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A Futuristic Approach for Smart Farming using IoT and ML

Dr. Siddalingesh Bandi[1], Ravishanker M[2], Vaishnavi M[3] , Yuktha K R[4]

[1]*Associate Professor, Dept. of ECE, Global Academy of Technology, Karnataka, India*
[2,3,4]*Student, Dept. of ECE, Global Academy of Technology, Karnataka, India*

Abstract - *Smart Farming is an emerging concept that uses modern technology to improve the quality of farming. IoT Sensors give sufficient information regarding the farm fields and allow farmers to take immediate precautions. This paper mainly focuses on developing a system that can monitor livestock, measure the level of water and the moisture content in the soil. It also uses a face recognition system in order to have increased security in the farm. A model is created to have an implementation of all the above applications in the smart farming system. For developing this system, we make use of Raspberry Pi and Arduino UNO. Compiling data gathered from the sensors and electronic devices, It becomes easier for a farmer to keep track of the fields in an efficient way. In order to provide a good user interface, we have also developed a software application for the farm through which, the smart farming system can be operated from any part of the world with the help of technology which can be a breakthrough.*

Key Words: **Smart Farming, Raspberry Pi, Sensors, Arduino UNO, Haarcascade, Android Studio.**

1. INTRODUCTION

Farming plays an important role for the survival of the whole world. Basic needs for the survival of a human being are provided by farming. Traditional farming methodologies are replaced by modern technology. Now, we are in a stage where technology is improving in various domains. In the current scenario, Farmers face lots of difficulties in order to monitor the livestock, For proper water management in the farm where the water level has to be detected constantly not leading to resource waste, for measuring volumetric moisture content in the soil in order to decide on the crops to be grown, To detect who enters the farm for controlling theft in the farm. Keeping these adversities in mind, we have developed a model for the smart farming system which includes a Livestock monitoring system where GPS is used to track the location of the livestock through latitudes and longitudes fetched by the satellite, a water level monitoring system which gives us the amount of water present in the tank and whenever the water goes below a specified level, it will be pumped from the pond to the water tank, A soil moisture sensor having electric resistance property is used to determine the moisture content in the soil, To enhance the security in the farm a face recognition system is used to open the gates of the farm only for the authorized people. A software application has also been created to get real time updates of all the activities happening in the farm.

1.1 Problem Statement

The Indian farming segment is in a critical stage because of advancements in the fields of technology and automation. Lands completely rely on rains and borewells for irrigation purposes. India is one of the top irrigated countries in the whole world, yet only 33% of the cropped area is used for irrigation. Also, real time animal tracking, unfixed soil conditions, location tracking and maintaining the security of the farm will be the major issues faced by farmers. To provide an efficient system that helps farmers to make better decisions , we use WSN, which handles different activities like cattle tracking, soil moisture detection, water level monitoring, and Face recognition for security. Any information related to the farm that is useful to the farmer, will be provided to the farmer. This digital transformation is changing the farm management at a rapid pace.

1.2 Objective of the Study

The objectives of this study is to :

- Track the location of cattle using a GPS module and the Internet of Things.
- Measure water level precisely using Ultrasonic sensors and the Internet of Things.
- Ensure security in the farm by implementing a Face recognition system using Machine Learning.
- Detects the surrounding temperature, moisture content of the soil.
- Develop an interface between the model and farmer by creating an application for easy access to everything.
- Create a model of Smart Farming.

2. METHOD OF IMPLEMENTATION

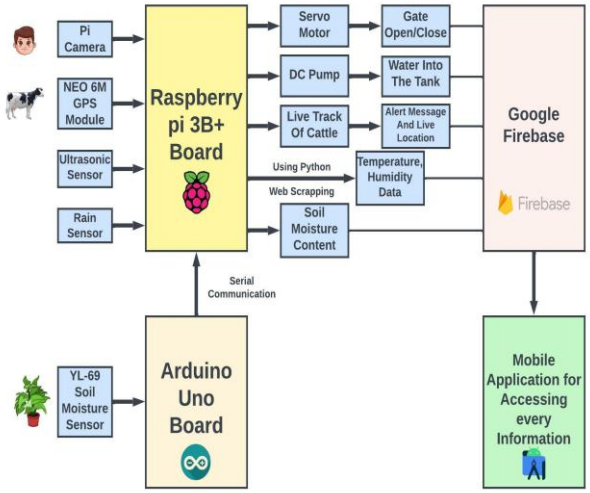

Fig -1: Block Diagram

2.1 Micro-controller Description

Raspberry Pi 3B+: Raspberry Pi 3B+ is a single-board computer which runs in an open source ecosystem. It has 40 pins out of which 26 are GPIO pins. It has a ARM Cortex-A53 CPU Broadcom processor working at 1.4GHz. It supports the use of wireless LAN and Bluetooth. It also offers a faster Ethernet and has improved thermal management. They are widely used for various applications such as weather monitoring, home automation and security.

Arduino UNO: It is an open-source microcontroller board which works on the basis of the Microchip ATmega328P having an operating voltage of 5V. The Input Voltage ranges from 7- 20V and Clock Speed can go up to 16 MHz. The board consists of 6 analog and 14 digital I/O pins that can be easily integrated with other circuits. It can be programmed using Arduino IDE with the help of USB cable of type- B. In order to support the Arduino it consists of different components like crystal oscillator, voltage regulator,serial communication etc.

The purpose of using this microcontroller here is because of its added advantage of having an in-built ADC converter which is required for soil moisture sensor.

2.2 Steps of Implementation

1. Collection of Sensor Data Information from the farm under study.
2. Uploading of Sensor Data Information into the cloud.
3. Accessing this information using Mobile Application and alert notification using IFTTT.

2.2.1 Collection of Sensor Data Information from the farm under study

A sensor is a device that creates an output signal in order to sense the physical phenomenon. The different sensors used here are:

YL-69 Soil Moisture Sensor: It is used to measure the percentage of moisture in the soil and this particular sensor has an operating voltage in the range of 3.3-5V. It is ideally used to construct an automatic system for measuring the moisture content and watering of the plants.

Having 4 pins and made up of two electrodes it works on the principle of Electrical resistance. When a current flows through these electrodes, the resistance to the current in the soil determines the amount of moisture present. If more current passes through the electrodes it implies that the soil has more water.

The output of this sensor is given in percentage and based on the crop we can set the threshold value to determine the moisture content.

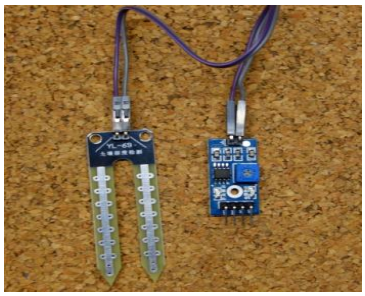

Fig -2: YL-69 Soil moisture sensor

HC SR-04 Ultrasonic Sensor: It is a sensor that helps to compute the distance through ultrasound when it travels in the air. A sound wave is sent by the transmitter and this wave is picked up by the object and is reflected back to the sensor.This particular sensor operates by transmitting a sound wave work by sending a sound wave(Ultrasonic Sound).They determine the distance to a object by finding the time lapse between the transmitted and received ultrasonic pulse. It requires a DC power supply of 5V and the measuring angle is 15 degrees.

The output of this sensor is given in percentage. It is used to find the percentage of water present in the overhead tank. If the level of water drops below the set threshold, water is pumped into the tank using a DC pump.

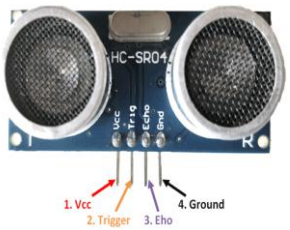

Fig -3: Ultrasonic Sensor

Neo 6M GPS Module: In order to locate all the locations on Earth with a good level of approximation a GPS module known as NEO-6M GPS module is used. This consists of a GPS chip which can track upto 22 satellites and it also requires an antenna which is connected through a U.FL connector. It consists of four pins namely TX,RX, VCC and GND. It had an operating voltage of 3.3- to 5.5V. The data it gets from these satellites will be in NMEA data format which is a standard format supported by most GPS manufacturers.

By using python, the latitude and longitude values can be parsed and used to create a google map link to locate the livestock.

Fig -4: Neo 6m GPS module

Rain Sensor: A rain sensor is used to detect the rainfall. It acts like a switch and works under the principle that the switch will be closed when there is rain detected. Basically, this board is made up of Nickel coated lines. An operational amplifier is used to calculate the resistance, a parallel resistance that will be created when rain falls on the sensor.

The purpose of the sensor here is to make sure that the pump is working properly and there is no air-lock in the pipe.

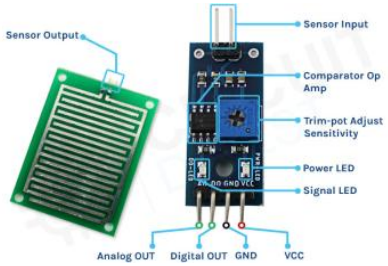

Fig -6: Rain sensor

Servo motor: It works on the principle of PWM ie. Pulse Width Modulation. The angle of rotation depends on the duration of the applied pulse to the control pin. It mainly consists of a DC motor and they are compact and have high output power. They can rotate approximately 90 degrees in each direction. They operate at a speed of 0.1 s/60 degree and voltage of 4.8V to 5V.

The purpose of this motor is for opening/closing of the gates by allowing only authorized persons to enter into the farm which is done using Face Recognition.

Fig -5: Servo Motor

Python Web Scraping: The process of parsing and collecting the raw data from the web is called web scraping. There are 3 main steps in web scraping .Request module, Making a request and response object. Request library is used to make a request to a specific URL.

Python request module makes use of its built system in order to send HTTP requests to a specific URL using POST,PATCH,HEAD,GET or PUT requests. When a request is made to a URL a response is returned. The response object is made of several attributes and functions that helps in normalizing the data.

The purpose of this in the project is to inform the farmer about the weather conditions of his respective area in real-time.

Haar Cascade Classifier algorithm: It is a machine learning algorithm used for object detection which is proposed by Viola and Jones which helps in identify faces.In real time video it gives a huge number of positive images as faces and the rest as negative images.The algorithm is light ,simple and works in real-time with a perfect frame per second.

There are different models stored as XML files in the repositories that can be read with OpenCV methods. In our project we are using haarcascade_frontalface_default.xml file for training the model.

2.2.2 Uploading of Sensor Data Information into the cloud

The data gathered from the sensors will be uploaded to the cloud using api keys and here we make use of google firebase.

Google FireBase

In order to create mobile and web applications, Google developed a special platform and named it as Firebase. It was an independent company that was established in 2011. This is a Google-backed app development software that has allowed all the developers to develop web, iOS and android apps. Not only will it provide tools for tracking analytics, fixing and reporting the app crashes, It provides a swift method in keeping the gathered sensor data at the device level. It can also work with Android APIs supported by Android Things.

2.2.3 Accessing this information using Mobile Application and alert notification using IFTTT

For a farmer to access everything in a single tap an app has been developed by using Android Studio.

Android Studio

Android Studio, popularly known as an IDE for android application development is frequently used, as it provides more features that add to productivity in building the android applications. It has a workable built in system that is gradle-based and an emulator for application testing and verification that is fast and has a wide variety of features. It uses an integrated environment where we can make changes to the code behind a running application without even having to restart the application. It provides large-scale testing tools and supports C++. Android studio makes it easier to integrate the app engine and the google cloud messaging as there is inbuilt support for google cloud platform.

IFTTT: The abbreviation of IFTTT is If This, Then That. If the condition is satisfied in the application, then a certain action is performed. A variety of tasks such as sending text messages can be performed using IFTTT when connected to Raspberry Pi.

3. SMART FARMING, IT'S ADVANTAGES AND DISADVANTAGES

3.1 Advantages

1. Live Cattle Tracking.
2. Efficient Water Management.
3. Provides security to the farm.
4. Real time moisture level monitoring and maintaining moisture content in the plot.
5. Farmers get live updates of the surrounding temperature and humidity which help them to plan ahead.

3.2 Disadvantages

1. Equipment that is based on smart farming requires a farmer to implement and understand the usage of technology and its advancements, which is a major challenge as it takes time for all the farmers to adapt to this technology.
2. It is costly and a one time investment.

4. RESULT AND CONCLUSION

4.1 Result

1. If any one of the cattle goes out from a certain boundary, the location of the cattle and a warning message will be sent to the farmer regarding the same.
2. When the water level in the tank decreases, the water will automatically be pumped from the water resource in the farm.
3. Only the authorized people will be able to enter the farm and will be able to govern all the activities that take place in the farm.
4. A model is created to give a clear picture of all processes that take place in the farm.
5. The farmer will be getting the real time updates and alerts of all the activities happening in his farm.

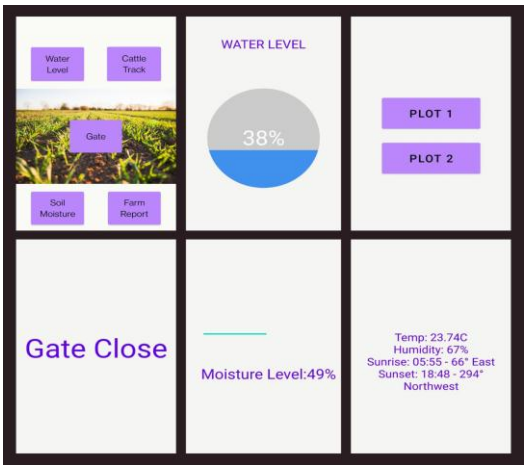

Fig -7: Application for accessing information about farm

Fig -8: Model of Smart Farm

4.2 CONCLUSION

Smart farming in the future is not just limited to basic principles, but is an idea for research, development in the fields of automation and innovation. IoT can also handle issues relating to climatic changes, animal tracking and welfare, thereby contributing to a healthy way of living for all the consumers. These systems help to determine the quality of soil. Farmers are able to solve irrigation problems, temperature problems, humidity problems, etc. The availability of sensors for the agricultural parameters and microcontrollers can be easily interfaced with each other and with the help of Internet of Things challenges faced by the farmers can be brought down and help him to have easy access to various information about his farm and also to automate certain operations. So, farmers are able to control various equipment related to agriculture and monitor their crops on smartphones or on computers.

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