

An Integrated Child Safety using Geo-fencing Information on Mobile Devices

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Abstract—In Indonesia, the child abuse has been huge problem as the number of case gains year by year. In this paper, the IT-based child abuse prevention is built by engaging the geo-fencing technique and gravity sensor. This paper is conducted to provide IT-based child protection that can facilitate the parents and government the children monitoring. The use of sensing module triggers the system to send notification to parents and systems server. Meanwhile, the geo-fencing technique aims to enable the feature of virtual fence which enable the parents to monitor the children.

Keywords—Child Abuse, IT-Based, Sensor, Geo-fencing

I. INTRODUCTION

Child abuse which is also known as child maltreatment (CM) is a global issue and can occur in any places in the world. This issue has been growing massively in the last 20 years [1]. The form of child abuse can be physical, emotional, verbal, or sexual. The child abuse issue is very important to be concerned because it can cause trauma to the child and affect the social life of child in the future.

There are organizations for preventing and treatment child abuse in every country. In Indonesia, the Commission for the Protection of Indonesian Children of Indonesia or Komisi Perlindungan Anak Indonesia (KPAI) acts as a formal institution towards the effectivity of child abuse prevention. This commission promotes the safety, permanency, and well-being of children, youth, and families by connecting child welfare, adoption, and related professionals as well as the public to information, resources, and tools covering topics on child welfare, child abuse and neglect, out-of-home care, adoption, and more. According to KPAI Data System, the number of child abuse since 2011 to 2016 is 22,109 cases. The crimes with children as suspects contribute a large number of child abuse in Indonesia. It is well-said in previous research that there is correlation between crime and child abuse. The children who get involved in criminal activity are children with abuse in the past [2]. This highlights the needs to monitor the child's activities and behavior. Nowadays the Information Technology (IT) has been used in all fields [3]. Long time ago, it took days to send mail or do financial activities. Meanwhile, today users only need computer with internet access to communicate real time. In order to support the child abuse prevention, this research contributes the IT-based prevention model using mobile technology and geo-fencing technique. The model is engaging the location-based application to monitor the child location, stating emergency status, and sending messages. The technique which is commonly used in developing location-based application is geo-fencing. The geo-fencing technique is a monitoring approach for geography areas with virtual fence which automatically detects the object moves into the fence or out

the fence[4]. Geo-fencing has been used recently for mobile application such as for logistics monitoring[5], emergency application to help survival of disasters[6], monitoring people with alzheimers[7], or even to monitor the agriculture areas[8]. In this paper, the geo-fencing technique is used to set up the areas of child's activities. The parents put the label the areas such as school, park, friends house, neighborhood, etc. It also includes the forbidden places for the children. The application is also supported motion sensor module and voice recorder module to automatically send the emergency alert to server, parents, and institution in charge. This research aims to provide IT-based child protection that can facilitate the parents and government the children monitoring. The use of sensing module triggers the system to send the current location and record the voice. The location and recorded voice will be sent to the server and parents. Finally, this research presents the prototype of IT-based child protection in order to bring more effective and efficient children protection.

II. LITERATURE SURVEY

Child abuse has been noticed as worldwide issue that needs to control by every country. Child abuse is also defined as a form of social deviant that can bring problem to social life of children [9]. The typical of child abuse can be identified as four abuses; physical abuse, neglect, emotional abuse, and also the sexual abuse [10][11]. Hence, it needs quick attention and action from institution in charge and parents. The Commission for the Protection of Indonesian Children is mandated to serve as an institution in charge for child protection concerns by collecting data on critical issues, including family and alternative care, children in need of special care and protection, and child rights [12]. It is responsible for handling the cases that are directly brought to government. According to previous research [13], government as control and monitor need to engage the whole society; the children themselves, parents, and neighborhood. Start from home, the parents must do things in the intervention though the child is around neighborhood, home, or school. More than just talks, parents must actively engage with the system of child abuse prevention. But, the problem appears when the parents are interrupted by other obligations such as working, doing house chores, etc. Nowadays, Information technology (IT) has been used massively in any fields. Long time ago, we have to visit the post office to send the letter in order to communicate with others. But today, IT helps us to communicate efficiently using the internet connection anytime and anywhere as long as the requirements are provided[14]. The prototype system for child monitoring system which supported media and motion using Raspberry Pi has been generated [15]. It accommodates the web camera to catch the continuous pictures. The captured pictures are directly sent to Raspberry Pi and

processed to be a real time video streaming. Moreover, it also enables the system to detect and identify the movement by using red-box. The video streaming and image motion detection stored on local drive of Raspberry Pi. To accommodate the parents monitoring, this system is viewable using gadgets with web browser and internet. In the other research [16], the mobile application for protecting women had been developed. The application was featured motion detection and image capturer. When the mobile phone detected the motion, it would send the notification the families. The captured image aims at abuse proof. Beside sending the images, the system was also able to send the location of user.

III. SYSTEM INFRASTRUCTURE

In this part, the infrastructure of IT-based child abuse prevention is discussed. Figure 1 shows the proposed model of IT-based child abuse prevention model. The model engages the use of technology such as geo-fencing, sensor module, voice recorder, and communication network is described.

A. Geo-fencing

Geo-fencing is known as virtual fence around conditional location. It refers to approach that set the limit for mobile users to a specific geographic location by tracking their location via GPS. In this research, the geo-fencing technique aims to accommodate a family member to set some areas of interest. Those areas represent places which are frequently visited by a child or forbidden places for child. Once the areas are determined, there will be alert to family member when the child entered or exited those areas.

B. Sensor Module

Smartphones are universally equipped with accelerometers, and GPS technology [17]. Sensor module in child protection application consists of those sensors. This application engaged geo-fencing technique to monitor children whereabouts. In order to do that, we will implement location sensor. Android has several methods to provide location information, such as GPS and network-based location [18]. In this application, we will use GPS to detect children location and their proximity to particular areas. Family member defines those particular areas by specifying its latitude, longitude, and radius. Location sensor will send childrens location continuously and determine whether the children enter or exit a fence. Motion sensor aims to detect device motion. Child protection application implements G-sensor to measure acceleration of the device. The G sensor stands for gravity sensor or accelerometer sensor which is used to detect the position of screen, landscape or portrait. This sensor often uses in games as game controller.

C. Voice Recording Module

The voice recording module aims to record the voice around the child during the emergency situation. The voice recording is considered because it can catch the proof of maltreatment while the gadget is out of childs reach. Moreover, the voice recorder on mobile phone does not require advance specification.

D. Communication Module

The communication module transfers the alert to family and institution in charge using 3G/MMS. The uses of MMS to ensure the message will be received by family even though the family members have not installed the system. In other side, the system will send the detail of location information the server via 3G network or Wi-Fi.

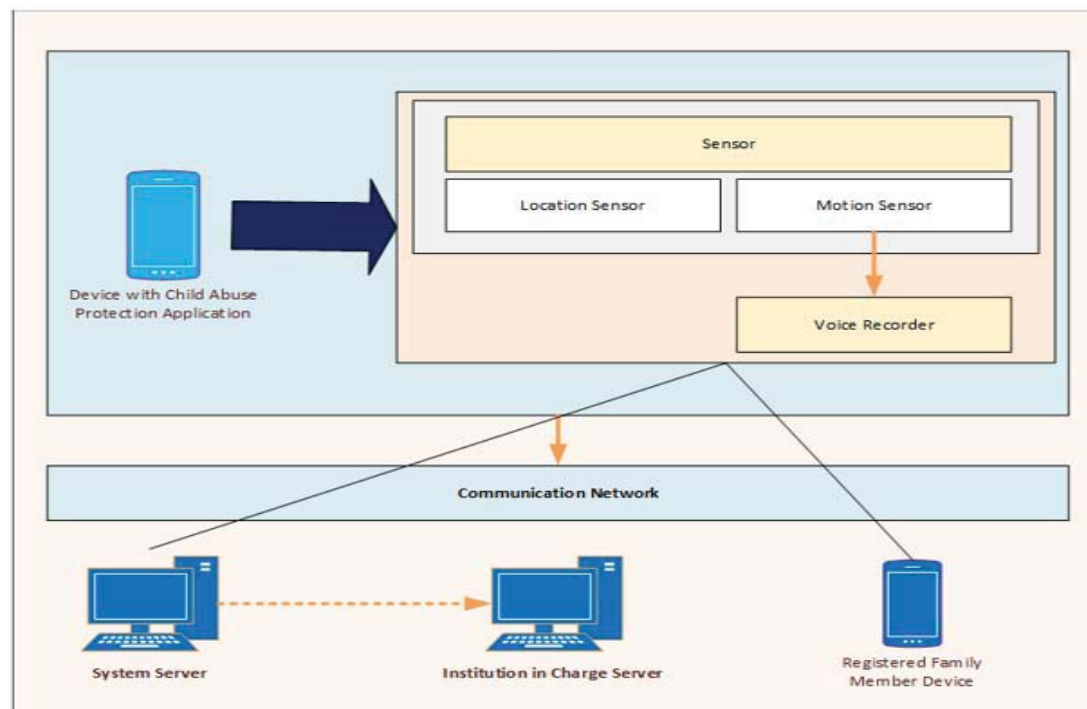


Fig. 1. System Infrastructure

IV. IMPLEMENTATION

Child protection application is implemented and tested on android operating system. Figure 2 shows processes flow of child abuse protection application. First, the registered family members will register the children who will be monitored. For each child, registered family member will set fences around some particular areas. The fenced areas consist of areas which should be monitored by family member, such as places which regularly visited by the child or places which should not visited by the child.

The application will proactively monitor child's location. Location sensor will send child's location continuously. Geo-fencing technique is implemented to monitor child's

movement around fenced areas. The application will send notification to registered family member when the child entered or exited fenced areas. Figure 3 shows the implementation of geo-fence technique in child protection application.

The application will also monitor the motion of the child's device. In emergency situation, the child can shake their device to create a motion. By calculating the device motion, system will know when the child is in danger and it will trigger alarm and voice recorder. Figure 4 shows motion sensor implementation in child protection application. Meanwhile, the alarm is used to alert the parents or caregiver about potential crime that can happen to the child. Voice recorder is used to obtain a voice record from child's device.

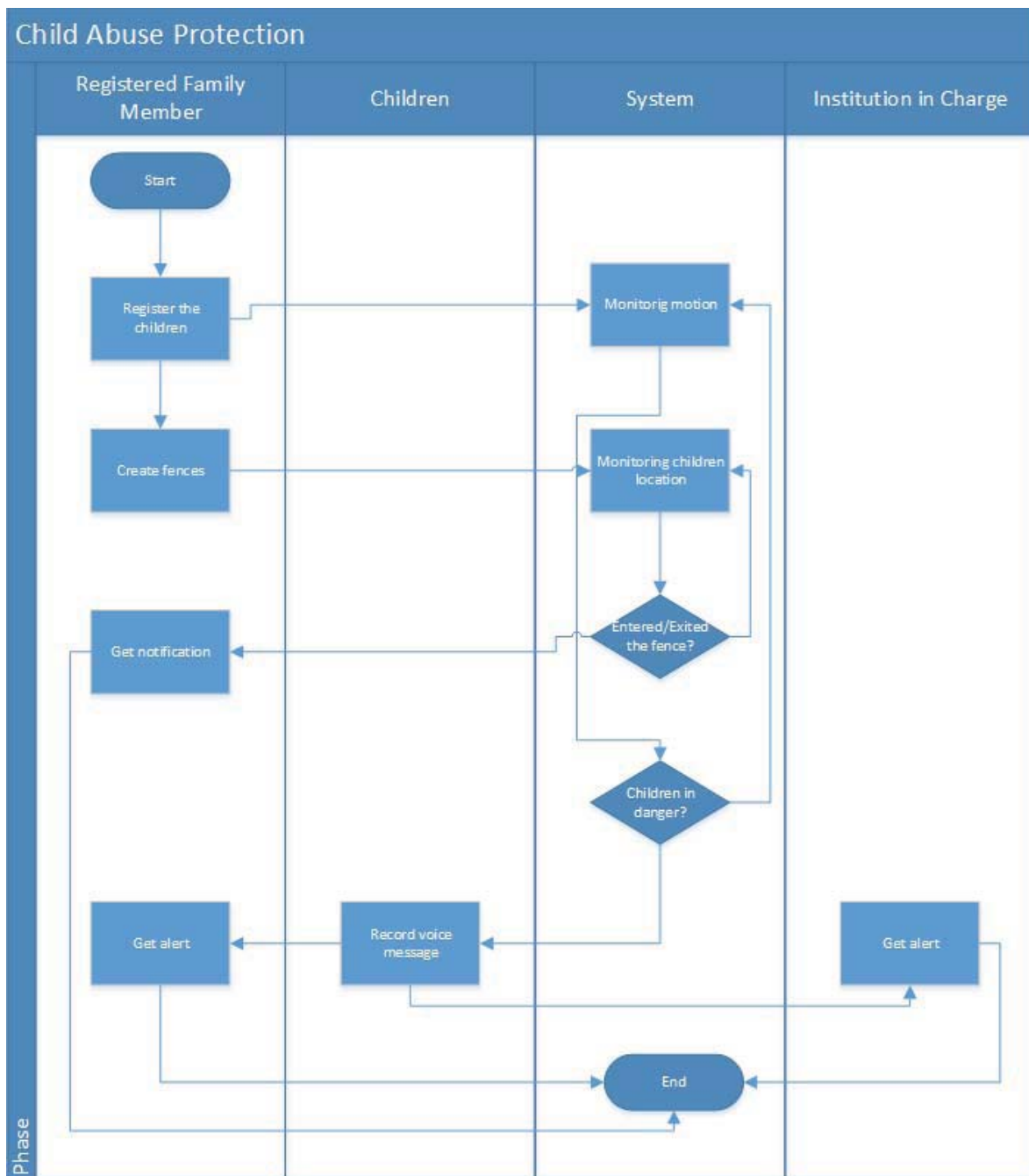


Fig. 2. Flowchart Child Protection Application

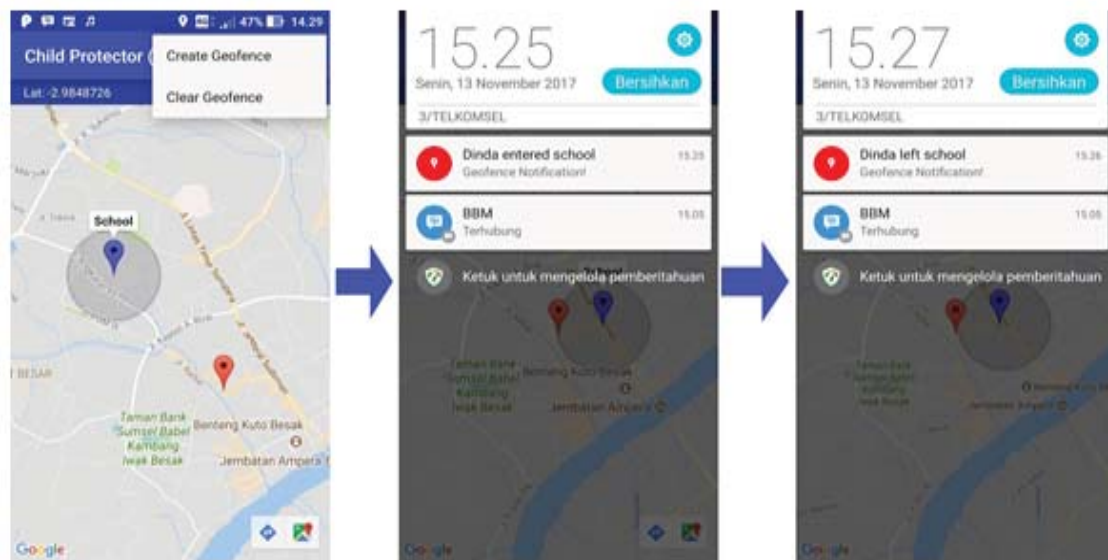


Fig. 3. Geofencing Technique Implementation

This record will be forwarded to registered family member and institution in charge to warn them about the potential crime which is about to happen. Voice messages will be sent continuously every 3 minutes until the child is safe.

and left the fenced area. We acquired information about application behavior which related to the implementation of geo-fencing technique. Table 1 shows the result of this evaluation.

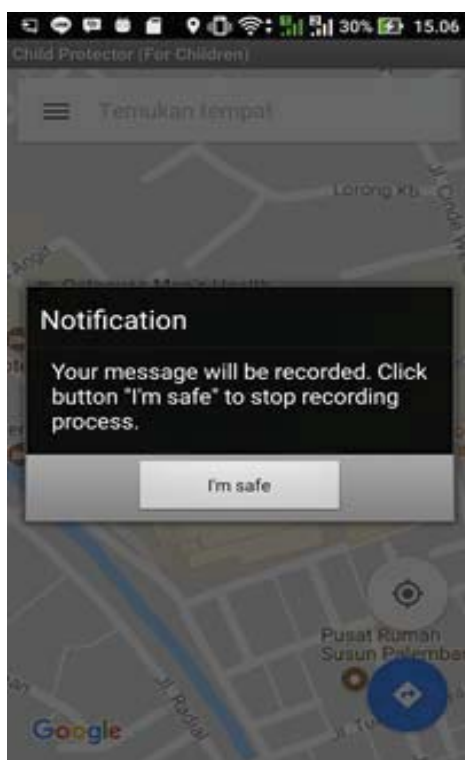


Fig. 4. Motion Sensor Implementation

V. SYSTEM EVALUATION

Evaluation process was conducted to see how the application work. To evaluate the application, we created a fence which represents an area of interest. Radius of the fenced area was 200m. A user who carried an android phone with children protection application installed in it, entered

TABLE I. SYSTEM EVALUATION RESULT

Experiment Number	Entered the Fence	Exited the Fence
1	32	33
2	37	42
3	25	26
4	28	30
5	33	31
6	31	31
7	27	29
8	29	32
9	32	36
10	27	31

The experiments show that registered family member received notification when the children entered the fence about 25-37 meters. Registered family member received notification when the children's location was about 26 - 42 outside the fence. The difference in each experiment result was caused by some factor, such as internet connection and GPS accuracy. When the GPS was off, the application was not able to send any notifications. This result is caused by the application cannot track the user movement around the fences.

VI. CONCLUSION

The IT-Based child abuse prevention has been generated. This application aims to facilitate the parents and government in preventing child abuse in Indonesia. By engaging the geo-fencing technique, the children can be monitored by parents even though the parents are in work duties. Meanwhile, the sensor module enable the system to send alert when emergency situation occurs automatically.

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