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Embedded System for Dynamic Location-Based Advertising

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ABSTRACT

Advertising plays a very important role in today's age of competition. Advertising is one thing which has become a necessity for everybody in today's day to day life, be it the producer, the traders, or the customer. The world still uses the age old and primitive techniques for advertisement. Our objective is to increase and maximize the efficiency of these already existing advertisement systems. There are various ways in which the advertisement system can be improved. One such way is to make the advertisement system vary and change according to the location of the vehicle. This ensures that we capture the target audience in a much creative and interactive way by providing them information and advertisements that are related to their current location whilst travelling. The target audience gets a much better and personalized viewing experience if he gets content that is relevant and related to his current near his present location. We intend to create such an advertisement system that will be dynamic and location based using a single board computer that is The Raspberry Pi 3 to keep the production cost to a minimum with the essential modules such as GPS, GSM-Support, Display-Support and optional Wi-Fi Integration. The location services can be made available to the proposed system using Open Source Google Maps API.

Keywords: Dynamic, Location-based, Google Maps API, Embedded System, Raspberry-pi

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I. INTRODUCTION

Industrials Revolution has made advertisements to play a major role in promoting private and public businesses. Advertising is a marketing communication used to make awareness of a certain product or entity.

Our project is a part of the smart city concept meaning the advertisement techniques used are Digital and advanced. Thus, our project will overcome issues like wastage of Physical Space, Reusability and Maintenance.

The proposed project comprise of "*Raspberry-pi*" at its core with basic modules such as GSM/GPRS/GPS and a HDMI Display.

Data of the Advertiser is stored on an offline database which can be updated manually on a regular basis. This data is form of advertisement videos displayed through an LCD.

II. LITERATURE SURVEY

Open Street Map is an Open-source alternative to Google Maps. Use of such Open-source map API may result into a profitable and rather beneficial for applications such as advertising for shops. A shop owner in Bangladesh successfully implemented Open Street Map in his application and achieved positive results. [1]

QR codes and Wi-Fi could be used simultaneously to achieve an efficient advertisement model for the customers as well as vendors. An Android application could be developed to make it easy for the vendors to deploy their advertisements and also the customers to get a more personalized advertisement experience. QR codes provide an additional layer to the experience in a way that the customer can scan the code if he/she is interested in the item. Such an advertisement system has been proven to be non-intrusive and capable of capturing the customer's attention. [2]

As we know location based networking has many critical issues that need to be solved. The issues of communication overhead and reachability need to looked after. To solve these issues, the concept of Angle Based Location Advertisement (ABLA) was developed. ABLA uses angle based change of routes and not the traditional

hop count based which increases the communication overhead. It has been proven that if we make use of ABLA, we achieve lower communication overhead with the same reachability which in turn improves the performance of our location based advertisement by achieving low overhead and better trade-off. [3]

The problems of inaccurate locations and information in highly urban areas due to unavailability of line of sight measurement units can be solved. Since our project mainly deals with highly urban areas this is an important factor to consider. We can make use of any current mobile devices instead of additional hardware or client side software. We can make use of Bluetooth technology in these devices to calculate the accurate locations. As we know Bluetooth Technology is highly accurate and available everywhere this technique can be easily implemented. [4]

III. Major Constraints

As this system makes use of the Raspberry Pi 3 as the central controller and a Sim808 module it has some constraints which pose an issue. Being a mobile system it faces the usual constraints of any mobile system. They are:

- Low Processing Power:

Although the Raspberry Pi is equipped with a 1.2Ghz 64bit quad core processor. It still has severe bottleneck while executing day to day tasks. On paper the processor my seem powerful, but in reality is it not able to function as per expectations. Boot up takes around 20 seconds, that being fast, for performing any normal operation you still have to wait for around 5 seconds before the system responds. This is noticeable during the first bootup of the system and the launching of our application.

This constraint weighed in when we tried to play videos on the Chromium Browser installed natively on the RPi. Even basic HD video file playback was significantly choppy on the browser's native HTML5 player.

- Low System Memory:

This is one of the biggest constraint of the Raspberry Pi. It only has 1GB of system memory. Initially the proposed system was supposed to run on the RPi's native web browser. After playing around with it for a while, we came to a conclusion that the system just wasn't capable of playing HD videos from the browser's HTML5 video player.

As this is an Advertisement System which plays advertisements one after another without any delay, the RPi couldn't keep up with the changing video files.

The browser's allocated page memory would run out far before it could play all the videos. This effectively crashed the browser and it would outright refuse to play any more videos.

- Low Storage Space:

The Raspberry Pi is running on a 16GB flash storage device, out of which only 15GB is usable. This limits the capabilities of the system to a great extent for future use.

Currently the system OS which is Raspbian Jessie with Pixel requires 4GB of disk space alone and another 1GB of disk space is allocated to Page Memory.

The support libraries for the project leave a footprint of about 200MB.This leaves us with the space of approximately 9GB.

Assuming each video file to be of 10MB, and their shorter version being 2MB we can store about 700 advertisements before running out of disk space. Alongside this, we face a risk of facing major system performance issues due to low disk space.

Although, deploying in small region would pose no threat for this system, but at a broader sense it is problematic.

- Low System Bandwidth:

The Raspberry Pi is connected to a network module running on the SIM808 chip. This chip although being a great all in one package for both GPS and GSM connectivity, it is severely bottlenecked due to the limitations of the GSM network. The GPS module on the other hand is great and provides an accuracy of -165 dBm which is more than enough for our application. The GSM module being limited to the 2g network bottlenecks the upload section of the system. Even an operation of simple Geocoding requires 3-4 seconds as it is limited to the 2g GPRS speeds of 56Kbps at its worst and is really unstable. Thus remote update for the system is near impossible by using the sim808 2G module as it would take a large amount of time to upload any advertisement files.

IV. Relevant Mathematics

Let 'S' be the system set for the proposed project.
S={ s, e, Input, Output, Success, Failure, DD, NDD }

- s : Start State = Start of the advertisement system by fetching co-ordinates of the exact location of the moving vehicle.
- e : End State = The final state of the advertisement system is when the advertisements are displayed in accordance to the location
- Input : set of all input parameters
  {GPS co-ordinates, Advertisements}
- Output: set of all output parameters
  {Advertisements, Source of Advertisement}
  Advertisements={Text, Video, Audio}
- Functions: set of all functions used
  Functions={f1, f2, f3, f4, f5}
  f1={fetch location co-ordinates from GPS module}
  f2={map co-ordinates to real world location using Google Maps API}
  f3={update location Json file}
  f4={match locations with the co-ordinates}
  f5={display matched advertisements}

- Success Conditions = {Correct display of expected advertisements as per the location algorithm}

- Failure Conditions = {Incorrect Advertisement, Runtime Error, System Failure }
- DD : set of Deterministic Data
  DD = {Advertisements, Default Advertisement locations}
- NDD : set of Non-Deterministic Data
  NDD= DD = {GPS co-ordinates, Location Radius}

V. SYSTEM SPECIFICATION

A. Hardware Specification

- Raspberry Pi 3 Model B or Higher :

Fig.Raspberry-pi

Initially the project was supposed to run on the Orange Pi SOC which is at par with the Raspberry Pi, at half the cost. But due to lack of software support and community support, RPi became a better choice. The RPi has support for full HD output at 60Hz refresh rate, a 1.2GHz quad core processor, 1 GB of RAM, SD card for secondary storage, Analogue Audio Output, Camera Interface, 4 USB A Ports, RJ45 Ethernet Port and an on board Wi-Fi module.

- Sim Module with GSM/GPRS support:

Fig.SIM808

Any SIMCOM module with GSM and GPRS support is required for the upload phase of the system. The GPRS provides a gateway for the Geocoding of the input advertisement location.

- GPS module:

This is one of the major components of the system. It is required forgetting the current Geo-Location of the vehicle where the system is installed. Thus, it is possible to map the nearby advertisements. GPS module should have basic support for receiving Latitude, Longitude and Course On Road measurement

- External Device such as Laptop/Mobile phone:

An External Device is needed for the upload/update phase of the system. The advertisements are supposed to be uploaded to the system via the Web Client of the external device. Also the external device can be used to directly access the advertisement system on the devices native browser.

B. Software Specification

- Raspbian Operating System:

This is the standard Operating System recommended for Raspberry Pi. It is based on the Linux Kernel and has wide support for Linux applications. The Raspbian with Pixel OS comes preinstalled with LXDE Desktop Environment which is Desktop GUI environment which requires few resources to run. LXDE is also required to launch our advertisement system once the desktop has been loaded.

- Python 2.7+:

The entire project is built on the python programming environment as it fast, exible, has a small footprint and has wide community support for latest and upcoming technologies.

- NginX Web Server:

It is a simple and light weight web server which handles all the client browser requests. It communicates with the application server through a socket file.

- UWSGI Application Server:

The task of an application server is to provide an execution environment for our programs. UWSGI is the perfect choice for our ask-based python framework. It acts as a gateway between our application and web server.

- OMX Player:

OMXPlayer is a video player made specifically for Raspberry Pis GPU. It is optimized for the platform and it ensures efficient use of systems hardware resources for video rendering. It can play HD videos in full screen at 24FPS without any noticeable stutter or lag.

VI. FUTURE SCOPE

Based on recent statistics and surveys our inclination towards a more smart and digitalized society makes this project more promising and viable within the next 5-10 years. The need for a better and efficient advertisement system is ever growing and hence the traditional methods will become obsolete eventually.

VII. CONCLUSION

By this proposed project we observe that the existing means of advertisement are inefficient and inadequate, thus they need to be replaced by advanced and modern

techniques. Hence, we infer that the future for advertisement can be improved vastly by making use of:

- Dynamic digital systems
- Location-based advertisement
- Personalized experience.

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