GE 101
Automation of Irrigation
(By Team IRRIGROW)

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***Abstract* – Over the past few decades, a significant shift has been observed from traditional irrigation to smart irrigation. In a smart irrigation system, the sensors provide real-time data to the actuators, which function on the basis of pre-defined instructions provided by the farmer. This project focuses on the designing and implementation of one such technique, which would ease the workload of the farmer and also increase efficiency by many folds.**

***Keywords* – irrigation, automation, drip irrigation, sensors**

I. INTRODUCTION

With the advancement of technology and breathtaking developments in software as well as hardware systems, the economic sectors are being automized. The growth of the agricultural sector plays a crucial role in determining the economy of developing countries. In the present scenario, a large number of people are moving away from agriculture, owing to less annual income. Reduction in manpower is one of the serious consequences, which is posing a threat to proper care and maintenance of the crops. Automation is the need of the hour, in order to save our declining agriculture sector. One of the integral subparts of agriculture that demands a high level of automation is irrigation. This will facilitate the provision of an adequate amount of water to the crops efficiently in a reduced time span and with less labor.

II. LITERATURE REVIEW

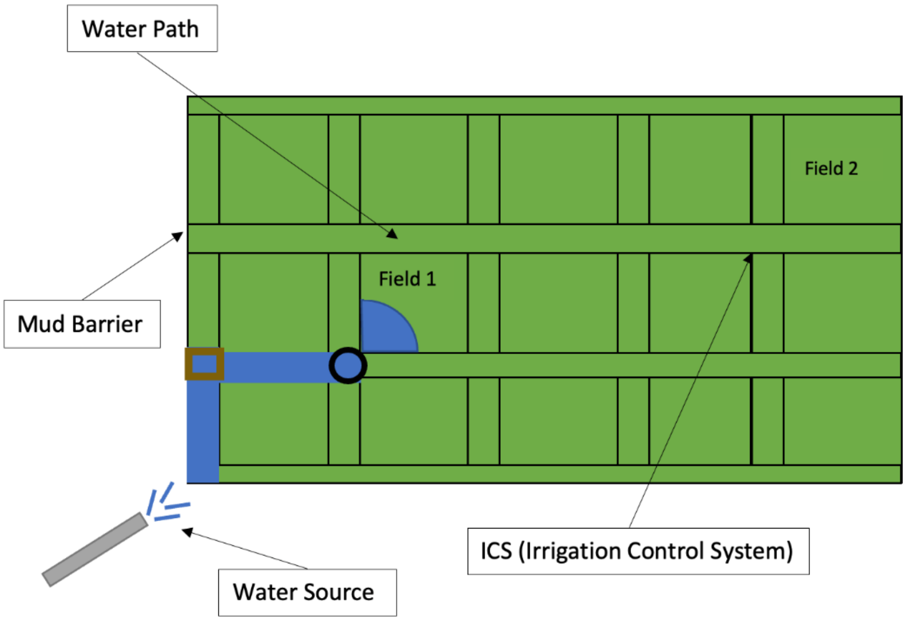
This section of the report provides an insight into the historical research works and existing approaches to mechanized irrigation.

Formulation and execution of automated irrigation systems began with the drip and sprinkler irrigation systems. Drip (or trickle) irrigation system involves laying down pipes, which provide water to the roots of crops drop by drop in a controlled manner, thus reducing stress on plants and conserving water.[1] In the sprinkler system of irrigation, small devices called sprinklers are installed at periodic distances, which sprinkle water in a circular region of a certain radius, that varies from sprinkler to sprinkler. This irrigation model is understood as a simulation of rain.[2] An advanced version of the sprinkler system, called the CADMAN mini traveler, was designed, which consists of sprinklers mounted on moving platforms.[3] With the introduction of the concept of the internet of things (IoT), a farmer can get real-time data on soil moisture, temperature, livestock health, etc. which are measured by certain devices and sensors installed across the farm.[4] This is followed by the usage of Wi-Fi modules to upload the collected data on the internet. A further extension involves voice controlling, using Alexa, Google Assistant, Siri, etc. [5] The GPS (Global Positioning System) signal processing technology has also played a crucial role in solving the problem of high precision positioning and navigation for installing the devices. It also helps in keeping a track of faulty devices, so that they can be repaired timely.[6]

Despite the availability of so many mechanized irrigation models, constant efforts are being made to improvise the existing systems as well as devise new cost-effective methods, in order to increase efficiency.

III. OBJECTIVE

One of the problems related to irrigation has been illustrated using the following diagram.



Majority of the farmers have divided their land into sections, as depicted in the schematic view, so that they can serve different purposes. There exists a network of "Kachi" channels between boundaries of sections to supply water. For instance, a water source is installed at one corner of the field, and a farmer intends to irrigate two sections out of the entire field; say Field 1 and Field 2. This can be achieved by setting up mud barriers at certain junctions so that the water flows directly to the desired field (Field 1). The water supply will, then, be turned on and the farmer will have to wait till the water rises up to the appropriate level. The same process is repeated, in order to irrigate field 2. This entire procedure is extremely tedious and time-consuming.

The above example dealt with irrigation of merely two sections. However, in practice, a large number of sections have to be irrigated by the farmers. The process is indeed inefficient. Moreover, it calls for the physical presence of the farmer. In rural areas, the water supply is intermittent. Thus, the farmer has to be alert at all times, so as to water his field and save his share of crops. As the manpower is reduced over time, the responsibility for irrigation of fields lies in the hands of the farmer himself.

Our project aims at resolving the issue by automatizing the majority of the portion of this task. An automated system of 'direction and flow controlling' tubes/pipes can be created that can be placed at the junction of the canals. All of them will be synchronized with each other. The farmer just has to select the field he wants to irrigate and the level up to which he wants to fill the water. The rest can be left up to the machine. It will create the passage to the desired section of the field by turning the direction of flow through each junction using the motor present in the design. It will water the field to the desired level by carefully measuring using a sensor and changing the path to another section, as soon as the level is attained. In this way, the whole process will be automated and can be controlled even from a distance. Using the same circuit, a different structure of pipe can be made, which is suitable for junction, and the farmer can easily step up and utilize time.

The whole process will be displayed on a screen and the farmer can monitor it, without being physically present at the desired location. Also, an app can be developed in the future, which will aid in the control and monitoring of the flow direction.

Automating the entire irrigation system will play a crucial role in reducing time and labor. Certain other problems can also be solved using the same design, such as the detection of channel breaks and efficient supply of fertilizers to the roots of the crops.

IV. IMPLEMENTATION

Here, we discuss the methodology we have carried out in our project in order to design a prototype of the device.

A. Equipment

1) Development Board

The role of a development board is to detect and analyze the data, collected by the various sensors, and based on the data, it controls the commencement and cessation of irrigation. The development board system that we have used in our project is the Arduino Uno R3 ATmega328P, which is basically a microcontroller.

2) Ultrasonic Sensor

We have used the ultrasonic sensor HC-SR04, which is used as a proximity sensor as it can detect even minute alterations in position. In our project, it plays an extremely important role in the continuous measurement of water level. Based on this real-time data on water levels, the Arduino will instruct the pipe and valve to cease their function once the desired level is achieved.

3) Electrical Valve

The water flow through the pipe needs to be controlled. For this purpose, we have used the Hero SV 24V (copper) solenoid valve. It works on the principle of electric current passing through a solenoid. By monitoring the opening and closing of the valve, the flow of water to the field can be allowed or stopped, respectively.

4) Servo Motor -

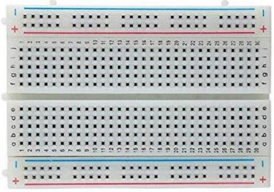
The rotation of pipe is facilitated by the use of a servo motor actuator, which provides high torque, essential for irrigating four quadrants of four different fields. We have used the TowerPro MG995 servo motor.

5) Relay

Relay functions as an 'automatic switch' which senses electrical stimuli and converts them into larger current by electromagnetism. In our project, we have used the INVENTO ISC 1502-4 12V 5A DC PCB Mount relay.

6) Breadboard

It serves as a base for developing electronic circuits by making quick electrical connections. It is often used alongside a development board such as Arduino. We have used the CPUF Breadboard 400 tie points.



7) Irrigation Pipes

The pipe that we have used for designing the prototype is the inlet drainage pipe. However, when the project is carried out on an industrial scale, pipes can be chosen on the basis of strength and climatic conditions.

8) T-shaped Connector

For directing the flow of water in a given direction, we have used PVC T-joint.

9) Power Supply

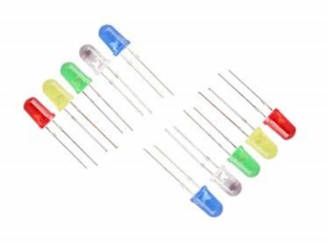
For supplying power to the entire system, the HYW 9V High power Zinc Chloride battery has been used.

10) Ply Board

We modelled the prototype of the device on a ply board, for a better practical demonstration.

11) LED

LEDs (Light Emitting Diodes) are small powerful lights which are majorly used for providing certain kind of visual signal. We have used 3V 5mm diffused LED.



12) Artificial Grass

The ply has been covered with artificial grass, in order to depict the field.

B. Programming of the equipment

ge101_main

```
#include<Servo.h>

//Name used for servo
Servo myser;

//Variable for pin
int serpin=5;
int pingPin=6;
int echoPin=5;
int relay=9;

//Varialbe for servo position,delay time, distance
int pos=0;
int dtime=0;
double dist=0;
int tim=1000;

//state repsent in which field servo is pointing
int state=0;
long water=0;
long level=2;


void setup(){
  Serial.begin(9600);
  myser.attach(serpin);

}

long distance(){
   long duration, cm;
   pinMode(pingPin, OUTPUT);
   digitalWrite(pingPin, LOW);
   delayMicroseconds(2);
   digitalWrite(pingPin, HIGH);
```

ge101_main

```
  digitalWrite(pingPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(pingPin, LOW);
  pinMode(echoPin, INPUT);
  duration = pulseIn(echoPin, HIGH);
  cm = duration/75/2;
  Serial.print(cm);
  Serial.print("cm");
  Serial.println();
  delay(100);
  return cm;
  }

int rotate(int state){
  if(state==0){
    myser.write(90);
    return 1;}
  if(state==1){
    myser.write(0);
    return 0;
  }
  }

void loop(){
  digitalWrite(relay,HIGH);
  myser.write(0);
  Serial.println(water);
  water=distance();
  if(water>=level){
    state=rotate(state);
    delay(tim);
    digitalWrite(relay,LOW);
  }


}
```

C. Future Insights

1.) Temperature Control

The irrigation system can be automated in a way such that water is supplied depending on the temperature and moisture control of the environment in which a particular crop is grown. These controls will vary from crop to crop and hence, before installation, the devices have to be programmed separately for every crop.

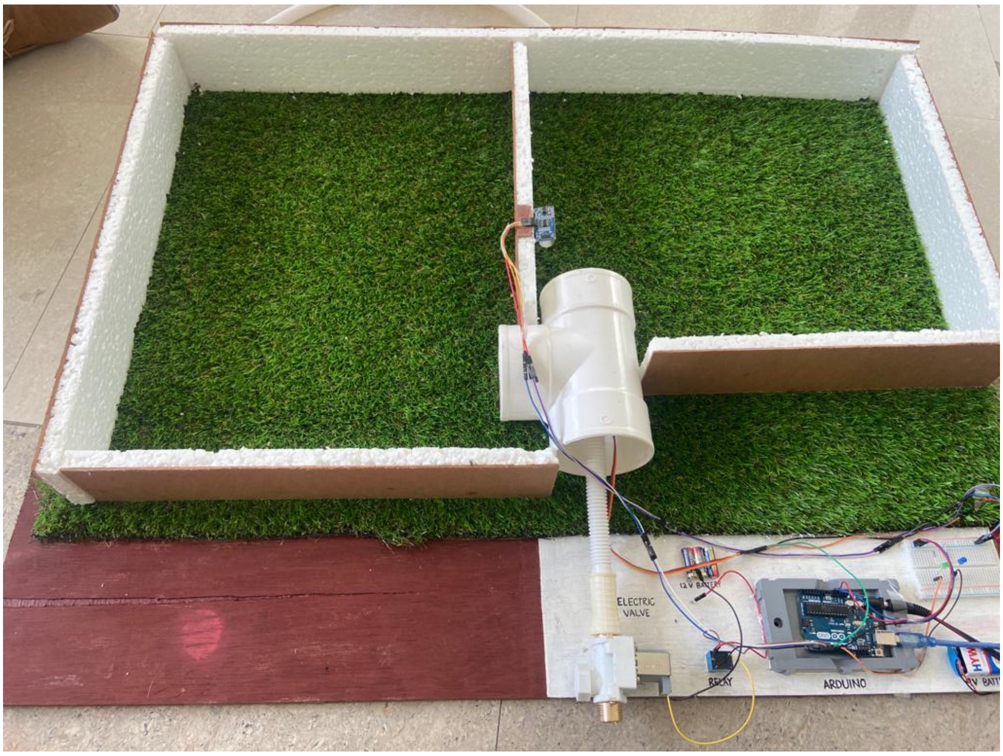
2.) Nutrient Supply

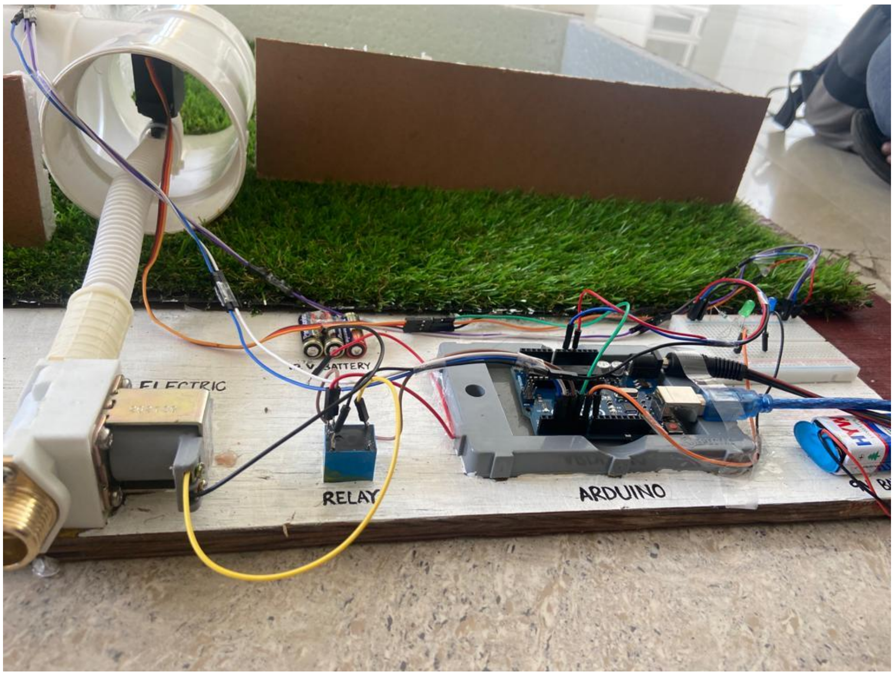
Water-soluble nutrients can also be provided to the roots of the crops, alongside irrigation. Thus, a single device can serve for dual purpose.

3.) Agro-App Development

A further extension of this project can be the development of an Agro-app, which will help the farmer in monitoring the growth conditions of the crops, such as temperature control, moisture content, air quality index, etc. Thus, the farmer can set various parameters, based on which the device will function.

PROTOTYPE





ACKNOWLEDGEMENT

Our team would like to express our heartfelt gratitude to our course instructor, Dr. Sudipta Sinha, and our mentors, Mr. Atul Kumar and Mr. Naresh Kumar, for guiding us throughout the entire project and supporting us constantly. We are thankful to the computer department of the Indian Institute of Technology, Ropar, for providing us with the funds and the facilities of the Technology Museum lab. We extend our gratitude to the Robotics club of the institute for educating us about basic robotics.

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