Automated Soil Moisture Detection and Protective Sensing based Smart Irrigation System using IoT (SMPSInSYS)

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ABSTRACT

The automated soil moisture and protective sensing based smart irrigation system using IoT (SMPSInSYS) were aimed wherein; the user can monitor his field from the remote location. This system makes use of a technology called internet of things (IoT). A NodeMCU was utilized which consists of Wi-Fi Module that connects the system to internet and an Arduino UNO (microcontroller) for accessing values of the parameters like temperature and soil humidity measurements of the area irrigated and controlling the proposed irrigation system. We focuses on detection of water level content in soil required for a specific crop using soil moisture sensor and it also takes care of physical protection of irrigation field by providing a smart sensing using IR sensor. Our system is used to control the water supply as well as to protect the field from an unwanted obstacle if entering into the field by providing the alert message to the user and protect the field by creating sounds. We aim at this system for better purpose.

Keywords: *Internet of Things (IoT), Arduino, Irrigation System, Sensors*

1. INTRODUCTION

India is the country where agriculture plays an important role for development of country. In our country, agriculture depends on the monsoons which has insufficient source of water. So the irrigation is used in agriculture field. In Irrigation system, depending upon the soil type, the water is provided to the plant. Currently, agriculture accounts 83% of the total water consumption in India [1]. Unplanned use of water inadvertently results in wastage of water. This suggests that there is an urgent need to develop systems in order to prevent water wastage without imposing pressure on farmers. Irrigation is very important for agriculture to produce high yield. Because the fields in need for irrigation can contain different plants such as trees, shrubs and vegetables, each of these field should be irrigated in a different plan having different amount of time. Of course the person who irrigates the field should be experienced in irrigation methods of the plants to have high yield from the plants. In case of wrong irrigation method, the expected agricultural output is most probably not considered [2]. Auto-controlling can transform the system to machines or devices which automatically work themselves for a particular specified program [2]. There should be some sensors and comparison mechanism to transform an ordinary system to fully auto-controlled system [2] [3]. In order to make the system to auto-controlled system we are using a microcontroller called as Arduino. It is nowadays used from basic interface device to expensive industrial application. Also with the amount of progress seen in the field of Internet of Things, we have decided to combine both of these technologies for our Mini Project.

A automated soil moisture and protective sensing based smart irrigation system using IoT (SMPSInSYS) is a system which works unmanned and it is autonomous. Our system falls in the category of automated control and

monitor system. The systems are required to be compact with longer time duration. Even the components of the systems play a vital role in making a system for they should be able to sustain all kinds of weather and difficulties in their sensing even to sustain a fall. The system has many components such as Arduino which is used to control the water supply from the pump to the field and the sensors like soil moisture sensor (SMS) to detect the moisture content in the soil, temperature sensor to get the temperature present in the field and the IR sensor for detection of any objects entering into the field which will be connected to the Wi-Fi Module (ESP8266) [4]. The IR sensor detects if any object comes in between then it will turn on the buzzer which will create some noise and from that noise the object can get distracted and will not enter into the field. By using the concept of internet of things (IoT) our system will send the information of the field to the farmer who will be in some remote location. In order to send the information from the field a Wi-Fi module is placed in the system and while the other Wi-Fi module is placed at farmer's location. Both the Wi-Fi module is connected to a same access point of the internet. This module will continuously send the information about the field to the farmer weather the field is ok or not. Whenever any object comes in between the sensor, the system will turn on the buzzer as well it will send the alert message from the system Wi-Fi module which is at the field to the farmer Wi-Fi module. For the programming essence of the SMPSInSYS we have used an Arduino UNO and accumulated Arduino IDE onto the Arduino UNO. The Arduino UNO is a credit-card-sized controller that plugs into your TV and a keyboard. It is a capable little controller which can be used in electronics projects and for many of the things that uses a microcontroller. Arduino IDE is known as Arduino integrated development environment. It is a library of programming functions mainly aimed at real-time computer vision. The library is cross-platform and free for use.

Our SMPSInSYS is capable of doing a lot more than the name suggests. It will be powered by Arduino UNO modules for the computing. It can have efficient sensing algorithms integrated into it, which helps it identify obstacles. It can be set to a specific path which it will continuously hover over for automation. If fixed in a specific location, it'll stay in that position or come back to that position even if it is pushed off. Multiple sensors can be clustered together for this purpose [4].

2. RELATED WORK

Through research of a bunch of IEEE papers and a few other articles makes it evident that autonomous irrigation system has a great potential in an automation research and it is used in agriculture applications.

2.1 T. Li-fang [2] in his paper states the following "We are witnessing the advent of a new era of auto control technology — water-saving irrigation — that can autonomously work in natural and man-made environments. The water saving irrigation can be the way to save the amount of water required for irrigation which is diverted from underwater, streams, reservoirs or other water sources by using different water-saving measures and an auto-control can help to realize irrigation in appropriate time with a right amount. We identify scientific and technological advances that are expected to translate, within appropriate regulatory frameworks, into pervasive use of autonomous water-saving irrigation for agricultural applications."

2.2 Karan Kanasura [4] in his paper states the following "In the irrigation field, soil moisture sensor, temperature sensors are placed in the roots of the plant and microcontroller handles the sensor information and

transmits data. One algorithm was developed to measure threshold values of temperature sensor and soil moisture sensor that was programmed into a microcontroller to control water quantity. A model of automatic irrigation system which is based on microcontroller and solar power was used only for source of power supply. Various sensors are placed in paddy field. Sensors sense water level continuously and give the information to farmer through cellular phone. Farmer controls the motor using cellular phone without going in paddy field. If the water level reaches at danger level, automatically motor will be off without conformation of farmer. Here he has done for only one specific crop. But our prototype has checked for different crops and it also includes the security application using IR sensor in the system."

3. PROPOSED WORK

3.1 Working of SMPSInSYS

The SMPSInSYS is combined with two technologies in which some of the components are linked to IoT and some of the components are embedded. Where the components which are embedded are connected to an Arduino Uno and the components which are using internet are connected to ESP8266 which is a Wi-Fi Module. The components like soil moisture sensor (SMS), temperature sensor, relay, LCD (16*2) are connected to Arduino UNO as shown in Fig. 3.1 by red indication. The soil moisture sensor (SMS) will check the water level content present in the field and the temperature sensor will detect the present temperature present in the field. Both the sensor will provide the information to the microcontroller(Atmega328) which is present in the Arduino, a relay is connected to it if the water content is less then relay will turn on and allow the pump to supply water until the water content is sufficient to the roots of the particular yield. The LCD (16*2) will display the temperature present in the field, the status of the soil, the status of the pump.

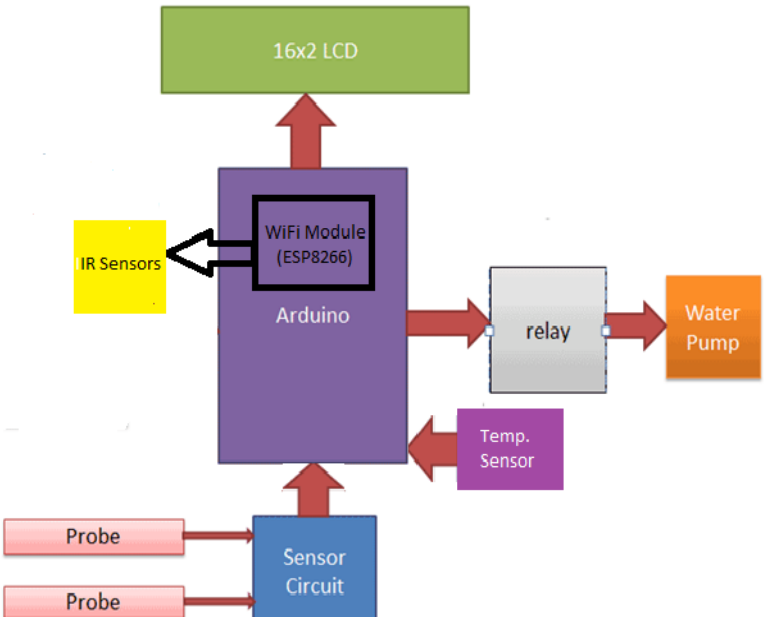


Fig 3.1 Block diagram

The components like IR sensors are connected to Wi-Fi module (ESP8266) as shown in Fig. 3.1 by black indication. The IR sensor will detect if any animal is trying to enter into the field then the Wi-Fi module will turn on the buzzer as well as it will provide the alert message to the farmer by using internet because it a Wi-Fi module. The farmer will also have a Wi-Fi module to receive the status of field weather it is ok or not.

3.2 Working of computer vision

The setup for the computer vision includes an Arduino UNO and a Wi-Fi Module. Arduino IDE is an open source embedded c library of functions mainly aimed at real time computer vision. Arduino IDE is installed on to the system. The speed of processing is totally dependent on the RAM of the system.

Prior to using the computer vision setup, it has to be first fed with training data. The Wi-Fi Module can be programmed to alert the user when it recognizes people (in case of surveillance) or any other objects as shown in Fig. 3.2.

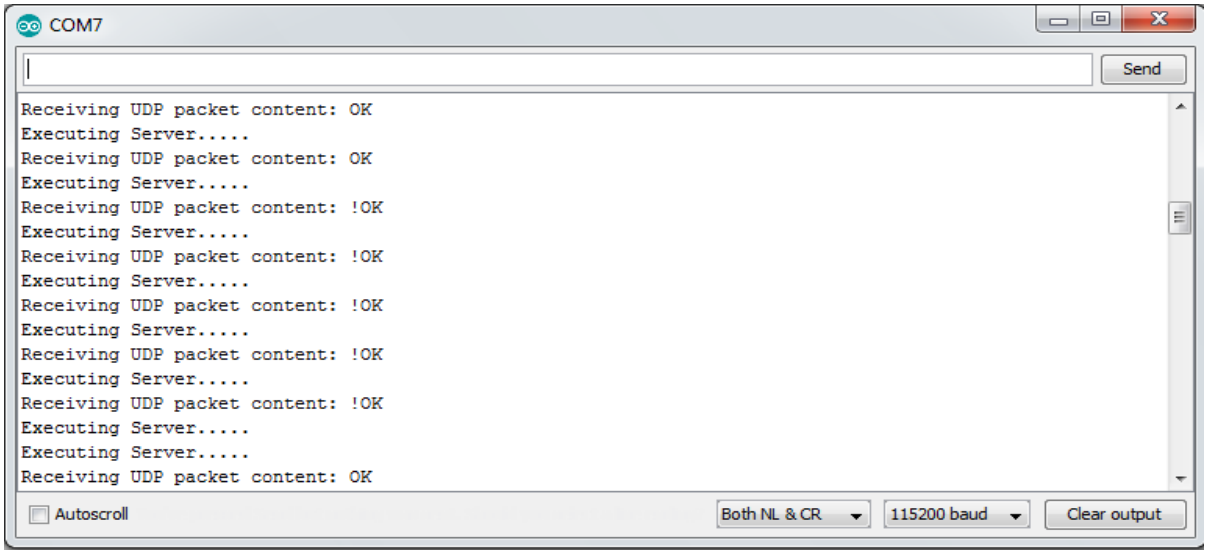
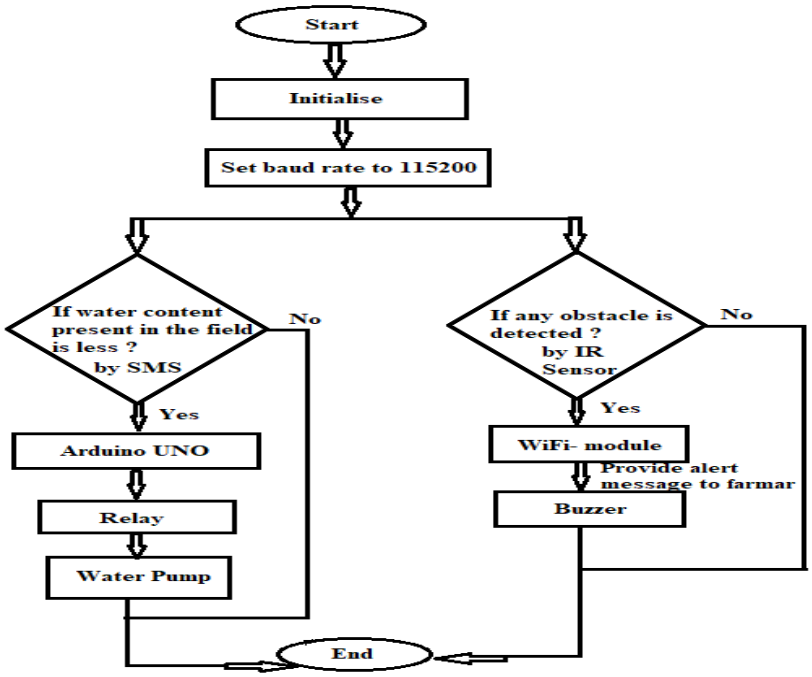


Fig 3.2 Working Process where field is providing OK or !OK based on recognition

3.3 FLOWCHART OF THE SYSTEM



The Arduino UNO is a credit-card-sized controller that plugs into your TV and a keyboard. It is a capable little controller which can be used in electronics projects and for many of the things that uses a microcontroller.

Arduino IDE is known as Arduino integrated development environment. It is a library of programming functions mainly aimed at real-time computer vision. The library is open source and free for use.

The Wi-Fi Module is a chip-sized module which can be used in many electronic devices like Mobiles, PCs, etc. This module is generally used to connect the system to the internet and to transmit or receive any data from one or many devices through internet.

4. HARDWARE AND SOFTWARE REQUIREMENTS

Table: 4.1 Hardware and Software requirements

HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
1. Arduino UNO. 2. Wi-Fi module (ESP8266). 3. IR Sensors. 4. Soil Moisture Sensor. 5. Temperature Sensor (LM35). 6. Relay (5V). 7. LCD (16*2). 8. Submersible Water Pump.	1. Arduino IDE

5. CONCLUSION

As mentioned above, one of the main applications is to reduce scarcity and wastage of crops operations [1].The wastage of the water and yield in the field gets reduced.

Another application is in agriculture sector, where the system can protect the yield from the excess rain [2].

This system was found to be feasible and cost effective for optimizing water resources for agricultural production. The system can be adjusted to a variety of specific crop needs and requires minimum maintenance.

With proper algorithms and a few modifications to the hardware, this SMPSInSYS system can be made completely autonomous. Thus it will be used in a more wide range of applications.

The major drawback is that the system will take a person as a unwanted object in case of security (protecting the field from unwanted object). This can be eliminated by upgrading it to an autonomous system.

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