CLOUD INTEGRATED LPWAN SYSTEM FOR REMOTE MONITORING OF HEART DISEASE PATIENTS

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Degree of Master of Science

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Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Science

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the supervisor: Dr. Kutila Gunasekera

Signature of the supervisor : **Date :** 9 June, 2021

ABSTRACT

In emergency situations, heart disease patients who live in remote area with little to no accessibility for proper healthcare services are at risk of not receiving proper and/or immediate care due to issues such poor network reception and language barriers. In urban areas too, patients do not always receive the medical intervention that they need, potentially for reasons including undermining the severity of the illness in question or delays in contacting relevant medical professionals. This thesis investigates the use of a mobile-cloud system, to minimize delays in receiving medical care for heart disease patients. The proposed method to achieve this, involves the use of a Low Power Wide Area Network (LPWAN), using the Long Range (LoRa) protocol to connect several patients over a large area to a centralized server. Each patient would be provided with a Wireless Sensor Node that contains the technology to connect to a central node, as well as sensors to detect the patient heart rate and also the location of the patient. To transmit data from nodes to the server, the network does not use the Long Range Wide Area Network (LoRaWAN) protocol, but rather uses its own MAC layer implementation that allows for the creation of a location based opportunistic network using LoRa nodes. Data that the central server receives will be forwarded to the cloud where it will then be analyzed in real time, and this data can be viewed on a dashboard by medical professionals. This thesis attempts to further the existing understandings of the limits of the LoRa protocol, and the impact of varying parameters of the network while also adding to the research done on opportunistic networks using the LoRa protocol. The results show that a LoRa network can be successfully utilized for such an application.

Keywords: LPWAN, LoRa, Mobile-Cloud

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LIST OF ABBREVIATIONS

Abbreviation	Description
3GPP	3rd Generation Partnership Project
BW	Bandwidth
CR	Coding Rate
CRC	Cyclic Redundancy Check
CSS	Chirp Spread Spectrum
DBPSK	Differential Binary Phase-Shift Keying
DQ-LoRa	Distributed Queuing LoRa
LoRa	Long Range
LoRaWAN	Long Range Wide Area Network
LPWA	Low Power Wide Area
LPWAN	Low Power Wide Area Network
MAC	Media Access Control
NB-IoT	Narrow Band Internet of Things
RFTDMA	Random Frequency and Time Division Multiple Access
RHR	Resting Heart Rate
RSSI	Received Signal Strength Indicator
SF	Spreading Factor
SNR	Signal-Noise-Ratio
TDOA	Time Difference of Arrival
TP	Transmission Power
UE	User Equipment
WSN	Wireless Sensor Node