Pangolin Habitat Environment Remote Monitoring System
Senior Computer Engineering Capstone Design Project

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1 Abstract:

The Senior Computer Engineering Capstone Design project is a system designed for the Brookfield Zoo to remotely monitor the environment of its pangolin habitats. This system consists of sensors attached to microcontrollers set within the environment, a database that take in readings and stores information, and a website that allows zoo employees to access the information from anywhere in the zoo. We have implemented and tested our system locally to confirm its quality and efficiency. Through the use of this system, the Brookfield Zoo will be able to easily monitor the environment of habitats and rapidly respond to any situation where the environment needs to be adjusted.

2 Introduction:

The system we created is to make recording environmental information of the pangolin habitat from the Brookfield Zoo a remote process. Located in Brookfield, Illinois, the Brookfield Zoo is at the forefront of the effort the ensure the continued survival of the White Bellied Pangolin species. To ensure the pangolin habitat is best set to accommodate the animals, monitoring their habitat is essential. The current system centers on leaving a sensor in the environment and some time later retrieving the sensor to download the information onto a computer. This method wastes time from needing to be retrieved and set back up and is unable to inform the zoo users of issues until the data is taken from it. Our system is designed to correct these issues by making the recording of the environment to a computer automated and remote, allow zoo employees to access this information from anywhere in the zoo, and alert set zoo employees if an issue is occurring within the environment. Below in figure 1 is an overall system diagram for our project.

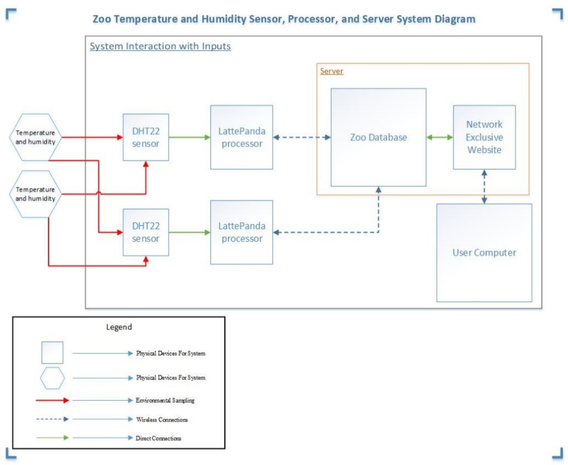

Figure 1: General System Diagram

3 Methods and Materials:

Sensor

The sensor used to view the environment's condition is the DHT22. The DHT22 is able to measure both temperature and humidity in its environment. This is perfect for our system as temperature and humidity are the environmental parameters that must be recorded. The DHT22 sensor can be seen in figure 2.

Figure 2: DHT22 Sensor

Website

The website is an html site which uses PHP programs to access an external database to allow the zoo to be capable of viewing environmental changes in habitats and updating microcontroller parameters. To access the site, a user must first log in to gain access. The website capabilities include the ability to update parameters stored on the database remotely to better suit the needs of the users. Additionally, the website is also able to take in stored readings from the database for the user and display them as graphs or convert them into excel files. The homepage of the site can be seen in figure 3.

Figure 3: Homepage of website

Database

The database used in our system is a MySQL database. The database will hold all the information collected and utilized for the system. It will hold every reading from the LattePanda as well as the needed parameters for the microcontroller to function. Additionally, it will hold a user's list for the website to allow people to log on. The information for parameters can be adjusted within the website and all the read data can additionally be pulled by the site as well.

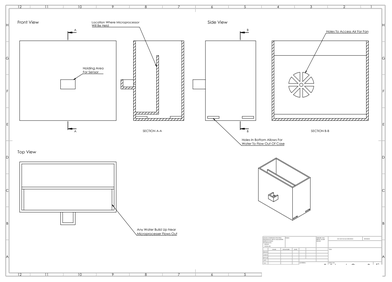

Figure 4: Protective case schematic

Protective Case

The case is made from acrylic to house the LattePanda. It is designed to separate the microcontroller and the sensor from each other to prevent the sensor from being interfered with by the LattePanda itself. It also will work to protect the LattePanda from being potentially damaged by water when the environment is cleaned. The schematic for the protective case can be seen in figure 4.

Microcontroller

The LattePanda is a Windows 10 based microcontroller. This device will be using the sensor to take in environmental readings for the habitat it is placed in. It will be connected to the Wi-Fi network at the zoo and connect to the database to check how often it must record, offsets to adjust its readings by, ranges of acceptable environment condition and emails to send alerts to. Using C#, readings taken are sent to the database and if a reading falls out of the acceptable environmental range, an email alert is sent out to inform zoo employees of the situation. The LattePanda microcontroller can be seen in figure 5.

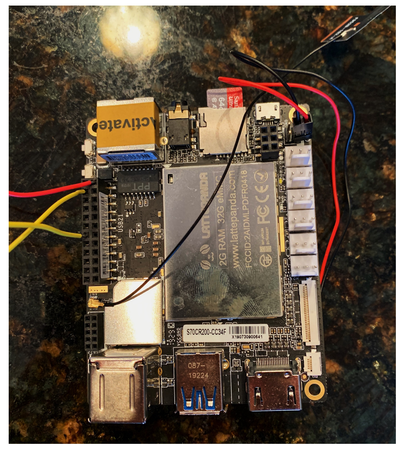

Figure 5: LattePanda microcontroller

4 Results:

Upon implementing our system in our test environment, the functionality was a success. Our microcontroller successfully used the sensor to collect readings and upload them to the database. When testing its email functionality, the LattePanda accessed the emails stored on the database and sent alerts to them. The database was able to hold all the needed data and allowed access to its information by the LattePanda and website. The website allowed for easy remote manipulation of the system operations and for downloading the data.

Additionally, as we implemented our system, we found ways to improve its efficiency. When the microcontroller takes a reading, it averages a series of readings collected over a short time to mitigate the effect of any potential faulty readings. We also set up the system to automatically alert users to calibrate the sensors to ensure quality readings over time. We have recorded what work we've done to set up the system and made a user manual for the zoo to better assist with utilizing and implementing the system.

5 Conclusion:

In conclusion, our system makes a significant impact for the zoo by allowing them to make continuous environmental readings remotely and to alert them when a potentially dangerous situation occurs. This functionality will greatly improve the quality of the pangolin habitat as well as ease the workload of the zoo employees. In the future, through the use of the user's manual, it would be possible for the zoo to implement our system for other habitats to record their environmental conditions if desired.

6 Acknowledgements:

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