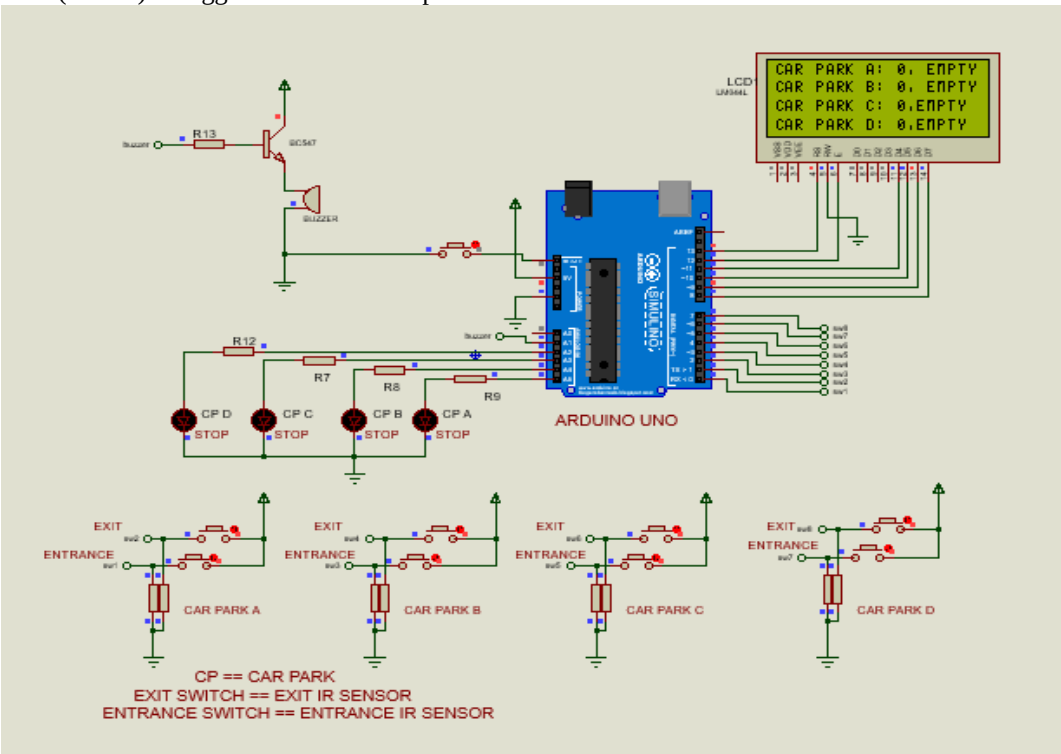

Fig. 2: Circuit Diagram

IV. PRINCIPLE OF OPERATION

In the simulation process, switches were used to signify the entrance and the exit of the car park. When a car drives in through the entrance door, the switch at the entrance closes and there is a positive voltage of 5v d.c which makes current flow into the microcontroller. This current flow triggers a high signal to the microcontroller which thus increments the counting on the LCD by one. This happens each time a car drives in. When a car drives out through the exit door, the switch at the exit closes and sends a low signal to the microcontroller, thereby decrementing the count on the LCD by one, each time a car drives out. There are nine (9) switches in the circuit. The reset switch (SW_{RST}) connects the buzzer to the microcontroller which reset the counts of the system (microcontroller) to zero (0). The alarm (buzzer) is triggered when the car pack is full. Its function is seen from the LED interfaced with the switches which will come ON (red colour) when the car slots for the intended level is full. In this work, it is noticed that it is only when the outgoing vehicle passes the exit door which closes the switch that the signal is processed in the microcontroller and sent to the LCD to indicate that a space is empty on that floor. So, another car can now enter through the entrance door. In this simulation process, the switch is activated by clicking the computer mouse, once at a time.

V. RESULTS.

Tests were performed on the project using Proteus 8.5 professional. The switch at the ENTERANCE of car park A, B, C and D were clicked individually with mouse. One click at entrance (A, B, C, and D) showed that a car has entered any level of the car park, and it continuous to increment. EXIT switch was also clicked showing that a car has left that level of the car park, and so it decrements untill it gets to zero and the LCD shows EMPTY. The function of the Liquid Crystal Display (LCD) is to give information on the status of the car park vis-a-vis the number of cars inside, and also when the car park is FULL. Once a vehichle leaves a slot, the free space count increments by one, indicating the level and number of spaces avaliable on that level. However if a vehicle goes through the entrance, at that point, the LCD shows avaliable spaces in their respective levels. On ocuppying the slot, the display decrements the avaliable space by one. Vehicles are mearnt to enter one at a time so motorist do not have to go searching for avaliable spaces from level to level.

Simulations were carried out and the results were obtained are outlined thus:

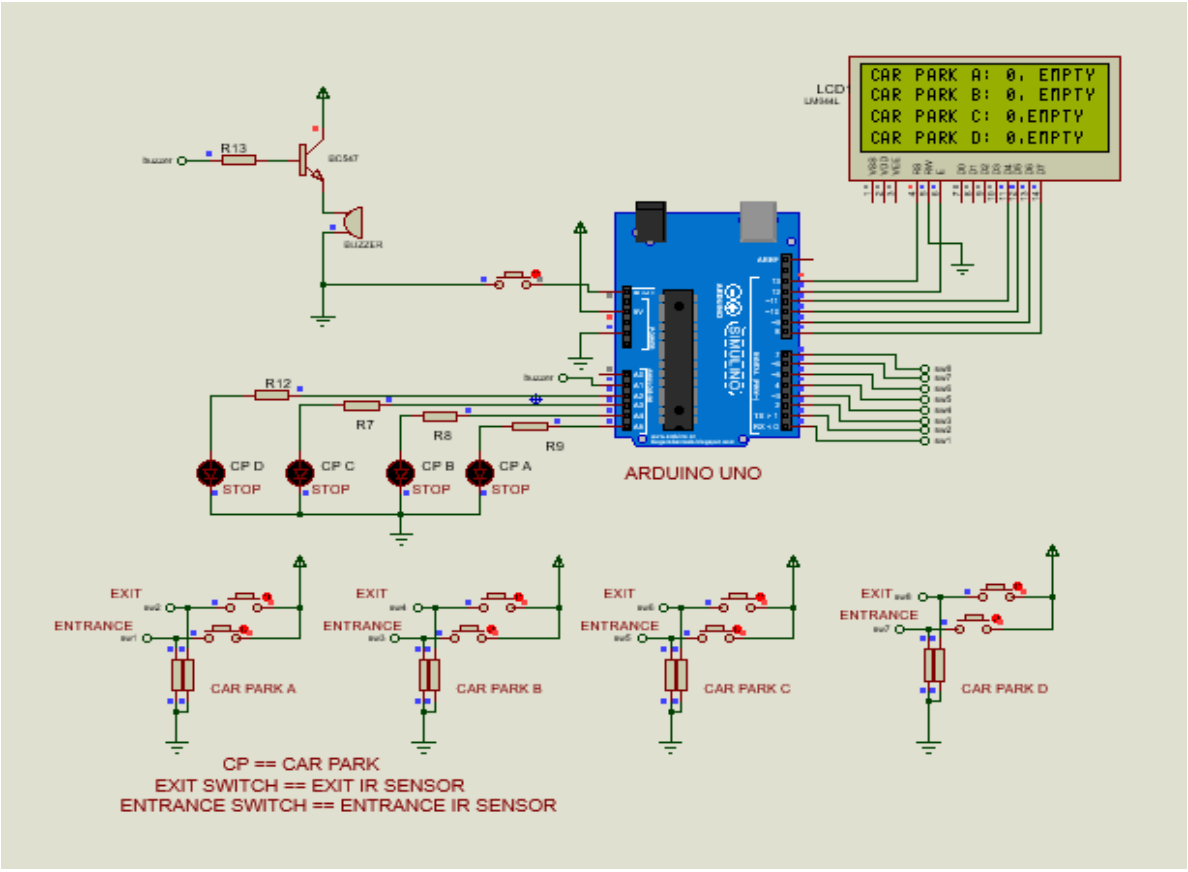

Fig. 3 Scenario 1: All the car parks are empty

Case 1 above shows when all the car park is empty. It is displayed by the LCD.

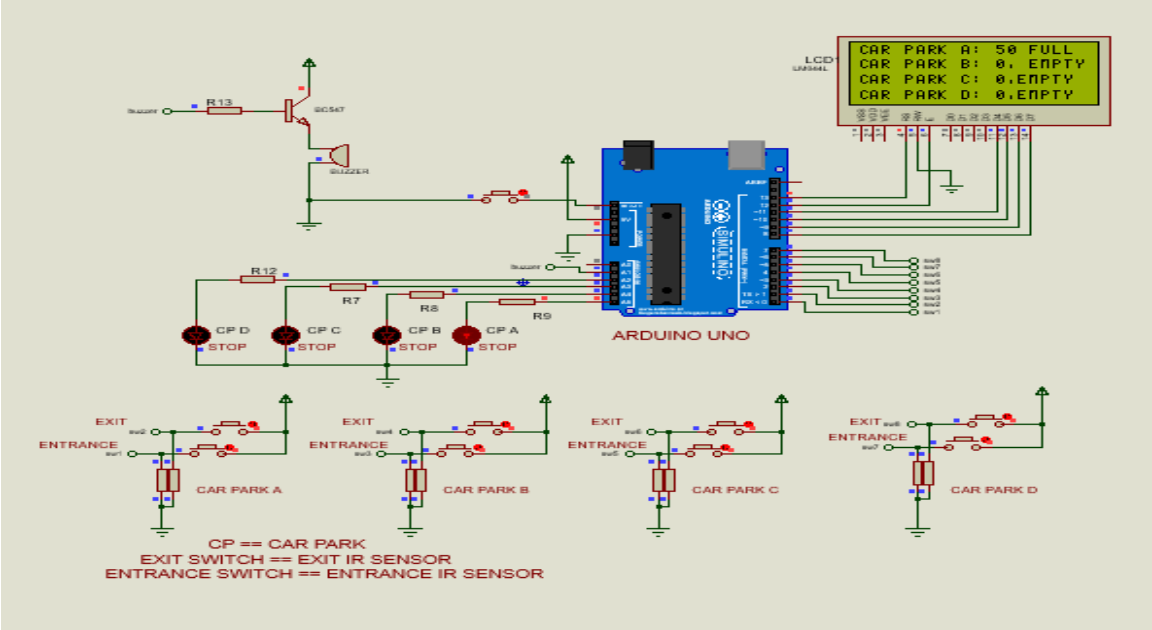

Fig. 4 Scenario 2: Car park A is filled.

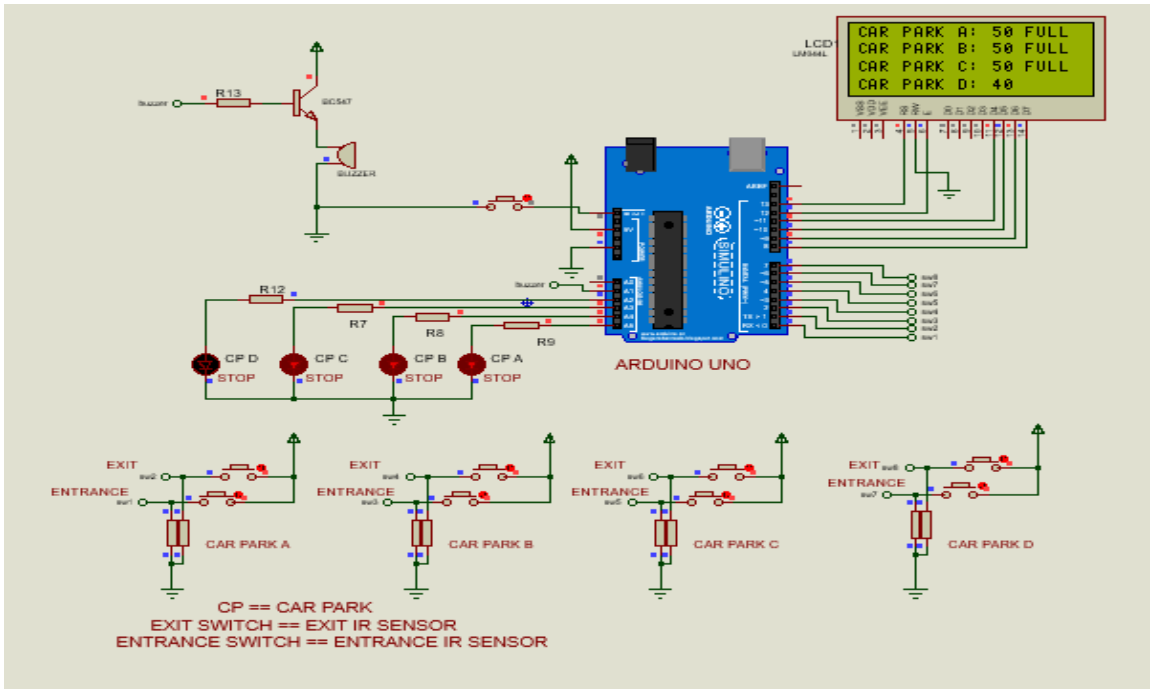

Fig. 5 Scenario 3: Car Pack A, B and C are filled

VI. DISCUSSION

Based on the results obtained, the following solutions profered by the of electronic space display unit for three-storey car park became obvious and strict adherence to instuction by the car owners/ drivers are necessary, viz:

(1) The Entrance and Exit indications are the only authorized point to be accesed by the car owners / drivers. This is to enhance the counting operations.

(2) CASE 1, showed when all the car parks are empty. The LCD showed zero (0) and EMPTY. The LEDs are off.

(3) CASE 2, showed when car park A is filled while other car park levels are EMPTY. The LED of CP A is turned ON (Red), and the LCD showed 50 and FULL.

(4) CASE 3, showed when car park A, B, and C are filled to maximuin capacity (50 cars) and their LEDs turned ON (Red), while car park D has 40 cars; so car park D is not yet filled.

(5) Channel attack cannot be experienced as seen while implementing with RFID technology. However security and privacy issues are overcome by adopting the model of this nature.

VII. CONCLUSION

The performance of this work on testing met design requirement. When implemented, this module will solve problems associated with parking of vehicles. This includes minimizing time wastage in sourcing for car park spaces, reduce traffic jam and enable drivers to maintain orderliness in a busy business area. Drivers are saved from penalties of

law enforcement agents and security operatives can focus on their duties/responsibilities without distractions. The management, owners of business premises, drivers as well as pedestrians will enjoy a congestion free environment when the traffic patterns of the environment cab be ascertained.

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