

**BUSITEMA UNIVERSITY**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF COMPUTER ENGINEERING**

**PATIENT IN AMBULANCE REMOTE MONITORING SYSTEM**

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## **DECLARATION**

I, NAWOYA SARAH Reg No BU/UG/2012/86 hereby declare that this report is my original work except where explicit citation has been made and it has not been presented to any institution for higher learning for any academic award.

Sign: .....

Date: .....

## **APPROVAL**

This is to certify that the project report under the title “Patient in Ambulance Remote Monitoring system” has been done under my supervision and is now ready for examination.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

AC: Alternating Current

Bpm: Beats per minute

CRT: Cathode Ray Tube

DC: Direct Current

EMT: Emergency Medical Technician

ECG: Electro-cardiogram

EMS: Emergency Medical Services

EU: Emergency Unit

ICU: Intensive Care Unit

GSM: Global System for Mobile computing

HR: Heart Rate

LCD: Liquid Crystal Display

LED: Light Emitting Diode

SMS: Short Message Service

SIM: Subscriber Identification Module

VHF: Very High Frequency

## **ABSTRACT**

According to statistics, many patients in Uganda loose lives due to unnecessary delays experienced in the life saving process. The doctors are not able to monitor the patient remotely and have no idea about the patient's health pattern prior to arrival in hospital. During an emergency like accident, heart attack, hypertension, high fevers or any case that requires immediate medical response, an ambulance is called into action. This forms part of the pre-hospital care system. Patient in Ambulance Remote Monitoring System as the subject system relies on the algorithm that continuously monitors the blood pressure, heartbeat rate and temperature of the patient while in ambulance. It uses non-invasive tools and does not require any technicality in reading or measuring the values. It displays the values for viewing in the ambulance as it provides a link between the ambulance and the hospital by being able to transmit the patient's vital values and receive feedback in form of text from hospital. The message from the hospital is also displayed on the LCD in the ambulance. Using GSM modem, the sending and receiving of texts is based on a mobile network and the messages sent are subject to standard charges by the service provider. The blood pressure sensor, the heart beat rate sensor are clipped on the patient's finger while the temperature sensor is inserted under the patients armpits or in-between the fingers. The blood pressure and heart beat sensor are built on the principle of Photoplethysmography. This principle determines the blood volume changes in the micro vascular bed of tissue such as breathing, blood forced into vessels and the heart pumping. It uses the emitter and detector to measure the pulses during the blood flow. The system development was motivated by the need to improve on the health care system of Uganda by improving on the life rescue process during emergencies. Generally, this system enables the doctors to remotely monitor the patient while in ambulance and to be able to guide the ambulance if there is need, example change direction or carry out a certain action on the patient in effort to save the life.



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# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background

In Uganda today, access to and delivery of quality medical services to the larger population is still a big challenge. According to the World Health Organization, Uganda's health care performance is still ranked as one of the worst in the world. The country is ranked 186<sup>th</sup> out of 191 nations [1]. This is influenced by the inadequate number of health workers in proportion to the population, inaccessible health centers and hospitals and lack of an efficient Emergency Health Care Unit. According to the Daily monitor published 17-march-2015; Uganda which has a doctor patient ratio of 1:15000 and a nurse patient ratio of 1:11000 can hardly speak of a working health care system. Mulago hospital officials say that, 30% of patients are lost at the casualty ward out of over 1000 patients received monthly. This is blamed on the lack of quality control and assurance systems to handle emergency pre-hospital systems. An ambulance is just one of the most important requirements of an effective pre-hospital care system [2]. Legislators of the Committee on Health who are currently benchmarking Israel's healthcare system said that presently the semblance of an ambulance service is what is rendered by the Ministry of Health, Uganda Red Cross Society, the police and army in emergency situations. The Commissioner for Health Services in Charge of Planning in the Ministry of Health, Dr. Francis Runumi, also noted that in Uganda, some vehicles bear the word "Ambulance" yet they are just patient transport vehicles. Ambulance services bring value not just to patients but also to the healthcare system as a whole [3].

During an emergency like accident, heart attack, hypertension, high fevers or any case that requires immediate medical response, an ambulance is called into action. These are usually attached to hospitals, police, army, Red Cross, or private ambulances. Ambulances have indicator lights and a loud siren to help them acquire the Right-of-way. In the life rescue process, they are directed towards the nearest health facility or hospital but are sometimes referred to another hospital due to absence of the necessary equipment. While at hospital, the physicians always first test for the vitals. They are the objective

measurement of physiological function used to monitor a patient's status prior to or during patient care. The four main vital signs routinely monitored by medical professionals and health care providers include; body temperature, pulse rate, respiration rate and blood pressure [4]. In some hi-tech ambulances, the physiological monitors exist plus some first aid kits. The emergency cases always catch the doctors off guard with no clue about the patient's condition. This is because of lack of coordination between the ambulance and the hospital.

Heart rate measurement is one of the very important parameters of the human cardiovascular system. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm). Athletes have a lower heart rate than less active people. Heart rate is simply and traditionally measured by placing a thumb over the subject's arterial pulsation, and feeling, timing and counting the pulses usually in 30 second period. This method, although simple, is not accurate and can give errors when heart beat rate is high. More sophisticated methods to measure the heart rate utilize electronic techniques. Electrocardiogram (ECG) is one of the mostly used and it gives accurate measurements but it is costly [5].

Temperature is a measure of the degree of heat intensity. The temperature of the body is an expression of molecular excitation. The human body's core temperature varies from day to day, and from time to time, but usually not more than 1.0°C. Humans are homoeothermic and body temperature is regulated at about  $37^{\circ}\text{C} \pm 1^{\circ}\text{C}$  [5].

Blood pressure is the force of blood against the walls of blood vessels; it is responsible for the movement of blood through the arteries. Two values make up blood pressure; systolic pressure which is the pressure the blood is exerting against the arterial walls when the heart is contracting and diastolic pressure which is how much pressure the arterial walls are exerting on blood when the heart is not contracting [6]. A systolic reading of 120mmHg (millimeters of mercury) and a diastolic pressure of 80mmHg is documented as 120/80mmHg. The method used for taking BP is auscultation of an artery using a stethoscope while a sphygmomanometer is applied over the same artery. [7] In Uganda today, all the vitals are measured when the patient is delivered to hospital hence there is no prior knowledge of the patient's condition

## **1.2 Problem Statement**

During emergency cases and hospital referrals, there is no direct monitoring of the patients conditions by the physicians and hence they are not updated of the patient's condition and progress. The hospital staff may be unprepared since they have no prior notice about the case yet to be received due to lack of a real-time link between the ambulance crew and the hospital staff. The hospital always gets overwhelmed with many emergency cases causing shortage of manpower and the necessary equipment. All this slows down the lifesaving process.

This system will therefore enable direct transmission of the measurements of the patient's temperature, heart beat rate and blood pressure from the ambulance to the hospital. Enabling remote monitoring of a patient and providing feedback between the ambulance and hospital where the hospital can respond back to the ambulance by either giving them a way forward or advising them to find another hospital.

## **1.3 Objectives**

### **1.3.1 Main Objective**

To develop a patient monitoring system that will improve on the life rescue process by enabling remote monitoring of the patient while the ambulance and getting feedback from hospital.

### **1.3.2 Specific Objectives**

- i. To identify and analyze the requirements needed to accomplish the development of the Patient in Ambulance Remote Monitoring system.
- ii. To design and to develop the Blood pressure, heart beat and temperature modules plus an algorithm to enable the transfer of the patient's measured values from ambulance to hospital.
- iii. To implement the Patient in Ambulance Remote Monitoring System
- iv. To test and validate the system

## **1.4 Justification**

Blood pressure, temperature and heart beat are usually the first signs monitored for in most patients like the unconscious. This is either done at hospital or ambulance. In the latter, the measured vital signs values have no medium of transmission to the hospital. This does not allow the monitoring of the patient's conditions prior to medication or

during referrals. There is also no mechanism for the hospital to respond back to the ambulance in case they are not ready to receive them. This puts lives at risk. This calls for a system that helps to monitor the patient's condition or progress by enabling the remote monitoring of patient and providing feedback between the hospital and the ambulance.

### **1.5 Significance**

The vital signs monitoring and communication device helps the physicians to monitor a patient's progress to allow prior preparation of the necessary equipment and to enable a 2-way communication between the ambulance and the hospital. This will enable the ambulance to change course in-case the hospital is not ready to receive them.

### **1.6 Scope**

This system is limited to measuring the patient's heart beat rate; temperature and blood pressure in ambulance and utilizes a GSM module for the transmission of data or signals collected by the sensors placed on the patient's body to the hospital emergency unit.

The system can send and receive a text message with any range as long as network is available and if there is credit to send the message. This project was slated to be completed in a time frame of 9 months.



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