



A dynamic framework to profile vehicle movements using crowd sourcing

By

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Project documentation submitted in partial fulfillment of the requirements for the
degree of

Masters of Science in Computer Science (MSCS)

NUST School of Electrical Engineering and Computer Science

National University of Sciences and Technology

Islamabad, Pakistan

(2017)

CERTIFICATE

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DEDICATION

To Allah the Almighty

&

To my Parents and Faculty

ABSTRACT

Innovation expansion empowers its acceptance in each field of life making it simpler to embrace the most recent headway for social maintainability. The ideas of smart homes/urban communities have been developing for a long while. The extent of smart homes empowers clients to oversee and control home apparatuses remotely. Nonetheless, noteworthy effort has been made in the field of IoT, which drives us to utilize innovation in constructing a maintainable society. In our research, our concentration is to use the cars with cameras affixed on rooftop or dashboard to have its influence in identifying the accidents and road rage cases. In developed nations like USA, UAE and some European nations, the security agencies utilize very complex gear, quick vehicles, automatons, and helicopters to get wrongdoers' vehicle. Additionally, street side units are set at each crossing point to screen the automobiles and in some situations, capture pictures of the cars, bikes etc.; therefore, the wrongdoers can't cover up. While, in under developed nations with restricted assets such plans can't be used because of administration cost and different limitations. We have proposed a simple system called CVEH that empowers creating nations to profile the wrongdoer vehicles through crowdsourcing and go about as an early cautioning framework to the law enforcement offices. The principle target of this work is to draw-in residents to assume their part in enhancing security of the area. The proposed CVEH system enables Vehicle-to-Infrastructure (V2I) correspondence to screen the development of wrongdoers' vehicle and imparted its data to Command and Control Center(CC). The CC projects the track of the vehicle and draw-in nearby law authorization organizations. The proposed system is produced and assessed on advanced cellphones. Besides, a mimicked analysis is led to demonstrate the productivity of the framework with crowdsource resources.

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Chapter 1

Introduction to Smart Cities and Crowdsourcing

Introduction

Traffic laws violation is major issue in most of the developing countries. Due to lack of proper mechanism of recording crimes/violations on the roads it becomes impossible to implement the existing laws. The proposed research is to enable public to report any traffic law violation through automated video/image acquisition and processing system and to upload the optimized content to a central server, without needing expensive infrastructure installation, which would further be used to extract identity of violators by segmenting and recognizing the license plates. Idea is to help law enforcing agencies and make every citizen responsible. It would also raise awareness in public about rules and regulation and in the long run it could help reduce number of accidents.

1.1 Introduction to Smart Cities

A smart city is the idea of urban advancement to assimilate the technologies of ICT and IoT in a safe way to handle a metropolis's resources. These resources contain native divisions' info schemes, institutes, public libraries, carriage organizations, medical systems and other civic services. The smart cities are endorsed to use municipal information science and know-how to help raise the productivity of the amenities. It lets municipal administrators intermingle with the public and the metropolitan setup and to stay updated with the current situation of the town, how it is growing, and how to help in achieving a healthier living standard. Using sensors combined with real-time surveillance systems, statistics are gathered from the people & sensors – then managed and evaluated. The info and data acquired are the solution to counter incompetence.

It is used to improve condition, operation and collaboration of municipal facilities, to decrease expenses and supply usage and to enhance interaction amongst people and administration. SmartCity apps are made to handle metropolitan movements and grant rapid replies to the queries. Therefore, it may be better equipped to react to these tasks rather than one with a straightforward correspondence with people. Up till now, the phrase itself stays uncertain to its details and thus exposed to several interpretations.

Smart cities proposition is critical if it is backed by appropriate objectives in different segments carrying together goals of an extensive collection of stakeholders. Certainly, our idea would be as follows:

Enhancing the smartness of a city allows the enhancement in the smartness of the people by improving connectivity, self-confidence, teamwork, know-how sharing and, due to this, creating competence and effectiveness by the optimum use of technologies. People, not just customers, should be participating in civil and commercial developments through technology.

Smart Cities are defined along six dimensions:

1. **Smart Governance:** Involves all sectors of the society, public or private, so that the city could work at its finest as one body powered by the technologies and data analytics. Smart Governance is about clarity and open government facilitated by applications in terms of people's ability to make decision and e-public facilities.
2. **Smart Economy:** Involves e-business procedures and e-commerce to enhance viable development and production.
3. **Smart People:** Individuals having e-skills from a younger age that helps in increasing ingenuity, critical analysis and nurtures independent thinking.
4. **Smart Mobility:** The integration of transportation and logistics systems helped by innovative technologies.
5. **Smart Living:** To provide better living standards by use of smart technologies and applications that empower reliable living, conduct and utilization.
6. **Smart Environment:** To achieve a clean environment with pollution and waste disposal under restraint using clean and alternative energies.

Three influential ideas are strongly linked to Smart cities enterprises: Technology, Institutions (Private/Public) and the intricacy of humans. The complexity of people has been handled by disciplines like Philosophy, Psychology etc. but it appears that their outcomes are not satisfactory to be accepted as a solution for most of the people, as observed by the rise in psychological ailments.

1.1.1 Terminology

As a result of the degree of innovations utilized in the name of smart cities, it's hard to separate a particular meaning of a smart city. The four principle factors (Deakin & Al Waer, 2011) that add to the meaning of the smart city are:

1. The utilization of an assortment of advances to societies and towns
2. The usage of ICT to change living standard and work environment
3. The presenting of ICTs in organizations
4. The territorializing of activities that bring ICTs and individuals collectively to expand the development and capability.

1.1.2 Characteristics

A smart city utilizes data advancements to:

1. Make effective utilization of people in general through AI and information examination to help a solid and sound financial, social, social improvement.
2. Involve people in general in nearby government by utilization of crowdsourcing, improving the learning base of the administration organizations by open cooperation and coordinated efforts.
3. Act accordingly proficiently and on time to the dynamic circumstances by refining the information of the town by learning and adjusting as indicated by the circumstance.

They advance towards a vigorous blend of all parts of human knowledge, shared insight, and counterfeit consciousness. The knowledge of urban areas lives inside the dynamically viable combination of advanced media transmission systems, universally inserted insight, sensors and labels and programming frameworks.

These sorts of intelligence in good cities are incontestable in 3 ways:

1. **Orchestration intelligence:** wherever urban communities build up foundations and group based disadvantage assurance and joint efforts, e.g. decoding of enigma by Alan Turing.

2. **Direction Intelligence:** Urban areas offer open stages, test offices and great town foundation to group development in bound locale
3. **Instrumentation Intelligence:** Metropolitan framework is formed through data combination, with investigation and prognostic displaying crosswise over town areas. There's plenteous distinction of assessment including this, altogether concerning police work issues in great urban areas. Tests of instrumentation insight are implemented in Amsterdam. this can be upheld through:
 - a) A regular logical train framework that is friendly for specialists to create apps.
 - b) Wireless gages and gadgets spread data at the reason in instance.
 - c) Variety of households stipulated with useful meters to increase the awareness of resource utilization and cut back its use
 - d) Solar energy refuses compactors, car reviving stations and vitality sparing lights.Smart town enactment is effectively getting utilized inside the fields of advancement economy, urban framework and administration.

1.2 Introduction to Crowd Sourcing

Crowdsourcing, a term that was coined by Jeff Howe of Wired Magazine, is employed to explain the procedure of outsourcing to an outsized body of freelance staff instead of through one entity or company. Crowdsourcing permits an organization to attach with a widespread network of talent, however foregoes several of the standard controls that typically exist once outsourcing to one company.

1.2.1 Crowdsourcing Concept

Crowdsourcing is an outsourcing model within which contributions are obtained from users (maybe over the internet) to get specific ideas and services that perhaps required by some people or organizations. this kind of outsourcing to attain higher results by dividing the tasks between the users had already gained success even before the digital era. However, crowdsourcing associated subcontracting is discriminated by the statement that in crowdsourcing the jobs can be done by undetermined group of people rather than specifically tasked cluster which crowdsourcing uses a

mix of top-down and bottom-up approaches. blessings of crowdsourcing embrace better prices, agility, fineness, tractability, measurability, or variety. Figure 1(Thawrani, 2014), depicts the design and data flow of crowd sourcing.

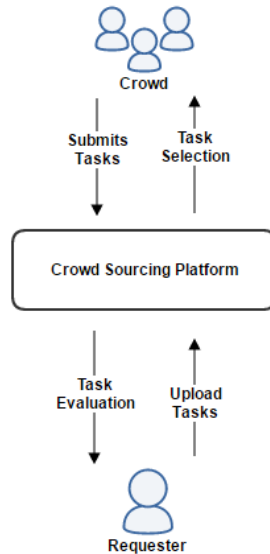


Figure 1: Architecture of Crowd Sourcing

Corporations establish different contests to get innovative concepts and extend their search of ideas outside their workforces e.g. LEGO ideas. It also aids in resolving some hectic small errands that would else be done by considerably large group of people in parallel e.g. Amazon Mechanical Turk. It is also used for the noncommercial work for the welfares of people e.g. Wikipedia. Despite the several descriptions of crowdsourcing, one constant has been the distributing the problems to the people and it being open to anyone wishing to try out to contribute in solving the problem. The solutions submitted by the contributors are then forwarded the group of people that broadcasted the problem. The participants are rewarded in some cases by cash prize, accolades or appreciation while in other cases; the only compensation they get is self-satisfaction or good reputation. The answers gotten by crowdsourcing might have been derived from a variety of operators that could range from laymen to the specialists.

In previous years mobile applications based on crowdsourcing have become more prevalent because of many built in sensors in mobile phones. The large amount of crowd sourced sensing data motivates the researchers to carry out previously costly or impossible tasks. More importantly the quality of this data, that is important, has not being given proper importance. The low-quality crowd sourced data is more likely to contain malcontent that can brutally damage the crowdsourcing application. So, in our research we have considered the quality of the crowd sourced data. We have focused on the estimation of user's movement course data that plays important part in several crowdsourcing applications. Such applications include perspective appreciation, indoor localization, indoor triangulation etc. we have provided an alternative for robust statistics by designing robust trajectory estimation methodology named as TrMCD, that can alleviate the negative effect of anomalous crowd sourced trajectories of user, separates abnormal participants from normal ones and overcome the problems caused by the spatial distortion in crowd sourced trajectories. we have conducted two experiments in the real field and compared results to discover that TrMCD is more effective and robust to estimate the trajectories of user motion and plotting fingerprints to locations physically. The TrMCD framework (X. Zhang, 2014)is explained by figure 2.

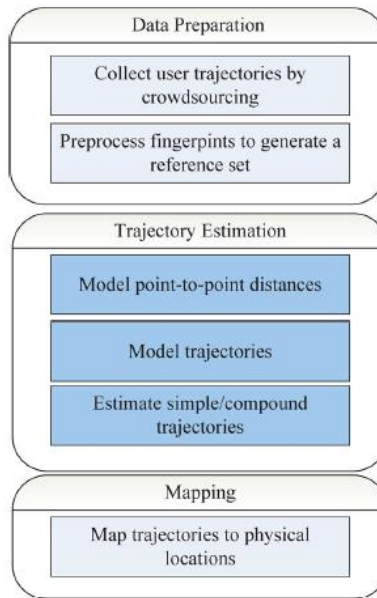


Figure 2: TrMCD Framework

1.2.2 Companies that Crowdsourc

Over the last decade, crowdsourcing has become very talked-about for each governments and businesses to collect knowledge and opinions. Crowdsourcing is primarily wont to complete tiny tasks or receive tiny bits of knowledge, as larger and additional advanced tasks aren't well-suited to the platform.

1.2.3 Types of Crowdsourcing

There are many varieties of crowdsourcing, and not all are through with money motives. Crowd balloting or polling is commonly used as a technique for obtaining info from crowds concerning their opinions, whereas artistic crowdsourcing involves various people in an exceedingly artistic work. On the opposite finish of the spectrum, crowd funding could be a special kind of crowd sourced product that's used as a technique for generating funds: crowd funding seeks tiny amounts from several people to fund businesses, artistic comes, charities and additional.

As way as tasks go, crowdsourcing tasks sometimes occur on either the macro or small scale. small work denotes terribly tiny amounts of labor for terribly low amounts of pay, and is what the popular platform "Mechanical Turk" will. Macro work could be a larger quantity of labor that needs

specialized skills and typically takes for much longer. Crowdsourcing is additional fashionable small work than macro work.

1.2.4 Major Concerns with Crowdsourcing

The main disadvantage of crowdsourcing could be a lack of internal control.

Particularly with small work, crowdsourcing tends to be of a low quality—it's largely suited towards work that doesn't need to be done accurately however merely must get done. Crowdsourcers themselves have their own set of issues, largely moral and financial: crowdsourcers tend to be from low financial gain economies and a few believe that their disposition to figure for such low rates is being unfairly capitalized upon.

Many employees that complete crowd sourced tasks are creating lower than the remuneration in their region, however because of crowdsourcing could be an international network there are not any protections for the employees. The employees also are freelance contractors, deed them liable for their own taxation. These factors along have crystal rectifier some to conclude that crowdsourcing ends up in the exploitation of developing countries whereas devaluing the work of these in developed countries.

1.3 Importance

After the incident of 9/11, the demand for camera-based video reconnaissance items has extended many folds with its essential use as a region checking framework by open wellbeing and security organizations (C. Norris, 1999). Despite the fact that such frameworks are modest and pervasive however are restricted by the basic difficulties of substantial framework sending including the wiring cost, the utilization of low power equipment and the advancement of broad administration devices (A. Hampapur, 2005). Once introduced, the required labor checking some continuous encourages at the same time is costly, much of the time; this wind up plainly ineffective because of the points of confinement of human reconnaissance (A. R. Dick, 2003). Here robotized video reconnaissance can help to naturally break down a scene and create alerts for the manual chief to follow up on. Presumably such frameworks in light of video investigation are the future yet not very many are

sufficiently strong to work in varieties and negative conditions (V. Gouaillier, 2009). Also, many endeavored frameworks like VSAM (Video Surveillance and Monitoring) (Kanade, 1999) and substantially more, contain different basic segments each helpless to basic issues, thus, affecting the efficiency of the general framework. With the urban development in Pakistan, there is a generous increment in the quantity of wrongdoings including vehicles, going from street infringement to genuine violations. By and by, there are numerous sensor-based arrangements basically utilized for street traffic estimation and blockage identification. Additionally, some of these frameworks are utilized to recognize minor traffic infringement, a mechanized stopping metering framework issuing a stopping ticket on a terminated meter, yet not utilized by wrongdoing settling offices. For wrongdoing recognition, vehicle observation used to recognize and track vehicles is winding up increasingly essential. In spite of the fact that a wide-territory camera-based video observation can help play out this undertaking, yet with expanding caseload and other overhead costs, manual visual following is unimaginable. Fundamentally such video reconnaissance is dealt with as a post-episode scientific examination instrument, with agents experiencing crowds of recorded information, which is a major issue affecting the effectiveness of doing constant observation. A mechanized framework fit for activating cautions in this circumstance can be helpful; in any case, contingent upon the idea of the scene the framework may produce numerous false alerts that should be evaluated by a human chief. Every one of the difficulties with video reconnaissance feature the requirement for building up a participatory stage in light of crowdsourcing (Brabham, 2013). Such on-line stages have been effectively utilized as a non-central critical thinking device, and to process vast bunches of information. The fundamental inspiration is to avoid a portion of the observation obligation from law requirement to the masses filling in as wrongdoing spotters (Tewksbury, 2012). This sort of participatory video observation has been utilized by the media business for behavioral scientific thinks about. Different ventures have utilized it to distinguish paranormal movement in video scenes of frequented houses (West, 2017), SETI program to find additional earthly intelligence (Anderson, 2002), and OCTV (Open circuit TV observation) venture including recordings recorded out in the open spaces (Lyon, 2001). For wrongdoing discovery and discouragement, the diverse human knowledge paradigm can work effectively, for example, after the Boston Marathon shelling a public call to

disclose the substance of the occurrence caught the guilty parties inside couple of days (Schafer, 2013). Essentially, this approach was additionally utilized after the London revolts in 2011 (Wilcock, 2012). In spite of the fact that with its debates, from false allegations and bits of gossip, a directed stage can be utilized to give natives quickly something to do by filtering through video accounts, while the agents coordinating the examination by closing down deception (I. Rahwan, 2013). With expanded enthusiasm for Automatic Vehicle Identification (AVI) innovations, for the most part used to distinguish traffic infringement, it will be valuable to include natives too. A proposed stage that permits volunteering wrongdoing spotter to record and offer the objective vehicle's data close by the robotized observation can help enhance numerous wrongdoing settling forms. The stage can help distinguish vehicles associated with a genuine wrongdoing, and in addition, track its course based the time and area of sightings staying away from any rapid pursues, or property harm. Besides, this gathered information can be utilized by law requirement and general society to recognize territories with high wrongdoing rates.

1.4 Project Goals

The aim of this research is to:

- Developing a smart phone application and web service for data collection using crowd sourcing
- Analyze image and video data to extract meaningful data
- Help law enforcement agencies in monitoring violations
- Public involvement in helping to monitor traffic violation
- Build better strategies to avoid violations
- Monitor consistent violators

Chapter 2

LITERATURE REVIEW

Introduction

This report presents a new approach of profiling vehicle movements using crowd sourcing as an input system, to mitigate hit and run cases without the installation of expensive infrastructure. It presents a mechanism which blends the benefits of smart phones and crowd sourcing for making easier the process of reporting hit and run cases and tracking the suspected vehicles with minimum cost expenditure. The reporting is simply using image processing while the tracking includes combination of image processing and crowd sourcing, getting the results swiftly and accurately. Crowd sourcing helps in involving the public in the social cause and the use of smart phones helps in mitigating the heavy traffic flow and the need to install complex servers for image processing; also, the process gets a lot quicker when all the processing is done on the client side.

2.1 Crowd Sourcing

With the introduction of web 2.0, the internet has evolved. In the past, it has served as data supplier to the users however because the technology evolved they have begun to come up with the content in addition. This course was later analyzed and used in several applications for instance Google maps, Wikipedia and social networks, which are run by bigger audience than the clique of specialists who produce data cautiously under scrutiny. The success of the crowd sourcing experiments provided the authorities new way to deal with the situations in which the data is distributed and can be gathered by a greater audience. The progress of technology and speedy advancement within the field of networks has created the contribution via net easier and the world has become a global village.

2.1.1 Crowdsourcing Model Introduction

The term Crowdsourcing has been devised from two different words crowd and outsourcing. It suggests that outsourcing an activity to a crowd that is difficult to come up with realistic leads to the laboratory under observation however will simply be completed by bunch of undisciplined volunteers or employees. Basic plan is to handover the service from professionals to public via net. (C. Keimel, 2012) Its success has given an opportunity to the educational circles,

researchers and native authorities to utilize its potential together with net a pair of web 2.0 and mobile application for areas that needed geographically distributed knowledge. It makes assortment of information simple and open doors for brand new analysis areas. Increasing trend of smart phones has contributed to the group sourced applications. it's potential which might explore the methods of clear and open government systems.

Latest smart phones utilized updated and economical sensors that modify the contribution in such application for larger sensible. It offers chance to gather knowledge, examine it and redirect it to central sever while not involving operators once approval is granted.

2.1.2 Types of Contribution

Crowdsourcing applications have two main types of inputs(G. Chatzimilioudis, 2012).

2.1.2.1 Participatory Contribution:

Crowd sourced applications at first depended on voluntary commitment. It's simply the involvement of the clients. Client makes information, dissect and transfer that information. The majority of the p2p communication applications depend on participator involvement. Participatory commitment without security concern is normally not as powerful in information accumulation. It's influenced by various ecological variables and human aptitudes are exceptionally required for such commitment.

2.1.2.2 Opportunistic Contribution:

Opportunistic involvement is fundamentally the most straightforward commitment since it's gathered by means of sensors. These sensors create information by running in foundation and they aren't influenced by proprietor's inclination, capacity or abilities. Commitment like these can help make wise framework for various sort of choice making which could be exceptionally exact now and again. For example, expectation of surge regions in shopping centers can be anticipated by getting area of individual and inform anybody around if there are a larger number of individuals than its ability.

2.1.3 Quality of Contribution

It is separated into two types.

2.1.3.1 Homogenous Contribution

Homogenous contribution is essentially nature of commitment which makes it imperative. Presently homogenous commitments are viewed as a similar weight commitment which can be gotten to and utilized as a part of group source application as equivalent. Illustration: Such as the information of manually written digits. That is could weigh practically same and will be homogenous. (G. Chatzimilioudis, 2012)

2.1.3.2 Heterogeneous Contribution

Heterogeneous contribution is evaluated and can be related to, challenge against, or finish different commitments. Illustration: While attempting to discover something lost through group sourcing application or area of any wrongdoing then every reaction is heterogeneous they can be related and go up against each other. (G. Chatzimilioudis, 2012)

2.1.4 Challenges

2.1.4.1 Acceptance from public:

Crowd Source Application are for open to say something to assemble topographically appropriated information. These applications are normally exceptionally accommodating in current thought of open government and assessment gathering. It can help gather information specifically from open who may be partners and aides in deciding. Such applications like online networking Facebook, Twitter and Linked.in are exceedingly showcased and clients consider it as fun group to take an interest in while on other hand application for governments' utilization have restricted promoting spending plan and open doesn't know whether their cooperation will have any effect or not. Open demonstrates the enthusiasm for any application which is always refreshed and has legitimate data. It encourages individuals to screen circumstance on based of popular sentiment which is not created as medias' news. Significant issue is to make mindfulness and acknowledgment of such pack sourced application in people in general. One route is to offer diverse motivations to open against their interest. It won't just rouse the cooperation likewise delineates the earnestness of the specialists. These motivations could be of the following sorts.

- Monetary

- Ethical
- Service Exchange
- Entertainment (G. Chatzimilioudis, 2012)

There is another test while outlining a crowd source application particularly to report violations that is security and protection of columnist. Guaranteeing secrecy is an intense occupation. Concealing points of interest of journalist may propel more open however it additionally offers use to correspondent. There can be more phony reports so to guarantee protection while keeping information genuine is greatest test. It can be unraveled while concealing client qualification while distributing report yet keeping it as record in the framework. Essential thought is to fabricate trust of the general population on such framework else they won't contribute. (Huang, 2014).

2.1.4.2 Adaption from authorities

Adaption from experts have been a greater test since acknowledgment from specialist can make application dependable for open. Then again, specialists that may incorporate lawmakers, current government office holders, civil servants, law authorization organizations and media aren't effortlessly persuaded to embrace new innovation to old ways. Law authorization organizations as of now utilizing help lines and to persuade how these applications will be extraordinary and won't be another wellspring of trick is troublesome employment. As specified in (Huang, 2014) that it was not a simple occupation to persuade the police experts to work and team up while they are greatest partners and it is difficult to build up any application without their nearby and steady criticism. Real issue with specialists is to guarantee the nature of commitment and decrease the phony reports. This issue was fathomed by including the element of encasing media, for example, picture or video of the wrongdoing which can be assessed by human and can dispose of if not persuading enough for an activity. (Dhruv Chand M, 2014)US government has made government information sources open while different nations are following the strides too. (Rodrigo Sandoval-Almazán, 2012) This has energized the portable application designers to use that information and assist individuals to gather information on various gatherings against various group issues with informing government. Overall

thought of group sourced application is beguiling yet this is still new to the underdeveloped nations in spite of high utilization of advanced cells. Mindfulness and acknowledgment by experts can be accomplished with the assistance of specialists and scholarly partners by persuading higher experts. These should be possible through limit working of It divisions in commonplace and government and in addition mindfulness classes about connecting data innovation to day by day life and government undertakings.

2.1.4.3 User Experience

Before planning any application it's imperative to make sense of the clients of the applications. (Schröder, 2014) This aide being developed of the application. Normally swarm sourced applications are intended for untrained clients yet human abilities are essential factor. Innovation mindfulness assume essential part in the utilization of any application so data about focused portion typically helps in giving better client encounter. While building up any application whether it's web application or versatile application one of the real difficulties is to guarantee easy to understand encounter that spurs the clients to go ahead application all the more frequently. Initial couple of second on the applications are extremely basic if the client comprehends application they will choose to remain or near the tab or uninstall application. In swarm sourcing application, our concentration is to make it as easy to understand as we can by diminishing the measure of writing and expanding intuitiveness through various gadgets. It will keep client engaged and engaged while he takes an interest and application can catch more noteworthy group of onlookers. This can be guaranteed through maps, sliders, dropdowns and prescient writings which makes the entire procedure a decent and intuitive experience. For the most part, crowd sourced applications utilize maps because of nature of spatial information. (Huang, 2014) User encounter is about the application's front end as well as spotlights on the possibility of reaction time. On the off chance that the application remains sit without moving for longer time it or stops while working client will probably uninstall the application. There are two models of improvement of group sourced applications. (G. Chatzimilioudis, 2012)

2.1.4.3.1 Centralized Model:

It sends every one of the information gathered and accumulated from group to the server and perform calculation and examinations on the server. This will cause a postponement if any reaction of gathered information is normal by client. It can be hazardous and moderates the framework if arrange has moderate speed or server has less computational power and more load while it doesn't influence the power and vitality of customer gadget.

2.1.4.3.2 Decentralized Model:

Then again, decentralized model performs calculation and investigations on the PDA. Handling calculation or inquiry is sent to customer by the server. On the off chance that the handling is little it's an exceptionally valuable method yet in the event that a great deal of preparing includes it might cause control to deplete at customer side particularly in cell phones. It decreases the reaction time.

2.1.5 Credibility of Data

Crime revealing applications are the mix of wrongdoing mapping and outsourcing. Mapping of the crimes is the system to outline violations in view of their land area on the maps. Because of utilization of mapping method believability of use boosts.

2.1.5.1 Techniques to Increase Credibility:

There are distinctive approaches to build the believability of the any application particularly an application to report wrongdoings. Some of the procedures are stated below.

2.1.5.1.1 Crime-mapping:

Crime mapping is essentially the area of wrongdoing as GPS arranges that can be plotted on the guide to see the genuine position of the wrongdoing. It can help application to advise clients close wrongdoing area about the episode. Thought of client security in light of spatial information makes open report with high validity.

2.1.5.1.2 Medial Evidence:

Phony or Prank reports can be diminished or dispensed with through including a component of joining media proof, for example, picture or video. This assesses and comprehend the idea of

wrongdoing. It denotes the report invalid so it can be utilized as a part of future to dispose of from certain beneficiary of give less need to certain beneficiary.

2.1.5.1.3 Reward:

Reward is yet another approach to rouse group to guarantee the validity of information. On substantial reports client can be compensated by something. This will inspire client to report dependably to guarantee the security of individuals.

2.1.5.1.4 User Credentials:

Client namelessness ought to be freely guaranteed and he/she shouldn't be openly retaliating for announcing any wrongdoing. Then again, framework should store accreditations of the client to ensure the data got is dependable and have a substantial source.

2.1.5.1.5 Reduce User textual input:

On the off chance that client's info is more from the assigned scope of information lesser possibility of phony revealing.

2.1.6 Areas of Implementation

There are diverse regions of usage for crowdsourcing applications following as are mentioned under.

2.1.6.1 Social Media (Content Generation):

Online networking, for example, Facebook, Linked.in, Twitter and so on are the cases of group sourced applications. There is diverse sort of online networking yet the fundamental philosophy is swarm sourced structure. Real concentration is to get the substance era by swarm and examine diverse patterns and receive target promotion framework. These frameworks are the leaders in present day world. It enables individuals to mirror their supposition and respond speedier than at any other time. Before innovation headway news use to travel gradually and response considerably slower however now inside seconds individual's response to occasion is everywhere throughout the media.

2.1.6.2 Classified Advertisements:

It is a standout amongst the most fascinating range of execution for swarm source system.

Characterized Advertisement framework is an old procedure where individuals post the commercials over a discussion that could be web or versatile application and purchasers can contact the publicist. These are swarm sourced application and application 12 acts like a scaffold amongst purchaser and vender. Customary Classified ad framework is changed through group sourcing on unique of target promotion and inclination premise.

2.1.6.3 Competitions (Kaggle):

Group source application one region of execution is rivalries for various issues unraveling. These rivalries enable the particular group to come around to contend to accomplish higher quality answer for prizes. These rivalries are most ideal approach to outsource explanatory issue for various basic leadership apparatuses. These arrangements can help the opposition presenting expert on show signs of improvement arrangement with in restricted resourced and members can clean their abilities too.

2.1.6.4 Open Government (Crime Reporting, Incident Reporting, Service Problem Reporting):

Crowd sourced application have been exceptionally fruitful in private associations. Numerous application and association are based on the structure. This has urged the administration to use the system for advancement of open part. Open government is moderately new idea yet its thriving with the headway in innovation. Group source application can be utilized for wrongdoing detailing, episode announcing and benefit issue answering to experts and help to inform individuals around in light of mapping and their GPS organizes. It will enable individuals to get firsthand data and specialists can use that data to find the issue and also basic leadership with respect to counteractive action of such issues. These applications can be exceptionally helpful if maps are coordinated to these. It can enable individuals to comprehend about the security of the region or administrations issue in particular zone, for example, water supply or sewerage issue before getting a home.

2.1.6.5 Traffic Problems:

Activity issues such a congested driving conditions warning, movement rules infringement and streets conditions data would employee be able to swarm source application for social advantage.

Individuals can include the data about course where movement is stick and individuals who are going to get out and about can check and picked elective by evading it. Activity rules infringement can be accounted for through versatile application or web application with media proof and enable movement to police to find the guilty parties, Road condition data can be gathered through portable sensors. This data includes a guide of streets conditions which can hurt vehicle in long run. This data is gathered through various sensors, for example, spinner and accelerometer. The adjustment in perusing can help anticipate the knocks out and about.(Prashanth Mohan, 2008)

2.1.6.6 Social Think Tanks:

In past social research organizations were made which use to bring all the basic scholars at one place and make extraordinary archives by watching distinctive viewpoints. These social research organizations are reformed by the headway of innovation. Today swarm sourced application can be utilized to produce social research organizations report without in regard to land area of specialists. These specialists can be united close on one gathering with the use of these applications. These social research organizations can work with in restricted resourced and create better outcomes by participating for all intents and purposes and can have sentiment of particular group over their work.

2.1.6.7 Freelancers:

Region of usage is to make groups through specialist discussions. Post an assignment and get a specialist for that particular errand against bits. This can encourage venture based employing. Today many individuals who can't resolve to all day employments use these discussions for procuring their work

2.1.7 Mobile Participation vs Web Participation:

Group sourced demonstrate is actualized by means of two mediums web and versatile. These applications encourage interest. Normally most applications utilize the two mediums in parallel to reach and draw in more clients. Following is the examination amongst web and versatile applications. It comprehends why mix of both is essential for swarm source applications.

1. The trouble of fashioning and utilizing as a fraud individual

2. It is inborn seclusion and insurance from the outside condition
3. It's greatly information rich physical structure

2.1.8 Usage in Government

Open and straightforward government is the most offering thought because of utilization of innovation in each field of life. Numerous nations have made including individuals out in the open division as mindful and enabled native extremely infectious and appealing. This not just make governments and open segment associations reliable additionally empower individuals to be capable in their everyday life. Center is to include individuals in announcing issues that are geologically disseminated. Government can outsource wrongdoing, episode, administrations issue, utility issues and different issues fall in broad daylight part area answering to their native by means of portable and web application. These applications not just help specialists to reaction and settle the issues in light of area and confirmation revealing yet additionally help them to check the wrongdoings and show it over guide with wrongdoing mapping wonders and tell clients (subjects) in view of their area about the wellbeing of the zone and the critical data. It not just server as announcing discussion amongst nationals and experts yet additionally a telling framework for open to maintain a strategic distance from any miss-happenings. It can prompt a straightforward and profoundly responsive government demonstrate.

2.1.9 Responsible usage of Mobile and Web Application

Mindful utilization of innovation has dependably been a critical part of improvement and progression of innovation. World has seen the innovation insurgency in recent decades. Innovation change where did huge employment in mechanization of our day by day life issues and undertakings it has accompanied reactions which can prompt hazardous threats. People could utilize present day innovation for goodness and additionally for abhorrent. Each mechanical development has symptoms since abundance of anything can cause hurt. Today organize has been so emphatically construct and turned into the foundation of correspondence over the globe. Everybody is connected to web by means of little gadgets called PDAs. These gadgets give us opportunity to associate with individuals over the globe with few ticks. Correspondence is modest and simple. Such livens

accompany extraordinary obligation. Today we can post over supposition on any social plan and can utilize interpersonal organization as feeling creators and pioneers. It can be utilized for individual or clique advantage however in the event that these discussions and applications are utilized capably it can prompt a superior and wonderful future. Correspondence was the key of human life. Men endure to make condition of workmanship correspondence framework. Research drove us to where we are today. In spite of the fact that correspondence has brought us nearer however it has offered approaches to programmers and stalkers to connect the secret or individual data too. To counter such situations security models have been fabricated and digital laws have been created. In swarm, sourced application it's vital that individuals utilize it obligation particularly if its plan for official purposes fudge data can prompt unsecure framework and also make put stock in issues among open.

2.2 Optical Character Recognition

The procedure of change of content in pictures into machine-encoded content is called Optical character acknowledgment. It's wide utilized as an assortment of information passage from composed paper learning records. It's a regular philosophy of digitizing composed messages so they will be electronically improved, sought, keep extra briefly, showed on-line, and utilized in machine forms reminiscent of mental component processing, computational etymology, vital data and substance mining. OCR could be an area of investigation in design acceptance, AI and PC vision.

Early forms required to be equipped with photos of each character, and captured one written script at a time. Propelled systems being able to fabricate a high level of recognition accuracy for some textual fonts are at present normal, and with help for a scope of superior image file arrange inputs. A few systems can recreate designed yield that intently approximates the underlying page together with pictures, sections, and diverse non-literary parts.

2.2.1 Applications:

OCR motors are produced into a few assortments of space particular OCR applications, tantamount for receiving OCR, check OCR, legal demand report OCR.

They can be utilized for:

- Data route for business archives, e.g. cheque, travel permit etc
- Automatic assortment plate identification
- Automatic defense reports vital information retrieval
- Mining personality card data in the contact catalogue
- Quickly create matter forms of composed articles, e.g. book filtering
- Create e-photos of composed reports accessible, e.g. Google Books
- Translating progressively to manage a portable workstation (pen registering)
- Defeating CAPTCHA unfriendly to bot systems, despite the fact that these are measure particularly intended to secure OCR. the point might be to check the quality of CAPTCHA against bot frameworks
- Assistive innovation for dazzle and outwardly hindered clients

2.2.2 Types:

- Optical character acknowledgment (OCR) – targets wrote content, one glyptography or character at any given moment.
- Optical word acknowledgment – targets wrote content, single word at once (for dialects that utilization a zone as a word divider). (Normally basically known as "OCR".)
- Intelligent character acknowledgment (ICR) – conjointly targets composed print content or cursive content one glyptography or character at once, once in a while including machine learning.

- Intelligent word acknowledgment (IWR) – conjointly targets composed print content or cursive content, single word at once. This is frequently especially accommodating for languages wherever glyphs aren't isolated in longhand.

OCR is for the most part a "disconnected" technique, that investigations a static archive. Penmanship development examination will be utilized as contribution to penmanship acknowledgment as opposed to just misuse of the states of glyphs and words, this strategy is prepared to catch movements, similar to the request amid which portions are drawn, the heading, and furthermore the example of golf stroke the pen down and lifting it. this additional information will manufacture the conclusion to-end strategy a great deal of right. This innovation is moreover alluded to as "on-line character acknowledgment", "dynamic character acknowledgment", "continuous character acknowledgment", and "insightful character acknowledgment".

2.2.3 Techniques

2.2.3.1 Pre-processing

OCR programming bundle ordinarily "pre-forms" pictures to improve the probabilities of triple-crown acknowledgment. Systems include:

- De-skew – If the archive wasn't adjusted appropriately once checked, it ought to must be constrained to be tallied numerous degrees clockwise or counterclockwise to shape lines of content flat or vertical.
- Despeckle – take away positive and negative spots, smoothing edges
- Binarization – Convert a photo from shading or grayscale to high contrast (called a "double picture" on account of there are 2 hues). The errand of binarization is executed as a simple method for isolating the content (or the other wanted picture segment) from the foundation. The assignment of binarization itself is essential since most business acknowledgment calculations work exclusively on twofold pictures since it turns out to be less convoluted to attempt and do consequently. furthermore, the viability of the binarization step impacts to a noteworthy degree the standard of the character

acknowledgment arranges and the watchful choices are made inside the option of the binarization utilized for a given information picture sort; since the standard of the binarization approach used to get the twofold outcome relies upon the sort of the info picture (checked report, scene content picture, verifiable debased record and so on.).

- Line expulsion – Cleans up non-glyph boxes and shapes
- Layout investigation or "zoning" – Identifies sections, passages, inscriptions, and so forth as particular squares. especially fundamental in multi-section designs and tables.
- Line and word discovery – Creates reference point for word and character shapes, isolates words if vital.
- Script acknowledgment – In multilingual records, the content may change at the measure of the words and along these lines, recognizable proof of the content is imperative, before the correct OCR will be summoned to deal with the content.
- Character detachment or "division" – For per-character OCR, numerous characters that are associated as a result of picture curios ought to be isolated; single characters that are broken into different things in view of relics ought to be associated.
- Normalize proportion and scale

Division of settled pitch text styles is expert nearly just by situating the picture to a homogenous matrix bolstered wherever vertical lattice lines would least be able to ordinarily run over dark regions. For corresponding text styles, a considerable measure of refined methods are required on account of whitespace between letters will by and large be greater than that amongst words, and vertical lines will run over very one character.

2.2.3.2 Character recognition

There are 2 essential types of center OCR algorithmic control, which can turn out a progressive rundown of applicant characters.

2.2.3.2.1 Matrix matching

Matrix coordinating includes examination a photo to a hang on glyptography on a pixel-by-pixel premise; it's also alluded to as "design coordinating", "design acknowledgment", or "picture

connection". This relies upon the information glyptography being appropriately separated from the rest of the picture, and on the hang on glyptography being in an exceedingly comparative text style and at indistinguishable scale. this strategy works best with composed content and doesn't function admirably once new textual styles are experienced. this is regularly the system the primary physical photocell-based OCR upheld, rather straightforwardly.

2.2.3.2.2 Feature extraction

Highlight mining isolates glyphs into little highlights like lines, shut circles and so on. The extraction alternatives downsize the spatial property of the outline and makes the notoriety strategy computationally efficient. These alternatives territory unit contrasted and Associate in Nursing theoretical vector-like outline of an identity, which could downsize to 1 or a great deal of glyptography models. General strategies of highlight location in portable workstation vision zone unit material to the present assortment of OCR, that is frequently observed in "canny" penmanship acknowledgment thus most up and coming OCR programming framework. Closest neighbor classifiers cherish the k-closest neighbors algorithmic lead region unit acclimated contrast picture alternatives and hang on glyptography choices and select the nearest coordinate.

Some product's utilization a two-pass technique for character acknowledgment. The second pass is accepted as "versatile acknowledgment" and utilizes the letter shapes eminent with high certainty on the essential go to recognize higher the remarkable letters on the second pass. This can be advantageous for rare textual styles or low-quality outputs wherever the text style is misshaped.

The OCR result is hang on inside the institutionalized ALTO arrangement, an enthusiastic XML composition kept up by the us Library of Congress.

2.2.3.3 Post-processing

OCR exactness is hyperbolic if the yield is unnatural by a dictionary – a stock of words which will happen amid a report. This may well be, perhaps, every one of the words inside the English dialect, or an extra specialized vocabulary for a field. this framework is tricky if the archive contains words not inside the vocabulary, as right things. Tesseract utilizes its vocabulary to impact the character division venture, for enhanced precision.

The yield stream is likewise a fathomable content stream or document of characters, however extra unobtrusive OCR frameworks will protect the underlying format of the page and make, perhaps, A commented on PDF that highlights each the underlying picture of the page and an accessible issue outline.

"Close neighbor examination" will make utilization of co-event frequencies to rectify mistakes, by taking note of that bound words are commonly observed along. perhaps, "Washington, D.C." is typically much more typical in English than "Washington DOC".

Information of the clear phonetics of the dialect being filtered may likewise encourage affirm if a word is most likely going to be a verb or a thing, perhaps, allowing bigger exactness.

The Levenshtein Distance recipe has also been utilized in OCR present handling on extra advance outcomes from AN OCR API.

2.2.3.4 Application-specific optimizations

As of late, the primary OCR innovation suppliers have changed OCR frameworks to deal with certain info sorts in a superior way. Other than an application-particular lexicon, higher execution is frequently accomplished by considering business rules, standard articulation rich information

contained in shading pictures. This approach is called Application-Oriented OCR or Customized OCR. It has been utilized as a part of various applications.

2.2.3.5 Crowdsourcing

Pictures can be handled rapidly by utilizing human driven group sourcing however better exactness in picture acknowledgment is accomplished by utilizing PCs. Amazon Mechanical Turk and reCAPTCHA are some true cases. Other than coordinate character acknowledgment, crowdsourcing has likewise been utilized to call programming designers to make picture handling algos e.g. rank-arrange competitions.

2.2.4 ALPR:

ANPR is a strategy that uses optical character acknowledgment on pictures to peruse vehicle enrollment plates. It will utilize existing TV framework, street govern social control cameras, or cameras particularly intended for the errand. ANPR is utilized by police powers round the world for implementation capacities, together with to envision if a vehicle is enlisted or approved. It's furthermore utilized for electronic toll grouping on pay-per-utilize streets and as a method for listing the developments of activity by interstates organizations. ANPR is regularly usual to store the photos caught by the cameras and from the auto plates, with some configurable to store a photo of the individual driving the vehicle. Frameworks unremarkably utilize infrared lighting to allow the camera to require the picture paying little mind to the time. ANPR innovation ought to examine plate varieties from better places. Concerns with respect to these frameworks have focused on protection fears of state stalking residents' developments, misidentification, high blunder rates, and improved government defrayment. Faultfinders have spoken to it as a kind of mass police work.

2.2.4.1 Technology

For better tag acknowledgment, the content textual style on the plates was changed. ANPR utilities OCR on the photos caught by the gadgets. Dutch experts acquainted slight holes in some with increment the disparity between the letters and make the more comprehensible for such procedures. There is deviation in content text dimensions and situating of letters in some tags,

ANPR frameworks ought to have the capacity to deal with these fluctuations to be compelling. More mind-boggling frameworks can deal with worldwide varieties, however most virtual products are only customized for each state. The gadgets utilized can be present winning street control execution or CCTV cameras, or they could likewise be versatile units, which are for the most part associated with the cars. Infrared cameras are likewise utilized as a part of a few frameworks to get particular photos of the tags.

2.2.4.2 In Mobile Systems:

In late 20th century, critical advances in innovation took programmed go plate acknowledgment (ANPR) frameworks from confined extravagant, strenuous to arrange, mounted based generally applications to "simple to use" portable ones. This was made potential by the production of bundle that kept running on less expensive PC based for the most part, non-master equipment that furthermore not required to lean the pre-characterized points, heading, size and speed amid which the plates would be passing the camera's field of read. more downsized parts at more affordable worth guides light-producing diode toward a record scope of organizations by authorization offices round the world. Littler cameras with the adaptability to peruse tags at higher velocities, nearby littler, extra solid processors that space in the trunks of police vehicles, permitted requirement officers to watch day by day with the benefit of enrollment code perusing progressively, once they will prohibit like a shot.

In spite of their adequacy, there range unit important difficulties associated with versatile ANPRs. one in everything about biggest is that the processor and in this manner the cameras should work sufficiently snappy to oblige relative paces of over a hundred mph (160 km/h), a conceivable situation inside the instance of approaching movement. This instrumentation ought to try and be terribly economical since the office supply is that the vehicle battery, and instrumentation ought to be little to decrease the house it needs.

Relative speed is only one issue that influences the camera's capacity to peruse an enrollment code. Calculations ought to be capable to catch up on every one of the factors which will relate degree impact on} the ANPR's capacity to supply a right peruse, associated to time of day, climate and edges between the cameras and along these lines the tags. A framework's enlightenment wavelengths may likewise have an immediately effect on the determination and exactness of a peruse in these conditions.

Introducing ANPR cameras on implementation vehicles needs watchful idea of the juxtaposition of the cameras to the tags they're to peruse. Abuse the right scope of cameras and situating them precisely for best outcomes will demonstrate troublesome, given the varying missions and conditions within reach. Street watch needs creative cameras that traverse numerous paths and might peruse tags at horrendously high speeds. Most in fact propelled frameworks zone unit flexible and may be outlined with a few cameras beginning from one to four which may basically be repositioned as required. States with raise just tags have a further test since an imaginative camera is ineffectual with approaching movement. Amid this case one camera is additionally turned in reverse

2.2.4.3 Algorithms

There are seven essential calculations that the product bundle requirements for recognizing a tag:

1. Plate confinement – responsible for finding and uninflected the plate on the picture.
2. Plate introduction and size – makes up for the skew of the plate and modifies the size to the predefined estimate.
3. Standardization – alters the shine and refinement of the picture.
4. Character division – finds the individual characters on the plates.
5. Optical character acknowledgment.

6. Syntactical/Geometrical investigation – check characters and positions against nation particular standards.
7. The averaging of the perceived cost over various fields/pictures to give a ton of dependable or guaranteed result, especially since any single picture may contain a reflected light-weight flare, be part darkened or elective brief effect.

The nature of everything about subsections of the program decides the exactness of the framework. all through the third section(normalization), a few frameworks utilize edge identification systems to broaden the picture qualification between the letters and the plate backing. A middle channel might be needed to downsize the visual commotion on the picture.

2.2.4.4 Difficulties

There are numerous potential troubles that the bundle ought to have the capacity to adjust.

These include:

- Poor record determination, on the grounds that the plate is essentially too far-removed however commonly resulting from the usage of a low-quality camera.
- Blurry pictures, strikingly movement obscure.
- Poor lighting and low refinement on account of overexposure, reflection or shadows.
- A question clouding (some portion of) the plate, all the time a tow bar, or earth on the plate.
- Read tags that territory unit totally unique at the front and hence the back owing to towed trailers, campers, and so on.
- Vehicle path change inside the camera's point of read all through auto put perusing.
- A totally unique textual style, very much enjoyed for affectedness plates (a few nations don't allow such plates, dispensing with the issue).

- Circumvention procedures.
- Lack of coordination between nations or states. 2 autos from various nations or states will have indistinguishable assortment however unique style of the plate.

While some of these issues is rectified among the bundle, it's fundamentally left to the equipment part of the framework to make sense of answers for those challenges. Expanding the pinnacle of the camera could maintain a strategic distance from issues with objects, (for example, extraordinary vehicles) darkening the plate however presents and will increment diverse issues, equal to the altering for the misrepresented skew of the plate.

On a few autos, tow bars could cloud one or 2 characters of the auto put. Bicycles on bicycle racks additionally can darken the tag, in spite of the fact that in a few nations and purviews, proportionate to Victoria, Australia, "bicycle plates" are estimated to be fitted. Some little scale frameworks yield a few mistakes inside the auto put. once utilized for giving particular vehicles access to a banished space, the decision is additionally made to possess a suitable blunder rate of 1 character. this is frequently a direct result of the possibility of Associate in Nursing unapproved car having such a similar auto put is kind of nearly nothing. Be that as it may, this level of value wouldn't be satisfactory in many uses of ANPR framework.

2.2.4.5 Usage:

Numerous urban areas and regions have created control frameworks to help screen the development and stream of vehicles round the street arrange. This had typically concerned watching chronicled learning, appraisals, perceptions and measurements, for example

- Car stop utilization
- Pedestrian crossing utilization
- Number of vehicles on a street

- Areas of low and high blockage
- Frequency, area and clarification for street works

CCTV cameras will be used to encourage control focuses by giving them live learning, allowing movement administration decisions to be made in period. By abuse ANPR on this recording it's possible to watch the go of individual vehicles, mechanically giving information concerning the speed and stream of arranged courses. These points of interest will feature drawback ranges as and after they happen and encourage the center to frame side by side of occurrence administration decisions.

A few provinces of the UK have worked with Siemens Traffic to create activity perception frameworks for his or her own particular administration focuses and for people in general. The situating indicates data concerning car parks, in advance street works, uncommon occasions and photos taken from CCTV cameras. ANPR frameworks will be acclimated give normal point-to-point travel times on unequivocal courses, which may be shown on a variable-message sign(VMS) giving drivers the ability to mastermind their course. ROMANSE conjointly allows explorers to imagine this situation utilizing a cell phone with a web alliance, (for example, WAP, GPRS or 3G), allowing them to take a gander at cell phone CCTV pictures among the Hampshire street arrange.

The UK organization Traffic ace has utilized ANPR since 1998 to gauge normal activity speeds on non-motorway streets while not the outcomes being skew by local variances caused by movement lights and comparable. the corporate as of now works a system of more than 4000 ANPR cameras, however guarantees that exclusively the four most focal digits are known, and no range plate learning is protected.

2.3 Smart Cities

Smart cities are gaining vast quality everywhere the globe, particularly within the developing nations because of increasing crimes and additional advancements in technology. the provision of the sensible phones at low cost rates has born to the thought of victimization sensible phones as

input tools in sensible town comes. this can be terribly fascinating for developing nations because it offers a prospect for them to deploy these styles of advanced comes at low installation and maintenance prices. ton of analysis is being meted out during this field and plenty of nations are benefiting from it.

2.3.1 Related Work:

In late decade, there has been significant work in different spaces of savvy urban communities. Ibrar Y. et al. (Yaqoob, 2016) talked about the correspondence and availability issue in begin urban communities. The foundation of savvy urban areas is the correspondence direct and within the sight of a great many gadgets, correspondence innovation can't give flawless network. In addition, creators introduced the contextual analysis of Stratford, Singapore and so on.

Alexey Medvedev et al (Alexey Medvedev, 2014) talked about utilizing the vehicle-mounted reconnaissance cameras set up of CCTV cameras. For this reason, they have suggested a mobile app CityWatcher, it records the video streams from the smart phones which are utilized by other approved IOT applications with the assistance of geo area, timestamp and other extra setting accessible. It is utilized to alarm the experts about the issues workers confront like splits, mishaps, potholes, jams and so on. These cautions are started by the drivers and they are then compensated through specific motivations.

W. A. Agangiba et. al (William Akotam Agangiba, 2013) have projected utilizing the computational abilities of the advanced mobile phones to make them helpful for the general public for wrongdoing recognition and detailing. The proposed structure helps in the discovery, revealing and in the end following the offenders utilizing the advanced mobile phones.

Divya Lal et. al (D. Lal, 2016) suggested an application that gives the choice to report the wrongdoings by utilizing different strategies. At the launch, the clients enroll themselves to the application. In order to report a wrongdoing, client can do so through a recorded voice message or a video or picture message. This data alongside the area is sent to the security forces to keep record of the clients; the app intermittently stores the GPS location of the client.

In (Ali, 2015), M. Eunos et. al projected SafeStreet, it's an advanced mobile app which uses crowd sourcing and GPS to its benefit. It encourages ladies to report inappropriate behavior cases out in the open spots. It empowers ladies to catch and offer their encounters namelessly. It likewise empowers clients to find a way to a sheltered area. All the detailed cases are put away on the server alongside the area and time of the episode. In light of investigation, it can likewise prescribe the protected travel time.

2.4 Related Applications and their Usage

Different work has been exhausted the sector of analysis crowdsourcing and traffic watching cooperation analyses. several the applications are designed over time by completely different authorities in several countries. These apps are initial contribution to open government phenomena and don't seem to be directly related to officialdom. Applications designed for news traffic violation, news traffic jams and notifying individuals regarding their commute route condition, traffic condition maps with real time update. (Delhi Traffic Police, Sigalert, INRIX Traffic Maps & GPS,) These are few apps for traffic issues. On the opposite hand, few were designed entirely for crime news, imply facilitate, crime maps of authentic crime knowledge and maltreatment news. a number of these applications are international whereas most of those applications are domestic level.

2.5 Our Technique

In this project, we have contributed a mechanism to classify and report suspected vehicles using crowd sourcing. The application outlines the vehicle passage using extrapolation. This way the surveillance of the suspected vehicles can be monitored without spending huge sums of money on infrastructure installation and maintenance.

2.6 Tools & Requirements

2.6.1 Hardware requirements:

- Android Smart Phone
- Web Server System

2.6.2 Software requirements:

- Android OS 4.3 and above
- PHP
- JSON
- JQuery
- JavaScript
- WAMP Server
- MySQL 5.4.3 and above

2.6.3 IDE's required

- NetBeans
- Android Studio

CHAPTER 3

Functionality & Design

Prototype Application

We have developed a prototype application **Citizens' Vehicle (CVEH)** which enables public to take part in catching guilty parties, create cautions and assume its part in lawfulness usage. In created nations, rapid vehicles in a joint effort with helicopters, quadcopters and observation cameras set at different areas are utilized to catch quick moving guilty parties. While, in under creating nations, exceptionally restricted assets are accessible to keep up the peace circumstance. These nations can't bear the cost of rapid vehicles, because of their cost and upkeep. Besides, it is additionally awkward to introduce cameras at each crossing point. Accordingly, under such conditions, CVEH gives a stage to keep up lawfulness through crowdsourcing worldview. Without appropriate reconnaissance, in an average attempt at manslaughter cases, vehicles can undoubtedly vanish in urban regions. In this manner, our proposed structures help in distinguishing the guilty party area and task its development through crowdsourcing. This outcomes in an early cautioning to law upholding organizations to make preemptive move to catch the guilty party. Figure 3 demonstrates the abnormal state level design of CVEH system. User interface and command & control center are the two main modules. The detail of these modules is clarified as under.

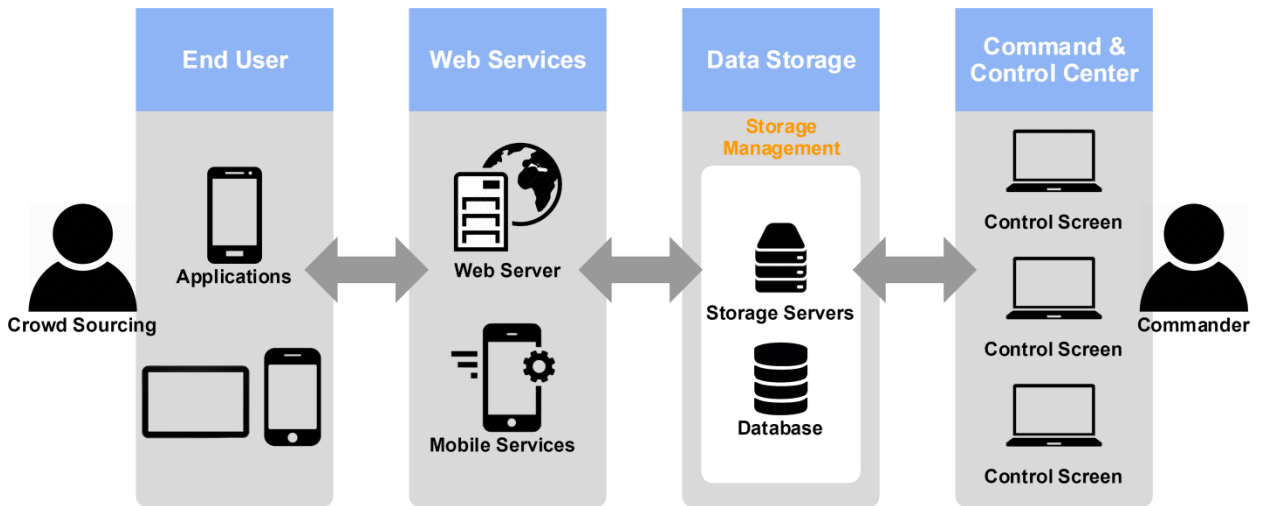


Figure 3: CVEH Framework

3.1 Proposed Design

The proposed system encourages end clients to dispatch grumblings through web or versatile application. The course of events outline in Figure 4 demonstrates the stream of proceedings amongst clients and CC module.

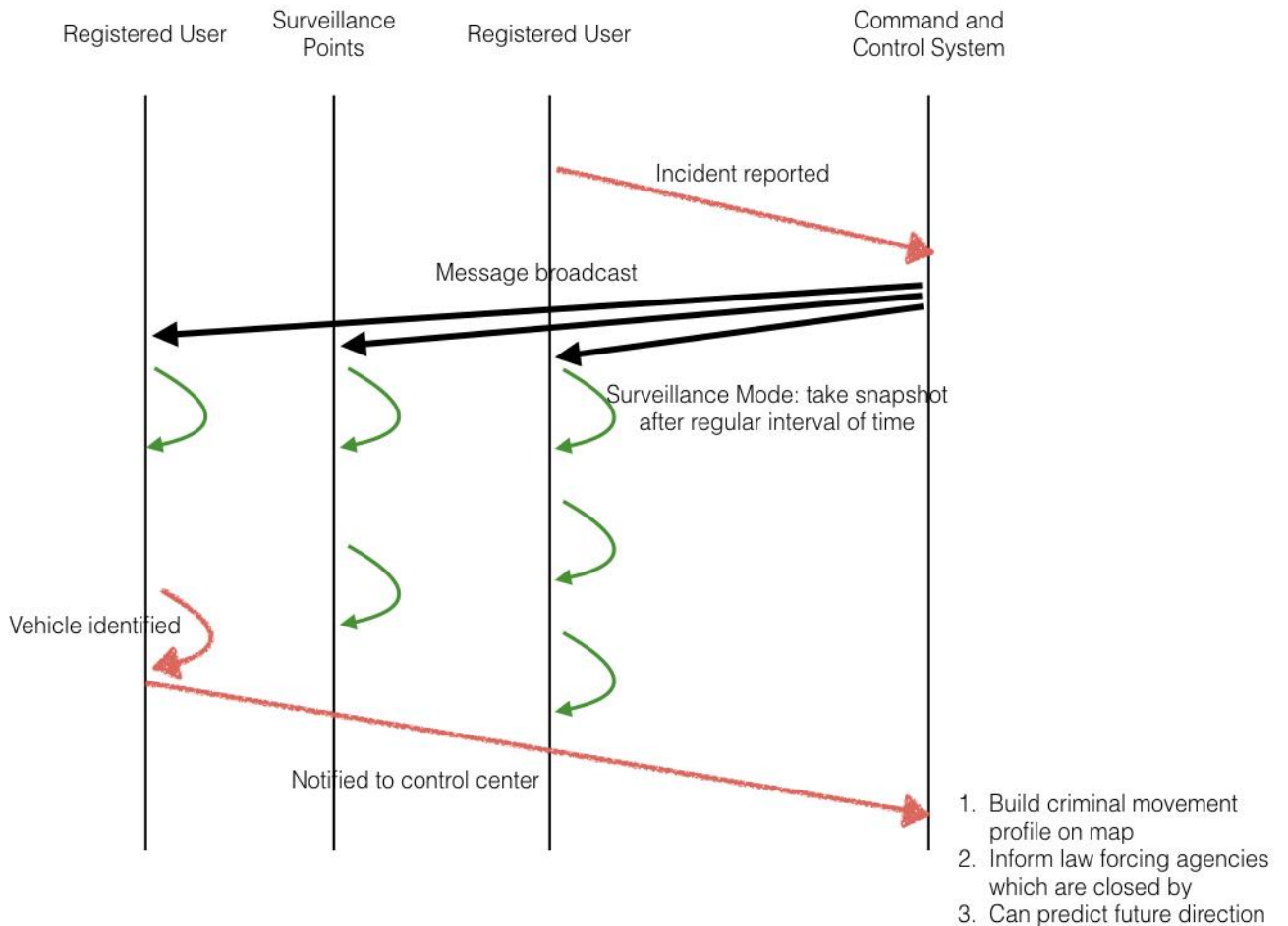


Figure 4: Flow of Events in CVEH

CVEH structure encourages emerging nations to capture guilty parties using crowdsourcing. The framework comprises of two noteworthy components, client module, and CC. The client module is the fundamental element of the application which runs on the smart phones. As a proof of idea, it is developed on the Android working framework. At the initial stage, the client installs

the application and enroll themselves with the application. The enrollment procedure confirms the client using its CNIC. Besides, in the further validation process, CNIC is utilized to enlist the user's smart phones. This enrollment procedure is compulsory to dodge any phony/manufactured client input. Along these lines, the client can utilize CVEH on any of devices issued to its name. Likewise, our application can likewise take a shot at Android based vehicle mounted reconnaissance frameworks. We additionally accept that mobile phones are mounted on the dashboard of vehicles and can go about as an observation framework. Besides, the walker can utilize CVEH in manual observation mode. After fruitful confirmation, the client can assume its part in detecting the earth and help to actualize the peace circumstance. If there should be an occurrence of any episode like robbery, snatching and the suspects utilize some automobile to leave the area, the CVEH client can report this activity using a picture of the guilty party and its helped vehicle. The client can likewise provide the data by filling a minimalistic form. In person on foot mode, the client can take the picture of the vehicle, the application's imaging module separates the license plate number from the picture utilizing OCR. This procedure is portrayed in Figure 5a. The client can enter different points of interest of the vehicle, for example, it's color, make/model and so forth. All the valuable data is sent to the CC. Besides, CC is additionally connected with online vehicle archive framework. The common data additionally contains the area of episode provided using location coordinates and the point in time where the event has occurred. On accepting the report, an alarm is produced which is communicated to every one of the clients display in the close region i.e. inside 10 km (adjustable). On account of no reaction inside 15 minutes of the alarm, all the enrolled clients inside the city are notified of the event; this is to expand the area of search for the suspected vehicle. Figure 5b represents the crime reporting and broadcasting module. On accepting the caution from CC, the surveillance activity of the application designed to operate in a reconnaissance mode affixed on/inside the car begins capturing the images after consistent intervals. Here, the application takes the images of its environment, gets the vehicle registration number from the image and compares it with the notifications it has received. Though, in CVEH handheld gadget setup, the notifications are flashed using pop-ups to notify the clients about

the crime alert and the client can also participate through physically taking the pictures of the area.

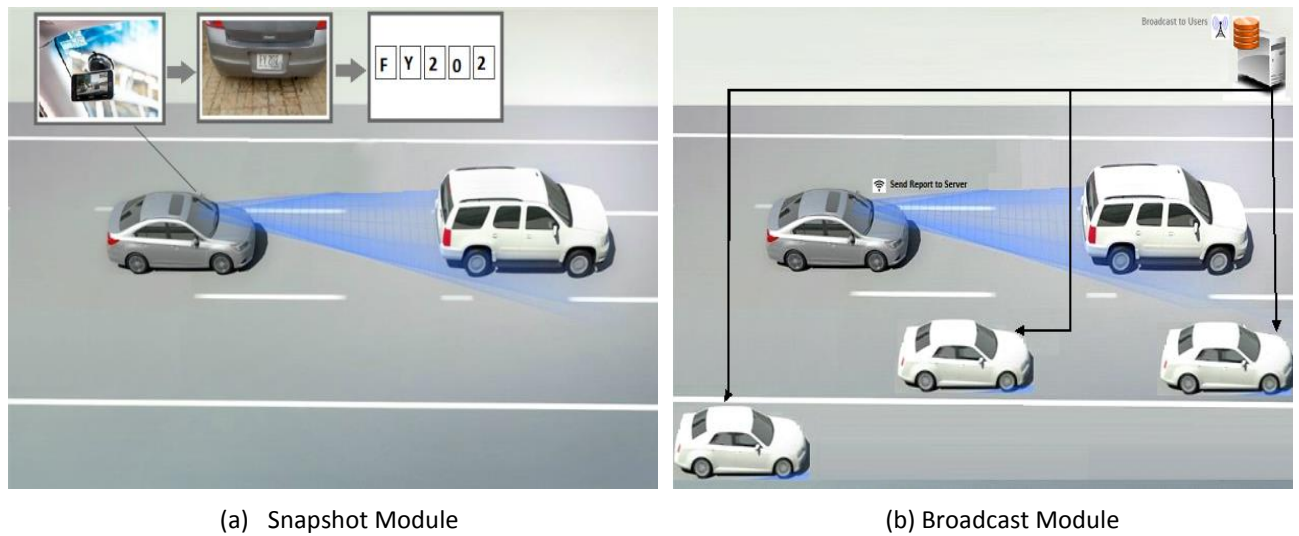


Figure 5: System Modules

On the definite identification of the guilty parties' vehicle, the information is directed to the CC. The CC profiles the movement of the guilty party vehicle in view of the group info and caution the law authorizing organizations that are situated at a minimum separation from the wrongdoer. The anticipated way is computed on the run using extrapolation. The CC is furnished with processing machines where the client's info is shown as criminals' passage reporting. The CC additionally incorporates a backup store, the data is placed here for advance examination. Inside the CC the Law Enforcing Agencies (LEAs) can observe the information of their enrolled clients, view the reported complaints on the map and can likewise specifically search for a particular crime report as depicted in Figure 6.

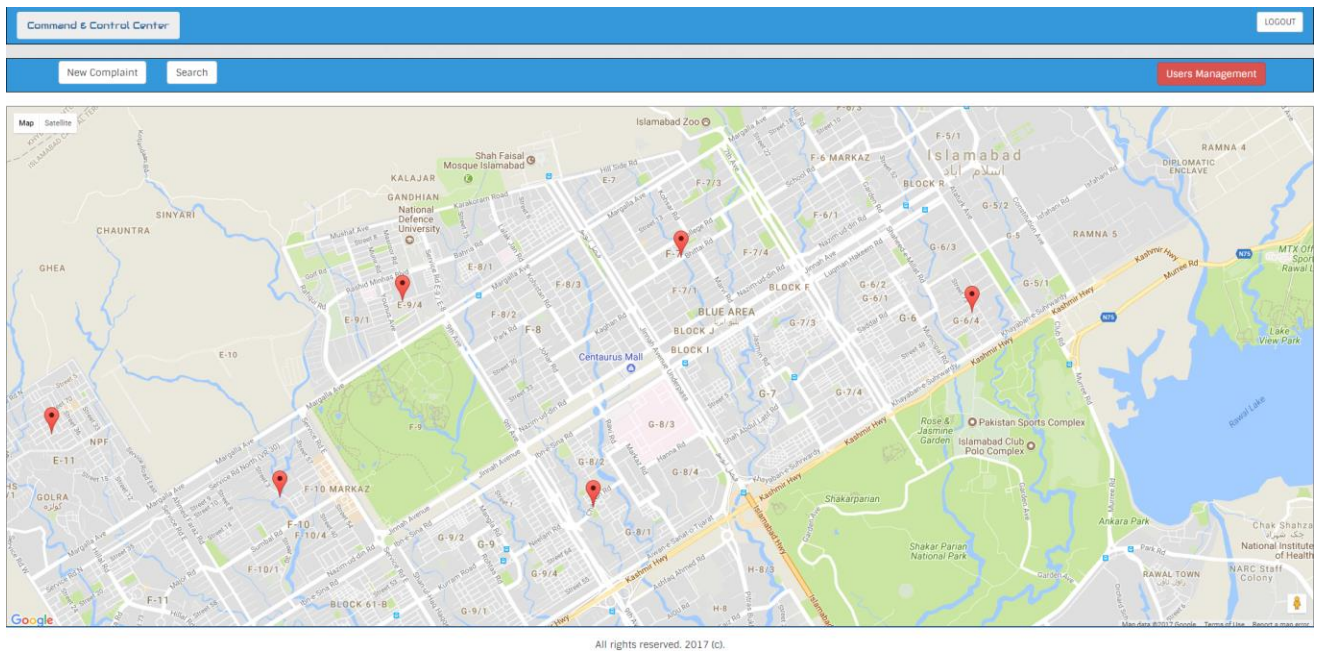


Figure 6: Command and Control Center, pointed locations are crowd sourced points

Besides, the CVEH application could also be teamed up with CCTV cameras placed at different crossing points; consequently, these cameras can be used likewise as talked about above.

The OPEN ALPR (Android) library (Machado, 2016) is utilized to extricate the vehicle data from the depiction; regularly, there can be numerous vehicles in a preview; in this manner, correct retrieval of all the vehicle data is esteemed essential. Additionally, to broadcast message/alarms, Firebase Cloud Messaging (FCM) (Firebase, 2014) is utilized. The OpenALPR is developed in C++. For other languages, different wrappers are available. It analyzes the photos and recordings to perceive vehicle enrollment plates. It separates the content from the plates and return it as a yield. FCM is a cross-stage solid informing arrangement. The FCM encourage to produce warning messages draw in and maintenance clients, it has the capability to bolster data load up-to 4KB.

3.2 Technologies Used

3.2.1 OpenALPR

It is an open source library written in C++ (OpenALPR Technology, 2014). In order to bind it with other languages, different wrappers are available. It identifies registration plates by analyzing the images and video streams. The registration number of the vehicle is extracted as the text characters.

There are multiple ways in which this software can be used. For example, it can be used to analyze camera streams and recognize the license plates from it, process the video files and save the registration plates, examine the pictures, incorporate the vehicle registration plate identification and it can also be run as a web service. Furthermore, it can also be used as a “black box” to provide the information to other systems, regardless of the programming language, by examining the video. It extracts the license plates data automatically by processing the pictures and generates the JSON data relating to the license plates located in the captured pictures. This data can either be uploaded to another server as an HTTP POST or downloaded from another server via beanstalkd queue.

OpenALPR can also monitor the video streams instantaneously to bunch up all the license plates distinguished by the cameras.

The OpenALPR agent The OpenALPR agent receives the video stream from an IP camera, applies certain course of actions to it and then pushes the license plate data to the OpenALPR web server. The data stream flows continuously and steadily between the camera and OpenALPR agent and between this agent and the OpenALPR web server. As the data sent to the cloud contains only text metadata about the license plates, it is comparatively low-bandwidth data.

OpenALPR operates as a pipeline. It takes an image as an input, then applies a variety of processes to it in different stages and the produces the most probable license plate number obtained from the image in text form. Figure 7 [17] shows the system flow diagram of OpenALPR system.

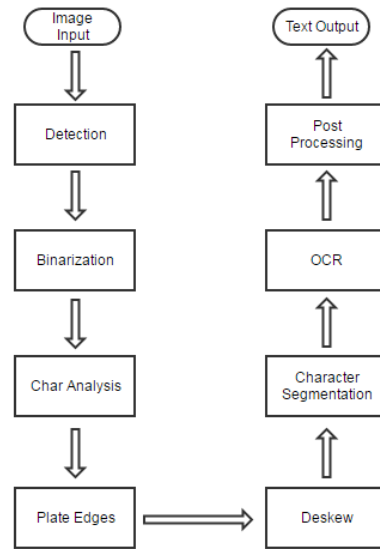


Figure 7: ALPR System Flow

The pipeline stages occur in the following order:

3.2.1.1 Detection

For each input image, the detection phase occurs one time only. The LBP algorithm, which is usually used for face detection, is applied to find the most probable license plate sections. Each of these sections is then sent to the later pipeline stages for more processing. The detection stage is generally the most rigorous processing stage. It can be GPU accelerated to enhance performance.

3.2.1.2 Binarisation

This stage and all the following stages happen several times, once for each potential license plate region.

The binarisation stage produces many binary images for each plate region. The motive behind using several binary images is to provide the user with the most likely chance of discovering all the characters and digits. A single binarized image might fail to spot the characters if the image

is excessively dark or excessively light for instance. It uses the Wolf-Jolien method as well as the Sauvola method with different parameters. All of these binary images are processed in later stages.

3.2.1.3 Character Analysis

Character analysis is an attempt to find out character-sized areas in plate region. This is done by finding all associated blobs in license plate region in the first step. Then such blobs are being discovered that meet the dimensions of a specified character format and also have bottoms/tops aligned with all other blobs of similar dimensions. Same region is analyzed several times. Small characters are considered first then gradually the larger words. If there is nothing in the region, the region is considered as thrown out and processing stops on that region. The region is saved only in the case when any potential characters are found in it. Such region is processed further.

3.2.1.4 Plate Edges

The next stage is to search for the edges of license plate. in the detection phase only a region is identified where a license plate may possibly exist. Mostly it provides a smaller or slightly larger region than actual plate. plate edges try to find out the exact edges of the license plate. in the first step, all the hough lines are being found out for license plate area. plate images are processed by platelines.cpp which then work out a list of vertical and horizontal lines. this list along the character height (calculated in Character Analysis) is used by plate corners to find the most probable plate line edges. many organize able weights are used by it to establish the most logical edge. then it uses a default edge, on the basis of ideal height/width of plate, to check whether it makes a match or not.

3.2.1.5 Deskew

The deskew stage replots the plate area to the standard orientation and size by using the plate edges. in an ideal situation, perfectly oriented image of the plate, without skew or rotation, can be achieved in this process.

3.2.1.6 Character Segmentation

In the character segmentation section, all those characters are isolated from which the plate image is formed. character segmentation section tries to separate all those characters that make the image plate. vertical histogram is used to discover the gaps in the plate. the character boxes are also being cleaned up in this phase by getting rid of disconnected small speckles and excluding the character areas that are not high enough. Then the "edge" regions are being removed so that the edges of license plate might not get classified as 'l' or a '1'.

3.2.1.7 OCR

The OCR phase considers each character separately. For every character image, it computes all likely characters and their confidences.

3.2.1.8 Post Processing

In post processing, we find out the most likely license plate characters sequence from the list of all the potential OCR characters and given a list of all possible OCR characters and confidences. It is then prearranged in the form of a top N list. All the characters that are under a certain threshold are discarded. We also have 'soft thresholds', the characters under it are added to the potential list but a probable blank character is also added to the list as the possibility of the low confidence character of not being the part of the license plate is still high.

The region validation is also handled in post processing, if required. For example, if OpenALPR is instructed that this license plate is from Missouri, then it will attempt and match up the outcome alongside a Missouri license plate format template. So, for example, if the list of the top 3 possible outcomes was:

- CFOCIG
- CF0CIG
- CF0C1G

So, the post processing will indicate that the third entry is our top match as the third entry matches the best with the given template and the rest of the numbers do not.

3.2.2 Firebase Cloud Messaging

FCM is a platform independent communication resolution that provides us a way of delivering messages reliably without any cost. It can be used to let know a client app that a new email or other information is available to synchronize. It can be used to send the notification messages to compel the user for reload and maintenance of services. For use cases such as instant messaging, a message can deliver a data load of up to 4KB to a client app.

It can also be used to fire notification posts or data messages to the clients using FCM, send messages to different message target audience i.e. deliver messages to the client application in any of three ways — to a solitary device, to cluster of devices, or to those devices that are subscribed to certain subject matters and drive messages from client apps i.e. send recognition messages, conversations and other messages from devices back to the server over FCM's dependable and energy cost-effective connection network.

An FCM implementation comprises of an app server that fires messages and a client app that collects and reads them. The messages can be sent from the app server using multiple ways i.e. via Admin SDKs or the HTTP and XMPP APIs. The notifications console can also be used to create messages without the app server.

Firebase Notifications is developed on Firebase Cloud Messaging and shares the similar FCM SDK for client development. Notifications can be used for testing purposes and also to send promotional messages with strong incorporated targeting and analytics. FCM is the best choice for deployments with complicated messaging requirements. Figure 8 [15], describes major modules of FCM and their interaction with each other.

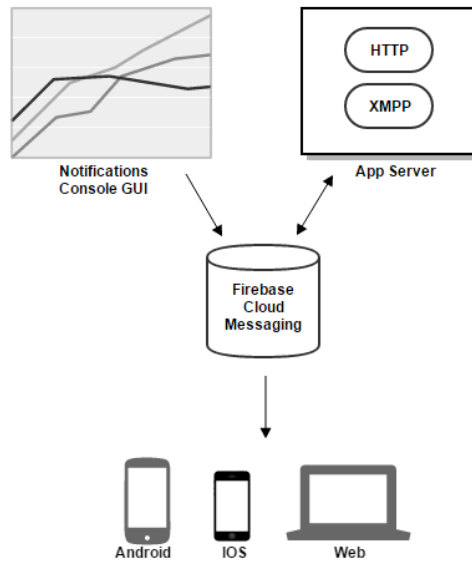


Figure 8: FCM Architecture

Chapter 4

Testing & Evaluation

Case study: ICT Surveillance System

As a proof of idea, we have considered the observation framework for the capital city of Pakistan, Islamabad. There is an absence of supervision systems particularly in the city and just fractional framework is accessible at sections and exits. The official license plates format is used as visible in Figure 9.

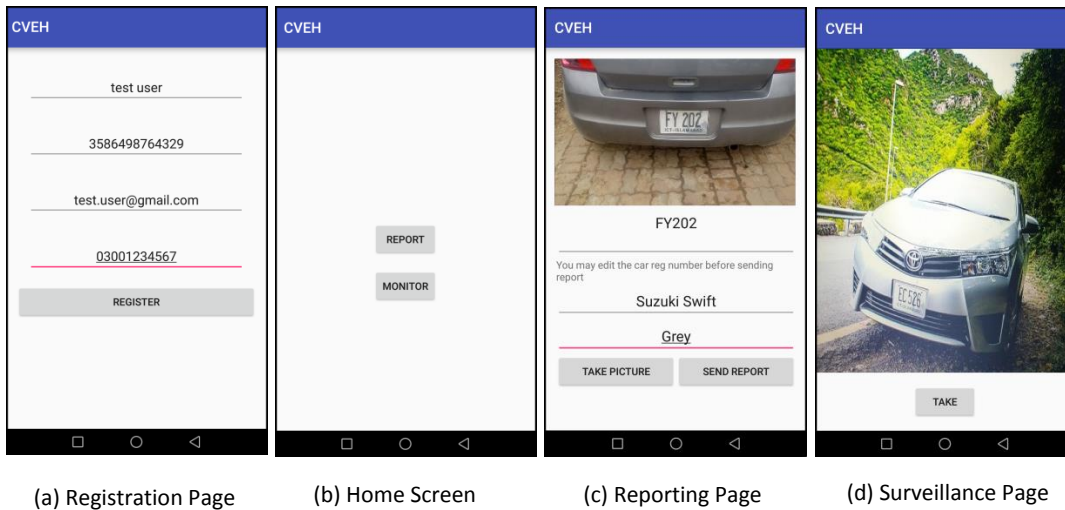
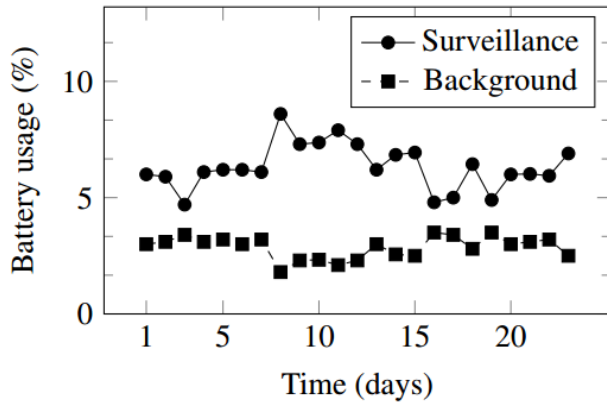


Figure 9: Images of different screens of our prototype application

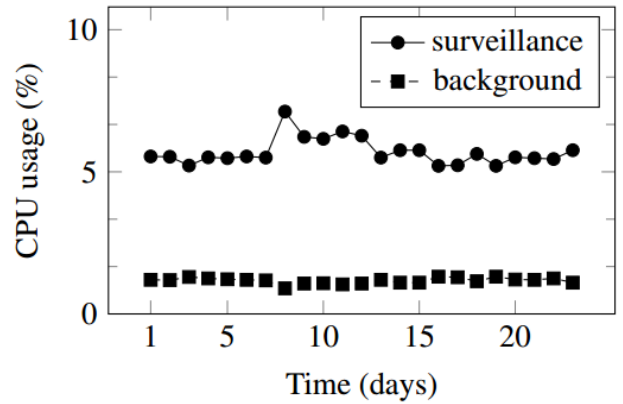
This enables CVEH to effortlessly recognize vehicles without utilizing intricate machine learning calculations implemented at handheld gadgets. Also, few observation cameras are introduced at different areas that can without much of a stretch turn into the piece of CVEH matrix.

4.1 Prototype evaluation

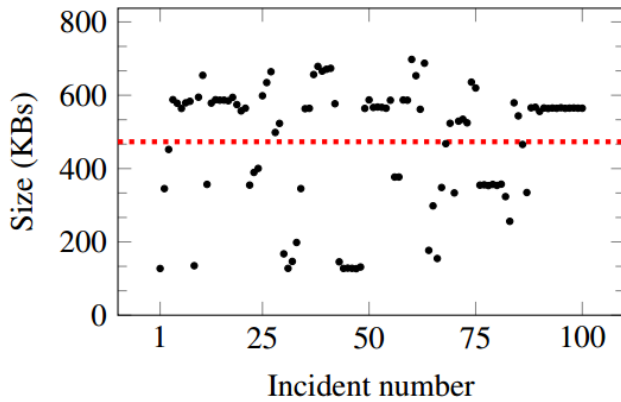
To assess the attainability of our system, we have dissected the framework in light of its asset utilization. The model application permits executing the center usefulness of the framework. We have built up a customer (passerby and vehicle camera reconnaissance) mode, and order and control focus. The proposed system gives the OCR usefulness through OpenALPR library.



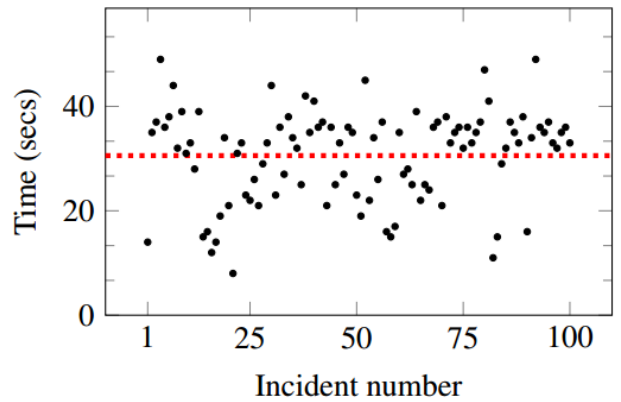
(a) Average battery usage per day (%)



(b) Average CPU usage per day (%)



(c) Internet data used per incident report (KBs). Mean size of internet data used μ_{size} for 100 reported incidents is 473.15 KBs.



(d) Time taken per incident report (seconds). Mean time taken μ_{time} for 100 reported incidents is 30.57 secs.

Figure 10: Resource Usage Statistics

The CVEH module at customer end distinguishes the number plate from the picture and concentrates the license plate number from the picture. The performance of these tedious tasks at the smart phones need memory, preparing force, and information bundle. In the benchmarking tests, we ran the application for successive 23 days and calculated the asset utilization of the system continuously. The Figure 10d demonstrates the time taken in registering a report and getting a reaction from the CC (just 100 solicitations are accounted for here). In all the correspondence, the mean time is about 30 secs (including the values acquired during the max use hours). In addition, amid the tests, memory, battery and CPU utilization is watched. Figure 10b demonstrates the CPU use is spiked a little at the points where various cars are

identified in a solitary depiction. The CPU utilization is calculated at different time intervals. Additionally, the memory and battery use is under 4 - 8 % separately. To decrease the memory utilization, we have put away a constrained data at CVEH customer end, a large portion of the information is put away as the efficient data structures (e.g. binary trees) to diminish the inquiry time. So also, the battery is straightforwardly identified with asset utilization, keeping all the asset use beneath to limit esteem, we prevail to proficiently used the battery as appeared in Figure 10a. To extricate the cars' license plate number from the picture, we have utilized a variation of an open source library "OPEN ALPR for Android" to customize it for Islamabad license plate format and to send the notifications to the clients we have utilized FCM. In addition, our framework is assessed using reenactments in MATLAB, where distinctive crowdsource volunteers are set on google maps to distinguish the wrongdoers' automobile. In the reenactment, the volunteers are varied from 100 to 1000 and all of these sources are non-stationary.

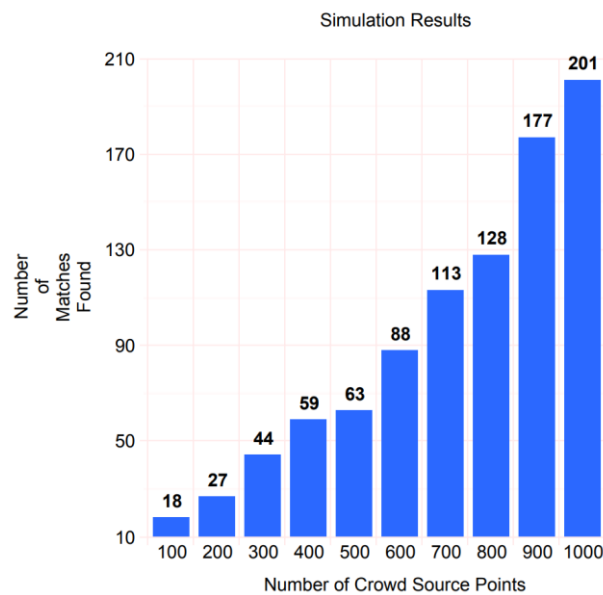


Figure 11: Simulation Results

The outcomes demonstrate that with the expansion in the crowdsource volunteers, the likelihood of distinguishing the suspect automobiles also increments as appeared in Figure 11.

This implies that the increase in the users can altogether enhance the execution of the proposed framework. Thus, with the expansion in the quantity of group source focuses, the proficiency of the framework increments and the reconnaissance should be possible with the insignificant cost of foundation which ends up being extremely useful for the creating countries.

Chapter 5

Conclusion

5.1 Approaches for Crime Reporting

We can register a report against a crime in 2 ways:

- Manual Report Registration
- Report Registration using Smart Phones

5.1.1 Manual Report Registration

In this case, we launch a FIR by going to the nearby police station or by calling at the police emergency help line and registering the report.

5.1.2 Report Registration using Smart Phones

Here, the report can be registered using smart phone apps that allow the user to register a report by entering some details and submitting the form to the police server or by pressing the emergency button on the smart phone apps provided by the local administration.

5.2 Surveillance Systems Method

The surveillance systems currently deployed need a large sum of investment and maintenance cost and a comprehensive infrastructure needs to be installed throughout the city which might not be feasible for developing nations due to the budget constraints.

5.3 Our Work

In our work, we have suggested the system CVEH to help creating nations for the manageability of society. Our proposed a structure is powerful and adaptable. To assess our engineering, we have actualized a model that takes a shot at Android PDA and benchmark the assets utilization. Additionally, we have likewise reenacted the impact of crowdsource volunteers on the identification of the suspected automobiles. The target of our application is to use the crowdsourcing for the advantage of community. In under developed nations, it's impractical to install gigantic foundation for the monitoring and tracking systems in this manner, CVEH is one of the conceivable ways to deal with defeat framework issue and help in accomplishing social manageability.

Chapter 6

Future Recommendations

Following improvements could be done in order to further enhance the effectiveness of the CVEH framework.

6.1 Functionality Enhancements

We will continue to further develop our application and aim to add further functionality like ability to run the surveillance mode in background.

6.2 Improvement in Protocol

We aim to further improve our protocol and provide more efficient mechanism to register report in lesser time and using fewer resources.

6.3 Dash Cam Support

We would like to extend our application by adding support for dash cams to be used as an auxiliary camera with the smart phones.

6.4 License Plate Format Library Extension

We also aim to contribute an add-on to the existing OpenALPR platform for all the Pakistani license plate number formats in the future. This could also provide a generic means of handling the issues faced by traffic police in daily routine.

6.5 Integration with Advance Cameras

The image processing can further be improved by integrating the application with advanced cameras capable of taking clear pictures in high speed chase and when the camera view is not stabilized due to bad condition of roads or any other reason.

6.6 Integration with NADRA Database

Integration with NADRA database can be done to regularize the user registration process and provide further safety from fake/prank reports.

References

- A. Hampapur, L. B. (2005). Smart video surveillance: exploring the concept of multiscale spatiotemporal tracking. *IEEE Signal Processing Magazine* , 38-51.
- A. R. Dick, M. J. (2003). Issues in automated visual surveillance. *International conference on digital image computing techniques and applications*.
- Alexey Medvedev, A. Z. (2014). Reporting Road Problems in Smart Cities Using OpenIoT Framework. *International Workshop, FP7 OpenIoT Project, Held in Conjunction with SoftCOM , At Split, Croatia .*
- Ali, M. E. (2015). SafeStreet: empowering women against street harassment using a privacy-aware location based application. *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development*. ACM.
- Anderson, D. &. (2002). SETI@home: An Experiment in Public-Resource Computing. *Communications of the ACM* , 56-61.
- Brabham, D. C. (2013). *Using crowdsourcing in government*. Retrieved from IBM Center for the Business of Government .
- C. Keimel, J. H. (2012). QualityCrowd — A framework for crowd-based quality evaluation. *Picture Coding Symposium*.
- C. Norris, G. A. (1999). *The maximum surveillance society: The rise of CCTV*. Berg Publishers.
- D. Lal, A. A. (2016). Advanced immediate crime reporting to police in india. *Procedia Computer Science*.
- Deakin, M., & Al Waer, H. (2011). From Intelligent to Smart Cities. *Journal of Intelligent Buildings International: From Intelligent Cities to Smart Cities*.
- Dhruv Chand M, S. S. (2014). Project Jagriti: Crowdsourced child abuse reporting. *IEEE Global Humanitarian Technology Conference* .
- Firebase. (2014, October 21). *Firebase Cloud Messaging*. Retrieved from Firebase: <https://firebase.google.com/docs/cloud-messaging/>
- G. Chatzimilioudis, A. K.-Y. (2012). Crowdsourcing with Smartphones. *IEEE Internet Computing*, vol. 16, no. 5, 36-44.
- Huang, Y. &. (2014). Designing a mobile system for public safety using open crime data and crowdsourcing. *The 2014 ACM International Joint Conference*.

- I. Rahwan, S. D. (2013). Global Manhunt Pushes the Limits of Social Mobilization. *Computer*, vol. 46, no. 4, 68-75.
- Kanade, T. &. (1999). A System for Video Surveillance and Monitoring CMU VSAM Final Report.
- Lyon, D. (2001). *Surveillance society: Monitoring everyday life*. McGraw-Hill Education (UK).
- Machado, S. (2016, January 6). Retrieved from <https://github.com/SandroMachado/openalpr-android>
- OpenALPR Technology, I. (2014, May 3). Retrieved from Open ALPR: <http://www.openalpr.com/>
- Prashanth Mohan, V. N. (2008). Nericell: Rich Monitoring of Road and Traffic Conditions. *SenSys '08 Proceedings of the 6th ACM conference on Embedded network sensor systems*, (pp. 323-336).
- Rodrigo Sandoval-Almazán, J. R.-G.-R.-R. (2012). Open government 2.0: citizen empowerment through open data, web and mobile apps. *ICEGOV '12 Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance*, (pp. 30-33).
- Schafer, B. (2013). Crowdsourcing and cloudsourcing cctv surveillance. In *Datenschutz und Datensicherheit-DuD* . Springer.
- Schröder, C. (2014). A Mobile App for Citizen Participation. *EGOSE '14 Proceedings of the 2014 Conference on Electronic Governance and Open Society: Challenges in Eurasia*, (pp. 75-78).
- Tewksbury, D. (2012). Crowdsourcing homeland security: The Texas virtual borderwatch and participatory citizenship. *Surveillance and Society*. 249-262.
- Thawrani, V. &. (2014). Crowdsourcing of Medical Data. *IETE Technical Review*. 31. 249-253. [10.1080/02564602.2014.906971](https://doi.org/10.1080/02564602.2014.906971) .
- V. Gouaillier, A. F. (2009). Intelligent video surveillance: Promises and challenges, Technological and commercial intelligence report. *CRIM and Technopole Defence and Security* , (pp. 456-468).
- West, M. (2017). Curated crowdsourcing in ufo investigations. In *Skeptical Briefs*. The Committee for Skeptical Inquiry. Retrieved from CSI : The Committee for Skeptical Inquiry: http://www.csicop.org/sb/show/curated_crowdsourcing_in_ufo_investigations
- Wilcock, D. (2012, June 26). *Police facewatchapp targets london riot suspects*. Retrieved from The Independent: <http://www.independent.co.uk/news/uk/crime/police-facewatch-app-targets-london-riot-suspects-7887778.html>
- William Akotam Agangiba, M. A. (2013). Mobile Solution for Metropolitan Crime Detection and Reporting. *Journal of Emerging Trends in Computing and Information Sciences Vol. 4, No. 12,*.

X. Zhang, Z. Y. (2014). Robust Trajectory Estimation for Crowdsourcing-Based Mobile Applications. *IEEE Transactions on Parallel and Distributed Systems*, 1876-1885.

Yaqoob, I. &. (2016). Enabling Communication Technologies for Smart Cities. *IEEE Communications Magazine*.