A Complete Environment Setup for Pet Care Using IoT

Mohsin Naik
College of Engineering
Northeastern University
Boston, MA, USA
naik.moh@northeastern.edu

Omkar Gaikwad
College of Engineering
Northeastern University
Boston, MA, USA
gaikwad.o@northeastern.edu

Vidhya Gangadhara
College of Engineering
Northeastern University
Boston, MA, USA
gangadhara.vi@northeastern.edu

Prathamesh Jagdale
College of Engineering
Northeastern University
Boston, MA, USA
jagdale.p@northeastern.edu

***Abstract*—Pet care and welfare are notable issues that receive a lot of attention and funding. Pets have assimilated into human life and have a strict schedule that must be adhered to in order to maintain their health and overall day-to-day activities. There are instances when it is impossible for the owner to be with their pet all the time, which results in under-care of the animal. By utilizing IoT technology, we want to provide a simple fix for each of the aforementioned problems.This paper presents an idea to construct a closed pet care environment system, in which the food,water and temperature can be monitored, controlled, and accessed by the pet owner.The food and the water level are monitored using the IR sensor and ultrasonic sensor respectively. Additionally, a Temperature Sensor will also be used to monitor the temperature. All these parameters are controlled by an Arduino board as an onboard computer. The pet owner will have access to monitor and control all the mentioned parameters using a Graphical User Interface (GUI). Additionally, the GUI will also comprise an Authentication panel that provides confidentiality of the user details.The GUI developed will help us to analyze and predict some information using past Data Analysis. Thus, by performing all the above operations and having access to the GUI, every pet owner can now care for their pet from anywhere at any time.**

***Index Terms*—ESP8266, Ultrasonic sensor , pet care, IR sensor, IoT**

I. Introduction

The practice of keeping domesticated animals is widespread and providing for their needs is already ingrained in our compassionate culture. A growing number of people own pets, and the demand for high-quality pet products is also on the rise. The Internet has been permeating every aspect of people's everyday lives for decades as a result of people's growing expectations for higher quality of life. We have entered an era where a wider range of things are linked rather than only between computers or mobile phones as a result of the Internet of Things (IoT) technology, which has caused a significant change in people's lives in recent years. Making objects smarter and linking them through an intelligent network, the Internet of Things (IoT) has made it possible to perceive and manage the physical world by "linking and disconnecting." Consequently, Internet of Things (IoT) technologies have been developed in this industry. With the help of the internet of things, pet owners may monitor their animals' health, follow their whereabouts and activities, and even communicate with them. These innovative pet care products are necessary to pet owners' daily lives.

In the current project, we use Internet of Things (IoT) technology to construct a robust system in which the food, water and temperature can be monitored, controlled and accessed by the pet owner- the three most important things that pet owners would worry about when they are busy or away from their animals. The IR sensor and the ultrasonic sensor, respectively, are used to monitor the food and the water level. In order to keep track of the temperature, a Temperature Sensor will also be employed. An ESP8266 board, which serves as the vehicle's onboard computer, regulates all these parameters. Using a Graphical User Interface (GUI), the pet owner will be able to monitor and manage all the aforementioned factors. In addition, the GUI will include an authentication panel that ensures the privacy of the user's information. A probable sickness may be indicated by any irregularities in a pet's daily meal, hydration, and temperature patterns, which are carefully recorded in the data that was obtained. Consequently, this module can help in notifying their pet owners for further examination of their pets.

The structure of the current work is as follows: Section II explores various linked pieces of work, as well as the drive behind the current study.A description of the theory can be found in Section III. The Simulation and Results are explained in Section IV from a hardware standpoint. The Future Scope of the project is discussed in Section V. We address the Conclusion at the end of Section VI.Section VII discusses Challenges Faced while implementing the project.

II. Related Work and Motivation

Pets require specialized treatment and supervision. This chore is more difficult than it used to be because of the hectic lifestyle we live nowadays. The creation, design, and implementation of a smart pet system are the aims of this effort. Numerous smart gadgets using IoT technology have been developed for the pet care sector to meet a variety of purposes. The smart pet feeder, which typically includes features like automatic feeding controlling, real-time monitoring, or consumption reporting, is among the most advanced and developed applications of IoT technology among the food feeder, water dispenser, and litter box that we have discovered through studying the smart pet care products.

III. THEORY

A. SYSTEM ARCHITECTURE

For the proposed pet care system each parameter i.e (Temperature, Food level, Water level) is measured using a temperature sensor, IR sensor, and Ultrasonic sensor respectively. All of these sensors are interfaced with the ESP8266 Wi-Fi module which acts as a central controller. The ESP8266 Wi-Fi module also comes with built-in TCP/IP networking software which allows the system to get connected to the Wi-Fi network this helps in broadcasting the sensor values on the web server, The web server is GUI used by the pet owner to keep track of the notifications, so that the owner can know when their pets require food, water, and Temperature regulation.

B. HARDWARE DESIGN

While Implementing, we start with the hardware part. We use ESP8266 Wi-Fi module as a microcontroller which will also act as a Wi-Fi module to keep the system connected to the Wi-Fi network.

A]. Temperature sensing: For temperature sensing Si7021-A temperature and humidity sensor is used. The Si7021 sensor is interfaced with the ESP8266 board. The SCL and SDA pins of Si7021 sensors are connected to the IO12 and IO13 pins of ESP8266 respectively.

B]. Food Level Detection: The food level detection system comprises an IR sensor and the ESP8266 module. The IR sensor is used to detect whether the food in the food container has reached below a certain level so that it can be refilled at the proper time. The IR sensor is interfaced with the ESP8266 Wi-Fi module. The Vcc and GND pin of the IR sensor is connected to the Vcc and GND pins of the ESP8266 module respectively. The Out pin of the IR sensor is connected to the IO5 pin of the ESP8266 module. The IR sensor is placed at a certain height on the food container to detect whether there is a need to refill the food container. Depending on the output of the IR sensor a decision on whether to refill the food container or not is made.

C]. Water Level Detection: To do the water level detection task an ultrasonic sensor is interfaced with the ESP8266 module. The VCC and GND pin of the sensor is interfaced with the VCC and GND pin of the controller. Also, the Trigger and Echo pins of the sensor are connected to the IO15 and IO16 pins of the ESP8266 module respectively. The Ultrasonic sensor is placed at a certain height on the water container to detect if there is a need to refill the water. The output of the ultrasonic is in the form of distance and then the distance is converted into terms of water capacity. Depending on the dimensions of the water container.

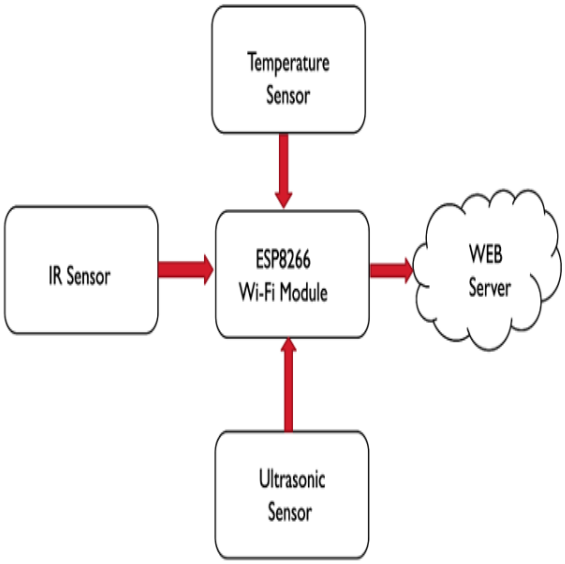

Fig. 1. Block Diagram

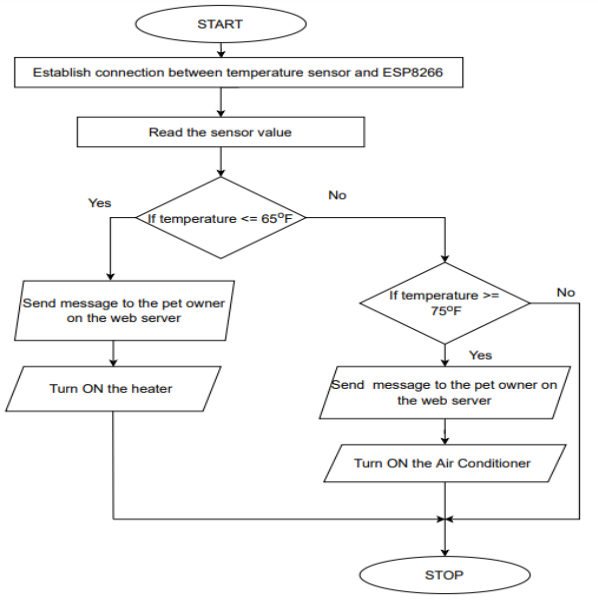

Fig. 2. Flowchart of Temperature Monitoring

1) SOFTWARE DESIGN: Arduino IDE platform is used to do the software development. The whole system is programmed using this Arduino software into the ESP8266 module. For reflecting the sensor's values on the web server a web page is created so that the pet owner can monitor the pet

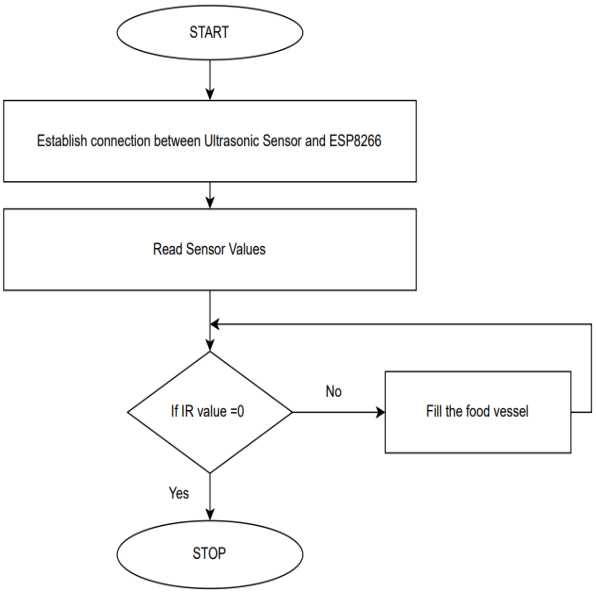

Fig. 3. Flowchart of food level detection

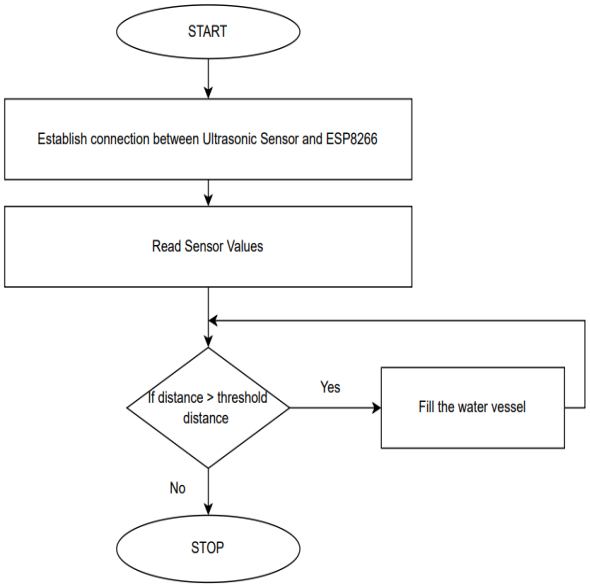

Fig. 4. Flowchart of Water level detection

environment in real time. The real-time monitoring is achieved as the ESP8266 module broadcasts the sensor values on the web server.

A]. Temperature Sensing: In the temperature sensing sub-system, the ESP8266 module will read the sensor value from the Si7021 temperature sensor. The sensor is connected to the ESP8266 via the I2C communication protocol. ESP8266 supports only one I2C connection. The command to get the temperature value from the sensor is '0XF3'.The sensor returns an output array of two elements. These two elements are used to calculate the temperature. For example, if the data array is the output array then data=[0 1]. The calculation to convert the data into temperature is:

$$Temperature = ((data[0] * 256) + data[1])]$$

To convert the temperature value to Celsius:

$$Celsius = [(175.72 * Temperature)/(65536.0)]]$$

To convert the temperature value from Celsius to Fahrenheit:

$$Fahrenheit = (Celcius * 1.8) + 32.]$$

If the temperature value is less than or equal to 650F. The ESP8266 will send a message to the pet owner on the web server by reflecting the sensor value. After reflecting the temperature on the web server the ESP8266 will turn on the heater to bring the temperature back to the required set range of temperature. The ESP8266 module will also check if the temperature is greater than or equal to 750F.In this case the ESP8266 will send a message to the pet owner on the web server by reflecting the sensor value. After reflecting the temperature on the web server the ESP8266 will turn on the air conditioner to bring the temperature back to the required set range of temperature. So, the set temperature range for the designed model is ranging from 650F to 750F.

B]. Food Level Detection: The logic behind the food detection sub-system is that the ESP8266 module will read the sensor values from the IR sensor. The IR sensor will return a '0' as a value when it detects that the food is not less than the desired level. And t will return '1' as a value when the food goes below the threshold value. The ESP8266 will periodically check for the food level in the food container. Depending on the value of the IR sensor the ESP8266 will send a message to the web server. If the IR sensor returns '0' as its output the controller will send a message on the web server that the food container is full. If the IR sensor returns '1' as its output this means that the food has reached below the threshold level and the ESP8266 will run the desired commands to refill the food.

C]. Water Level Detection: For water level detection the ESP8266 module will read the values from ultrasonic sensors. The output of the ultrasonic sensor is in the form of distance. A reference distance is marked and noted on the water container. The ESP8266 will check if the sensor value i.e Distance is greater than the threshold distance set. Also, the threshold distance varies depending on the dimensions of the water container. If the distance is greater than the threshold distance it indicates that the water level is below the required level and it needs to be refilled. The ESP8266 will run the desired commands to refill the water If the 'distance is less than the threshold distance there is no need to refill the water.

IV. SIMULATION AND RESULTS

Figure 6, is the circuit diagram design on a Hardware level to test our application in real-life situations. After ESP8266 is connected to the WiFi a web server is generated with a local IP address. on going to the generated IP address we can see our web application, which is shown in Figure 7, the application

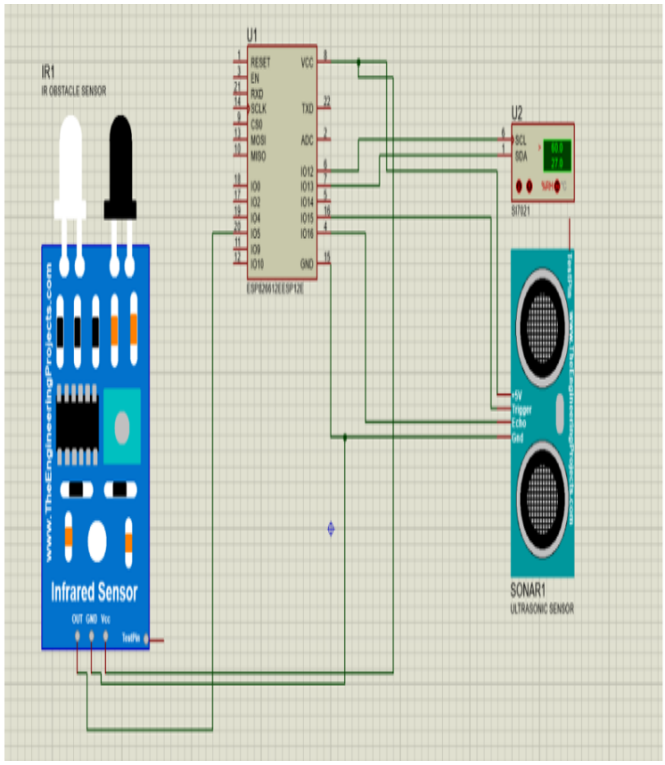

Fig. 5. Circuit Diagram

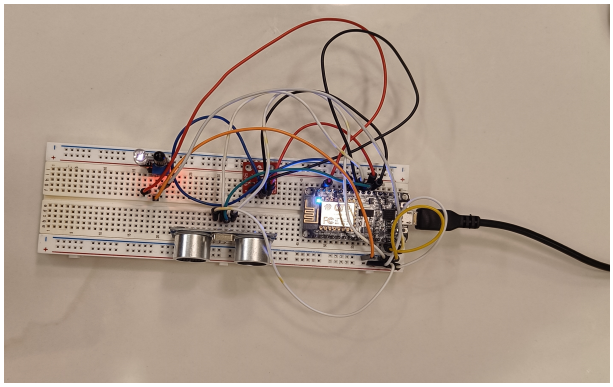

Fig. 6. Hardware Interface

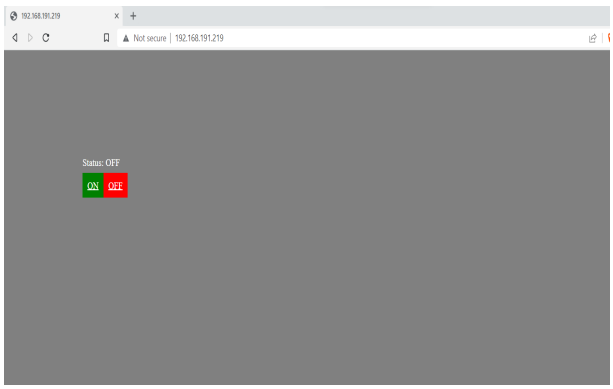

Fig. 7. Web server

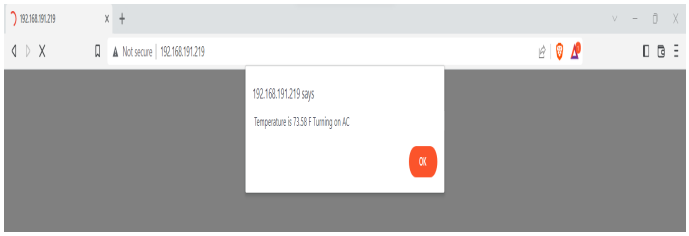

Fig. 8. Notification Alert for Temperature

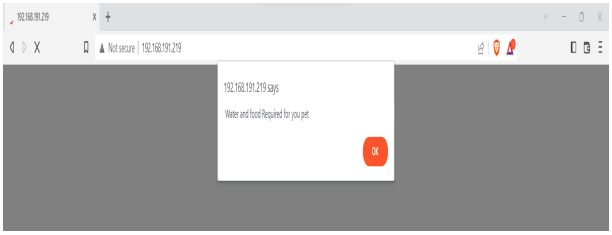

Fig. 9. Notification Alert for Food and Water

has two basic buttons to turn on and off the LED button. There are two major notifications we receive in our web application.

A]. Temperature Notification: After getting a Temperature value our system checks for the value if it lies in the predefined window of the ideal temperature range, if the value is not in the range we give an alert to the web server saying the Temperature is low or high and do the respective changes to make the temperature ideal (turn on the AC if the temperature is high and turn on the Heater). Figure 8 shows the alert notification received on the web server.

B]. Food and Water Notification: For food and water we are using an ultrasonic sensor and an IR sensor respectively. for the IR sensor, we are using the Digital Output mode which means if there is no object in the line of sight the sensor gives us the value of 1, if the object is present in the line of sight the value returned is 0. as we can see from Figure 10 the serial monitor displays the output as 1 meaning the food is not up to the desired height which we decide earlier and the notification is sent to the pet owner. for water sensing, we are using an Ultrasonic sensor. Figure 11 shows the triggered graph of the Ultrasonic Sensor. The Trigger pin sends and wave and the echo pin receives it and the distance is calculated using the following formula.

$$Distance = ((SoundSpeed) * time)/2$$

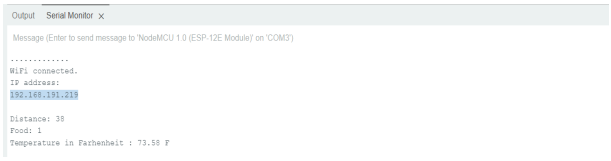

Fig. 10. Serial Monitor Output

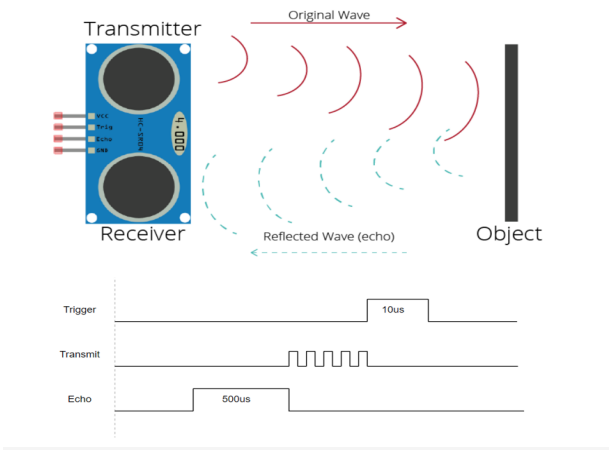

Fig. 11. Ultrasonic Trigger and Echo Graph

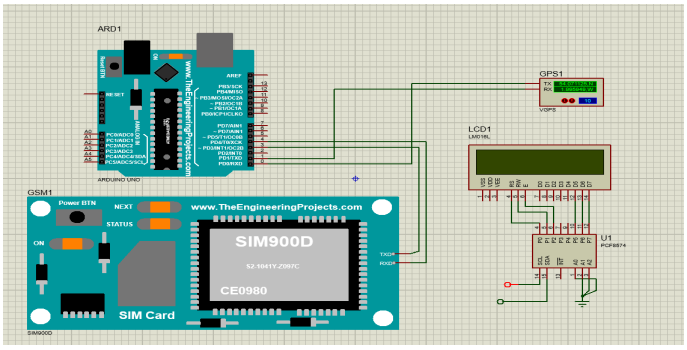

Fig. 12. Circuit Diagram For GPS

V. Future Scope

So far this project focused on the detection part of the pet-care system, i.e. after detecting that the pet requires food, water, and temperature regulation the system was notifying this to the pet owner, in future we want our system not only to detect the changes but to perform the necessary changes. For this, we would be adding a second on-board computer, we are thinking of adding Arduino Uno as it is compatible with the ESP8266 module, Figure 11 shows us the circuit diagram of the GPS module connected to Arduino which in turn is connected to GSM module. So when the pet goes beyond the house premises the notification will be sent to the pet owner on the web server. In the notification, we will be able to send the coordinates, of the location of the pet.

The other addition we will be adding is to connect the second onboard computer to a Motor which will regulate the food and water dispenser. We can also connect to a google home or Alexa to regulate temperature via wifi communication.

Apart from this the current web server can be accessed only remotely, to access the server from anywhere, we can connect the server to AWS and Azure cloud, where the pet owner can be authenticated using a token and username and password as a next layer of protection.

VI. Challenges Faced

The calibration of the Si7021 Temperature and Humidity Sensor was one of the biggest challenges we encountered during this project. Si7021 has two pins, SDA and SCL, and it provides us with an array of two elements; however, we were unable to configure the sensor properly due to noise and other factors, so we are getting a marginal error of 3 degrees Fahrenheit. Additionally, we intended to add a GPS system to find pets and wanted to link Arduino to ESP8266 via serial communication. However, the serial communication failed due to a comm port issue, therefore we decided to add the connection of the GPS module with GSIM in the future scope.

VII. Conclusion

To sum up, the current project uses IoT to make it simple for pet owners to care for their animals when they are not around. The room's temperature may be monitored and managed by the owner thanks to the temperature monitoring feature. When the pet owner is not nearby to monitor the pet's daily activities, the food level detection feature helps to prevent the circumstance where the pet runs out of food. The water level detecting feature is the same.

VIII. Acknowledgement

We would use this opportunity to express gratitude to Dr. Leonardo Bonati for their valuable guidance at various stages of the project. We are also thankful to Eli Maccoll our Hourly Class Assistant, for helping us select components. We would also like to thank the Electrical and Computer Engineering Department for providing the facilities to execute the project.

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