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An IOT Application Towards Smart Agriculture

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Abstract: One of the main Sustainable Development Goals of the UN is to end hunger in the entire globe by 2030. To make this a reality, agricultural lands must become more productive. Low yields from several rural Indian agricultural fields result in low production. These agricultural fields face numerous problems, such as a lack of water supply, uneven manure application over the field, timely pesticide application, etc. One of the difficulties farmers have been facing is to provide enough water to their fields in a timely manner. To address this issue, farmers must physically inspect their field plots to determine the moisture content and water needs specific to each crop. In this paper, we explore this subject in order to address a massive issue by introducing microcontroller based semi-automated system. The results of the testing of the complete system are quite positive.
Keywords: Smart agriculture, automated pump, Zero Hunger, sustainable development goal, IOT application.

I. INTRODUCTION

The Sustainable Development Goals (SDGs), also known as the Global Goals, were established by the United Nations in 2015 as an international call to action to end poverty, protect the environment, and ensure that everyone will live in peace and prosperity by the year 2030. The 17 SDGs recognise that sustainable development requires a balance between social, economic, and environmental goals and that decisions made in one area will have an influence in others.

Fig1: The Sustainable Development Goals (SDGs)

One of these 17 SDGs, Zero Hunger, is the most crucial global goal for the modern world, and its implementation requires a concentration on agriculture. Today's agriculture faces numerous challenges, including shrinking agricultural land, a manpower shortage, and the threat of climate change, uneven distribution of manure throughout the field, timely application of pesticide, and we must address these issues and increase productivity. Adequate water supply is one of the main contributors of agricultural output, yet in many situations, it depends on rain and submersible pumps. When using a submersible pump to feed water to an agricultural field, multiple users share a single pump, and the farmer who is actually actively engaged in agriculture is responsible for its operation.

Fig2: Actual agriculture field where multiple users shear a single pump

They control the pump to keep the water level in the field at the proper level based on their previous experience, but this type of work has many difficulties, such as the fact that farmers do not always farm at the same time, that they require water at different times, that the water level may vary depending on the type of crop, that the timing of harvest may vary, etc. In this paper, we present a solution which aids farmers by creating a semi-automated pump that addresses all the challenges. For a pump to be intelligent, a lot of effort has already been done. However, each design has its own benefits and drawbacks. One of them, E. Said Mohamed et al., discussed the application of various machine learning approaches to boost production in their paper [1], which may have been useful in the field of agriculture. Another strategy employed by M.S. Mohd Raf et al. [2] was using MIT Apps Inventor to construct the Android application for this project. Additionally, this system allows users to remotely turn on and off water pumping systems using an Android smartphone interface, but the timing of the pump's on and off states is not specified in this study. A smart agriculture system is proposed by C.M. Mohan Raj1 et al. in their paper[3] where there are many agricultural applications that lend themselves to photovoltaic (PV) solutions. When utility companies determine that a PV solution is the best option for a remote agricultural necessity like water pumping for crops or livestock, they install systems in these applications, which are a combination of individual installations and utility company systems. Here, they solely addressed how a solar-powered water pump operates and how it differs from other energy sources. In their study, S P Vimal 1 et al. offer an intelligent automated irrigation system[4] where, they demonstrate a good attempt at automatic irrigation by administering the correct amount of water at the correct time, reducing water waste, and minimizing human labor to turn OFF/ON the valves. The simulation and prototype model for autonomous irrigation systems are presented in this research. A Shiv Shankar Singh approaches a smart irrigation system. in this article [5] For controlling the operation of the water pump, the system has two control modes: manual control and automatic control. The BOLT module transmits data to the cloud, and an automatic graphical display of sensed data is provided to the user. Here, a variety of sensors have been employed. Neha Kailash Nawandar and colleagues offer a smart agriculture system in their paper [6] because to its effective data management and decision-making abilities. This method works well in greenhouses and backyard gardening. But we also want to introduce these facilities for huge areas, not just for dwellings or greenhouses. Hence, this paper did not resolve our issue. Nikesh Gondchawar1 et al. in their study propose an Internet of Things (IoT) based Smart Agriculture[7] where these operations will be carried out by combining sensors, internet or ZigBee modules, cameras, and actuators with micro-controller and raspberry pi. All of these operations will be controlled by any remote smart device or computer connected to the Internet.. Undoubtedly, the implementation of such a technology in the field can help to boost crop productivity and production overall. The cloud system extracts the necessary information from the weather bureau and contrasts it with the data set collected on-site. in another study by Krishna Singh1 et al., they Propose Intelligent Irrigation System Suitable to Multiple Crop Cultivation [8]. The quantity of water to be released based on each crop variety in the field is then determined through analysis utilizing data science techniques. Just the production of various crops was discussed here. They discussed AUTOMATIC IRRIGATION SYSTEM FOR AGRICULTURE FIELD[9] by Prof. Rashmi Jain et al. This project's primary goal is to wirelessly monitor the paddy crop field. Here, we use temperature, humidity, and flow sensors to measure the temperature, moisture, and water level in the well.

The ADC transforms the analogue value from the sensors into digital format. The output from the ADC is provided to the AT-mega controller. They just concentrate on raising production. But we wish to keep the field's water level constant. Y Kim et all they discuss examine Remote Sensing and Control of an Irrigation System[10] Y. Kim developed a remote sensing and control irrigation system using a distributed wireless sensor network with the goals of variable rate irrigation, real-time in-field sensing, and controlling a site specific precision linear move irrigation system to maximize productivity while using the least amount of water possible. The system included information on the design and instrumentation of variable rate irrigation, wireless sensor networks, and real-time field sensing and control using the required software. The entire system was created utilizing five in-field sensor stations that gather data and transfer it to the base station using GPS. There, the appropriate steps were performed to manage irrigation according to the database provided with the system. The system provides a promising low-cost wireless solution as well as remote controlling for precision irrigation. A proposal for automated farming was made by Abdullah Tanveer et al. [11]; in this article, they covered all of the automated control aspects with cutting-edge electronic technology using microcontrollers and GSM phone lines. Because the project is automated, less labor is required. This is a complex setup that can respond to the majority of climatic variations that take place inside the greenhouse. It operates on a feedback system that enables effective response to external stimuli. Although this setup eliminates issues brought on by human mistake, it is expensive and not entirely automated. A Smart Agriculture System is discussed by Muthunoori Naresh et al. [12], where the paper suggests a concept of integrating the most recent innovation into the agricultural field to convert the traditional water system management techniques to contemporary strategies in order to create simple profitable and temperate trimming. Rajkumar et al. Intelligent Irrigation System [13] uses a GSM mobile network to control an irrigation control system for water and electricity efficiency. This project's primary objective is to develop agriculture, where new technology may lead to increased agricultural growth and water supply. The pumping motor is turned ON and OFF by microcontroller-based automated controls using the most recent electrical technology when they detect the amount of moisture in the earth. In their research, J. Karpagam et al. provide an IoT-based Smart Irrigation System [14], where the primary goal of this project is to create a Microcontroller system to autonomously water plants and communicate this information to farmers. All of the work that has been done so far has pros and cons, but none of them deal with the issue that we have created. In our study, In our research, we suggested a structure that would minimize any real-time issues that might arise during the transition to agriculture. Figure 3 illustrates our system’s architecture.

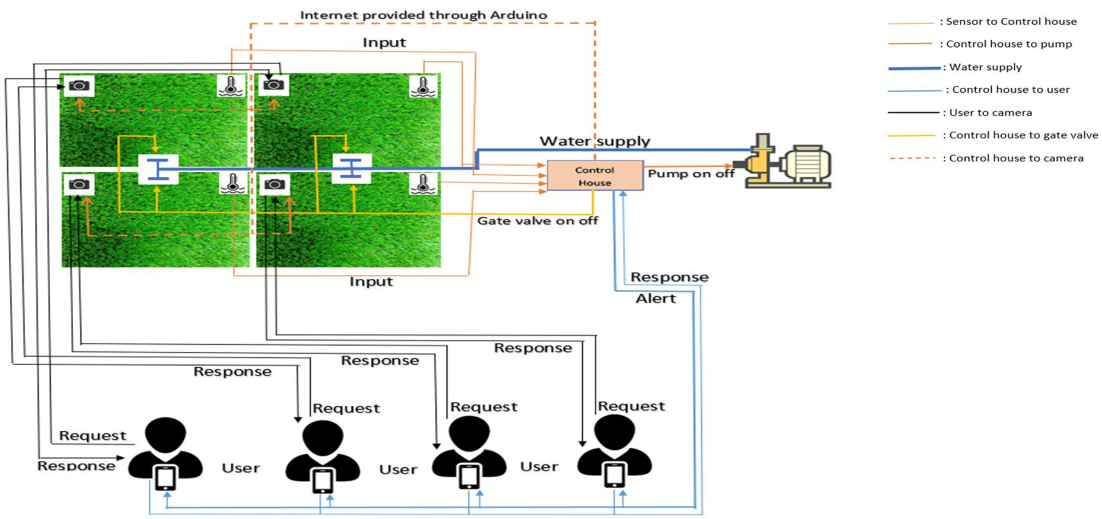

Fig3: System architecture

Our whole system is seen in Figure 3. The water level sensors, cameras, and gate valves for each field will be set first. With an Arduino board, a sensor transmits data it has collected in the field. The gate valve and pump are then turned ON and OFF by Arduino, as per the sensor input. The Arduino board immediately sends a message of warning to the user over the internet as soon as the pump turns on. Users can make a request to the field camera to take a picture or video after viewing their notifications if they'd like. When users review the response, if the field doesn't need to be watered, they send a message to Arduino instructing it to close the gate valve. We provide another option to the user through which they can access the camera anytime to take their own decision which include operation of the pump and gate valve.

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II. METHODOLOGY

We need some equipment in order to carry out our project. Such as Sensors, Relays, capacitors, battery connectors, and wire connectors and Arduino which is a microcontroller-based electronic prototype board that is open-source and easily programmable with the Arduino IDE. Other parts include the gate valve, camera, and TX RX LEDs. The following two diagrams explain the interconnection between components and flowchart of the system.

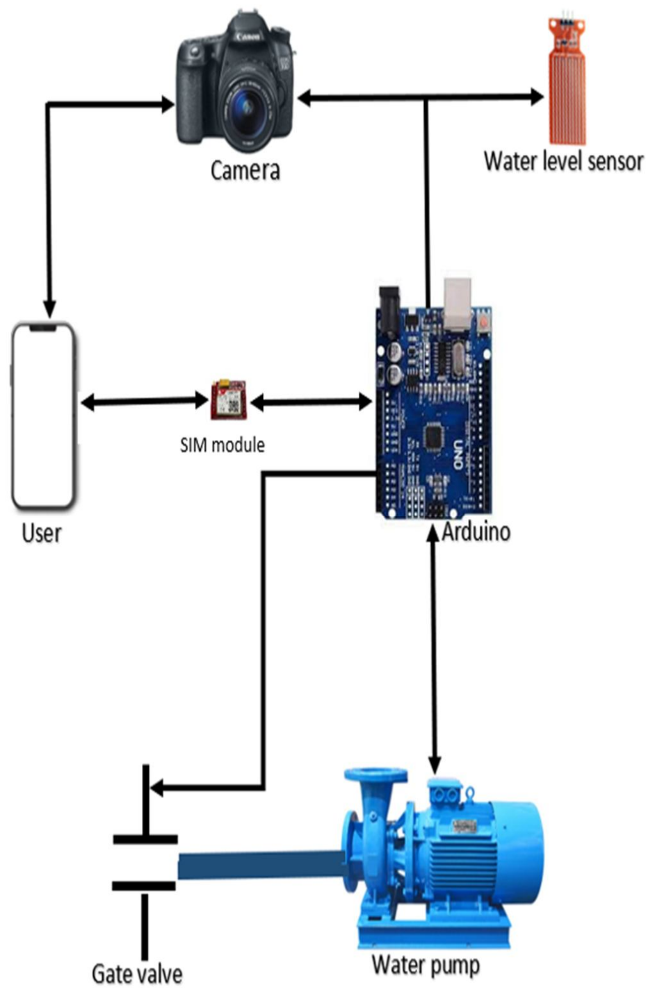

Fig4: Block level interconnection between devices

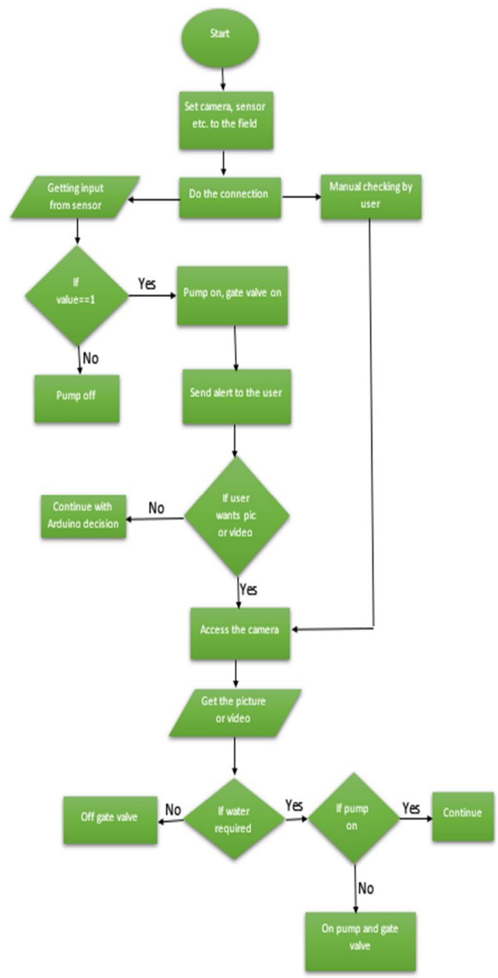

Fig5: Flowchart of the system

To implement the system, we divide the total process to few subprocess such as

1) Arduino and sensor interconnection
2) Arduino to pump interconnection through switch which is controlled by Arduino, based on the sensor input
3) Arduino to Get Valve interconnection.
4) Arduino to user internet connection through SIM800 module
5) Camera with user interface where user can directly access the camera which is a low-quality camera as we will use a picture resizing algorithm.

The above steps are explained below-

a) *Arduino And Sensor Interconnection* –We are used Water Level Sensor for our project because in agricultural field we need to analyze the water level and based on the water's surface level,total operation will be performed. The water level sensor just needs to be connected with Arduino board. Here we connect the +VCC, GND and S pin of water level sensor with the PIN 7, GND, A0 of Arduino board respectively. Based on the sensor value Arduino board get appropriate signal so that proper controlling program can be triggered which are programmed through Arduino IDE.

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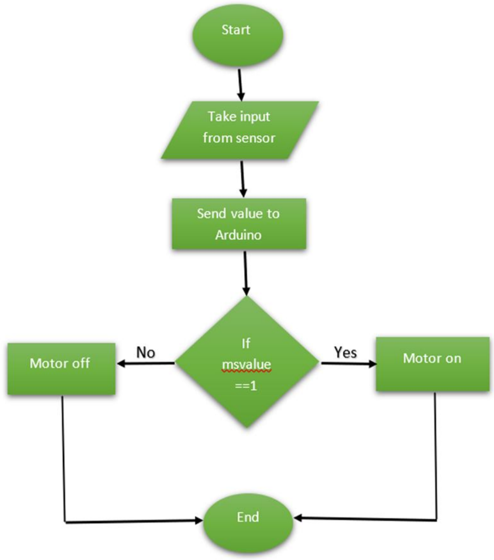


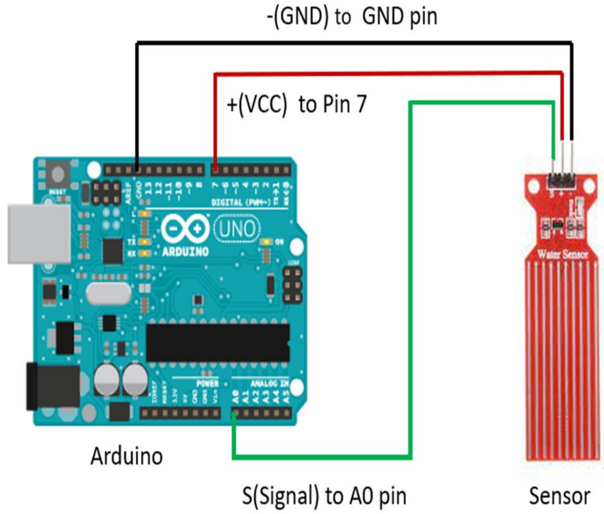
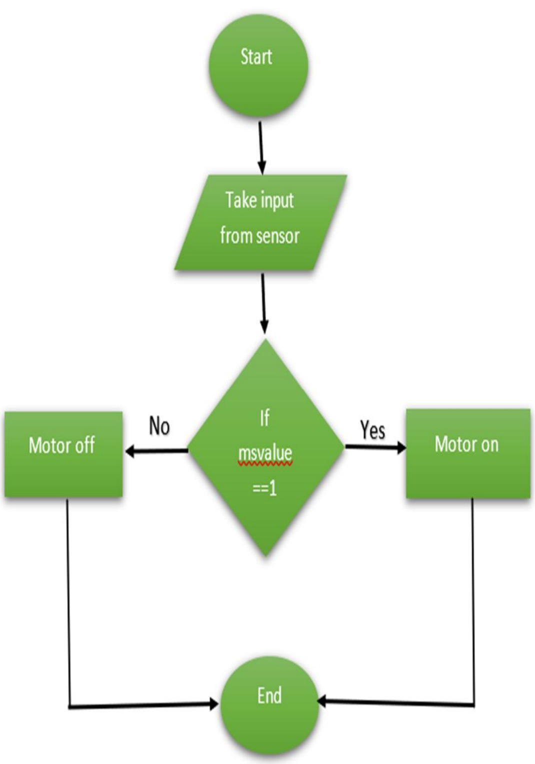


Fig6: Flowchart of interconnection between Arduino and sensor Fig7: Pin level interconnection between sensor and Arduino

b) *Arduino To Pump Interconnection*-This pump is used to automatically supply the correct amount of water to each part of the field. They are also reasonably priced. In our project, an Arduino is connected to a water pump. Based on sensor input, Arduino primarily regulates the water flow rate and instructs the pump to start. The pump primarily has two wires: one for connection and one for ground. These two wires are linked to the Arduino's 5V and GND pins.
The flowchart in the accompanying diagrams, which shows how the Arduino is connected to the pump and how it operates, illustrates the operational process.



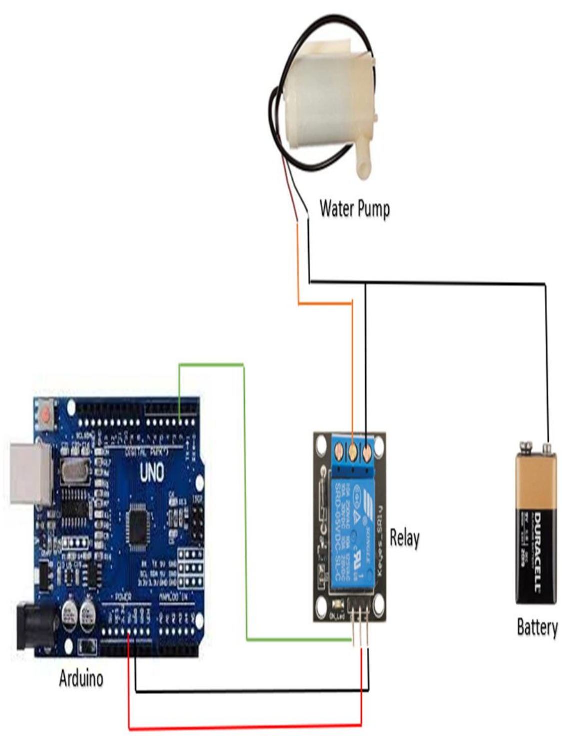


Fig8: flowchart of Arduino and pump connection Fig9: Block diagram of Arduino and pump connection

Arduino to Get Valve Interconnection-Manual control is utilized to operate the valves in our homes. Nevertheless, in this project, get valves can operate autonomously, which is what distinguishes it. In accordance with our project, an Arduino relay module controls the Get valves. The Get valve can also be controlled by the user via an internet connection as required. In the illustrations that follow, the Arduino and get valve are linked, and the flowchart displays the code that really controls the get valve.

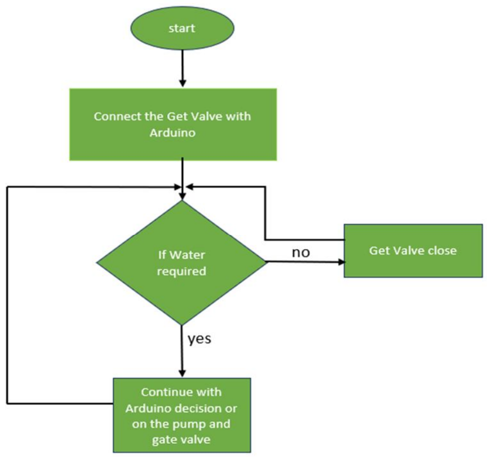


Fig10: Flowchart of gate valve and Arduino board connection

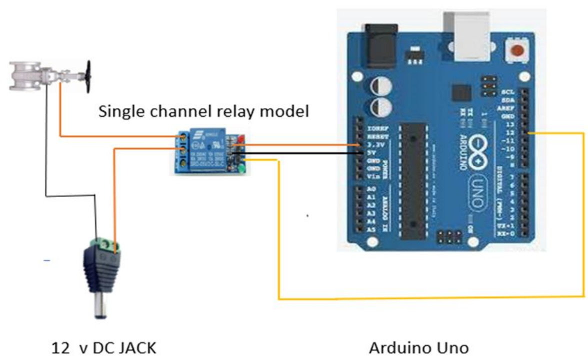


Fig11: Block diagram of gate valve and Arduino connection

c) *Internet Connectivity through SIM800 Cellular Module-* Internet access via the SIM800 Cellular Module is necessary because we are running cameras and providing real-time updates to users online. The SIM800 is a cellular communication device that can connect to the internet, send email and SMS texts, and make phone calls. The module is designed to work similarly to a mobile phone, however in order to do so, it requires external peripherals. The connections are relatively straightforward for a fundamental serial communication configuration involving an Arduino and a SIM800. Three wires are all that are required to connect the Arduino and SIM800. It also provides the send and receive lines for the UART.The following diagram represent the interconnection between the Arduino board and the SIM800 module.

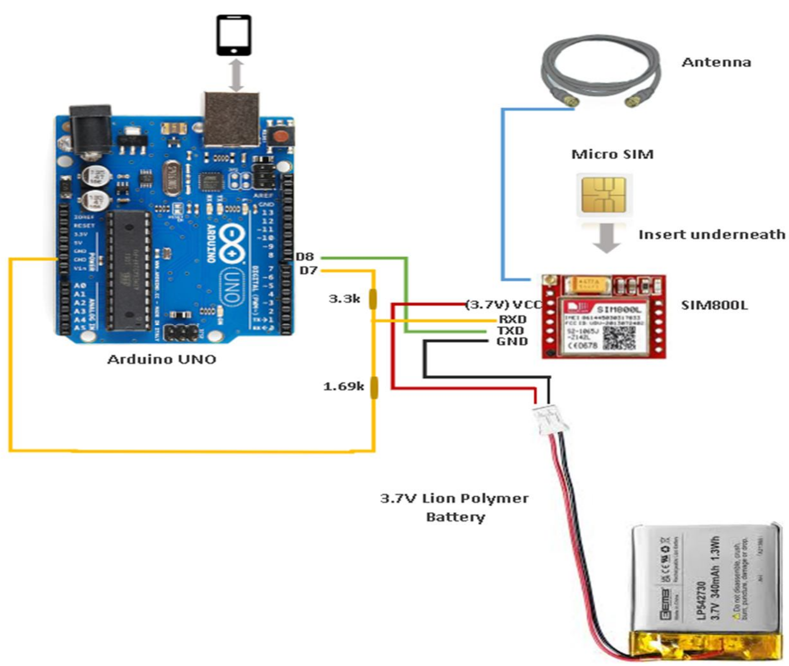


Fig12: Block diagram of interconnection between Arduino and internet module

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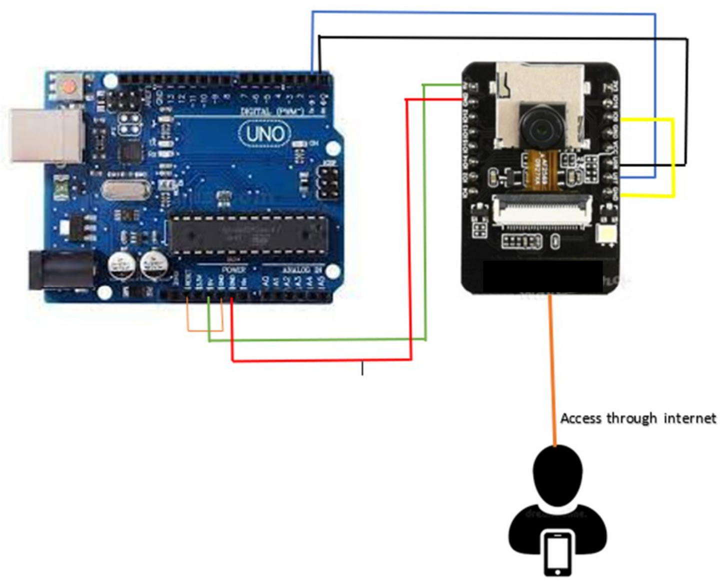
d) *Arduino-User-Camera connection*- The user can access the camera at any moment to obtain a real – time field image thanks to the camera's connection to the Arduino board. Here, we apply the SUPER RESOLUTION GAN deep learning model to upskill a low resolution image to a high quality image(SRGAN). We primarily employ an internally developed efficient sub pixel convolution neural network (ESPCN) so that the user can view a clear video and EDSR for image of its agricultural area and decide whether to follow the Arduino's judgement or not. A program created in Arduino controls the camera.



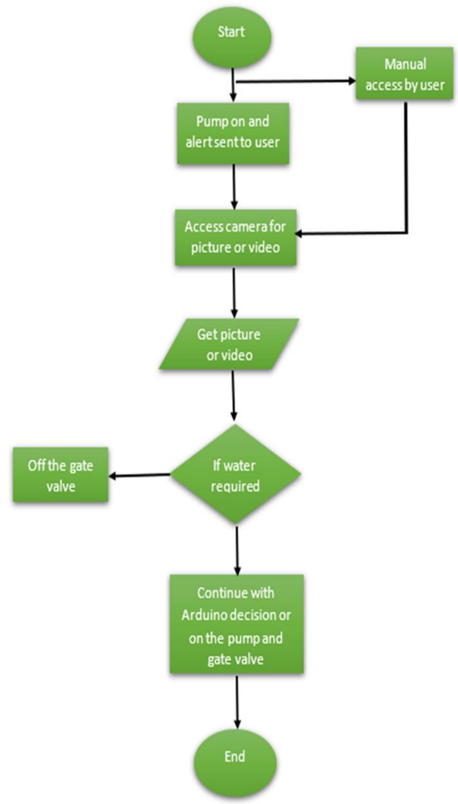


Fig13: Interconnection between camera and user through Arduino   Fig14: Flowchart of user-camera interconnection

III. RESULT AND CONCLUSION

We receive the right outcome as anticipated after connecting all the devices, including the Arduino-sensor, Arduino-get valve, Arduino-pump, Arduino-camera, and Arduino-user, through the internet. Here, we employ a user-end simple interface software that is created to allow the user to manage all activity. The following Figure displays the user-layout end's page and Using a deep learning model, the user end of this particular program can also upscale the actual image of the ground, and the output of this specific program is displayed.

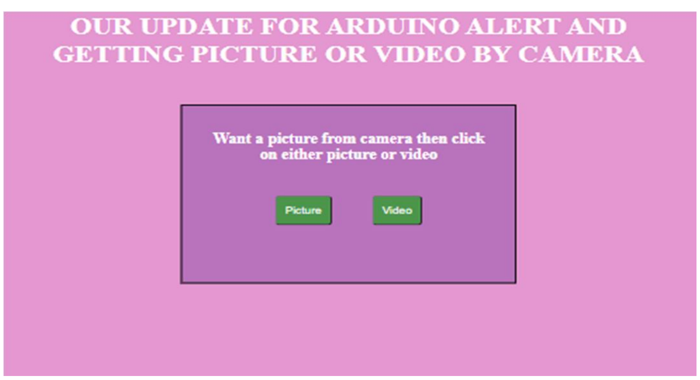


Fig15A: Primary user interface

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Fig15B: User interface with an alert message

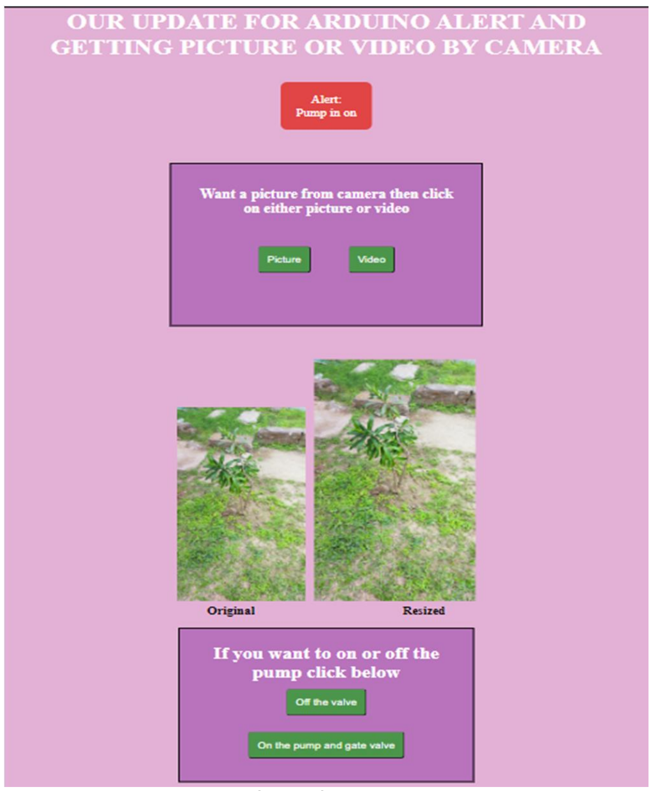

Fig15C: User interface after resizing the original picture

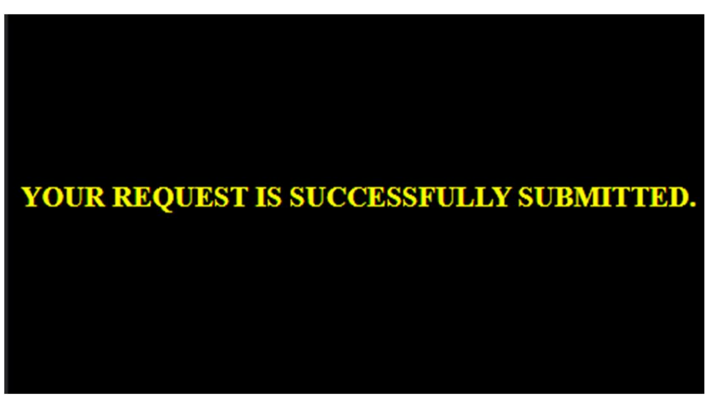

Fig15D: Feedback according to user decision

This particular thing may give us another option to watch the field when we wish to see it. And based on our observations, we can make a number of choices that could significantly boost the field's production. Because it can function automatically with user intervention if necessary, this pump is referred to be semi-automated. There are numerous opportunities to automate this process, but more work is still required, such as identifying the various crops and the water levels that each one needs, identifying weather predictions, etc. These issues need to be resolved in order to design a completely automatic pump which will be addressed in future.

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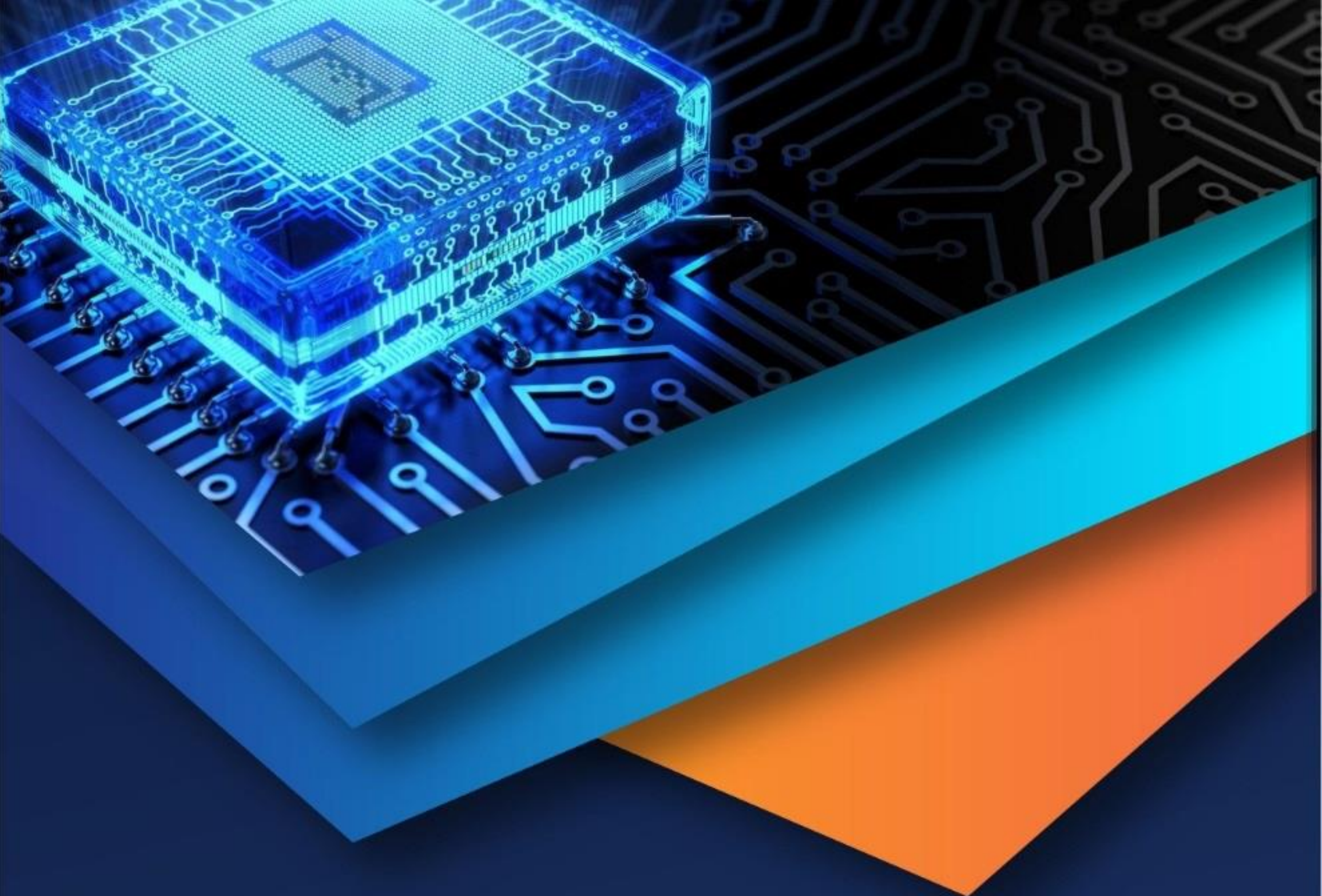

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