Progress Report
Parking Convenience System

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The document is a summary of the progress that Pvision Electronics has made since the inception of its novel product, the PVision Parking Convenience System. The system is designed to allow drivers to easily spot all the vacant parking spots in an outdoor parking lot before even entering it, thus, saving time and money. The system works using real-time pictures of the parking lot and employing intelligent image processing algorithms to obtain a visual mapping of the parking spots in a parking lot and their vacancy status. Customers are able to view a schematic image of the parking lot on a large display outside the lot and make their way over to the vacant spot most convenient to them instead of mindlessly circling the area scanning for possible parking spots.

The implementation of the project plan has been running as expected despite unforeseen delays in the receipt of important parts such as cameras and the output display system which were shipped from overseas. During the planning stages, the project was divided into three main spheres that required monitoring – business planning, the first prototype and the second prototype. As such, the progress was tracked for the relevant components as outlined below.

1. Business Planning
    - Marketing Research
    - Business Model

2. First Prototype
    - Research and Planning
    - Funding
    - Functional Specifications
    - Design Specifications
    - Testing

3. Second Prototype
    - Research and Planning
    - Funding
    - Implementation
    - Final Testing

The specifications of functionality and design as well as the testing were considered with regards to the three pronged approach that PVision Electronics has been following for the product's development – input system, embedded unit and output system. These are discussed in details in the following sections.

Input System

The input system for the first prototype consists of two consumer-grade cameras with 720p video capability. The final prototype will use IP Cameras capable of transferring data via Ethernet cables. The real-time images form the cameras give a live view of the parking lot. These are fed into the embedded system which performs image-processing to determine the status of any parking spot as vacant or occupied.

Current status

Testing on the first prototype was accomplished quite successfully. Currently, the IP cameras for the second prototype are awating testing in an actual parking lot at SFU. The testing is subject to campus security's liaison with the parking manager who has approved the project.

Action Items

A power-over-ethernet switch (POE) has been purchased and must be installed to enable communication between the IP cameras and the embedded system.

Embedded System

The embedded module consists of the image processing algorithms, which are able to take the input images of the parking lot that the IP cameras provide, to determine which parking spots are vacant at any given time. This consists of the core software of the system which meshes together, three algorithms - the RGB color method, edge detection method, and base-image comparison method described in design specification.

Current Status

As per schedule, testing has been completed for the first prototype. The development of each algorithm (using *C++* initially and now *JAVA*) is complete and the embedded system returns results with over 90% accuracy under normal testing environment. Extreme case testing will be conducted as soon as cameras are installed in real parking space.

Action Items

The current task of the image processing algorithms is to integrate the image libraries to the source code and to build more robust system that is resistant to extreme weather conditions.

The installation process for real parking lot cameras is still pending as the parking manager requires further coordination with campus security to carry out the installation. For the indoor model (first prototype), handling two webcam in single computer is still unstable and functionality is limited to the use of a single camera which delivers above satisfactory results. Therefore, more integration testing will be conducted thoroughly to guarantee fail-safe system for the final product.

Output System

The output system for the first prototype is in the form of a graphics processing unit (GPU) which works in conjunction with a prototyping board (the Arduino Uno) to relay the results pictorially from the embedded system to the system users – drivers and parking lot administrators.

Current Status

User interface (UI) screen design and implementation is complete and it now can provide real-time parking management functionalities for the lot-managers. Integration with the Arduino still requires more work due to limited integration options were available in *C++*. The whole system is converted to *JAVA* with eclipse as its complier. The programming language conversion has been successfully complete and the team was able to decrease the total processing time by simplifying the time-consuming algorithms.

A website has been developed for the Pvision Parking Convenience System in order to increase accessibility to the system and to provide an opportunity to the users to have a live visual experience using computer and cellular devices.

Action Items

The major area needing work in the output module is the integration of the image processing code with the Arduino using *JAVA*. For the final prototype, we intend to use a much larger display system (LED), the work on which is in progress.