RESEARCH ARTICLE OPEN ACCESS

IOT-Based Predictive Maintenance for fleet Management

Dr.P.Venkatesan*, Dr.P.Jamuna Rani**
*(Department of Electrical and Electronics Engineering, Mahendra Institute of Technoogy, Namakkal
Email: drvenkatesanp@gmail.com)
**(Department of Chemistry, Mahendra Institute of Technoogy, Namakkal
Email: jamunaranip@mahendratech.org)

----------**********----------

Abstract:

In recent years, the Internet of Things (IoT) and big data have been hot topics. With all this data being produced, new applications such as predictive maintenance are possibleIn this project we are going one step ahead with GPS and going to track a vehicle using GPS and GSM. This Fleet management system can also be used for Accident Detection Alert System, Soldier Tracking System and many more, by just making few changes in hardware and software. Tracking of vehicle is a process in which we track the vehicle location in form of Latitude and Longitude (GPS coordinates). GPS Coordinates are the value of a location. This system is very efficient for outdoor application purpose. This kind of Fleet management system Project is widely in tracking Cabs/Taxis, stolen vehicles, school/colleges buses etc. This system is basically an embedded one. Embedded stands for hardware controlled by software. Here, the software using a Arduino controls all the hardware components. Arduino plays an important role in the system. Currently almost of the public having an own vehicle, theft is happening on parking and sometimes driving insecurity places. The safe of vehicles is extremely essential for public vehicles. Vehicle tracking and locking system installed in the vehicle, to track the place. The place of the vehicle identified using Global Positioning system (GPS) and Global system mobile communication (GSM). These systems constantly watch a moving Vehicle and report the status on demand. When the theft identified, the responsible person send SMS to the microcontroller, then microcontroller issue the control signals to stop the engine motor. Authorized person need to send the password to controller to restart the vehicle and open the door. This is more secured, reliable and low cost.

Keywords — **Fleet Management System, Global Positioning System, Global Navigation Satellite System, Internet Of Things.**

----------**********----------

I. INTRODUCTION

This These days support of an association is developing as a major issue a smart answer for establishing out and keeping up the truck is the proposed procedure.Modern data analytic algorithms struggle to process the massive amounts of data produced by these IoT devices.

Internet of Things (IoT) is a new paradigm that is growing quickly. By 2020 many believe billions of devices will be connected to the internet. Some of the applications of IoT are smart farming, smart transport, smart health, smart cities, smart homes, and smart grids. With all these devices connected to the internet, big data becomes more prevalent. Modern data analytic algorithms struggle to process the massive amounts of data produced by these IoT devices. Predictive maintenance, an example of smart transportation, attempts to predict the health of equipment using machine learning. Predicting vehicle faults is not a trivial task. Labeled datasets of vehicle faults are rare compared to historical data of normal vehicle behavior because it is not financially viable to break equipment to gather fault data. Common prediction measures are equipment remaining useful life and the health status of the equipment. The state of the art of predictive maintenance and related IoT architectures follow to deployed a fleet- from rest of fleet and to diagnose the deviations using a history of fault data. According to, MineFleet is a commercial predictive wide predictive maintenance system for a fleet of 19 buses and were able to detect buses that deviated.

Proposed an IoT architecture using Senml. They used gateways to connect legacy devices to the internet. used expert systems on the cloud to analyze vehicle data to help mechanics make decisions. Analyzed CAN-bus data of military vehicles to perform vehicle diagnostics. Proposed an IoT middleware for managing IoT devices, using gateways and software defined networks.

The present work involves anIoT architecture for a predictive maintenance fleet management system and fleetwide data analytics, currently under development, that runs on a proposed architecture. The predictive maintenance architecture of this work is focused on public transport buses.

TABLE I

DIFFERENCE BETWEEN GPS AND FLEET MANAGEMENT

Sl. No	GPS	FLEET MANAGEMENT
1	In GPS tracking we can track only live location	We can store present and previous data
2	Drive management is not possible	Drive management is possible
3	Root mapping is not possible	Root mapping is possible
4	Complete history cannot be documented	Complete history can be possible
5	Geo zone cannot be limited in GPS	Geo zone can be limited in FMS
6	We cannot make alert call based and SMS based	We can make call alert and SMS alert
7	We cannot monitor fuel consumption, harsh drivingand hard breaking	We can monitor fuel consumption, harshdriving and hard breaking

II. LITERATURE SURVEY

Engelbrecht, J., Booysen, M. J., Bruwer, F. J., & van Rooyen, G.-J. (2015). Survey of smartphone-based sensing in vehicles for intelligent transportation system applications. IET Intelligent Transport Systems

Mrs. ManasiPatil, AanchalRawat, Prateek Singh, Srishtie Dixit,"Accident Detection and Ambulance Control using Intelligent Traffic Control System", International Journal of Engineering Trends and Technology (IJETT).

In highly populated countries like India, every 3.7 minutes a death swoops in. A leading cause of the global burden of public health and fatalities is road accidents. The loss of human life due to accident is to be avoided. . Traffic congestion and tidal flow are major facts that cause delay to ambulance, as most of the countries follow predetermined sequence of traffic lights. Sometimes the accidents are also not detected in time, which also in many cases leads to loss of life.The idea here is to provide an Intelligent Traffic Light System ,which would help the ambulance reach the destination in minimum possible time by providing an adequate route of passage. Along with this a controller is to be fit on vehicles, which would help in fully automatic detection of the occurrence of accident and locate the vehicle as well. Apurva Mane, Jaideep Rana, (2014) International Journal of Current Engineering and Technology,"Vehicle Collision detection and Remote Alarm Device using Arduino". D. Donko and A. Alispahic IEEE, (2012) "Implementation of tracking mobile application and analysis of spatial data".

The paper presents utilization of existing aspects of global navigation and global position system (GPS), and visualization of Earth using satellite images, in order to gather and store particular data. The analyzed GPS data are related to the position and tracking of important person, vehicle or device. The described model of developed monitoring application allows more comprehensive and detailed analysis and insight in the traffic congested areas on the map in the specific amount of time, which is achieved by creation and manipulating of multidimensional data model presented in the paper. The paper also describes practical aspects of implemented monitoring center for GPS devices and possible future improvements

III. MODULES

A. Arduino

The Arduino is open source physical processing which is base on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino gains a few inputs, for example, switches or sensors and control a few multiple outputs, for example, lights, engine and others. Arduino program can run on Windows, Macintosh and Linux operating systems (OS) opposite to most microcontrollers' frameworks which run only on Windows. Arduino programming is easy to learn and apply to beginners and amateurs.

Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer. It's an open-source physical processing stage focused around a straightforward microcontroller board, and an environment for composing programs for the board. Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Arduino activities can be remaining solitary, or they can be associated with programs running on your machine (e.g. Flash, Processing and Maxmsp.) The board can be amassed by hand or bought preassembled; the open- source IDE can be downloaded free of charge.

Focused around the Processing media programming environment, the Arduino programming language is an execution of Wiring, a comparative physical computing platform.

Fig. 1 Arduino Board

B. GPS module

The GPS receiver gets a signal from each GPS satellites.The satellites transmit the exact time the single are sent.So give the travel time of the GPS signal from three satellites and exact position in the sky, the GPS receiver can determine your position in three dimensions east, north and altitude. As with position the speed accuracy of GPS depends on many factors. The providesthe GPS signal in space with a global average user range rate (URRE) of <0.006 m/sec over any 3 second interval, with 95% probability.

Fig. 2 GPS Module

GPS stands for Global Positioning System and used to detect the Latitude and Longitude of any location on the Earth, with exact Universal Time Co-ordinate time. This device receives the coordinates from the satellite for each and every second, with time and date. GPS offers great accuracy and also provides other data besides position coordinates. The module connects to the Arduino through a 9600 bps Transistor-Transistor Logic-level interface. Only four wires are needed to read the module's GPS data. This module Compatible with 3.3V-5V interface. It also has an Electrically Erasable Programmable Read-Only Memory and a Flash which is useful to save configuration data

C. GSM Module

It has On board Micro SIM card holder. Its Working frequencies are quad- band network, 850 / 900 / 1800 / 1900MHZ.It can communicate with TTL(Transistor– transistor logic) serial port. It can communicate with controllers via AT commands. This module support software power on and reset. It able to make and answer phone calls ,Sending and

receiving SMS. It can send and receive GPRS data through TCP/IP, HTTP protocol.

Fig. 3 GSM Module

GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network.TER 4

A customised Global System for Mobile communication (GSM) module is designed for wireless radiation monitoring through Short Messaging Service (SMS). This module is able to receive serial data from radiation monitoring devices such as survey meter or area monitor and transmit the data as text SMS to a host server

IV. FLEET MANAGEMENT SYSTEM

Tracking of vehicle is a process in which we track the vehicle location in form of Latitude and Longitude (GPS coordinates). GPS Coordinates are the value of a location. This system is very efficient for outdoor application purpose

This kind of Fleet management system Project is widely in tracking Cabs/Taxis, stolen vehicles, school/colleges buses etc.

This circuit is designed for tracking the location of vehicles. Most of tracking systems are made by using GPS. This is very simple and cheap. Tracking systems are mostly used by fleet operators for tracking a vehicle location, routing and others. This is a very good method for preventing our vehicles from stolen. This tracking system sends us the geographical coordinates and by using these coordinates we can track our vehicle position on electronic maps using internet. By using these tacking systems we can share real time information about transportations. And also can be share real time information or position bus/taxi/cab with passengers. Means passengers can see the real time of arriving bus/taxi/cab on Mobiles.

PayaRadyab system comprises a device called tracker and a software. Our designed and fabricated tracker, Rad100, is used for receiving satellite waves and transmitting the received information to the desired web server using a GPRS connection. When Rad100 receives the satellite waves at least from 4 GPS/Glonass satellites, by exact calculations and necessary operations, the position of the device can be achieved and stored on its memory card. It will send such information to a web server as either synchronous (online) using the GPRS or SMS platforms in the GSM communication network, or asynchronous (for later offline loading into the program).

the generic framework for the IoT based fleet automation is described with the overall framework design is shown in Figure 1.1. The complete framework for the management of transportation resource management involved to provide efficient fleet management based on the user's requirements. The overall architecture includes mainly three layers for the resource management.

D. Fleet IoT Layer

The first layer of this framework includes the necessary sensors Information of the truck and the configuration of the board with GPS. The information regarding the sensors with configuration of the circuit to represent the IoT information for the fleet management is described

E. Fleet Web Layer

The layer of the framework describes the user interface and the could sever configuration. The user interface for the communication among the users are managed in layer. The information

transmission among the IOT configuration and the user interface consume the input and output management among the cloud server and IOT information of the truck. The information are stored and retrieved from the cloud server to the interface of the fleet web layer

F. Fleet Data Maintenance Layer

The layer includes the truck information maintenance for the automatic updation of the necessary information to reduce the resource wastage. This layer provides information such as fuel observation, engine temperature, fuel consumption, location, etc. of the truck. Based on the provided information the fleet data is sustained among the cloud server and user interface.

Intelligent real-time monitoring of trucks calibrates weight in the motion of cargo vehicle and its location through the GPS is to provide reliable and affordable intelligent truck monitoring system through the emerging technologies like Internet of Things (IoT) and Cloud Computing that supports the productivity, profitability, and safety for the commercial cargo industry.

G. Truck weight calculating without Load

Two conditions will be applied as per Einstein's Theory of Relativity to calculate the weight of the truck precisely without a load attached to it. Initially truck's weight is measured without any load attached to it when the truck is not in motion on the flat surface. Now, the truck's weight is calculated without any load attached to it but the truck should in motion. Weight calculation takes place on the flat surface.

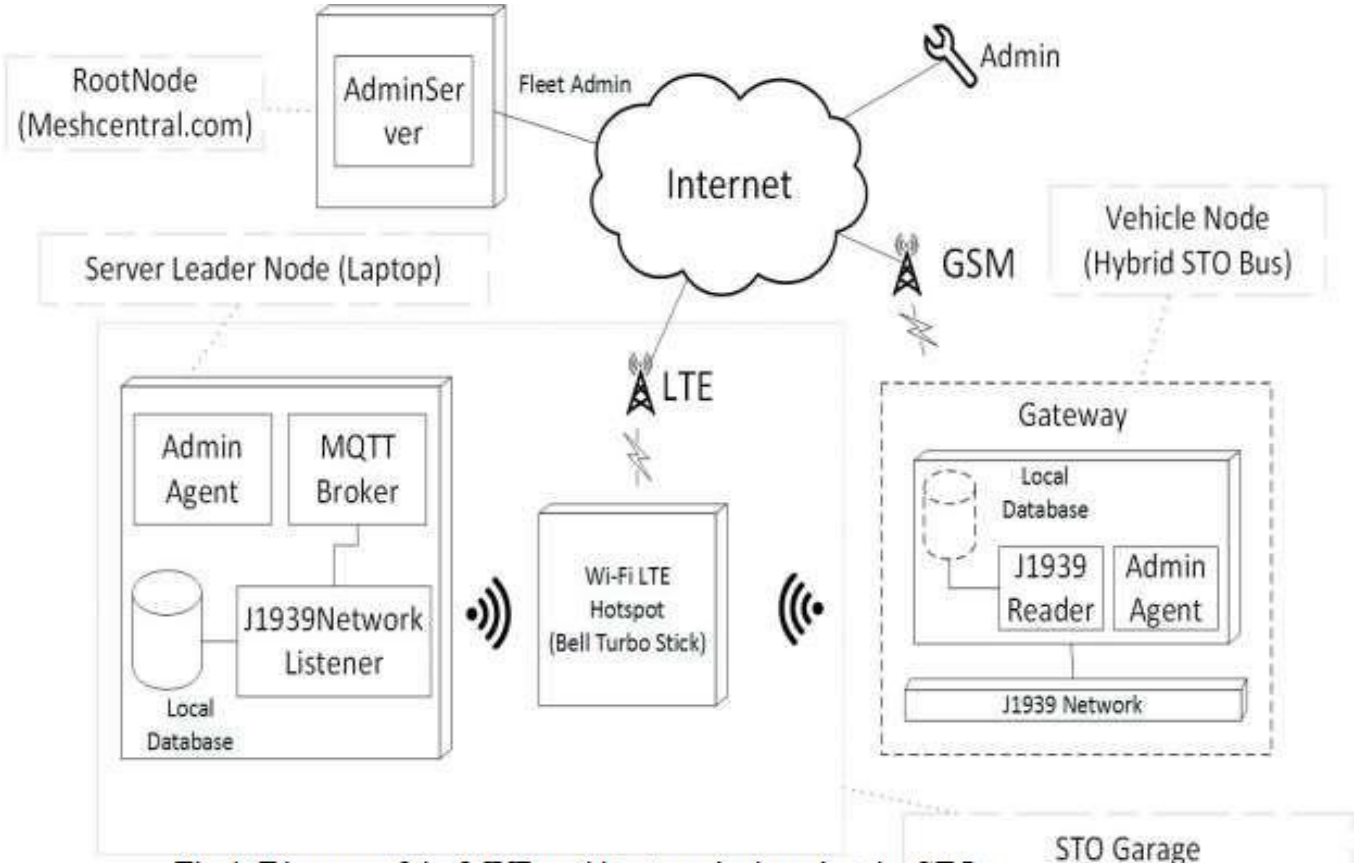

Fig 4. Diagram of the MVP architecture deployed at the STO

H. Truck weight calculating with Load.

Two conditions will be applied to calculate the weight of the truck precisely with the load attached to it. Here, weight measurement is done by the spring suspension method on various road conditions. Cargo is loaded on the truck first. Next, the truck's weight is measured when the truck is not

in motion on a flat surface. A cargo is loaded on the truck. Next, truck's weight is measured but the truck should be in motion. Weight calculation takes place on the flat surface, hilly roads and various road conditions.

V. HARDWARE SETUP OF FLEET MANAGEMENT SYSTEM AND RESULTS

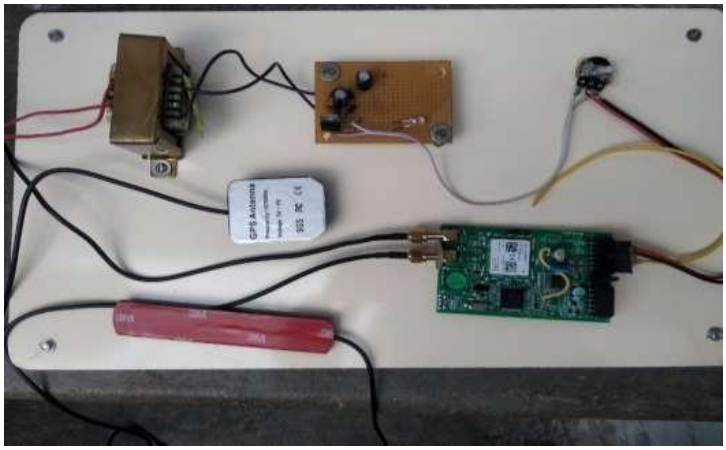

Fig. 5 Hardware of FMS

Use of present FMS system

- Predictive Maintenance
- Weight Variation Identified with IoT board – Asset Management
- Live Tracking
- Work Flow of Real-Time Monitoring
- Truck History
- Off Line Weight Scaling
- On Line Weight Scaling:
- Maintaining Vehicle Health
- Driver Details and Live Camera
- Truck Current Location Map

Truck data can be more easily gathered and examined by simply equipping vehicles with IoT sensors. The information gleaned from the sensors can then be used to track, monitor, analyze, and maintain a complete fleet and in real-time. IoT board is made of Qualcomm new generation processor of multimode Smart LTE Cat 4 module. This board gives 150Mbps downlink and 50 Mbps data rates at maximum based on LTE and it supports wireless communication via Wi-Fi and BLE. It is applicable for industry and user applications which requires high data rate and high-speed internet access.

a. Dashboard

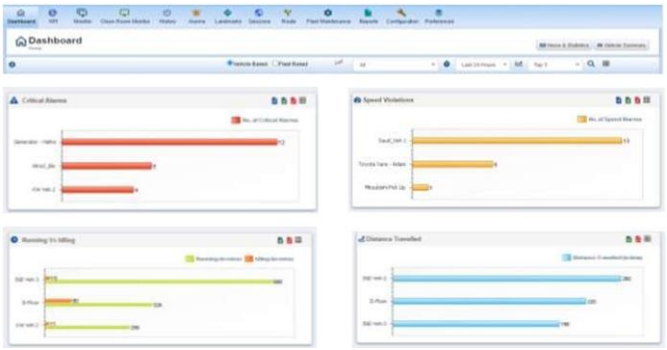

Fig. 6 Dashboard

The dashboard also track empty miles, how much of the fleet is availabe, average mile and age, as well as insurance costs. The dashboard uses picklist parameters, so that the user can easily customize their view by the type of vehicle they like to know more about.

b. Key Performance Indicator (KPI)

Fig. 7 Key Performance Indicator

The Key Performance Indicator (KPI) tracking helps measure efficiency across your fleet. Setting fleet management benchmarks and measuring KPIs is the best way to enhance fleet productivity and control costs

c. Monitor

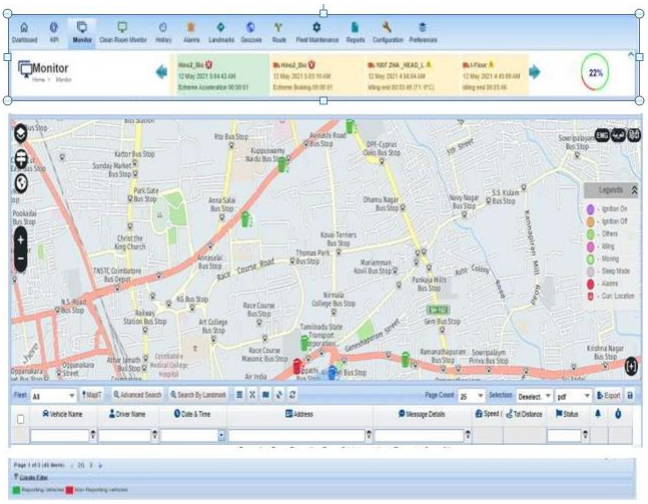

Fig. 7 Monitor

The Monitor is a way to track the activity of a company's mobile assets, normally using a GPS tracking unit fitted to the vehicle or equipment being tracked. The GPS unit regularly transmits the equipment or vehicle location using a built in cellular or satellite connection.

d. History

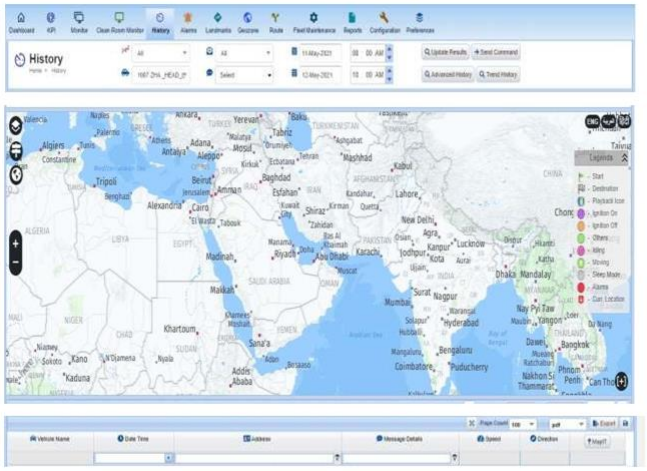

Fig. 7 History

The History is a related application of business intelligence technologies are reporting, online analytical processing, data mining, process mining, business performance management, benchmarking, and predictive analytics

e. Alarms

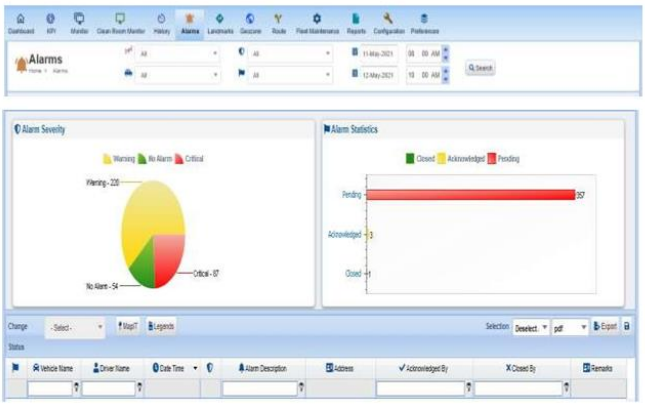

Fig. 7 Alarms

VI. CONCLUSIONS

The work of the fleet automation based on the IoT Logistics is employed to manage the resources with the minimum amount of human resource. The monitoring of fuel level of the truck will check the separation crossed by the truck and furthermore checks the fuel utilization regarding the separation crossed. Consequently by giving preliminary control measures to the driver for the correct support of the truck. This will be actualized in the courses where efficiency is required. It will lessen asset for keeping up countless vehicles and furthermore confines fuel, speed, temperature, and so on tapping by driver. Constructed a vehicle tracking system controlled by a smart phone specifically an embedded device. Designed and implement cost effective vehicle tracking system yet an efficient one. Designed a user friendly and a safe system to control vehicles especially aimed to aid the elders.

REFERENCES

[1] Amarasinghe, M., Kottegoda, S., Arachchi, A.L., Muramudalige, S., Bandara, H.M.N.D., Azeez, A., 2015. Cloud-based driver monitoring and vehicle diagnostic with obd2 telematics. 2015 Fifteenth International Conference on Advances in ICT for Emerging Regions (ICTer) doi:10.1109/icter.2015.7377695.

[2] Bonomi, F., Milito, R., Natarajan, P., Zhu, J., 2014. Big data and internet of things:A roadmap for smart environments. volume 546.

[3] Braden, D.R., Harvey, D.M., 2014. A prognostic and data fusion based approach to validating automotive electronics. SAE Technical Paper Series doi:10.4271/2014-01-0724.

[4] Budakoti, J., 2018. An IoT Gateway Middleware for interoperability in SDN Managed Internet of Things. Ph.D. thesis. Carleton University.

[5] Datta, S.K., Bonnet, C., Nikaein, N., 2014. An iot gateway centric architecture toprovide novel m2m services, in: Internet of Things (WF-IoT), 2014 IEEE World Forum on, IEEE. pp. 514–519.
Ding, B., Mends, D., Kiringa, I., Yeap, T., . Iot architecture with hybrid communication modes for fleet management, in: Technical report, Faculty of Engineering, University of Ottawa, Ottawa, Ontario, Canada.