An IOT-Based Intelligent System for Real-Time Parking Monitoring and Automatic Billing.

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***Abstract* - Military is the backbone for the countries to restrict the entry of terrorists and maintain peace inside the country. They use plenty of electronic gadgets to fight the terrorists and protect the border. During critical conditions, they may get attacked. But due to lack of first aid during such time may cause them their life. Even though they have communication medium it is impossible to monitor their body condition. So some soldiers can get physical illness during these conditions. In critical military operations, the health and safety of army soldiers are of utmost importance. This project proposes an IoT-based healthcare monitoring system designed specifically for army personnel deployed in remote or hostile environments. The system utilizes wearable sensors to continuously monitor vital parameters such as heart rate, body temperature, SpO_2 levels, and physical movement. These parameters are collected using microcontrollers and transmitted wirelessly to a remote monitoring station via Wi-Fi or GSM modules. Additionally, a GPS module is integrated to track the real-time location of soldiers, ensuring quick medical response in emergencies. The data can be accessed by medical teams through a secure cloud platform, enabling real-time monitoring and timely interventions. This system enhances the ability to detect health anomalies, injuries, or critical conditions early, thus improving the chances of survival and reducing the workload on field medics. The solution is scalable, cost-effective, and can be further enhanced with AI, solar-powered wearables, and secure communication protocols for future battlefield readine.**

Keyword- Internet of Things (IoT) ,Smart Parking, Real-Time Monitoring ,Automatic Billing, Parking Management System, Sensor Networks)

I. INTRODUCTION

IoT is a network in which all physical objects are connected to the internet through network devices or routers and exchange data. IoT allows objects to be controlled remotely across existing network infrastructure. IoT is a very good and intelligent technique which reduces human effort as well as easy access to physical devices. This technique also has autonomous control feature by which any device can control without any human interaction.

In modern warfare and remote military operations, the health and safety of soldiers are of paramount importance. Army personnel often operate in extreme and hostile environments where timely medical assistance is not always readily available. To address this challenge, the integration of the Internet of Things (IoT) with healthcare systems presents a transformative solution. An IoT-based health care monitoring system for army soldiers enables continuous, real-time monitoring of vital health parameters such as heart rate, body temperature, oxygen levels (SpO2), and location. Using wearable sensors connected through wireless communication modules, the system can transmit critical health data to a central command or medical unit. This ensures rapid response in case of abnormal health conditions, fatigue, or injury, thereby enhancing soldier safety, operational efficiency, and decision-making on the battlefield. The implementation of such technology not only supports remote health diagnostics but also strengthens the overall tactical readiness of the armed forces.

IoT operates through a combination of four key components: sensors, connectivity, data processing, and user interfaces. Sensors collect real-world data, such as temperature, pressure, heart rate, motion, or environmental conditions. This data is then transmitted through communication technologies like Wi-Fi, Bluetooth, Zigbee, GSM, LoRa, or 5G to centralized systems or cloud platforms. Once received, the data is processed using microcontrollers, servers, or cloud-based analytics tools. The results are then relayed back to users through dashboards, mobile apps, or automated system responses, enabling monitoring, decision-making, and remote control.

The applications of IoT span across numerous sectors. In smart homes, IoT enables intelligent control of lighting, heating, security, and appliances. In industry and manufacturing, IoT supports predictive maintenance, inventory tracking, and process automation. In agriculture, it helps monitor soil moisture, crop health, and weather conditions. Healthcare is another crucial area, where IoT enables remote patient monitoring, fitness tracking, and management of chronic diseases. Smart cities leverage IoT for efficient traffic management, waste collection, pollution monitoring, and energy usage.

II. LITERATURE SURVEY

In this paper [1] A parking lot guidance system was introduced in Japan in the ancient city of Nara in 1982. This system was part of a plan to relieve congestion caused by the tourist traffic attracted by the many shrines and Buddhist temples that dot the area around Nara Park. It was a simple, small-scale system that collects information on how filled up the four parking lots around the park are and displays this information for individual parking lots on variable road signs on the road. In the six years since then, similar systems have been introduced in six cities to relieve traffic congestion exacerbating urban traffic problems brought about as a deleterious effect of motorization. But as urban traffic problems have become even more complex, the simple, small-scale systems used heretofore are no longer adequate for solving urban traffic problems caused by the lack of parking spaces as cars driven by would-be shoppers, office workers, and tourists drive around looking for an empty lot or parking spot. These problems have created a demand for highly sophisticated large-scale systems that collect and disseminate parking lot information over an entire urban area. Such large, high-function systems were introduced in 1988 in the three cities of Toyota, Kurashiki, and Takasaki. Among these, what is described here is the "Advanced Toyota Parking Guidance and Information (PGI) System" (PGIS), which collects and presents not only parking lot information but also urban area congestion.

In this paper [2] This "age of the automobile" has also become an age of competition between cities as the area served by large stores and other commercial establishments expand in size. As a strategy to survive to the next generation, the city of Toyota is aiming to become a "civic amusement center for families to enjoy," by promoting "the business of providing comprehensive urban amenities" and by (1) becoming a model city for traffic management (with the provision of urban infrastructures such as highways and parking lots) and (2) making the city center more attractive (the concentration of urban functions by redevelopment, etc.). As part of this effort, the PGI system was planned as a support system to further enhance the urban infrastructure such as roads and parking spaces. To make a smooth transition to the "highly information-oriented society" expected to arrive in the 21st century, Toyota is following the promotional policy of the Teletopia basic plan (to create a utopian highly information-oriented society and city through telecommunications) and making use of the new information and communications means referred to as "new media" in furthering an agreeable regional society on the theme of "Toyota, the motor city brimming with vitality and neighborliness." Here too the PGI system is proposed as a "driver information system" that broadens how automobiles can be used. Toyota's PGI system was built as a "support system" for making more effective use of parking facilities and because there are two train stations in the covered area, for the park-and drive. To make it (1) easy to find a parking spot, (2) easy to know where parking places are, and (3) easy to utilize parking lots, this PGI system aimed to increase the efficiency with which parking lots are used, which will ultimately do away with the useless traffic caused by driving around looking for a spot to park and relieve the traffic congestion and confusion caused by cars waiting for an empty spot in a parking lot.

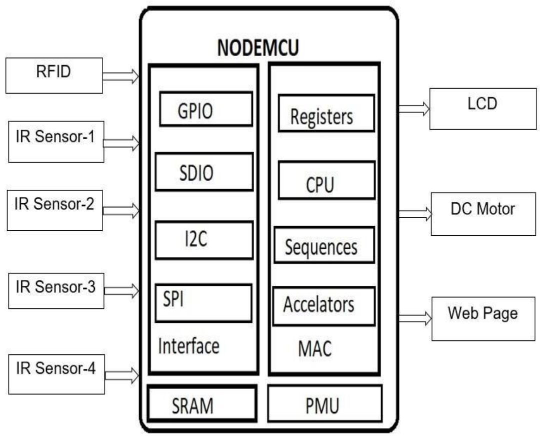
In this paper[3] The existing car parking management system at the university is fully manual which only allows the authorized vehicles that are registered by having the entrance sticker. The whole university area including entrance and exit gates, academic area, administrative and parking zones are all under video surveillance. But this can only serve for video capturing and storing and is not connected to any proper management and monitoring systems. To overcome the above-mentioned problems encountered while car parking in the parking area of the University campus, we propose an Automated Car Parking Monitoring and Management system called (CPMMS). Our proposed system has strong hardware and software components. This system can assist the security department to handle the parking problems more effectively such as locating the car if a person forgets its exact parking location or to locate and pursue the liable person for damaging or blocking someone's car while wrong car parking in the parking lot. A survey based on a quantitative questionnaire is also conducted to investigate the problems encountered by the students, faculty, and staff members. The survey's results confirm the above-mentioned problems that the students, faculty, and staff members are facing and thus our proposed system fulfills all the requirements that need to be addressed by providing appropriate solutions to these problems.

In this paper [3]The realization of such a "smart parking" system relies on four main requirements. 1) Parking Space Detection: First of all, the system relies on the availability of real-time parking information, based on which it makes and upgrades allocations for drivers. As already mentioned, current sensing technologies provide several options to monitor parking spaces. Moreover, whenever the system must make an allocation, it requires location information on all vehicles with pending requests. Based on this information, it estimates the traveling time to an allocated spot and provides driving directions to it. Current vehicle tracking devices/systems provide solutions to this problem. Vehicle tracking systems combine GPS tracking technology with flexible advanced mapping and reporting software.

In this paper [4] ehicle tracking updates, including location, direction, speed, idle time, start/stop, and so on. This technology has been widely used in bus systems. 2) V2I and I2V Communication: The second requirement involves effective two-way communication between vehicles and the allocation center (infrastructure): vehicle-to-infrastructure (V2I) and infrastructure-to- vehicle (I2V). In our "smart parking" system, V2I communication involves drivers sending their parking requests, providing driver information, and confirming reservations to the system. I2V communication includes the DRPC sending allocation results, driving directions, and payment details back to vehicles. Cellular networks (CNs) are usually applied in V2I and I2V solutions, i.e., drivers interact with the system through their mobile phones. In our implementation, we have developed a smartphone application through which drivers interact with the "smart parking" system. Using the application, drivers may log in the system with a unique ID, associated with which is a driver's general information, such as license number, credit card number, car size, etc. The ID is registered by the driver, and the DRPC maintains a database to store the driver's basic information.

In this paper [5] In the development of traffic management systems, an intelligent parking system was created to reduce the cost of hiring people and for optimal use of resources for car-park owners. Currently, the common method of finding a parking space is manual where the driver usually finds a space in the street through luck and experience. This process takes time and effort and may lead to the worst case of failing to find any parking space if the driver is driving in a city with high vehicle density.

III. SYSTEM BLOCK DIAGRAM



A. EXISTING SYSTEM

There is no automatic system to park the car in the parking slot. They were collecting the amount from the car owner. Then only they will allow parking in the parking slot.In the existing system, there is no full automation or RFID used for parking Lots.Manpower is required to maintain the car parking.The driver doesn't know the exact free lots available in the Parking space.Time delay, fuel consumption is more in manual car parking.

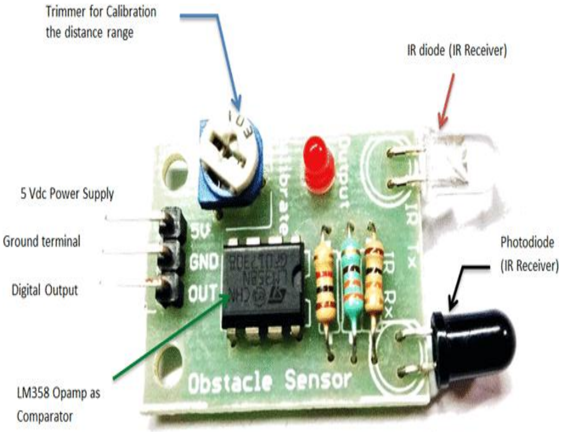
B. PROPOSED SYSTEM

The proposed system consists of detecting the parking lot vacancy using an IR sensor.whenever the user leaves that slot that time for that id payable amount is generated depending upon the parking time.Also, we can Monitor the parking lots through the web.Manpower is reduced by this automation.Reduces cost for users by knowing the time-wise cost.Reduces fuel consumption and time delay.

C. HARDWARE DESCRIPTION

IR Sensor

The IR sensor detecting the parking lot vacancy. Then the IR sensor is detected and whenever he leaves that slot that time for that id payable amount is generated, whenever next time that person will park his vehicle on any slot. We are using the IR sensor to detect the slot is occupied or available and the data are sending to the microcontroller.



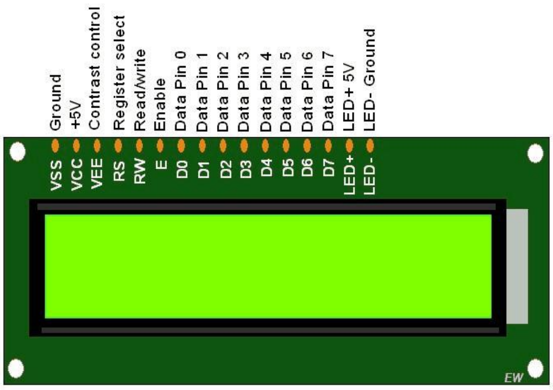
RFID Reader

Vehicle identification is done by RFID sensors and id is generated for that user, when a user parks his vehicle in a parking slot. When the same RFID is read by the RFID reader at that time only an amount is updated for that id.

RFID READER MODULE

LCD

The vacancy information of the parking lot can be obtained through a webpage as well as an LCD. Also, user entry and exit status will be displayed.LCD (Liquid Crystal Display) screen is an electronic display module and finds a wide range of applications. A 16×2 LCD is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations, and so on.



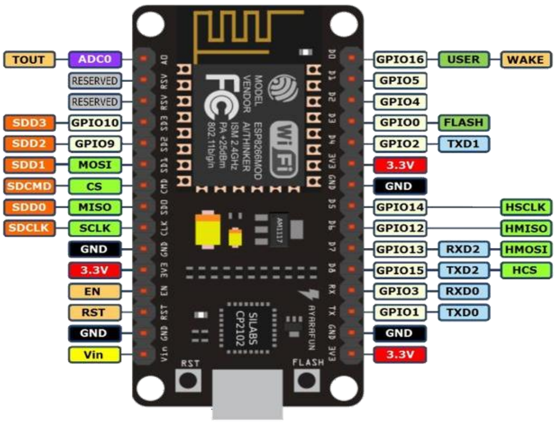
DC MOTOR

The entry and exit gate of the car parking lot works automatically using a DC motor when the RFID tag is read by the RFID reader.

DC Motor

NODE MCU

In this part, acquired data is processed using Node MCU. The Wi-Fi modules esp8266 are inbuilt in the Node MCU. Here we use the C language for programming node MCU. Node MCU will make decisions based on data given in the sensor.



Node MCU

Uses of Node MCU(ESP8266-01)

The ESP8266 is a very user-friendly and low-cost device to provide internet connectivity to the projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making the Internet of Things as easy as possible. It can also fetch data from the internet using API's hence your project could access any information that is available on the internet, thus making it smarter.

ESP-12E Module

The development board equips the ESP-12E module containing ESP8266 chip having TensilicaXtensa® 32-bit LX106 RISC microprocessor which operates at 80 to 160 MHz adjustable clock frequency and supports RTOS.

IV.RESULT

The power supply is taking from the Laptop and given to the Hardware. A web page is designed to monitor car parking. In this car parking, there are 4 slots are available to park the cars. There is a barrier gate, which works when RFID is read by an RFID scanner. The RFID tag will work as a FASTAG. When the user's RFID reads, the parking time will start. After scanning, the gate will open and the user can park the car in the available slots, which can be viewed by the web page and LCD, which is at the car parking. When the user entered the gate, the LCD will display "User Entry". Once the user parked in the parking slot then the IR sensor will detect the car as an obstacle. Then that particular slot will be Occupied, the same will be updated in both web page and LCD as slot Occupied. After completing the user's work the user will come and take the car from the parked slot. When the user came out from the parking slot, the IR sensor will detect none. So it will be updated as "slot Empty". Then the user has to read RFID to go out. When the same RFID reads again the parking timing will stop. And based on the parking time, the inbuilt program will calculate the amount for the parking. Then it can be viewed by the user. This amount will be deducted from the RFID, as it is working as a FASTAG reader. Then the gate opens and the user can go out. This same operation will occur every single car, which is coming for the parking.

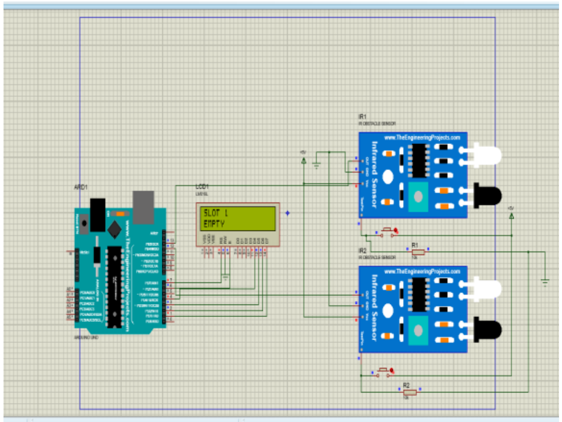


Fig: 1: When IR 1 sensor detects none

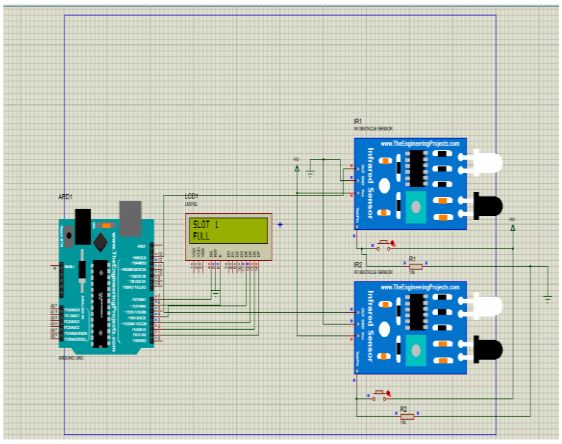


Fig: 2 When IR 1 sensor detects an obstacle(car)

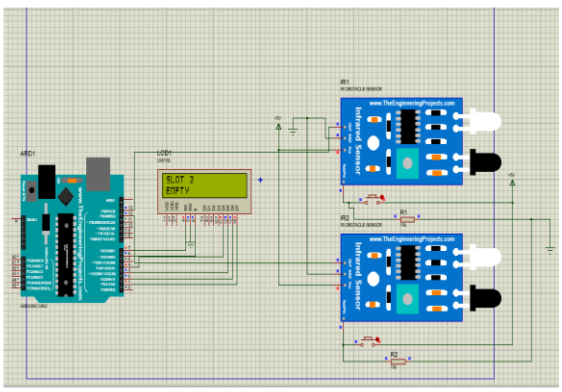


Fig: 3 : When IR 2 sensor detects none

Fig: 4: When user's RFID is read

Fig: 5 Web page when there no car is parked

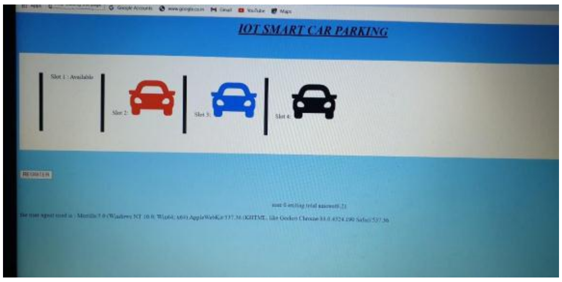


Fig: 6: Web page Updation, When the User exited from the slot

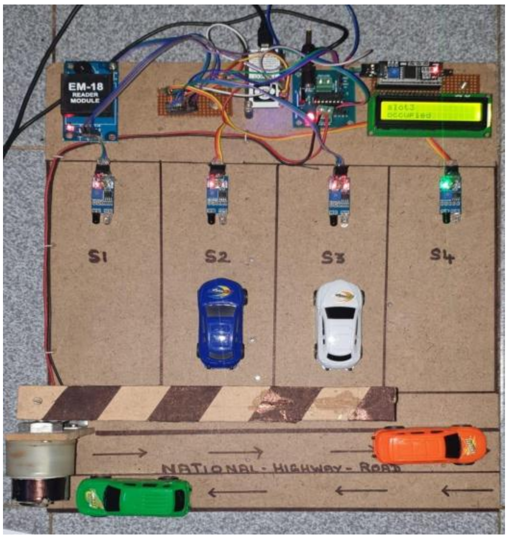


Fig: 7: Car parking prototype, while no vehicles in entry/exit (Gate closed)

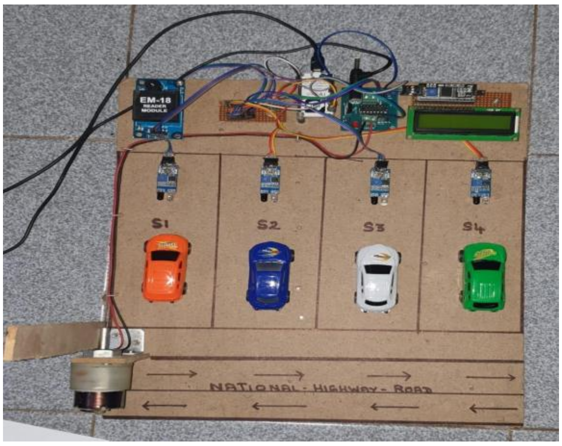


Fig: 8: Car parking prototype, when vehicles come entry/exit (Gate opened)

V. CONCLUSION

Smart parking facilitates the problems of urban livability, transportation mobility, and environmental 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. The proposed system has developed from traditional servicing channels like toll-booth and parking attendants. It involves the use of an IR sensor, ESP8266-01 Wi-Fi Module, Cloud server. The Internet of Things integrates the hardware, software, and network connectivity that enable objects to be sensed and remotely controlled across the existing network. Such integration allows users to monitor available and unavailable parking spots that lead to improved efficiency, accuracy, and economic benefit.

REFERENCES

[1] Lin T, Rivano H and Le Mouël F "A Survey of Smart Parking Solutions," in IEEE Transactions on Intelligent Transportation Systems, vol. 18, no. 12, Dec. 2017,pp. 3229-3253.

[2] Bibi N, Majid M N, Dawood H, and Guo P, "Automatic Parking Space Detection System," 2017 2nd International Conference on Multimedia and Image Processing (ICMIP), Wuhan, 2017, pp. 11-15.

[3] Ji Y, Guo W, Blythe P, Tang D, and Wang W, "Understanding drivers' perspective on parking guidance information," IET Intell. Transport Syst., vol. 8, no. 4, June 2014, pp. 398–406.

[4] Guan H, Liu L, and Liao M, "Approach for the planning of parking guidance and information system," J. Highway Transport. Res. Develop., vol. 1, 2003, pp. 034.

[5] Caicedo F, "Real-time parking information management to reduce search time, vehicle displacement and emissions," Transport. Res. D, vol. 15, no.4, 2010,pp. 228–234.

[6] Grodi R, Rawat D B, and Rios-Gutierrez F, "Smart parking: Parking occupancy monitoring and visualization system for smart cities," SoutheastCon 2016, Norfolk, VA, 2016, pp. 1-5.

[7] Pala, Zeydin, and Nihat Inanc. "Smart parking applications using RFID technology." RFID Eurasia, 2007 1st Annual. IEEE, 2007.

[8] Rahman, Mohammad Shaifur, Youngil Park, and Ki-Doo Kim. "Relative location estimation of vehicles in the parking management system." Advanced Communication Technology, 2009. ICACT 2009. 11th International Conference on. Vol. 1. IEEE, 2009.

[9] Anthony's, Robert B. "Automated vehicle parking system." U.S. Patent No. 5,414,624. 9 May 1995.

[10] Van Deursen, Ton, and Saša Radomirović. "Algebraic attacks on RFID protocols." In Information Security Theory and Practice. Smart Devices, Pervasive Systems, and Ubiquitous Networks, pp. 38-51. Springer Berlin Heidelberg, 2009.

[11] Arnott R, Rave T, and Schob R Alleviating Urban Traffic Congestion. Cambridge, MA, USA: MIT Press, 2005.

[12] Atar R, Mandelbaum A, and Reiman M, "Scheduling a multi-class queue with many exponential servers: Asymptotic optimality in heavy-traffic," Ann. Appl. Probab., vol. 15, no. 4, pp. 2606–2650, 2004.

[13] Benenson I, Martens K, and Birr S, "Parkagent: An agent-based model of parking in the city," Comput. Environ. Urban Syst., vol. 32, no. 6, pp. 431–439, Nov. 2008.

[14] Benson J, Donovan T, Sullivan P, Roedig U, and Sreenan C, "Car-park management using wireless sensor networks," in Proc. 31st IEEE Conf. Local Comput. Netw., 2006, pp. 588–595.

[15] K. Cheung and Varaiya P, "Traffic surveillance by wireless sensor network: Final report," Univ. California, Berkeley, CA, USA, Tech. Rep. UCB-ITS-PRR- 2007-4, 2007.

[16] Chou S, Lin S, and Li S, "Dynamic parking negotiation and guidance using an agent-based platform," Expert Syst. Appl., vol. 35, no. 3, pp. 805– 817, Oct. 2008