# **CHAPTER 3**

# **RESEARCH METHODOLOGY**

## **3.1 Research Environment**

The locale of the research is limited to the area around the University of San Carlos Talamban campus of Cebu Philippines. The positioning system is limited in support only to the Philippines. (External software dependent: Google Maps, no control over positioning)

## **3.2 Research Respondents**

## The target population of the research is student motorcyclists. The study uses selective random sampling of motorcyclists in and around the university, in order to keep immediate relevance. Slovin’s formula is used to obtain a sample size of 60, considering the population of 150 student motorcyclists within the campus and a margin of error of 10%.

## **3.3 Research Instruments & Sources of Data**

The research uses a researcher-made simple semi-open structured interview-questionnaire. Measurement and quantification of relevant data, like orientation and acceleration, will come from the use of the sensors built in the smartphone itself. Other sources of pertinent data include national statistics and physics publications. (We used a closed questionnaire-survey)

Data gathered from the use of built-in sensors may result in semi-biased results and physical simulations of motorcycle crashes cannot be conducted in actuality for safety and legal reasons. For these reasons, a controlled environment was necessary to produce and gather meaningful data. The interview-questionnaire’s reliability will be analyzed using Cronbach Alpha and Normality testing by IBM SPSS.

## **3.4 Research Procedures**

### **3.4.1 Gathering of Data**

Data from the sample is gathered using an interview-questionnaire, where each element (person) is questioned only once. This will quantify the public opinion on the possible demand and economic feasibility of the research. Additional data related to this is regarded to past national statistics regarding motorcycle incidents and accidents.

### **3.4.2 Treatment of Data**

Data gathered through the interviews will be analyzed using IBM SPSS by way of summation of data and finding medians. The data will then be presented through a tabular form containing the summarized results of the interview-questionnaires.

## **3.5 Design and Implementation**

The software development process for the research is an iterative and incremental model. Each component of the application is treated as a separate application and developed using a mini-waterfall model. Revisions are done any time during the development process.

### **3.5.1 Analysis Phase**

Existing researches have focused on pedestrian and elderly fall-detection schemes. Fall-detection algorithms vary from research to research. Use of acceleration, g-force value, sudden spikes, and changes of orientation are common techniques utilized by these researches. Of relevance to this research is the use of threshold-based algorithms which begins active assessment of falling only when a certain threshold, like g-force, is broken.

The researcher-made system employs the use of a modified Kangas et al.’s vector summation algorithm. The application also observes stricter timeframes to compensate for the discrepancies between pedestrian and motorcycle falls, mainly due to the difference in physical capabilities (acceleration, g-forces). Other parameters are modified for this same reason. This system also adds another element, visual location based on GPS.

Few of these existing systems used techniques to deal with false positives and negatives to promote accuracy as fine-tuning of the systems themselves were done beforehand. Those that did utilized the creation of a ‘critical time period’ wherein the situation is assessed by way of manual termination by user if fall is false. This system also uses this technique as motorcycle falls are more erratic than pedestrian ones.

This phase will produce a document specifying and assessing the target goal, features, possible problems that may arise, and assumptions.

### **3.5.2 Design Phase**

The application model utilizes the Android operating system and its accompanying programming language for application development. Google Maps is implemented in the system as an external application. The design scheme requires the use of Smartphone sensors, mainly the accelerometer, as well as its telecommunication capabilities.

The sensing algorithm is the algorithm that is used to detect the occurrence of a fall/crash. It implements a critical duration of time wherein false positives and negatives are discerned.

The telecommunication algorithm is a sub-program that sends a message and notification to correspondents that were assigned beforehand. The information sent includes the time of incident and location in the form of a URL. This URL is used to pinpoint a location using Google Maps on the recipient’s device.

The system employs the system shown in Figure 2.3 to assess the occurrence of an accident. This is the flow of events that the application is expected to accomplish during a certain run of the application.

The user interface consists of 3 major screens. The first screen is the main menu from which a user can access the other two screens: the calibration settings, and the phonebook. The calibration screen is responsible for adjusting the program’s algorithms dependent on motorcycle build, usual leaning angle, among other factors. The phonebook is where contacts that would be notified when a crash occurs would be displayed and modified.

As of this phase, prototypes of these components are finished, with their accompanying documentation regarding methods, functionalities, and variables.

**3.5.3 Implementation Phase**

The system is composed of five components: user interface, system configuration, monitoring process, data processing algorithm, and notification service. The smartphone itself is a physical constant that, for the purposes of this research, is assumed to be placed in a waist container (small bag, pocket), or a backpack.

The deliverables of this phase are the actual completed components of the programs that may or may not be subject to further revisions dependent on the results of the testing and evaluations.

### **3.5.4 Testing Phase and Evaluation**

Debugging is done on each of the components. Each component is proofed for functionality, and then assembled into an application. The unevaluated compiled application is then installed on the test phone, and will be subject to software and physical testing.

## **3.6 Testing and Evaluation**

Onboard sensors are tested to their default values and telecommunication capabilities are assessed to their neutral capabilities to create a baseline model for software testing. Variables that are relevant to the algorithm are created as to simulate different motorcycle accident circumstances.

Repeated software testing is then conducted by inputting values such that a motorcycle crash is simulated. Such an example is inputting the motorcycle’s current acceleration, the rider’s leaning angle, with physical characteristics like motorcycle build, direction and distance from crash point constant. Afterwards, these data are used in the algorithm to test the detection of the program.

Physical testing is conducted in a controlled environment. In a given motorcycle accident scenario, thin mats are placed appropriately in a spacious room to the possible areas where the smartphone may impact.

A person who has that phone in his person would then throw himself in a way that would emulate that scenario; this can alternatively be done by throwing only the phone itself. The recorded data and its accompanying result are used to check detection success.

Results are quantified in percentage of accuracy and compared using Weighted Mean. Once tested for accuracy, the final application is assembled and completed. Necessary tests are undertaken again for thoroughness. The application is then planned to be updated steadily for possible commercial use in the future.