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Improvement in Irrigation Technology Using Smart Sprinkler Changer Bot

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***Abstract* - Agriculture is one of the most important sectors for India and Indian economy. It contributes about 17% to the total GDP of our country and provides employment to over 60% of the population as one of the primary occupations in the country. Indian agriculture has registered an impressive growth over last few decades. For a major sector in Indian agriculture, farmers depend upon artificial watering system other than rainwater and natural water sources. Irrigation has proven to be more efficient watering system for farmers over the years. Irrigation helps to increase productivity even in low rainfall. The productivity of irrigated land is higher compared to un-irrigated land. In areas that have irregular precipitation, irrigation improves crop growth and quality. But farmers face different problems while using the irrigation systems e.g., lack of mechanism. During the rabi season which is between October and February farmers face a major problem in irrigation specially at night time. In this season plants need extra water other than the rainwater or naturally provided one. Now a days farmers use latest technology for irrigating a land using sprinkler irrigations. Government also promotes the irrigation systems in farms by providing various subsidies on sprinklers sets which plays an important role in preferences by the farmers to the use of sprinkler irrigations. For the agriculture purposes, 75% of electricity supply is usually distributed during night time This supply is generally provided in shifts of about 8 hours only. In case of irrigation systems, 80% of farmer has more than two sets of sprinkler type of irrigation. One set of a sprinkler is capable of irrigating more than one acre land in a single night (one set includes 30 pipes and 8 sprinklers plus 5 as extras). So, the farmers who have two or more sets of sprinklers, they assemble a position of sprinklers in shifts during day time while the power supply is given at night time. The main issue begins after 1st shift ends and 2nd shift starts, as due to such arrangement of sprinkler, farmers have to change the valve manually in night time nearly at 3 am (due to the 8-hour shift of power supply). This is one of hardest tasks for the farmers as it is already as dangerous to enter the field at night time as it can get and the reptiles impose the living risks. Plus, during rabi season it is of no help that on an average, the temperature can drop as low as 14 degrees Celsius which is again adverse for the health of farmers. Another risky factor for farmers, who have to enter the farms at night for the irrigation purposes is attacks from wild animals. According to a report by Times of India, 7794 claims of crop damages were registered only in Maharashtra region till the last September. These attacks by wild life sometimes lead to the injuries to farmers and result in fatal situations specially if occurred at night time. Other than this, farmers are also exposed to the danger of electric shocks due to improper voltage supplied. As a solution to this issue and for the convenience of the farmers, our team has built a systembot which will automate the change in the shifts of sprinklers using valves[1]. The Bot helps the farmer to access the sprinklers and monitor the water flow through these pipes remotely. Our aim is to provide a system which will change the shifts of sprinklers automatically according to the time period of the shifts required and power supply at a low budget.**

Keywords: Irrigation Technology, Smart Sprinkler, Changer, Bot.

1. Introduction

Our system works in two phases. The first phase of the Bot has the purpose to detect the water level in the water source, usually a well, and command the motor in accord to it. In most cases, due to water levels being lower than the required by the motor, it leads to the damages to the motors. In general cases, 75% of farmers do not have enough water in their wells. The system present today are not capable of detecting the water level of the well which may lead to the running of water pump on dry mode, which results in failure of motor. To avoid this, farmers need to be present at farm to monitor and to turn off the water pump if required when the well gets empty. This phase includes, Atmega328p, sensors, auto circuit boards, the 3 phase motors and power supply etc. This phase of the Bot is beneficial for the farmers in detection of the water level and maintaining the health of the motor.

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In the second phase of the Bot, the system aims to shift the pipes used in sprinklers according to the user provided data. Using AtMega328p, the Bot monitors the time period for which the sprinklers in different shifts are active and changes their shifts once the specific time period decided for the water supply is over. This phase works on green energy i.e., Solar Power.

In this phase, the farmers will be able to monitor the Bot remotely via a GSM module. The valves are provided with the limiting switch to avoid the valves from crossing the extreme conditions and preventing the damages. For emergency cases, the battery back-up of 48 hours is provided in this phase for the bot. Due to the lack of electricity supply in some regions, farmers use diesel water pump. As of today, in India over 30 million agricultural pumps are installed, out of which nearly 8 million pumps are diesel-based. These pumps, when full can supply power for up to two shifts of sprinklers. These shifts for the sprinklers need to be changed manually. Our Bot provides an automatic solution to this manual shifting of the sprinklers and also the shift in sprinklers is done remotely through valves.

The Bot system is designed for convenience of the farmers across India. As there is no such system present till date or the systems which are slightly similar to this one are not as efficient, this is a totally new approach to the above-mentioned issue. The Bot is suitable for all the seasons and is easy in practical application. The system is designed specifically for the night work in the fields. The system is not only cost-efficient but also eco-friendly.

2. Working Principle

There are three main components in the project that is ATmegha328 555IC & DC synchronized motor here is the working principal. The ATmega328 is a microcontroller chip that depends on the AVR design. It has an 8-digit RISC (Diminished Guidance Set Registering) processor centre which permits it to execute directions at a high velocity. It has 32 KB of Blaze memory for putting away the program code 2 KB of SRAM for information capacity and 1 KB of EEPROM for non-unpredictable capacity. It likewise has 23 broadly useful I/O sticks that can be utilized for various capabilities.[6] The ATmega328 can be modified utilizing an assortment of programming dialects like C or Get together and it very well may be customized utilizing an In-Framework Software engineer (ISP) or a bootloader. The 555 clock IC is a well-known coordinated circuit that is utilized as a clock or oscillator. It has three methods of activity: astable monostable and bistable. In the astable mode the 555 IC works as an oscillator creating a square wave field. In the monostable mode the 555 IC creates a solitary heartbeat result of a decent length. In the bistable mode the 555 IC works as a flip-flop with two stable states. The 12V DC 100 RPM simultaneous engine is a kind of engine that works at a decent speed and is synchronized with the recurrence of the power source. It has a stator with a bunch of windings that are associated with a DC power supply. The pivoting attractive field delivered by the stator connects with the attractive field created by the rotor making it turn at a decent speed. The rotor of the coordinated engine is comprised of a bunch of long- lasting magnets that are charged in a decent example. Together these parts can be utilized in various applications. For instance, the ATmega328 can be customized to control the speed and heading of the simultaneous engine involving the result of the 555 clock IC as a clock signal. The 555 IC can be designed in astable mode to create a square wave field which can be utilized to drive the simultaneous engine at a decent speed. By changing the recurrence of the square wave yield the speed of the engine can be changed. The ATmega328 can likewise be modified to control the heading of the engine by turning around the extremity of the DC voltage applied to it[2].

3. Application of Model & Advantages

This bot for the farmers all across the India, while keeping our mind on the cost-efficiency of the project as well as its easy installation. The bot is applicable in monitoring the water levels in the water sources e.g., wells available in farms. This monitoring will further help in keeping track of time period for which the motor will be running. This will help in increasing the life of the motor as well as saving the electricity used in the fields. The bot is also applicable in the fields with lack of electricity supply as it runs on the solar power and is provided with a 48 hours of battery backup for case of emergencies. The bot is a first in itself as there has been no such system introduced before and is a completely new and innovative approach to the farmers problem of shifting the sprinklers. The Bot is used remotely as the GSM module in the design provides a wireless connectivity between user and the bot. And hence the users can be relaxed in aspects of their irrigation systems once the Bot is applied in their fields. The Bot is designed especially for night work and considering the climates of all seasons. The team has specifically focused on making the Bot as an easy to apply device.

The Bot has its own advantages. It works on solar energy which leads to zero emission of the pollutants helping the environment. Also, the Bot being completely waterproof works in the favour of users/farmers. The Bot is capable of automatically changing the sprinkler shift during absence of farmer on field especially during night time. This Bot is provided with a long life on the fields. Besides being durable, our proposed solution is also cost efficient and affordable for every farmer. The Bot can absorb the fluctuations in its input

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running on 440 V and if farmers already have any of such similar systems, the Bot is well capable of collaborations.

4. Important Design Aspects

The design aspects of the system are that the incorporates ATmega328p controller and auto circuit with other external peripherals such as power supply, sensors, relay, valve, motor etc. The printed circuit boards are to be designed to accommodate all of the components and connections required for the projects. Consider factors such as the size and layout of the board on which components are assemble to which user can identify. ATmega328p has versatile, range of features and capabilities that make it suitable and function ate the project objective. These are chosen because of the standalone applications with other development tools and programming environment.[8] Floating Sensors are used for application the level detection of water and the Polarized sensor that use polarized object to detect the presence or absence of an object. The selection of these sensors is integrated carefully considering the factors as compatibility with the microcontroller board and the required input/output interface. The design of a valve is tailored to meet the specific requirements of the system, including flow rate, pressure, temperature, fluid type, and other factors such reliable, efficient performance and long-lasting durability. The relay design aspects are considered the minimum current and voltage that the relay can switch by determines the connect rating.

The relay is designed for easy mounting and installation in specific application. The numbers of poles and throws are determined by contact configuration. The required speed and torque, energy efficiency, and environmental conditions are design aspects any of a synchronous motor. The motor we use for this system has the suitable aspects as mention above. The design of the user interface is intuitive and user-friendly, taking into account the target audience and the purpose of the project. User Interface aspects depending on the application, the user interface include buttons, switches, displays, or other components. Before the final product is released, it is important to test and validate the system to ensure that it meets all of the design requirements and specifications [7].

5. Area of Application

This project is fully applicable in agriculture for irrigation purpose. To develop and solve the issues face by farmers now a day related to old sprinkler system. After successfully installing this system in a farm are able to establish the joint business related to agriculture and crop due to excess of time. The installation of this bot will be proven to useful to farmers in the monitoring of water level in the water bodies present in the fields remotely.

6. Value Addition

The actual value of the project is very well known to society (farmers). Due to the present condition in which they can face major issues which completely solve by this project. Major value addition aspects are time- saving increase efficiency safety cost-effectiveness & customize.

1) Time-saving

Time plays a major role in our lives. Our system saves important time in the farmers life which they can utilize this time for other work. When a system plays a role in the night time the major issue of the farmer is solved by this which is seeping time from this they are they are physically and mentally stable in day-to-day life.

2) Increase efficiency

This system increases the efficiency of irrigation which plays a major role in boosting the GDP of our nation. Normally without our system farmer can irrigate only half an acre overnight but when our system is there the ratio of irrigation is nearly double which is the major difference and play an important role.

3) Safety

Our system is a totally DC power supply which prevents the electric shock & fully automatic which reduces the chances of wild animal attacks because farmers will not go to change the valve manually.[3]

4) Cost-effective

Major parts of the system are already installed at farms which make the system cost-effective and affordable to all types of farmers & landlords.

5) Customize

The major part of the project is the time of the system. In some crops limited water and, in some crops, excess water is needed to grow to satisfy this condition we make the option to manage the period. Farmer sets this time according to their requirements. This process is very easy to like increase volume by pot so anyone can set the time (delay) of the system.

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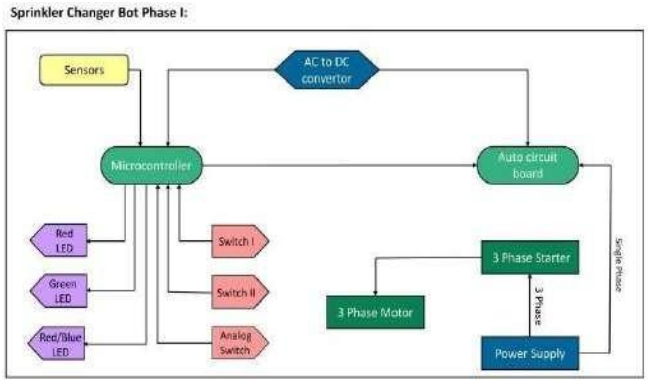
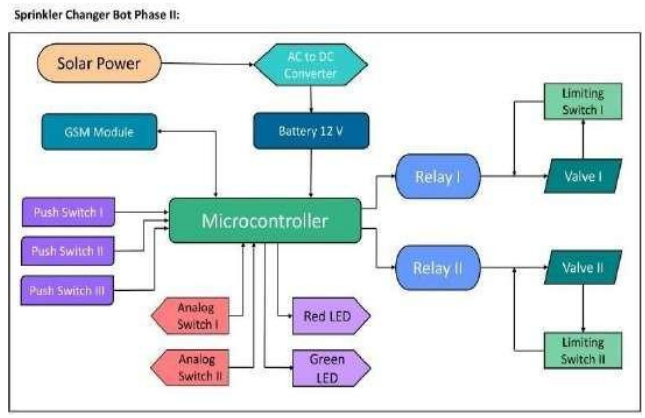
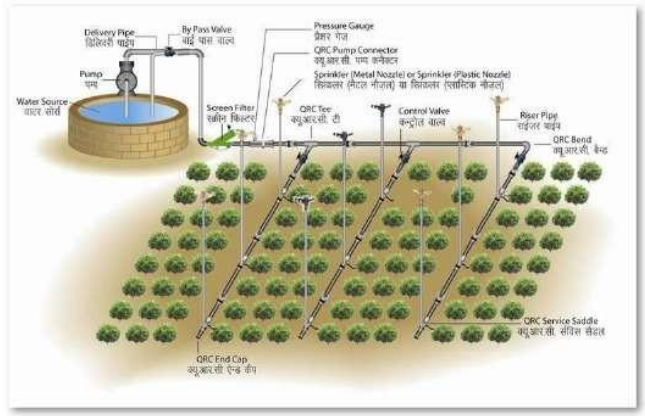
7. Block Diagram







Layout of Sprinkler Irrigation System (छिड़काव सिंचाई प्रणाली का रेखाचित्र)

8. Parameters on Which Performance of the Project Tested

The project is tested on various parameters like quality, durability, cost, energy, environmental issues & installation.

1) Quality

The quality of project is very well response by trial user. Components used in the system are high quality and having ability of absorb the fluctuation & Temperature above 150 Degree Celsius.

2) Durability

Durability of the system is based on the quality of spare-parts used to build the external case & internal components. To maintain this condition, we use the chromium case body to prevent corrosion and due to this life of the system increases. If outer part of the system is durable it results in the internal parts being durable because in this system, we used high quality components.

3) Cost

The initiate value of the projects is more than the actual one because when the system is commercial the value automatically decreases as the production increases.

4) Energy

The system is totally based on the green energy concept. The power used by system is solar powered so the external electricity is not needed.

5) Environmental aspects

Our system is total eco-friendly because the energy source used by system is solar power & the other parts are total recyclable.

6) Installation

Our system is easy to install by any one due to perfect design of project & also easy to change parameters of the system (time).

9. Commercial Viability of Project

The commercial viability of the sprinkler changing bot is that its ability to automate the process of the changing the valve of the sprinklers in large area. This could save significant time labour costs for businesses that need to do this regularly. These are primary advantage. However, the success of the product would depend on whether the cost of developing and manufacturing the bot can be outweighed by the potential profits generated from sales. Additionally, competition from similar products or manual labour could also affect the demand for product. A sprinkler changer bot could potentially have commercial viability, depending on various factors such as market demand, competition, and cost of development and production can be kept reasonable. Proper market research and cost analysis would be necessary to determine the product's commercial viability.

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[2] Modified 555 Timer IC Using Only Two Comparators2021 1st International Conference on Electronic and Electrical Engineering and Intelligent System (ICE3IS), https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&queryText=555%20timer%20ic.

[3] DC synchronous motors are DC motors whose rotation rate is equal to the frequency of the applied voltage frequency. DC synchronous motors have multi phase electromagnets in their stators which create a magnetic field. Due to the magnetic field created in the stator, the rotor which has permanent magnets or electromagnets starts rotating in the same rate and consequently another synchronous rotating magnetic field is created inside the motor. https://www.robotpark.com/AC-Synchronous-Motor

[4] The primary function of a motor starter is to start and stop the motor to which it is connected. These are specially designed electromechanical switches similar to relays. The main difference between a relay and a starter is that a starter contains overload protection for the motor. So the purpose of the starter is twofold, i.e., to switch the power automatically or manually to a motor and at the same time protect the motor from overload or faults. https://www.electronicshub.org/what-is-motor-starter

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[6] The high-performance Microchip pico Power® 8-bit AVR® RISC-based microcontroller combines 32 KB ISP Flash memory with read-while-write capabilities, 1024B EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART https://www.microchip.com/en-us/product/ATmega328P

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[8] A continuous water-level sensor based on load cell and floating pipe https://ieeexplore.ieee.org/document/8394554

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