Initial Project Proposal

Year: 2016 Semester: Fall

Project Name: Automatic Number Plate Recognition(ANPR) Parking System

Creation Date: Apr.10, 2016 Last Modified: Dec. 15, 2016

Team Members (#1 is Team Leader):

Member 1: Zhihao Liu Email: liu869@purdue.edu

Member 2: Kaiwen Yu Email: yu356@purdue.edu

Member 3: Zhuofan Li Email: li1365@purdue.edu

Member 4: Tian Qiu Email: qiu58@purdue.edu

1.0 Description of Problem:

While most families own a car or cars, they usually need to buy permits or tickets to park their car in a parking lot or go through a highway toll collection booth. Taking the parking garage as an example. For hourly or daily garages like in an airport, drivers need to get their ticket when they start parking and pay at the ticket machine or at the exit when they leave. If someone was in a hurry to catch your flight, this cumbersome process will definitely cause inconvenience. Also, people can lose their tickets, taking even more time to recover. From the garage owner’s perspective, cheaters will try to tailgate another car so that they can park for free, which is a pain for many garage owners. Many parking garages discourage tailgating through the use of signs. If drivers are looking for a garage with parking permit, they still need to obtain their permits through mail or go to the office to get one, which means garage owners need hire a custodian to maintain the service. The overhead of those activities can be reduced, reducing the cost.

2.0 Proposed Solution:

With the problem described above, we came to an idea that addresses the root of the problem. Our design is to turn the manual work into a digital process. A camera will be used to obtain a picture from the front or rear of the car, then send the picture to a server. Our server will analyze the picture and figure out the corresponding plate number. If the driver did have the parking permit, then the system will control our microcontroller to open the barrier gate for the driver. Assistant LEDs and sensors will assist driver to find available parking spots.

3.0 ECE477 Course Requirements Satisfaction

We plan to use two microcontrollers and printed circuit boards in this project which will satisfy senior design course requirement.

3.1 Expected Microcontroller Responsibilities

Two microcontrollers are expected to be used. The first microcontroller is raspberry PI, which is used to take the picture of vehicles, process the images and determine whether the plate number is valid or not. Then send the valid flag signal to second microcontroller.

Another microcontroller is to take the control of the “parking lot management system”. Parking lot manage system basically consists of three parts. One part is to receive the signal from raspberry PI. Second is to control the engine to heave entry crossbar. Third is to show how many parking spot left in this parking lot according to sensor results from each spot.

3.2 Expected Printed Circuit Responsibilities

The printed circuit boards will be used to connect the Raspberry Pi with other devices such as LED, sensors, camera, power supply and LCD screen. We plan to use LED-Strip or LED bulb to clearly show drivers the procedure to use our parking system. These LED should be connected through PCB to Raspberry Pi. Since we may need multiple cameras, we will need an extra USB camera besides camera module on Raspberry Pi. Sensors will be used to detect the position of cars. These devices will be placed on multiple small printed circuit boards and connected to Raspberry Pi.

4.0 Market Analysis:

Our system can be divided into two parts: “Automatic number plate recognition “and “Parking lot manage system”. According to a new market report published by Transparency Market Research "Automatic Number Plate Recognition Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2014 - 2020," the automatic number plate recognition market globally is forecast to reach USD 1,023.2 million by 2020. From our perspectives, even at Purdue, many parking lots can be implemented our system. If we bring this to the market, there will be large potential market for a starter company like us to share.

5.0 Competitive Analysis:

The market for ANPR (automatic number plate recognition) has been segmented based on applications, end-users and geography. For example, ANPR can be used by government to recognize cars for the security reason. Also for tolls collection and some other areas. Our team will majorly focus on a parking system combined with ANPR. A company called **Smart Parking** in UK offers a parking system with ticketless, barrier-free system. And drivers can pay & walk, using their registration number as ID, and parking offences will be generated automatically if needed. **Wintone**, a Chinese company, offers ANPR system in China, which can recognize exclusively Chinese license plate, which are almost uniform type of plate. One of the difficulty for us is that there are lots of different types plates in US, which makes plate recognition more complicated. For the market, there isn’t a leading company for ANPR in US yet. There are still many opportunities to enter this industry.

5.1 Preliminary Patent Analysis:

5.1.1 Patent #1:

Parking lot management system

US 20120299749 A1

A parking lot management system determines a current parking space inventory for one or more parking lots using a parking database. The parking lot management system receives, via a network, a location associated with a parking customer, and identifies a parking lot of the one or more parking lots currently having available parking spaces based on the customer's location. The parking lot management system sends, via the network, at least one of a current occupancy, parking rates, or a location of the identified parking lot to the parking customer. The parking lot management system further receives a parking space reservation inquiry from the parking customer, and identifies a parking space from the identified parking lot based on the parking customer's location.

5.1.2 Patent #2:

Electronic payment parking lot system and method

US 20020032601 A1

There is provided an integrated system and method for payment and enforcement of parking services. The invention utilizes a digital carrier, such as the electromagnetic energy spectrum or wired network to effect the payment transaction and enforcement. The invention typically includes interfaces for an electronic meter, web server, and motorist device. The motorist utilizes the device, e.g., cellular phone or handheld device, to access an individual account on the web server, providing information pertinent to the transaction. Upon receipt of the information, the web server verifies account information and the account balance, authorizes the transaction, and debits the motorist's account accordingly. The web server communicates with the electronic meter, which displays the paid time units or an expiration flag. The web server communicates with handheld devices of paid parking enforcement officials to provide instantaneous notification of expiration of time units and other information pertinent to paid parking services.

5.1.3 Patent #3:

Automated parking lot system, method, and computer program product

US 20060212344 A1

A system, method, computer program product and propagated signal for an automatic parking system. The system includes a sensing subsystem for detecting an occupancy status of a vehicle parking space, said sensing subsystem providing a real-time occupancy status signal for said vehicle parking space wherein said occupancy status signal includes an occupied mode and an unoccupied mode; a communications subsystem, coupled to said sensing subsystem, for transmitting said occupancy status signal; and a management subsystem for receiving said occupancy status signal, said management subsystem processing a parking transaction for said vehicle parking space automatically upon a mode change of said occupancy status signal. A method includes automatically opening a parking transaction upon detecting an occupation of a parking space or area and automatically closing a parking transaction upon detecting a vacation of a parking space or area. Additional elements may include an authorization system and a notification system. The methods include identified parking methods for detecting automatically changes in an occupancy status of one or more parking spaces or areas and automatically initiating/closing, as appropriate, parking transactions responsive to appropriate detected changes in occupancy status signals associated with each of the one or more parking spaces, as well as methods of making and using the disclosed systems. Computer program products and propagated signals include computer-executable instructions for implementing the systems and methods.

5.2 Commercial Product Analysis:

5.2.1 Commercial Product #1: AutoVu ALPR

AutoVu is at the core of your license plate-enabled parking (LEP) system, allowing you to automatically capture license plate numbers to enforce parking permits or time-limited zone rules, and conduct lot inventories. With powerful features such as digital wheel imaging for chalking and shared-permits enforcement support, the AutoVu system captures license plate characters, vehicle images, time stamps and GPS coordinates, decreasing the number of parking ticket disputes and increasing compliance.

5.2.2 Commercial Product #2: PlateSmart’s ARES

PlateSmart’s ARES fixed ALPR software solution is eliminating the need to manually inspect vehicles and write tickets. ARES is able to automatically scan and log all vehicles coming onto a lot, with the ability to alert management or officials to violations. All license plate captures are time and date stamped and include full-color license plate images. In addition to controlling access, ARES can keep a count of vehicles in the lot, alerting appropriate personnel if the lot is at or close to capacity.The system can also be connected to local law enforcement, instantly alerting them if a hotlisted vehicle attempts to enter the lot.

5.2.3 Commercial Product #3: ELSAG's Fixed Plate Hunter-900® (FPH-900®)

ELSAG's Fixed Plate Hunter-900® (FPH-900®) automatic license plate recognition (ALPR) technology, also known as License Plate Reader technology, is revolutionizing tolling operations and traffic monitoring. Fixed cameras mounted on toll plazas, tunnel entrances, bridge structures and other strategic places read the license plates of vehicles passing through at a rate of over 900 plates per minute, per camera. The system compares each plate number to a database of drivers who have pre-paid tolling fees and are therefore allowed pass through the toll station without stopping to pay. If the license plate recognition technology reads a plate that is not on the database, alarms will alert officials. The highly advanced ALPR tolling systems perform without any effort from operators or additional hardware, greatly reducing costs.

5.3 Open Source Project Analysis:

5.3.1 Open Source Computer Vision(OpenCV):

OpenCV is a library of functions for real-time image processing. It supports popular programming language such as C++, C, Python and Java and operating system like Windows, Linux, Mac OS, iOS and Android.

Since it supports many language and operating system, it will be much more easier to develop and realize our design.

OpenCV is released under a BSD license and it’s free for both academic and commercial use.

Pros: It’s free to use OpenCV. It also has huge library that can help us to realize our project. There is a big community that use and support OpenCV to help us trouble shooting.

Cons: The documentation of OpenCV is bad so it will take us more time to look for useful information.

5.3.2 Tesseract Open Source OCR Engine:

Optical character recognition (OCR) is the electronic conversion of images of text into plain text on computer. Tesseract has unicode support and can recognized many languages and also can be trained to recognized more language.

Tesseract Open Source OCR is released under Apache License Version 2.0

Pros: It supports many languages and it’s free to use.

Cons: It’s not easy to make it work perfectly. We must do some image filtering to remove unrelated content on a picture.

6.0 Sources Cited:

[1] OpenCV, 2016. [Online]. Available: <http://opencv.org/>. [Accessed: July 6, 2016]

[2] tesseract-ocr, 2016. [Online]. Avaliable: <https://github.com/tesseract-ocr>. [Accessed: July 6, 2016]

[3] Electronic Payment Parking Lot System and Method. Gebre Admasu, Michael Gurmu, assignee. Patent US 20120299749 A1. 25 Apr. 2002. Print.

[4] Xiao, Hong, Dongchen Wang, Rahul KHUSHOO, Andre Turner, and Afshin Moshrefi. Electronic Payment Parking Lot System and Method. Patent US 20120299749 A1. 25 Apr. 2012. Print.

[5] Marcus, Cooper J., and Neil Rosenblatt. Automated Parking Lot System, Method, and Computer Program Product. Patent US 20060212344 A1. 21 Sept. 2006. Print.

[6] “ANPR Pay & Display car park management | Smart Parking,” *ANPR Pay & Display car park management | Smart Parking*. [Online]. Available: http://www.smartparking.com/automatic-number-plate-recognition-anpr. [Accessed: 10-Jul-2016].

[7] “Automatic Number Plate Recognition Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2015 - 2023,” *Automatic Number Plate Recognition Market*. [Online]. Available: http://www.prnewswire.com/news-releases/automatic-number-plate-recognition-market---global-industry-analysis-size-share-growth-trends-and-forecast-2015---2023-300205438.html. [Accessed: 10-Jul-2016].

[8] “Automated License Plate Reader MPH-900 ALPR Bus Safety LPR Camera,” *Automated License Plate Reader MPH-900 ALPR Bus Safety LPR Camera*. [Online]. Available: http://www.elsag.com/tolling.htm. [Accessed: 12-Jul-2016].

[9] “Commercial Markets,” *PlateSmart*, Apr-2016. [Online]. Available: http://www.platesmart.com/commercial-markets/. [Accessed: 12-Jul-2016].

[10] “AutoVu Automatic License Plate Recognition | Genetec,” *Genetec*. [Online]. Available: http://www.genetec.com/solutions/all-products/autovu. [Accessed: 12-Jul-2016].

Appendix 1: Concept Sketch



3 major things with micro controller

Team 8