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Arduino based Smart Greenhouse with Two-Way Communication

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Abstract - *As the world is getting better and better the need of human workers risking their lives for the need of their respective field is reducing drastically. The human life is obviously more precious than the need of working under some hazardous condition. One might say that the automations are stealing the jobs of the one in need but the robotics industry is in the rise and they create more jobs further more in that field. This project reduces risk to human being but also labor. This will bring change to the society. We were inspired by the ease with which a system can control the environment and surrounding parameters. This system can help the people to monitor and control the green houses very efficiently and in better way. This project provides the system that can reduce the human effort in a great way and also ensure the safety of the operator by complete being in to the isolated and harsh condition and finishing the work in an efficient way. Here we make use of the Arduino nano as the brains of the system by providing the appropriate modules and NRF24L01 as the communication device. The parameters are checked by the use of different modules and sensors on the system over the farm side. The sensors such as the temperature and the humidity sensors are used in the system and also the methane gas detection sensor is used here. Other than this the system has the actuators that will help the system to maintain the limits to these parameters. As for the transmitter side the system has the Arduino as the brain of the system with the presence of the NRF24L01 module as the transmitter and the 10k potentiometers to set the limits of the parameters.*

1. INTRODUCTION

As we know that farming is the most crucial profession of human survival. Each year the farmers around the world together grow billions of tons of crops that we consume each and every day. The farming is not an easy job, there are various environmental things that has to be considered before taking any step.

Here the system is provided with the ability to set the limits on the parameters on which the whole process of farming is dependent on. This acts as the helping hand that can control the environmental parameters such as the temperature, Humidity, Gas presence, etc. in the close proximity such as the greenhouse farms. It's not just the farms that these systems can be used for, these can be used for the places such as hospitals, medical dispensaries, food storage, etc.

The system which is divided into two parts has the ability to control, monitor and set the parameters to maintain the optimum quality of surrounding for the crops. This entire setup is wireless system that can be modified by suing all kinds of various sensors to monitor and control these parameters. All of this happens in the real time and the monitoring stays on 24/7.

1.1 MOTIVATION

In general terms the farms are maintained and taken care of by the farmers. But even the farmers are helpless in terms of controlling the parameters in the surrounding such as amount of heat, light, humidity, gas released by methane and several other things. The majority of the farmers in our country are highly dependent on the weather forecast on the news channels, but even these forecasts can be wrong sometimes. There have been many scenarios where the entire climate of the region has been out of order. This often leads to the failure of the crops. There are various systems in the market that can do the similar jobs but have are often made for the system that are low in number. Is the particular farmer have a large number of crops and close farm system such as the greenhouse system then it is too hectic for the farmer to go to each and every farm and set up the parameters limits manually.

This system helps overcome these problems and control the environment in the particular way and make it easier for the farmers on the monitoring and maintaining the system. The system is not just limited to the farming but also applicable to the medical and food storage sector. There are many ways for operator to communicate with the robot. By doing a small research we picked NRF24L01 module as a compatible communication method. We needed something cheap but reliable. In this project we have used transceiver module. Here we have the benefit of providing a very small amount of power for the communication which is actually less than lighting up a small LED.

1.2 LITERATURE SURVEY

After detailed comparisons with previous work, many of previous work used the GSM based communication system which was good for long distance data transmission but they have some issues like unable to receive SMS during the bad weather. This often create problems such as unable to know whether the system is

responding to the SMS or not and unable to know for sure if the system is ideal or the SMS services is down.

There were also the systems in the past as same as to ours but the problem with such system was that they had the controls and CPU in the same room as the green house. That means each green house has its own personal control and a person has to be present physically to monitor them if things go wrong.

1.3 SCOPE OF PROJECT

Nowadays robotic systems and control units are not limited to switches and joysticks. There are many ways like regulators, potentiometers, joysticks, switches, cameras, voice command, artificial intelligence, etc. Similarly, a farm system can be controlled by numerous methods as mentioned above but, we are using a feedback system which keeps the parameter in limits.

In further development we can add image processing to monitor the quality of the plants which will help us keep these plants in the safety without our help in each and every moment. This can be done by providing a camera to the computer which will analyze the color of the plants, the algorithm in our computer will recognize the required command for the changes in the surroundings. This will help the farmer to maintain the quality of the product and also providing more time for more crops.

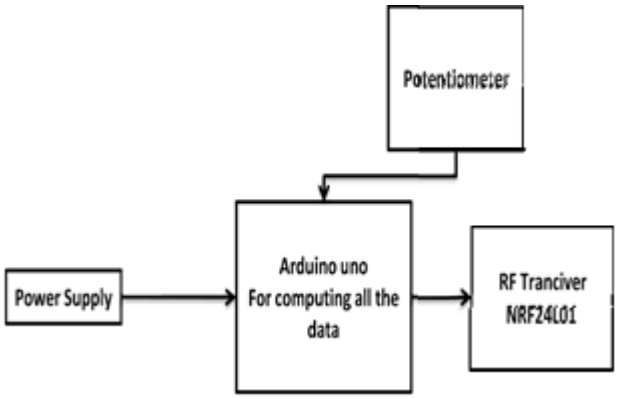
In terms of development for system we can add a numerous amount of attachments that can be changed with regards to our application. This can vary from controlling the farm parameters to providing a comfortable room for patient in a hospital. With enough computing power we can provide a system with an AI system that can take its own decision at critical situations.

1.4 PROBLEM DEFINATION

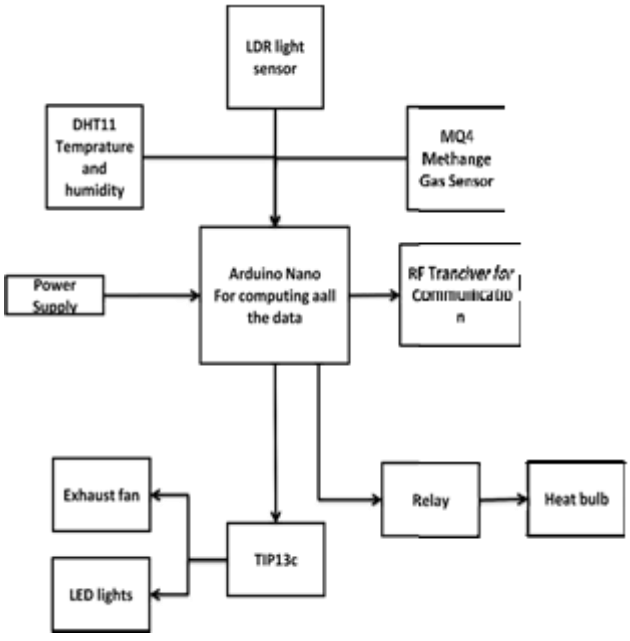
Even though joystick and switches are the highly used system around the world for the controlling of the system but they have their own limitations and restrictions as mentioned above in the sub topics.

To provide a better control over the temperature in the system we came up with the idea to use the DHT11 module. The module that we use has features like calculating temperature and humidity and proving the data in digital format. There are numerous ways that we can use this data for over a certain application. The most prominent way we can use this is for the quick temperature check. Furthermore, these systems are useless if they are not capable of doing something meaning full. Hence, we provide the system with the actuators such as heat bulb and exhaust fan to keep the parameter such as the temperature in control. In terms of communication we are using transmitter and Receiver module this transmitter and receiver module is capable of long-range communication in an open field for above 500 meters normally. It has the benefits of low power consumption and easy configuration with the Arduino. The coding technique that we have used is supposed to be simple and effective and easy to modify for future if required. In terms of communication we are using transmitter and Receiver module this transmitter and receiver module is capable of long-range communication in an open field for above 500 meters normally. It has the benefits of low power consumption and easy configuration with the Arduino. The coding technique that we have used is supposed to be simple and effective and easy to modify for future if required.

2. BLOCK DIAGRAM



Block diagram of Transmitter Section



Block diagram of Receiver Section

Arduino UNO:

The Arduino UNO is the most important part of the entire system that will work as the computer system on our robotic arm. It gathers the information from its connected

devices and performs the required calculation on it. Along with that it also provides the required output to the output devices connected to it. There are numerous techniques possible on this little piece of computer.

NRF24l01:

nRF24L01 is a single chip radio transceiver for the world wide 2.4 - 2.5 GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, and modulator. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0mA at an output power of -6dBm and 12.3mA in RX mode. Built-in Power Down and Standby modes makes power saving easily realizable.

TIP31c IC:

The 12v Driver is just as same as motor driver. It makes sure that the LED strip and exhaust fan has enough power to brighten them self at the maximum brightness. This driver consists to the TIP31c IC that provides the 12v supply to the LED strip and exhaust fan and can also handle PWM signal from the Arduino to vary the brightness at a proper rate than just generic power supply.

LDR Light sensor:

LDR sensor module is used to detect the intensity of light. It is associated with both analog output pin and digital output pin labeled as AO and DO respectively on the board. When there is light, the resistance of LDR will become low according to the intensity of light. The greater the intensity of light, the lower the resistance of LDR. The sensor has a potentiometer knob that can be adjusted to change the sensitivity of LDR towards light.

MQ02 Methane Sensor:

The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of the Arduino. The MQ-2 Gas Sensor module is useful for gas buffer and transmits it to the Green leakage detecting in home and industry. It can detect LPG, i-butane, propane, methane, alcohol, hydrogen and smoke. Some modules have a built-in variable resistor to adjust the sensitivity of the sensor.

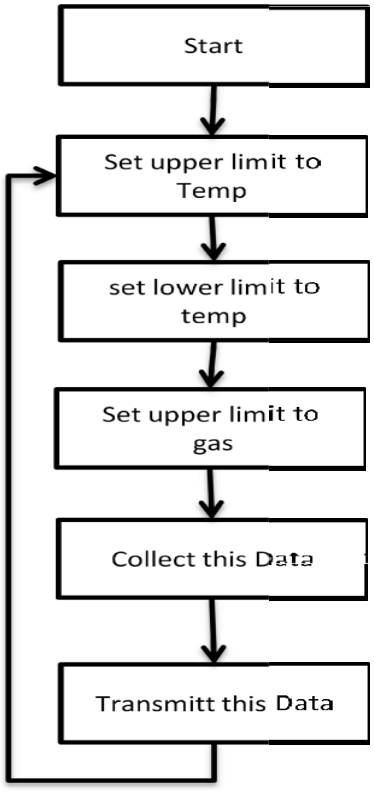
DHT11:

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term house stability. This sensor includes a humidity measurement component resistive-type and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

Relay:

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. Controlling a relay module with the Arduino is as simple as controlling any other output as we'll see later on. This relay module has two channels (those blue cubes). There are other models with one, four and eight channels. This module should be powered with 5V, which is appropriate to use with an Arduino. There are other relay modules that are powered using 3.3V, which is ideal for ESP32, ESP8266, and other microcontrollers.

2.1 Flow Chart



2.2 Transmitter:

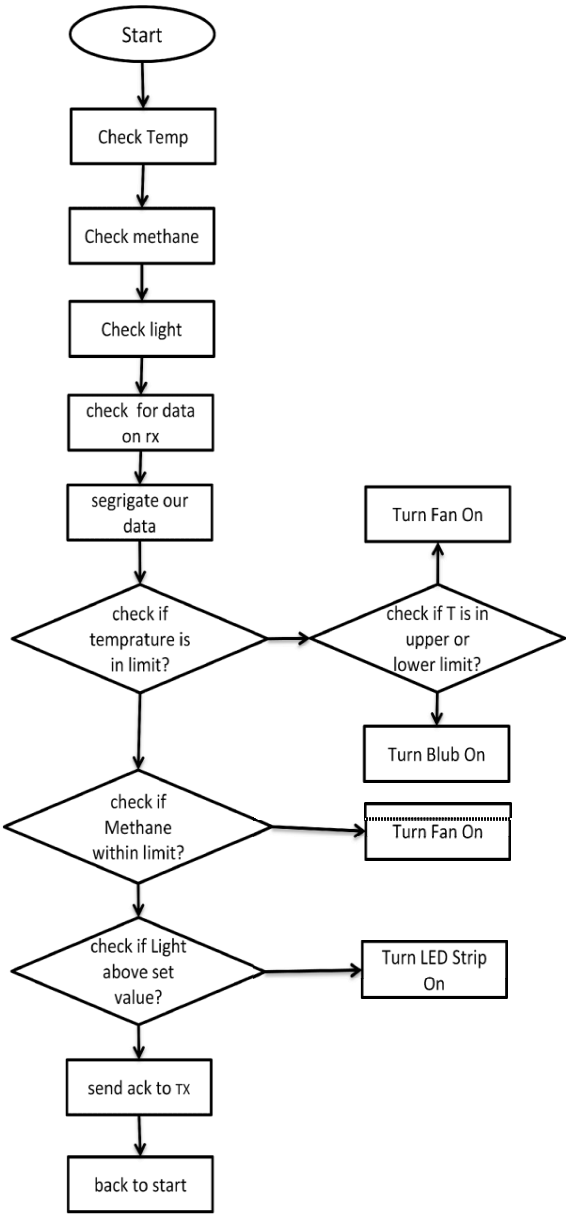
• The algorithm starts with the control room setting the parameters.

• The first one here is the upper limit of temperature.

• Next task to set the lower limit to the temperature.

• And the last parameter is the upper limit to the methane.

• The Arduino collects all 3 data to the buffer and transmit it to greenhouse.



2.3 Receiver:

• In receiver side, the farm, has the modules connected that check the values of each parameter for each cycle.

• It starts with checking the temperature, the methane and then Light.

• Next thing is to check is there is any data available on the receiver.

• If there is anything available then that data is stored in the buffer.

• This data stored in the buffer is then segregated into their variable.

• Then the system checks if the temperature is in the limit or not.

• If the temperature is not in the limit then it checks if temperature is above or below given limits.

• If the temperature is above the given upper limit them the fan is turned on.

• If the temperature is below the set lower limit them heat bulb is turned on.

• Similarly if the methane is above the set upper limit then the fan is turned on.

• The light value is set in Arduino itself.

• If the light is less than the set value then the LED strip is turned on.

• The data from the 3 modules are stored in a variable.

• These data are then sent to the control room.

2.4OBJECTIVES

- To develop a system that can maintain a suitable environment for crops.
- To reduce the human interference in the process of crop growth.
- To fabricate a system then can replicate a real environment its own.
- To produce a wireless system where each greenhouse can be monitored from one place.
- To control the parameters wirelessly and efficiently.
- To design, develop and implement a reliable Smart farm with enhanced control and stumpy cost.

2.5 EXPECTED OUTPUT

The operator will be able to set the parameters from a control room and this data will be received by the farm. The farm will use this data to compare with real values. If the parameters are out of range then the actuators will help them come back in their limits. The farm will also send the data from these modules to the control room as sigh of acknowledgement and to monitor parameters.

3. CONCLUSIONS

The data is sent successfully and received back successfully. The system is quite complex in terms of hardware and software but it is versatile in terms of

modules and applications. We can use different sensors and actuators to make this system more independent. Even though it can't fully replace a human farmer but is surely a one step to future.

"LPG Leakage Detector using Arduino with SMS Alert and Sound Alarm" Rhonnel S. Paculanan, Israel Carino International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue-6C2, April 2019

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"Design and Implementation of Arduino based Riders Safe Guard 2.0" K. Murali Chandra Babu, P.A.Harshavardhini, N. Koteswaramma International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9, Issue-1, November 2019

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