MAJOR PROJECT

ON

HEALTH CONDITION MONITORING OF ANIMALS USING SENSOR NETWORKS

Submitted To: -

AMITY INSTITUTE OF INFORMATION TECHNOLOGY

AMITY UNIVERSITY KOLKATA

Under the Guidance of: -

Dr. ABHIJIT PAUL

FOR THE PARTIAL FULFILMENT OF THE AWARD OF THE DEGREE

Submitted By: -

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January 2020 – April 2020

Declaration by the student

I, **Priyadarshi Guha**, student of “Amity Institute of Information Technology, Amity University Kolkata” (hereinafter referred as “AUK”), in “Bachelor of Computer Applications” (hereinafter referred as “BCA”) Year “2017-2020”, bearing Enrollment Number A91404817008 declare that the major project (“Major Project [ETMJ100]”) titled **“Health Condition Monitoring of Animals Using Sensor Networks”** which is submitted by me to the department in partial fulfilment for the award of the degree.

Signature

(PRIYADARSHI GUHA)

A91404817008

Date: -

Place: - Kolkata

CERTIFICATE

Amity Institute of Information Technology

Amity University Kolkata

On the basis of the report submitted by **Priyadarshi Guha** (A91404817008), student of "Bachelor of Computer Applications" (hereinafter referred as "BCA"), I hereby certify that the report titled "**Health Condition Monitoring of Animals Using Sensor Networks**" which is submitted to the department of "Amity Institute of Information Technology, Amity University Kolkata" (hereinafter referred as "AUK"), in partial fulfilment of the requirement of the award of the degree of **"Bachelor of Computer Applications"**, is an original contribution with existing knowledge and faithful record of work carried out by him under my guidance and supervision.

Dr. Abhijit Paul

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Amity University Kolkata

Date: -

Place: - Kolkata

CONTENTS

- # Abstract

With the increasing development in the field of sensor networks, remote monitoring of data has resulted into the development of various wireless health monitoring devices which are capable of collecting and analyzing the users' health conditions. The use of such devices is not limited only for humans but can also be used for monitoring health data for animals. This paper discusses an attempt to develop a prototype health monitoring system for animals which can be used to collect and store the physiological reading of animals. The prototype model is designed using Simulink and is implemented using the Arduino microcontroller. The model uses various sensors to collect health related data and then uploads the collected data into the ThingSpeak IOT cloud service for future use. The paper also provides the result of simulation of the prototype model using Simulink and sample health related data collected from the PhysioNet.org archive.

Keywords: Remote health monitoring, Arduino microcontroller, sensors, networking, wireless, Simulink, ThingSpeak, IOT.

1. Introduction

Wireless health monitoring devices are a cheap and easy way to keep track of the bearer's health condition. Using such devices on animals provides a way for continuous monitoring of their health conditions without interfering with their natural day to day behavior. The prototype model discussed in this paper provides us a non-invasive way to monitor the health conditions of animals using a wearable system of sensor networks focused on collecting health related signal data and wirelessly uploading them for real time monitoring and future use. The proposed model is designed in Simulink using the Arduino hardware support package to be built around an Arduino UNO microcontroller with various sensors responsible for collecting healthcare data like electrocardiogram (ECG), pulse rate, blood oxygen saturation levels and body temperature. The data collected by the system can be monitored in real time by using the Simulink Data Inspector and it is also automatically stored in the ThingSpeak IOT Cloud Service for later use.

2. Block Diagram

The prototype model proposed in this paper uses three sensors; the first is the ECG sensor which is responsible for recording electrical impulses through the heart muscles which is also called the electrocardiogram reading or simply as the ECG. The second sensor is the Pulse Oximeter and Heart Rate sensor which is an integrated sensor for recording the heart rate signals and the pulse oximetry which is used to monitor the oxygen saturation or put more simply, the amount of oxygen carried by the body. The third sensor is a simple temperature sensor to measure the body temperature of the bearer. The model is designed to use the sensors to collect the various reading, convert them into appropriate format and then upload them to the ThingSpeak IOT Cloud Service.

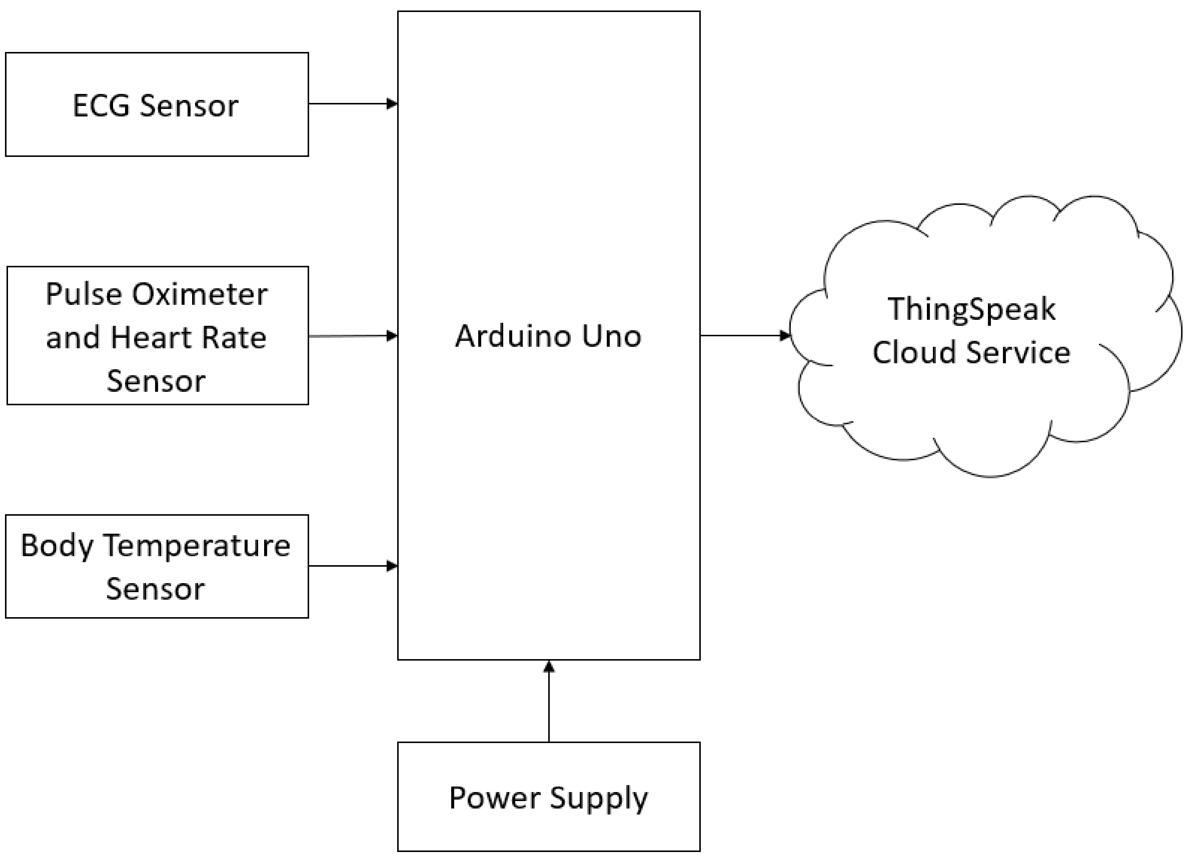

Figure: The prototype model

3. Components

The model discussed in this paper uses the most common and simple components to demonstrate the capabilities of the model to encourage its implementation in the real world. Each component can be replaced with a more suitable counterpart as per the required needs of the user and the environment.

3.1. Arduino Uno

The Arduino Uno is a microcontroller board equipped with a set of input and output pins both analog and digital which can be used to interface with other components likes sensors and other circuits. The prototype model proposed in this paper is designed to be built around a Arduino Uno but other microcontroller boards can be used as per the purpose demands.

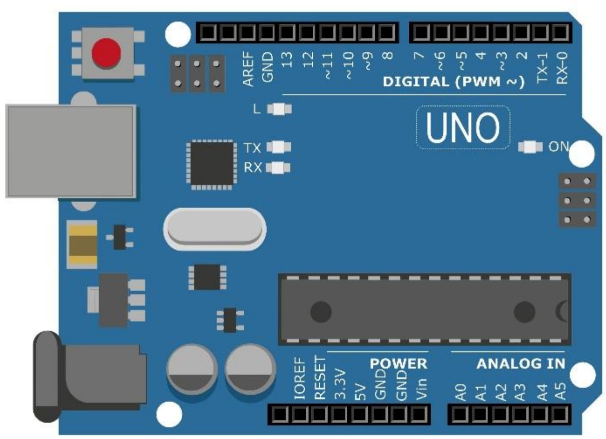

Figure: Arduino UNO

3.2. AD8232 ECG Sensor

The AD8232 ECG sensor is a fairly common sensor used to record the biological ECG signals. This sensor feeds the ECG reading of the bearer as an analog input to the model.

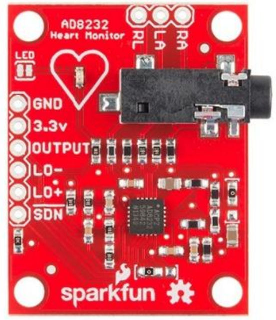

Figure: AD8232

3.3. MAX30100 Pulse Oximeter & Heart Rate Sensor

The MAX30100 sensor is used to record the oxygen saturation levels and the heart rate of the bearer and feed both the readings into the serial monitor from where the they are forwarded to the model as a serial input.

Figure: MAX30100

3.4. LM35 Temperature Sensor

The LM35 temperature sensor is used to read the body temperature of the bearer. The sensor reads the body temperature in units of millivolts which are then converted into appropriate temperature units like degree Celsius or degree Fahrenheit.

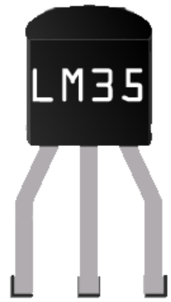

Figure: LM35

4. Simulink Model

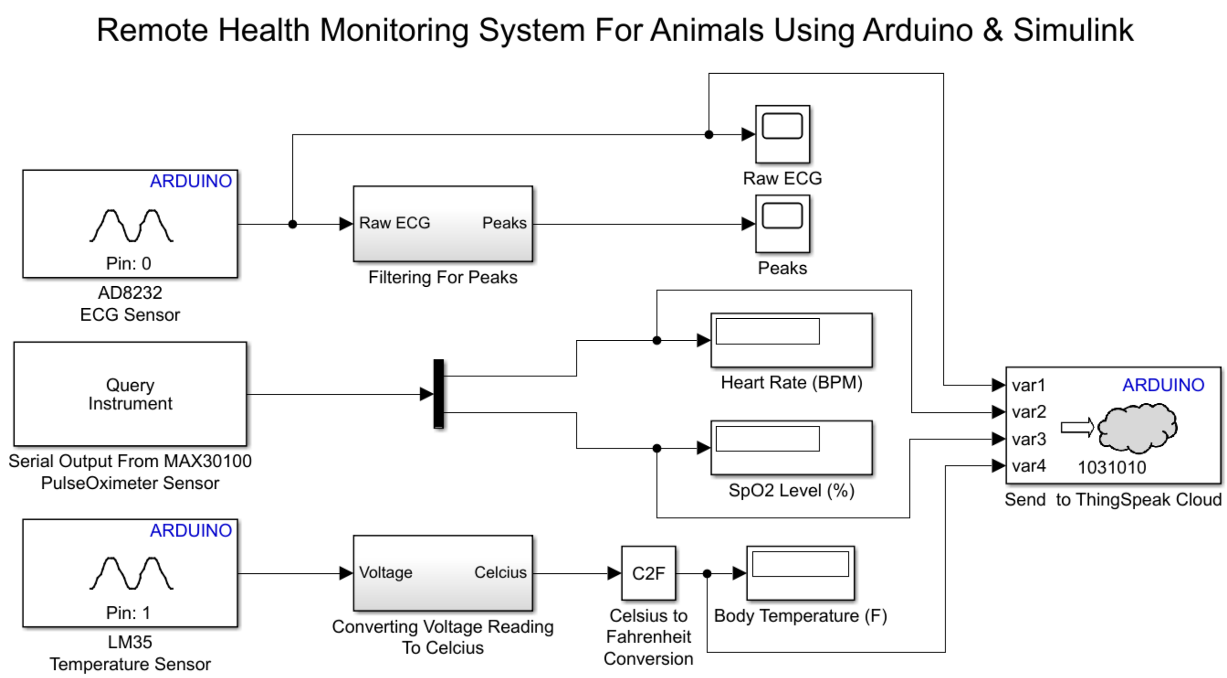

Figure: Simulink model of the prototype device

In the figure above, we can see the Simulink model for the prototype device and how the output from each of the sensors are taken as separate inputs, and after undergoing some form of conversion are displayed to the user and at the same time are uploaded into the ThingSpeak IOT cloud service.

The analog input from the ECG sensor is passed through a filtering function to find out the peaks in the recorded ECG.

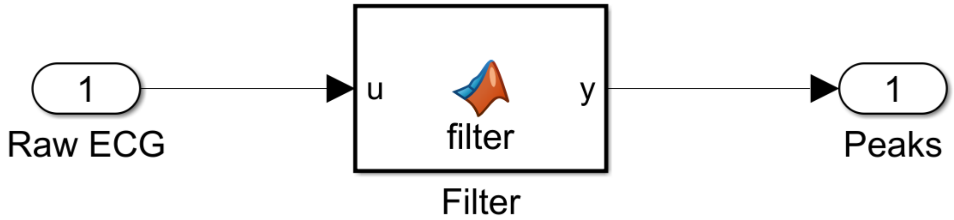

Figure: Finding peaks using a filter function

The Query Instrument block is used to read the output values of the MAX30100 sensor from the serial monitor at the COM Port the device is connected to.

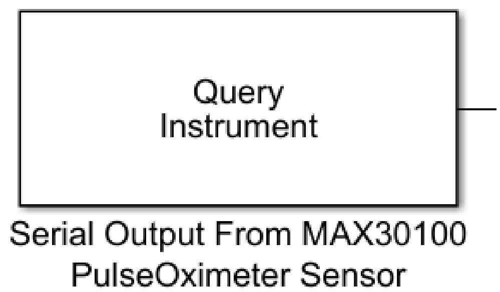

Figure: Query Instrument Block to read the output from the MAX30100 sensor

The LM35 sensor generates output in units of millivolts which can be easily converted into terms of degree Celsius using some simple mathematical operations. As body temperature is commonly measured in units of degree Fahrenheit, the C2F block is used to convert the temperature from Celsius to Fahrenheit.

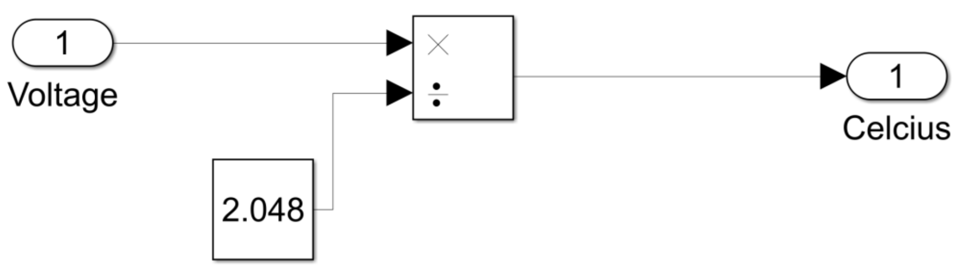

Figure: Converting millivolts readings to degree Celsius

5. Simulation

To test the model, a simulation was run using some sample data for each of the signals acquired from the PhysioNet.org Archive website. The results of the simulation are shown in the figure below which were displayed using the Dashboard blocks in Simulink.

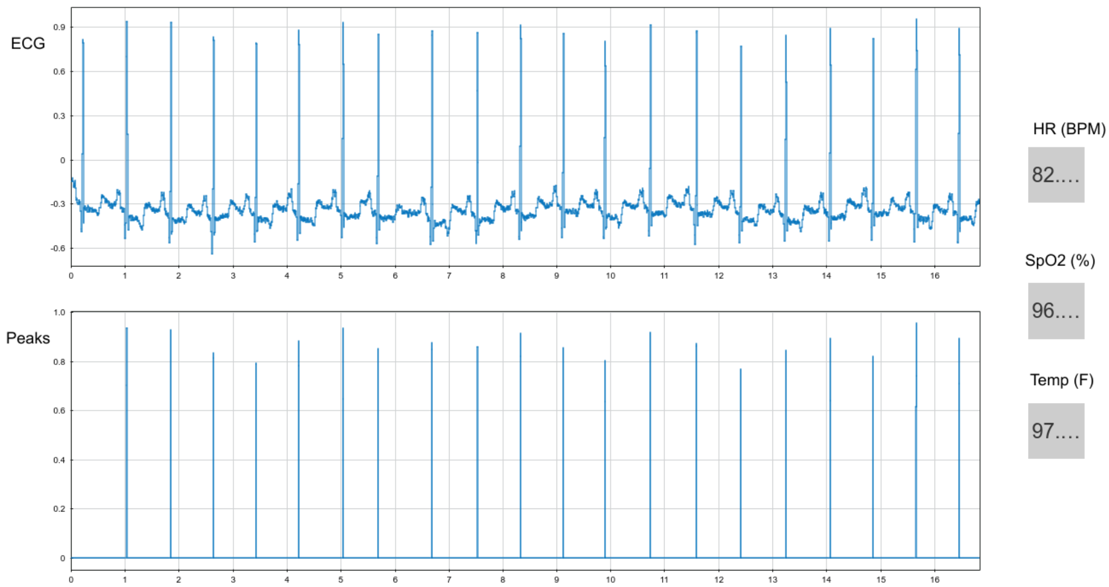

Figure: Simulation results

6. Implementation

Based on the model designed in Simulink, a prototype device can be built around an Arduino UNO board using the sensors as mentioned in the components section.

AD8232	Arduino UNO
GND	GDN
3.3 V	3.3 V
OUTPUT	A0
LO-	11
LD+	10
SDN	--Not Connected--

Table: AD8232 PIN Table

MAX30100	Arduino UNO
VIN	3.3 V
GND	GND
SCL	A4
SDA	A5
INT	--Not Connected--

Table: MAX30100 PIN Table

LM35	Arduino UNO
1	5 V
2	A1
3	GND

Table: LM35 PIN Table

The complete circuit diagram of the device is shown in the figure below.

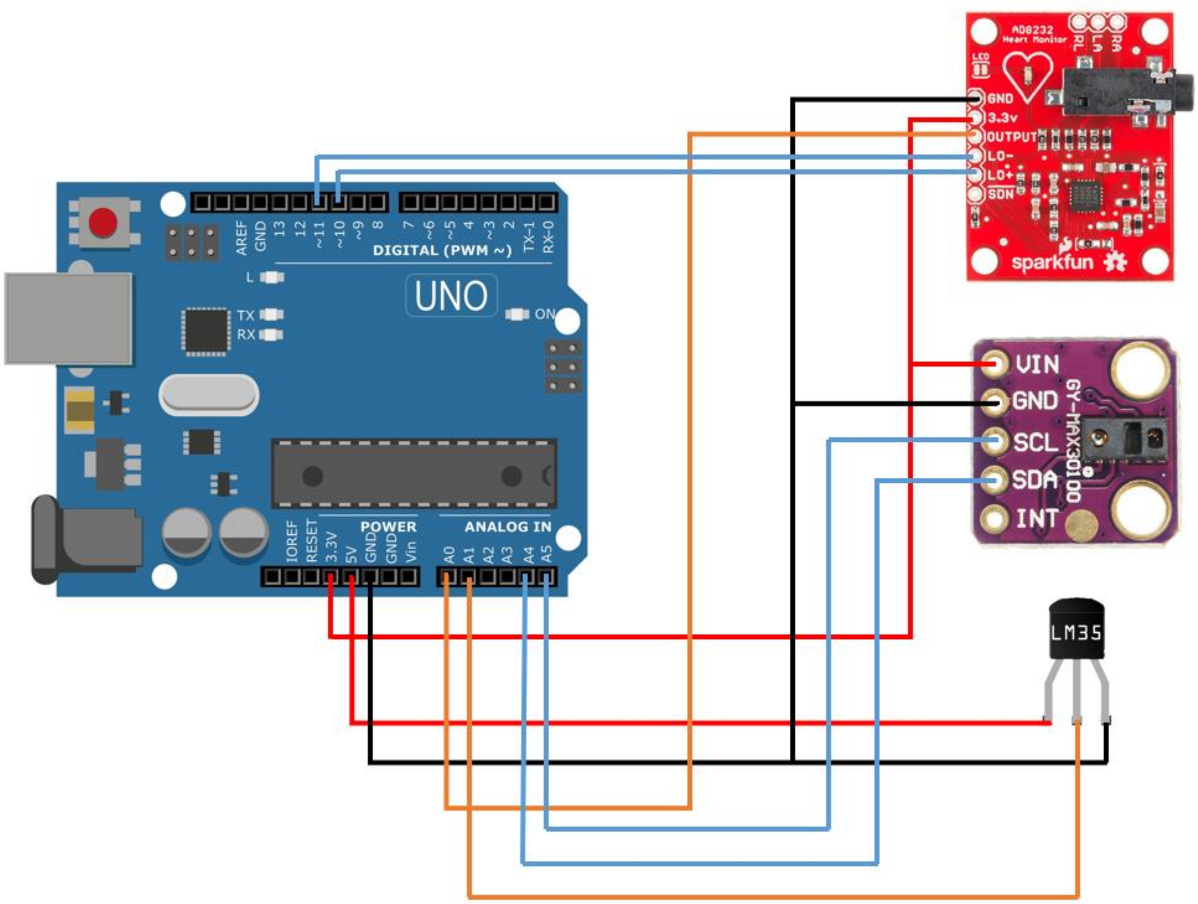

Figure: Circuit diagram

7. Conclusions and Future Work

This paper proposes an idea for the application of IOT to build a remote health monitoring device for use on animals to facilitate a non-intrusive solution to keep track of their health conditions without intruding or interruption with their natural behavior. The model discussed in the paper for simulation demonstrates the potential use and performance of the model. Simulations suggest that the device is capable of monitoring health conditions in real time as well as wirelessly uploading the collected data for future use. The final product can be modified easily by replacing the sensor components as the requirements demand. After appropriate modifications, the model can be applied for use on livestock, domestic use, by animal clinics, shelters, wildlife reserves, and other such situations. As future work, further development of the hardware components can result the device to have a smaller size as well as being cost effective and low on power consumption.

8. References

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