

# CRIME SURVEILLANCE 360° - A SMART REAL-TIME CRIME EVIDENCE ANALYZER AND REPORTER

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## **ABSTRACT**

From developing countries to developed countries crimes are one of the major issues that the societies and governments have to deal with. In Sri Lanka, the statistics of Sri Lanka Police (SLP) reveals that the average crime reporting just for the SLP between the years 2005 to 2014 was around 55,000 to 60,000 annually; representing a total of 22 crime categories. It is a well-known fact that the crime occurrence rate in Sri Lanka is between 150 to 164 incidents per diem. Each year, 40% of these reported crimes remain unsolved. These statistics are strictly based on the crimes that are reported only to the SLP. Therefore, in the law enforcement officers' own words; "The island-wide actual crime occurrence rate is much higher". Going deep into the domain problems such as; 'some crimes remain unreported due to a variety of personal and external issues of victim's or witness's', 'reported crimes cannot be solved due to lack of evidences', 'negative attitude and psychological factors of general public towards crime reporting' and 'relatively less efficient methods of crime reporting, collecting, analyzing and processing of information' were identified as areas requiring improvement. The proposed application is designed to address these shortcomings.

This mobile and cloud solutions collect evidence of crimes from general public and properly indexes them, groups identical evidences, analyzes evidence, generates crime information briefings, notifications and crime map. It also generates statistical information and probabilistic analytics, and in overall, behave as a social media application that creates public awareness and makes information gathering easier for law enforcement officers.

Addressing the above includes improvements to: identical crime reports recognition, data deduplication, using of a wide range of multimedia formats, managing data on a common platform, analytical techniques for incoming data in terms of accuracy and efficiency on identifying and forecasting of crime trends and patterns.

## **1. INTRODUCTION**

Nowadays crimes tend to increase exponentially due to a variety of social and personal issues of the people. Even though the development of infrastructure facilities of the country is on a positive note, it can be clearly seen that new crime trends appear each day along with the developments of the technology. People at domestic, corporate, and government levels, along with law enforcement authorities have taken almost all possible approaches to secure their properties. Yet, it is still a fact that all those approaches are insufficient to make much of an impact on criminal activities in terms of preventing or at least minimizing them. Therefore, the government, law enforcement authorities and other relevant parties keep seeking for solutions that will address the major shortcomings in law enforcement.

In Sri Lankan context, calling 119 service to report a crime can be considered as the optimal solution up to present. But when considering the vast geographical area needed to be covered by of law enforcement departments, 119 service can attend to and address only a limited number of problems. When considering the global context of law enforcement, there are a few applications such as ePolice[1] – an integrated multimodal biometric application to address the needs of law enforcement operational units, CrimeStoppers[3] - a web form to report crimes and Broadcastify[2] – radio transmission of law enforcement officers'

broadcasted via their website, which are actively functioning today. But still, the issue of preventing or minimizing crimes beforehand is addressed only very narrowly by those solutions.

Therefore, the necessity of a solution that can handle crime surveillance 24\*7 still exists.

## 2. BACKGROUND

Intended uses of most of the available law enforcement applications are; to use crime reports for biometric analysis, create public awareness, broadcast in TV stations and other entertainment channels. But the true focus of such applications that handles highly sensitive data should not just be limited to above purposes. Primary focus of such applications should be on prevention and solving of crimes. The most primitive focus of such applications has to be on avoiding crimes.

Researchers who are working on this sphere have released their own versions of algorithms and equations [4][5] to analyze crime reportings. Based on a variety of variables of crimes, they generate probabilistic analytics. These analytics have issues when adopted to local and global contexts.

As for the crime report analysis and management, one of the major issues is in accurately identifying identical crime reporting. Due poor design, lack of user experience and negative mind set of general public towards crime reporting, essential evidence related to crimes remain unreported.

## 3. LITERATURE REVIEW

According to the police department [6] of Sri Lanka, the average crimes reported to the police during the period of 2005 – 2014, is around 55,000 to 60,000 per annum. This represents an assortment of 22 crime categories with a reporting rate of 150 -164 incidents per day. Each year, 40% of these reporting crimes remain unsolved due to lack of evidence and a variety of other system issues. Below are the statistical analysis of crimes for the period 2010 - 2014.

Table 4: Analysis of Total Crimes Reported Vs Total Crimes Solved (2010 - 2014) in Sri Lanka

Year	Total Reported	Total Solved	Reported Rate (Year Reported :Years Total Reported )	Solved Rate (Year Solved Total: Years Reported Total)
2010	53499	22465	20%	42%
2011	54521	23937	21%	44%
2012	57162	30976	22%	54%
2013	55349	32791	21%	59%
2014	50962	16343	19%	32%
<b>Five Years Total</b>	<b>271493</b>	<b>126512</b>		

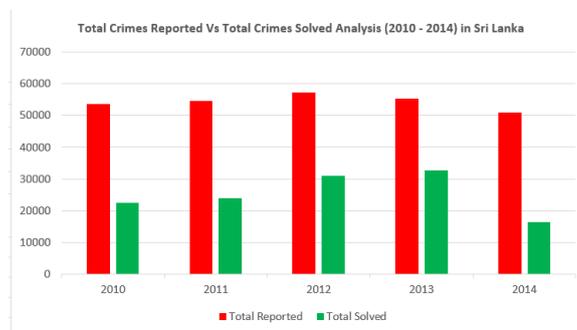


Figure 1: Total Crimes Reported Vs Total Crimes Solved Analysis (2010 - 2014) in Sri Lanka

Several applications have been developed globally and locally to address shortcomings of crime reporting. Globally the most popular applications are ePolice, crime stoppers, savadhaan India. ePolice application is an integrated platform that addresses the needs of all law enforcement operational units. This also include functionalities such as case management, investigations, booking systems, demographic databases, automated biometric identification system (ABIS), forensic analysis (eg: DNA), mobile platform. The system facilitates integration and data exchange capabilities with global agencies (Interpol, FBI, Scotland Yard). Users of the system can generate intelligence reports, and analytics as well as comprehensive ad hoc reporting [1].

‘Crime stoppers’ is an independent charity in UK that helps law enforcement to locate criminals and solve crimes. Public can provide information regarding crimes through an anonymous phone call or via a web form [3].

‘Savhdhaan India – India Fight Backs’ is a television show that airs dramatized criminal cases from across the India [7].

In local context, University of Peradeniya, University of Sri Jayawardenapura collaboration with Inspector General of Police and Sri Lanka Police Department has conducted several projects to address the issues related to crime reporting and solving.

‘Tell IGP’ is the system that is being currently used in Sri Lanka to get evidence via online. This application is a basic web form. Only about 17 crimes per day are reported through this web form [8].

#### 4. METHODOLOGY

The current state of crimes in Sri Lanka was identified and two different detailed questionnaires were created focusing on crime information sources, categorization of evidence and actions taken. Ten questions were used to determine predictor or impact variables. These questionnaires targeted 200 people requesting them to clarify the relevancy and potential of the proposed system. Out of these 200 persons, 55 were law enforcement authority officers. The rest were members of general public. Method of delivery

was by hand or by email. One hundred and fifty two usable responses were received.

The requirement by the general public for such a software solution was diverse and also was subject to their profession, knowledge and educational levels. The pie chart below shows how the responders to the questionnaire would respond to a crime. The results are assessed as percentages.

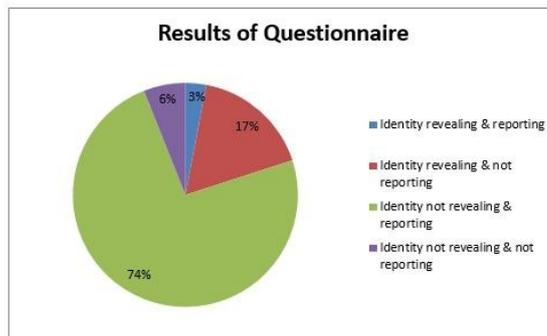


Figure 2: Results of Questionnaire

The vital necessity of a proper system for crime reporting as well as analyzing of those reports was identified as the outcome of the questionnaire.

Crime Surveillance 360° is an ongoing research project. It is a solution combination of a mobile and web based application which consists of strong data processing and visualizing modules. It is designed and developed to advance the user experience to higher levels, thereby improving the occurrence of crime reporting by the public. Given below is the high level architectural diagram of the proposed system, CS360°.

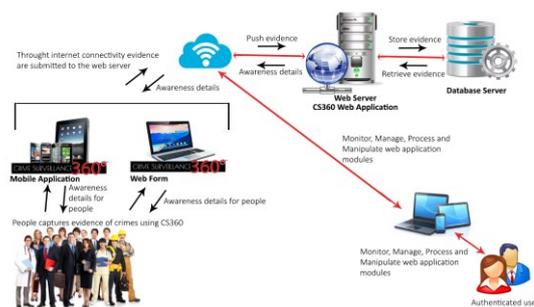


Figure 3: System Architectural Diagram of CS360°

The mobile application can be installed to any of the android based smart devices. Once the user of the application witnesses a criminal activity, he or

she can then capture that incident in a wide range of multimedia file formats in the application and send to the web server. The supported file formats available for capturing evidence consist of Image, Audio, Video and Text. The ‘Call 119’ facility is also included in this application. The mobile application is fully equipped to address minor issues such as unavailability of data and GPS that may occur during the reporting of a crime. If the user could not submit the data immediately for some reason, such as being out of network coverage, low battery or simple unwillingness, the evidence will automatically be saved in the draft folder of the mobile device. Should the evidence be submitted later than a week, it will be saved in the server as ‘late evidence’.

When evidence of crime is received at the server, a notification is generated and the system administrator is alerted. The officer who monitors the incoming reports, analyses whether it is true or not. Approved reports are sent forward for further processing. If multiple reportings of the same crime are found, they are categorized and grouped by using the index tree data structure and query base ordering. Should a report be disapproved, it will then be saved under ‘disapproved evidence’ category. *In theory, the stored evidence will never be discarded or deleted, even after the crime is solved.*

Based on incident location information received, the system will generate a ‘crime map’. This map is designed using Google Maps API. In order to pinpoint the exact location on the map, Geotagging is used.

The analyzation of the crimes is based on the day of the week, time of the day, location of the incident, crime category (type of the crime) and the police area. After collecting and analyzing the data over a period of time, statistics and probabilistic analytics are generated online-real-time. These tasks are performed by using the Google Charts API and variety of time series models. In designing and developing a good user experience latest UI trends such as responsive design, flat colors, symbols and interactive design being followed and cutting edge technologies are used. All these have made managing, controlling, processing and monitoring of reports easier by centralizing the assimilated evidence.

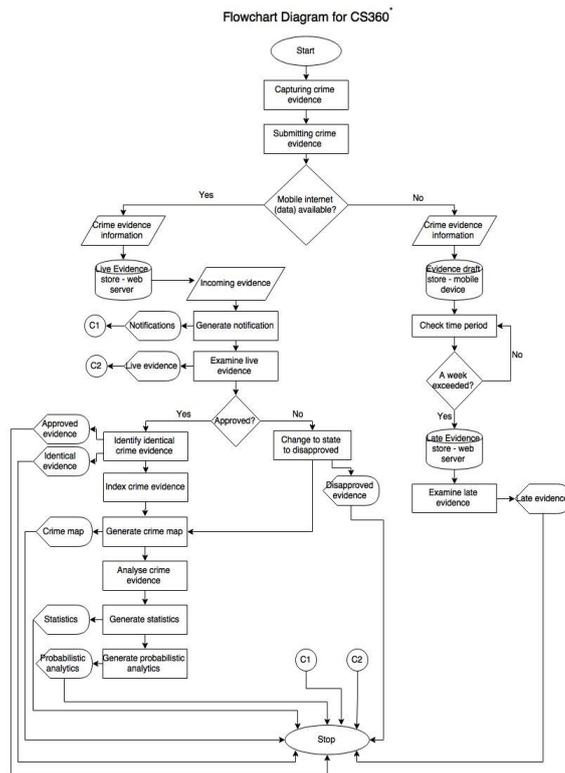


Figure 4: Flowchart Diagram for CS360°

### 5. RESULTS AND DISSCUSSION

Currently the mobile and cloud solutions are developed as a functional system. However, the practical difficulties in applying and integrating this system into the Sri Lankan law enforcement arm is the unwillingness to change to a new concept and the lack of administrative and top level support in implementing new ideas.

It should be further noted that no person who is providing evidence can remain absolutely anonymous because the IMEI number of the mobile device will be recorded.

Below are the main interfaces of the mobile application’s menu and the web based application.



Figure 5: Main Menu of CS360° Mobile Application



Figure 6: Login View of Backend Users



Figure 7: Control Panel View of Backend Users

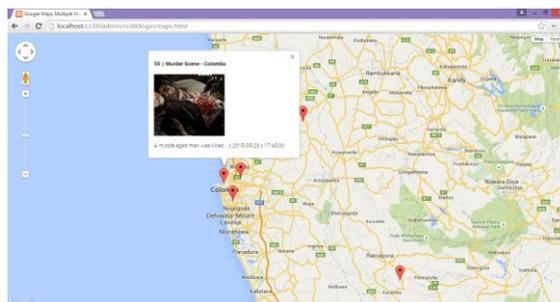


Figure 8: Crime Map View of CS360°

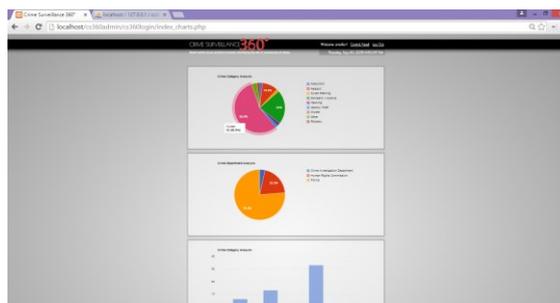


Figure 9: Crime Statistics View of Reporting Crimes

## 6. CONCLUSION

This is developed as a working prototype of an innovative, smart real-time crime reporting and analyzing application for prevention or minimizing of crimes occurring in Sri Lanka. Available applications, researches, and other available sources were analyzed. The deficiencies of the existing systems were clearly identified and many issues addressed. Presently, CS360° provides five components; mobile application, identical evidence identifier + categorizer, crime evidence statistics + probabilistic analytics generator, crime map and crime evidence notifier. The ultimate aspiration is to further enhance CS360° to the level of a fully automated, customizable and global crime reporting platform.

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