

Conceptual Design for Smart First Aid System

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ABSTRACT

In recent years, we have noticed the effective of information technology to develop societies. In addition, the role of e-government in providing services to citizens. Health scope is one of the important scopes for citizen that invested these technologies to develop providing healthcare services.

In this article, the authors will propose a conceptual design to build a smart first aid to provide medical services in real time, this design based to connect all people with a smart first aid center to send an immediate medical intervention. Authors try to address the citizen needs by covering some previous articles to clarify the objectives, follow that identify the main and sub functions that satisfied the user needs, until reach to the domain stage of design.

Keywords: *E-Health, Health Information System, Engineering Design, Smart First Aid.*

1. INTRODUCTION

To build any system you need to define its key elements. By understanding what these elements are, you will be able to understand the system easily. The Smart First Aid system depends on four pillars, these pillars are:

- Health information system (HIS) refers to invest the information technology in health scope through the computerized system of health. In addition, enhance the management of health services.
The essential functions of HIS are data gathering and generation, analyze, disseminate and use health data, these functions used to generate the optimal information and provide a decision-making for any health case. [1, 2].
- The term E-Health refers to the use of new technologies in the health field to enhance the services that provided by health institutions to the consumers. More precisely, we can say e-health means the use of information and communication technology (ICT) to deliver health services to citizens. In order to get the greatest benefit from technology in health field [3].

- First aid is an immediate and initial care that providing to person who suffering an emergency medical condition that results in any injury faced the people. To preserve the life of the person before the arriving of the medical providers.

The first objective of first aid is to provide medical services in the real time, it means these services can be efficient when earlier detect the health problem, to decrease the effect of health problem or injury, but this service should be provided by skilled people, because some cases need a special care before arriving to the hospital [4].

The most common health problems need a first aid involve imbalance in the circulatory, breathlessness, severe bleeding, burns, and war injuries and disasters [5].

The providing of first aid depends on the type of injury.

- Engineering Design means the creation of a specific design with compliance with engineering requirements.
In other words, it can be the process of finding solutions to the problems that man suffers by developing a design subject to engineering standards [6].

Therefore, this article will focus on designing a new system to provide a first aid service for critical cases that needs to immediate interventions.

2. LITERATURE REVIEW

The early detect of emergency case contribute to ensure providing good health care in real time. for this reasons, The United Nation Refugee Agency (UNHCR) said that the early detect is the first objective of HIS, and it recommend to set an Early Warning and Response System (EWARS) to work as an importance function of HIS. [7]
Health information system contributed to enhance health scope, but most technologies focus on the management medical scope rather than the diagnoses or monitoring [8]. Patient Health Record (PHR) also is one of the HIS applications. It used to save all personal information that related to patient health. This method used instead of the



traditional way to save this information (documentation), but in some developing countries, the lack to record this information leads to increase the mortality [9].

Therefore, Ismail and his partner provided new design to develop the standard international compliant data access. This model presented a web application to evaluate it, and collect a feedback to improve it. This model can be a base for implement the healthcare information system in these developing countries [10].

The transition from the use of traditional methods of providing health services to consumers using ICTs in order to improve the services provided by health institutions to beneficiaries is E-health [11]. These services consist of "Six C" which are (content, communication, commerce, community, clinical care, and computer applications) [12]. This development in the field of e-health has facilitated the provision of health services to consumers, where it is possible to get these services anywhere and anytime by the person who need these services [13].

The Smart Hospital is one of the services provided by the E-health system, where an easy environment for doctors and patients is provide, by offering various electronic services to all beneficiaries [14].

However, the availability of these services was limited to being in the smart hospital. When people are in a place far from the hospital and if they are expose to various accidents or sudden illnesses, they need first aid until the arrival of the medical teams or until they are transferred to the hospital.

The first aid characterized by that it must be provide to the injured person as soon as possible to save the life of the injured person, and to take advantage of this feature two important things must be available, the first thing is to report about the emergency case, and the second is the speed of response to this reporting. For example, the explosion or terrorist attack is the big disaster that face the society. The first aid focuses to isolate the area of the scene to make control of the life-threatening complications, and provide the first aid immediately [15]. This services start with the critical cases, and take-of them to the nearest hospital to complete the necessary treatment, like the severe bleeding in the head, but the less cases can provide first aid at the scene like non-fatal injuries [16]. These services for non-fatal injury can be contribute to decrease the percentage of disability due to accidents. For example in Bangladesh, the immediate first aid which provided by the trained and non-trained people can play the role to decrease the percentage of the effect of injuries [17].

Electric shock occur when electrical pulses passed through the person-body. The severity of electric shock varies from the simple to severe, which may affect the heart and circulatory system, and may lead to death. Therefore, the first procedure is find the source of electrical power with the emphasis on not touching or approaching the victim,

and provide the procedures for cardiopulmonary resuscitation by specialists [18].

To build a system like Smart First Aid system, we need to use scientific methods like Engineering Design. From another definition of Engineering Design, which is the use of scientific principles, technical information and imagination in the definition of a problem suffered by man, and work to develop a clear scientific plan, which when fully implemented will meet the human needs [19].

We can understand that Engineering Design is a combination of both engineering principles and design art. Engineering Design has many approaches; one of these approaches is top-down approach, the top-down design method relies heavily on the system's analysis of its subsystems, where the main target of the system is determined at the top of the pyramid. When descending to the second level of the pyramid, the main functions of the system are determined so that each of these functions is a system independent of the rest of the other systems. Each of these functions can be decompose into a set of sub-functions. In this way, the system is simplified and its components are determined until reach a stage where these components are not capable of being analyze. In this case, the designer has to choose one option either make or buy the component [20].

3. MOTIVATION

After reviewing many articles by authors, many disadvantages were founded. To overcome these disadvantages and to get the most advantages of ICT, in order to have a secure and safe environment. This was the main motivation and catalyst for the preparation of this article. These disadvantages are as follows:

- a) Most articles relied on external changes in the human body without the use of internal sensors.
- b) The articles focuses on a specific set of human emergencies and did not cover all emergencies.
- c) The sensors that used in these articles depends either on the image or on the sound in determining the emergency case. However, these sensors are affected by noise surrounding them, so they need an ideal environment to do there function properly.
- d) Experiments were conduct in ideal conditions, where devices were install in specific locations to obtain the best results. However, in actual application, getting similar results is almost impossible, because the human emergency should happen in a specific location, and these devices should surround the infected person. Therefore, the proposed systems are effective in hospitals or in the home.
- e) Some of these articles offered the use of robot in the implementation of these projects, the robot that



proposed to be use in first aid. However, the use of this robot needs to be connect with a doctor who oversees the first aid operation. This may be a waste of time.

3. SYSTEM COMPONENT

As we mansion in section 1, the top-down approach start from the customer need as a top level of system. Therefore, the safety environment system, which we propose, can describe as following steps:

Step1: The first is to address the customer's need; it will be (Safety Environment). In addition, determine first-level functions that satisfied the required of customer's need. The customer's need and first-level functions shows as follow. In addition, figure 1 shows the system diagram of the customer's need and first-level functions.

1. **Safety Natural Resources:** Making natural resources safe means protecting the lives of people and their property from the dangers of natural disasters such as earthquakes, hurricanes, floods and volcanoes. By taking the necessary precautions to reduce the damage caused by such disasters. The authors will deny this function because it is not related with this article.
2. **Safety Health People:** this is the main object of this article, and it will be describe later.
3. **Safety Infrastructure:** This function, focus on establish all safety activities for all infrastructure like building, nuclear power programs, etc. The authors will deny this function because it is not related with this article.

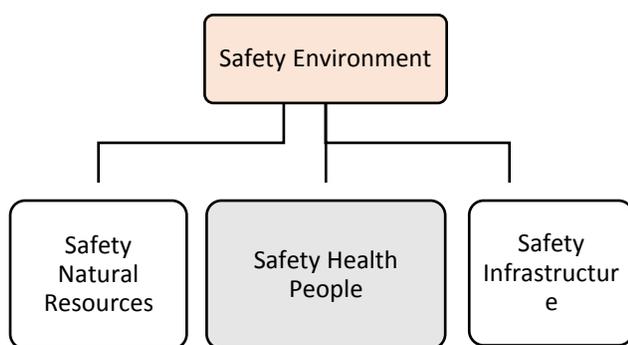


Fig.1. System diagram for the first step of safety environment system

Step2: In this step, the authors address the sub-function to satisfy the upper function until to reach the make or buy level (describe it later). The system components (sub-functions) as followed:

Safety Health People Emergency request: the main idea for this function is to send an automatic emergency message in critical case. this message depend on a medical sensor, this function contains as:
Sensor: this sensor can make it from the engineering specialist (Engineering domain stage). this is the first crazy method of this article, because this sensor will plant it in/on the Central nervous system (Central nervous system (CNS), is the largest part of the human's nervous system, which senses all body-signals to identify the human's problems and coordination of internal processes [21]), to capture any abnormal body-signal.

Internet connection: this is an important required because the sensor has to still online with medical center all the time, then we can obtain this connection from the following:

WIFI: this services can be obtained for free, or buy internet packet from any providers, and it consist of:

WIFI Modem: it is easy to buy it if we register with local internet provide.

Wire: this is the traditional connection, and it need as followed:

Wires: buy it from any internet services.

Modem: buy it from the internet provider.

Sim card: another connection type, buy it from any communication providers.

Warning signal: used to send the warning signal to the medical center. This function is built in the sensor to make as followed:

Send request signal: send an emergency signal when the sensor detect critical case.

Send GPS: to send the patient's location. The user can be buy it.

Acquiring and processing center: this is the medical center, which is always online with all patients, it is contain a smart software to receive any critical case and analyze the patient information with the previous information to make decision, what it is possible to face this patient. Finally send message to the nearest helper. It consist of following:

Smart emergency software: this is the important component. It analyze the patient information to measure the critical case. It consist of the following:

Arrive emergency signal: to receive the signal from the sensor.

Analyze people information: analyze the patient information after receive signal, it consist of the following:

ID: to know all personal information of patient.

Address: to detect the position of patient.

Previous case: to retrieve all previous information of patients.

Find nearest helper: find the nearest helper of patient.



Dispatching signal: the software immediately send all information to another device of the medical center (Computerize device).

Computerize device: medical center must contain the computerize devices to work with software. It consist of the following:

PC's: it must be available for any computerize system. It easy to buy it.

Monitors: to monitor all cases. It easy to buy it.

Storage: any computerize system need it to save information, It contain:

DBMS: Data Base Management System is better storage system. The user can buy the license of it.

Internet connection: because we want online system. This services need to ensure continues. it consist of:

Connection cable: it is easy to buy it from any internet provider.

Modem: buy it from any internet provider.

Internet subscription: buy the internet packet from any provider.

Emergency response: Emergency response: this is an important function to response for any emergency case. It consist of the following:

Receive dispatching signal: receive the information about the critical case from the medical center. It consist of the following:

ID: it consist all personal information about patient.

Address: it contain the patient location.

PC: it is important to be available to receive the emergency message. In addition, it use to find the shortest path to deliver the patient location. It consist of:

Find shortest path: to find the optimal path.

Dijkstra algorithm for shortest path: can buy the code of this algorithm from any programmer.

Robot: after received an emergency signal and find the optimal path, use a smart robot to be send to the patient. It consist of the following:

Delivers: if the patient is not-unconscious, use the robots to deliver some required to use it.

Medical requirement: the user can buy it from any provider.

Instruction: make it from physicians in order the analysis of patient's case.

Treatment: this is the second crazy function. The robots here help the patients instead of medical's helper to help the patient especially if they unconscious. It consist of the following.

Smart device built in with robots to make treatment like (smart hand to take injection).

Make decision: the robots can make decision depending on patient case.

Smart medical scan: can buy it from any provider.

Analyze case: in order on scanning, the robots analysis the patient's case. It consist of:

Smart intelligent software to make decision: can buy it.

Send a report about patient case to the medical center.

Helper: If the patient case need to deliver to hospital, need a helper to deliver him. It consist of:

Ambulance: with all medical required. Can buy it.

People: to carry out patients. It consist of:

Drivers: to drive the vehicle. Can give a salary for them.

Doctor: to make treatment and analyze the critical case, these doctors of course have a salary.

Nurses: to help the doctor, also they have a salary.

People: to carry out patients. It consist of:

Drivers: to drive the vehicle. Can give a salary for them.

Doctor: to make treatment and analyze the critical case, these doctors of course have a salary.

Nurses: to help the doctor, also they have a salary.

Medicines: to use it if the patient need a medicine, these medicines can buy them from the medicine store.

Hospital: if patient have a critical case and need hospital, the hospital must be available to receive this case to treatment. It consist of:

Emergency team: expert team for making first aid. It consist of:

Doctors: to make an operation if patient is need, these doctors should have a salary.

Nurses: to help the doctors, also they have a salary.

Staff: another team must be available to help doctors and nurses in the hospital. In addition, they have a salary.

Emergency room: to make a first aid. It consist of:

Benches: buy it from any medicine stores.

Medical equipment: buy it from any medicine stores.

Medical supplies: consist of:

Cotton: buy it from any medicine stores.

Gauze: buy it from any medicine stores.

Operation room: to use it if patient needs an operation. It consist of:

Anesthesia machine: buy it from any medical company store.

Oxygen: buy it or charge it from any medical company store.

Ready ECG: buy it or charge it from any medical company store.

Figures (2, 3, 4, 5, 6). Shows the system diagram of second step of safety environment system.



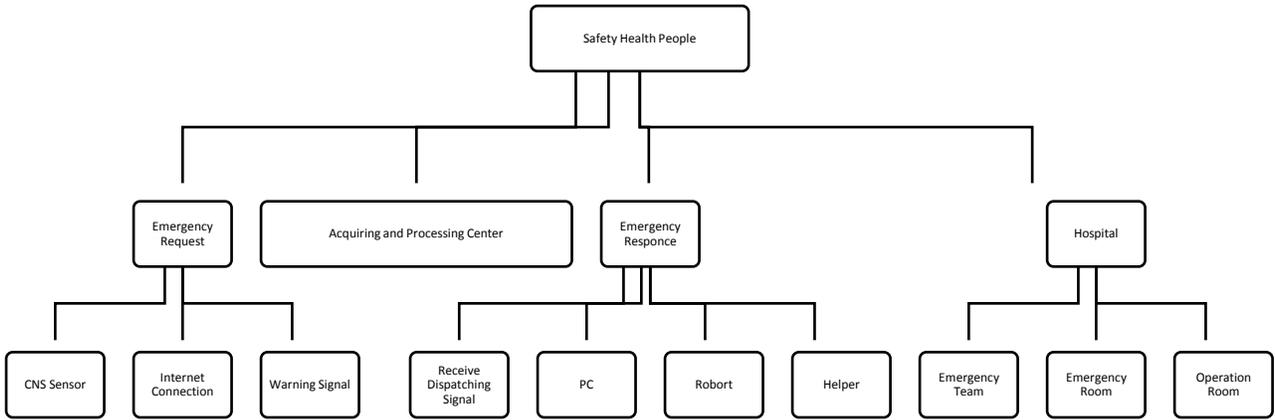


Fig. 2. System diagram of second step of safety environment system.

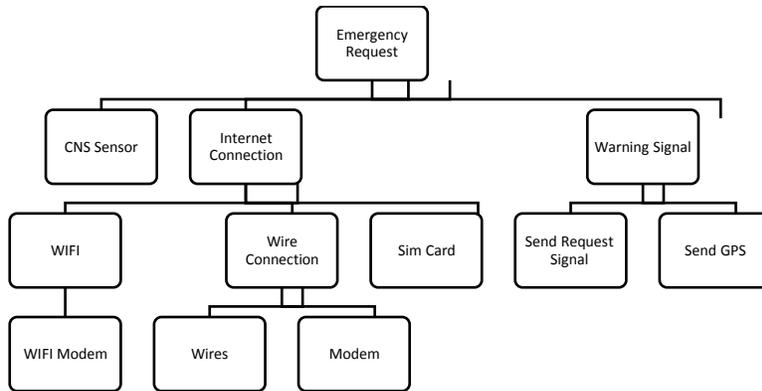


Fig. 3. System diagram of second step of safety environment system.

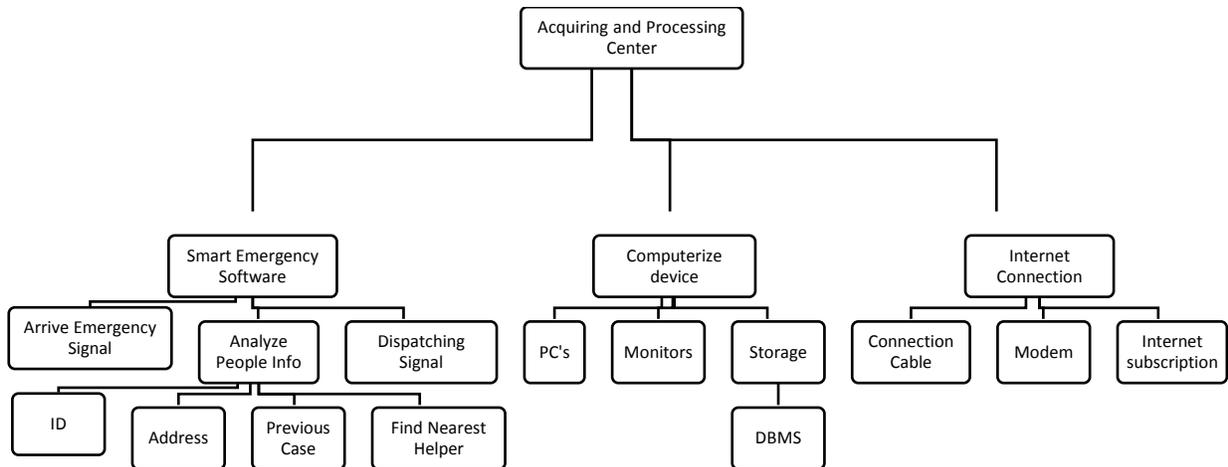


Fig. 4. System diagram of second step of safety environment system.

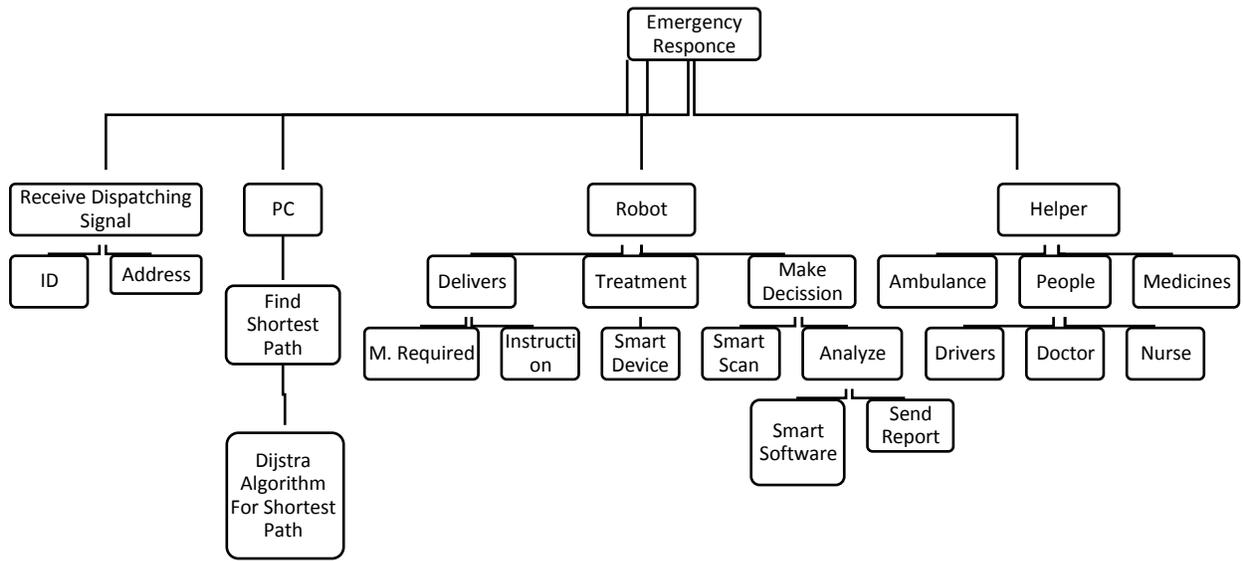


Fig. 5. System diagram of second step of safety environment system.

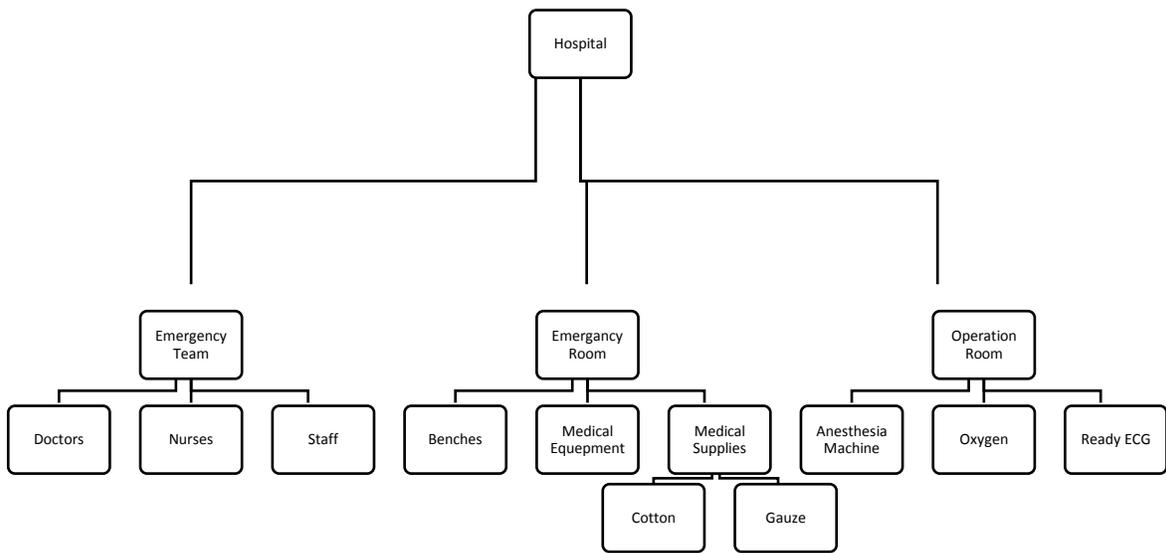
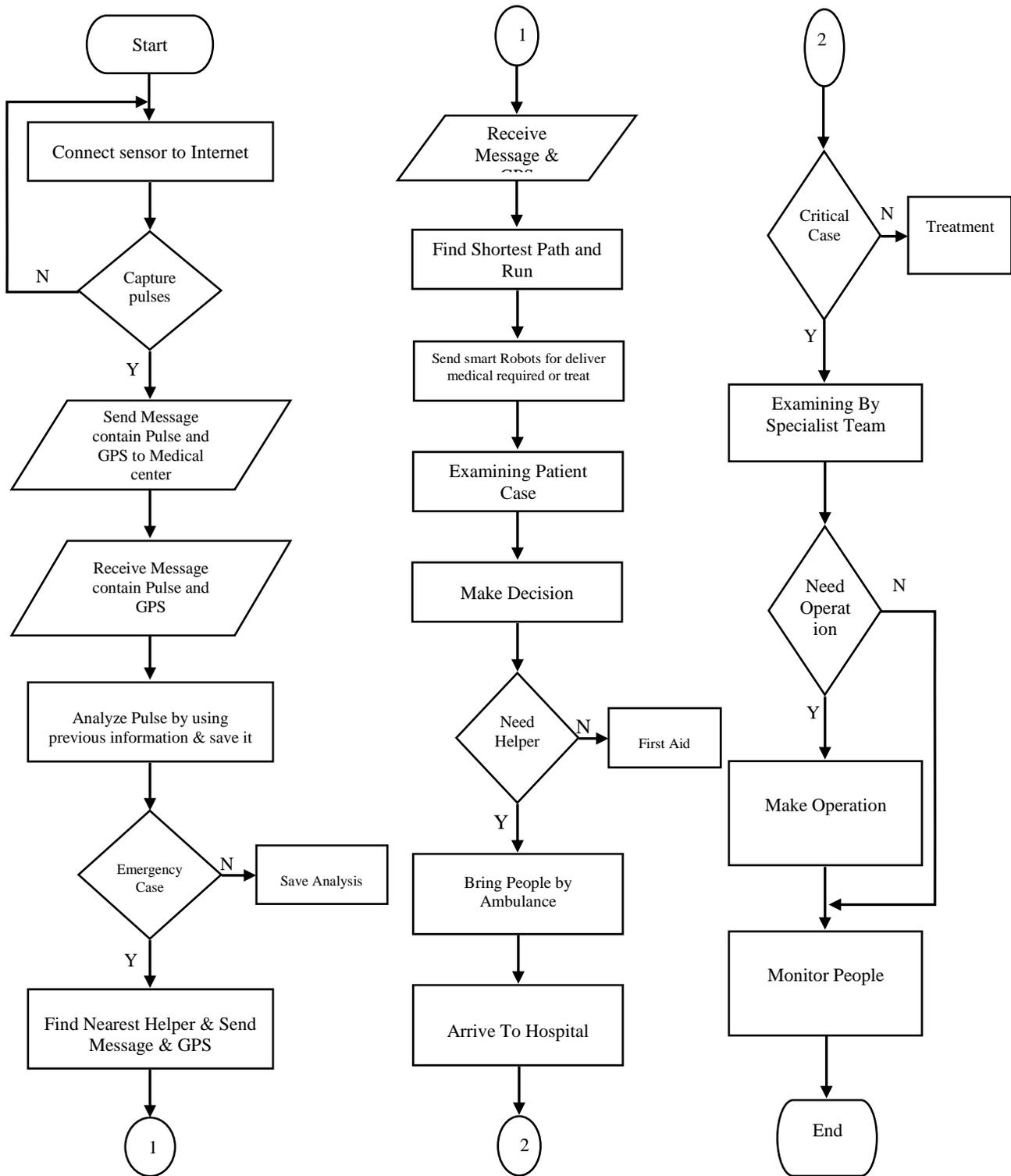


Fig. 6. System diagram of second step of safety environment system.

4. FLOW CHART SYSTEM



4. CONCLUSION

First aid is the first treatment for the injured person. Therefore, the use of a smart first aid system is one of the important services that must be available in the e-health project. This system must be build according to the correct scientific basis to get the best results. In this article, we suggest a conceptual design for a smart first aid system by using one of engineering design methods, which is top-down approach. In addition, we suggest the use of a robot to do the first aid job. This robot should connect to a first aid database to be able to deal with each emergency, so that the robot can do first aid operation without the need to human intervention.

In addition, the robot should has the ability to communicate with the sensor that installed in the person's body to view the historical data that related to the health status of the person.

This work is a conceptual design for the system. At the stage of actual application of the system. The system will be adjustable according to the needs of the system and the situation that belongs to it, depending on the feedback that will be obtain from the users.

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