High Voltage Aspects of Smart Agriculture through GIS Towards Smarter IoT

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***Abstract*- Prevalent scientific advancements have empowered latest technological ways to appear. Now-a-days, industries are proliferately demanding process automation in all fields. Automation culminates into better standard, enhanced production and decreased capital. The fusion of Geographical Information System (GIS) and IOT will bring a dynamic change in the production sector and agro-economy. 'Internet of Things' (IoT) technology is one of those approaches, where using the standard internet protocol, desired technology can transfer wirelessly the data obtained by digitizing the data of the object or the domain of the adapter that it is adapting to the server. This paper presents a low-cost and flexible solution to control and monitor agricultural tools, basically a DC driven Appliance for irrigation or for any other purpose, using Smart Plug devices. The Smart Plug is a power switch which can be accessed via WiFi or any similar communication protocol. This work presents the development of a Smart Plug with a wireless IoT Module. The proposed smart plug has the characteristics of simple design, low cost, easy to transfer the data to any place with the help of MQTT Protocol which is easy to use and easy to control. The foremost concept used here is that continuous control of DC Motor, is carried out using H-Bridge circuit using Power IGBT. Here basically the DC Appliance is chosen because there are only handful methods of parametric control and that the proposed method is reliable and can even work with the smallest step possible. Furthermore, GIS is used in getting the localised satellite data of the farmland and with the help various on-field sensors and local data management unit, it can pass on to the field so that one can yield maximum production and profit from a piece of land.**

Keywords- GIS, IOT, MQTT, Automation, Smart-Plug

I. INTRODUCTION

The application of GIS has been doing a crucial job in crop production round the globe by adhering farmers in enhancing production, reducing the capital, by residing over their land manoeuvre more efficaciously. Agricultural mapping plays a key role in surveilling, soil management and farmland irrigation. Reduced cost and elevated frequency of satellite imagery in national scale inventory are the reasons why satellite image-based techniques are still the front runners where a large hectare are worked upon with an enhanced resolution. The information acquired by GPS imagery relates well with most agricultural inventory variables like crop height, grain volume and biomass. Estimation with an associated precariousness can be found out by the statistical extension of field variables or by mathematical models related to field measurement associated with remote sensing data. Most primitive technologies are switching to this principle in order to enhance their applicability in various fields with utmost efficiency. We can see that several high-power equipment we use in our daily use like, HVAC Systems in companies or irrigation systems for farmers, all have switched to DC mode as it gives the freedom, they want to accomplish their task. All this equipment will have better applicability if they can be controlled very minutely with higher precision. This can be achieved profoundly by using DC Motor as the control aspect. Direct currents (DC) motors have been used in variable speed drives for a long time. The versatile characteristics of DC motors can provide high starting torques which is required for traction drives. Control over a wide speed range, both below and above the rated speed can be very easily achieved. The methods of speed control are simpler and less expensive than those of alternating current motors. In this paper, our focus is on average-scaled agriculture field. GIS technology provide strong technology support for intelligent decision support system. The application of ES can provide the implementary scheme for the agricultural production. GIS can synthetically manage the various space-time data to provide the decision and the consultation services for the agriculture production. A 5 HP DC shunt motor circuitry is designed and developed using pulse with modulation (PWM). The pulse width modulation can be achieved in several ways. In the said project, the PWM generation is done using timer IC.

In order to have better open loop speed control as demand varies frequently like in traction system and many operations in industry must be control manually, PWM is most efficient and cheap speed control method for dc drives. By varying resistor pot only, we can control the speed of motor which implies the simplicity and ease of achieving the result. The motor proposed is a real time working project, and this can be further improvised by using more no. of IGBT, i.e. two or four quadrant choppers, which will vary the motor in bidirectional mode.

II. Literature Survey

Obtaining the design strategy has been one of the foremost ingredients in the conventional IoT study. The issue of merging multiple levels of complexity through different appliances being worked upon at a particular time is also a point of concern too. According to Ganu et al., "The basic contributions of the work are design of low cost standalone smart plug that can schedule appliances during off-peak periods, design of simple and quenching data mining algorithm to determine peak and off-peak periods, design of novel decentralized load scheduling algorithms that contribute to peak load reduction and load levelling, evaluating the above mentioned algorithms experimentally. To ensure Grid and Appliance safety, nPlugs circumvent scheduling appliances during the stretch of supply-demand imbalance. Peak load reduction and Load levelling without any centralized control is contributed by scheduling algorithms used by nPlugs."[1] According to Fernández et al. (2015), "The model here is expected to have the following features like Remote control of Power Outlet, monitoring the current consumption in real time, power supply time schedule customization and programming, interrupting vampire currents automatically, preventing electrical fires and electrocutions, etc." [3] According to Rokach, "Basic methods of obtaining this information are census and ground survey.

However, particularly for multinational agencies and consortium, remote sensing can provide common data collection and information collecting strategies." [28] According to Zhiquing, "At present, there are three methods of collecting agricultural land based on remote sensing data. The first method is the visual interpretation method which needs to have professional knowledge and experience. However, as this method is limited by subjective factors of people. The randomness is large, and more time and effort will be spent." [25] According to Guo, "The second method is automatic extraction method. This method is based on spectrometer data feature or spatial information of remote sensing image. Feature parameters are designed and all kind of classification models are made in order to achieve automatic classification.[26] However, despite the many proposals in the literature for demand response approaches or direct load control the control of residential users' energy demand (which significantly affect the overall energy load variability) is still limited to pilot projects with little penetration perspective in the near future.[15],[16,[17],[18],[19],[20]

The reason is that the implementation of these mechanisms requires investments (for updating user appliances and communication infrastructures) which are not clearly justified for the end users.[21] The third method is combination of both remote sensing data and non-remote sensing data. For example, the efficiency and accuracy of the information can be improved in support of GIS data. Existing systems have a problem that we cannot differentiate between crops which give same colour on sensing by satellite. Hence, we need to overcome this drawback by developing a new algorithm which will be based on supervised learning algorithms [27].

So far as the Literature Review is concerned, Smart Plug can work in off-peak periods taking into consideration the fact that multiple device will eye that period and it has a good control over the off-peak load management taking the help of simple data mining algorithm. It can further extend its applicability during on-peak too using several algorithms mentioned above by accommodating several deferrable loads. Besides the idea of current consumption in real time, power supply time schedule customization and programming, automatic vampire currents interruption, electrical fires prevention and electrocutions add some treasures to its applicability. That's where the proposed model will add some efficacy.

III. Model Explanation

The best thing about DC Motor Speed control is that after we are powering the supply on, it generates 5V DC. The logic section works on +5V DC and the IGBT triggering sections are working on +30V DC. The Motor is driven on +220V DC. Power Supply is the main ingredient for this prototype. The required DC power supply is 0-30 volt & 0-5 volt can be available from the DC Power supply else can be rectified by means of rectifier circuit through diode or thyristor. Additional major components required for the circuit are Opto-coupler, Timer IC, IGBT, etc. This system will include:

- Space Database System
- Crop Map controlling Sub-system
- Crop Map showing subsystem
- Crop Map exporting subsystem
- The searching and querying subsystem

The foremost thing used will be an input satellite image that will help in mapping the coordinates of the image. After that, control points during geo-referencing will be considered to point the image with indigeneous geographical location. This geo-referenced snap will be forwarded to work as input to digitisation in .tiff format. For digitisation, we always tend to create different datasets of the snap based on data type and differentiate certain layers by transforming the raster layer into vector layer. From this we can have our agricultural map as training data for the system.

IV. Implementation

Here basically a 3kW DC Motor is taken whose speed is to be controlled by digital potentiometer. The Motor control circuit is formulated using Buck Converter Topology using Transistor and IGBT. To give the 230V supply from the existing household supply, an AC-DC rectifier has been designed which can give a sustained low ripple DC Supply when connected from an AC input. The circuit has been designed using Inductor, capacitor and diode rectifier. The Multilevel Control Module and the current sensing module is yet to be designed. In the multilevel module, 2-3 extra MOSFETs will be connected in parallel and will be tested for load scheduling in the same way mentioned as like a single MOSFET. For the current sensing module, a current sensor of

proper rating along with heat sink will be designed. Spiral Model for the project has been selected as the need of training the system for variable time intervals are quite high.

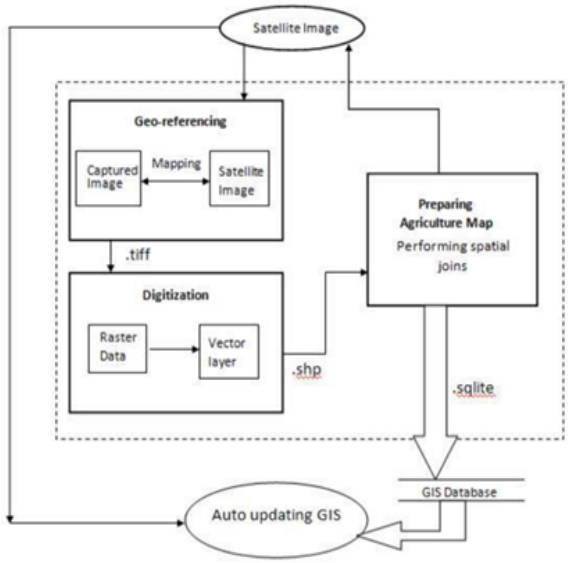

Fig. 1. Flow Chart of GIS

For this to happen, steps like, Georeferencing, digitisation of existing satellite image after designated time lap, have to be repeated. This will help the system to get updated with required data and after full system training, desired output can be obtained.

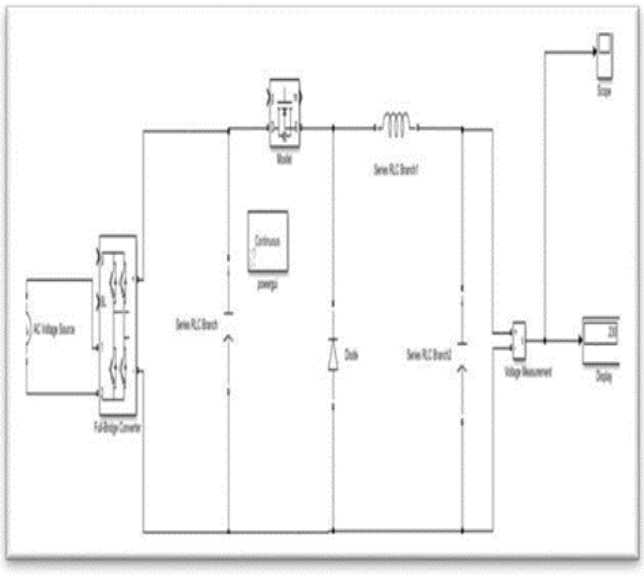

Fig. 2. 230V Converter Circuit

Here in the circuit presented above, there are two parts. First one is the Chopper Part and the next one is the PWM Control part. In the Chopper Circuit, the 240V, 15A Motor is connected with the H-Bridge Design. In the H-Bridge Circuit, 4 IGBTs are connected with freewheeling diode across them. A supply of 240V is given to the circuit besides the 300V which is given to excite the field winding of the motor. All the required parameters are shown in the form of plots in Scope. The Pulse Generator of 500Hz is used to drive the PWM Circuit with 4 switches connected. These 4 switches make a link with the four IGBTs through the 4 tags specified. The duty cycle was varied and the relative change in the speed was observed. Parameters like IGBT Current, Diode Current, Speed, Armature Current and Load Torque was measured and its curve with respect to time was also analyzed. Decision tree learning Algorithm completely takes care of my implementation part that can also facilitate me to decide the measures to signify the crops. It is a commonly used method in Data Mining. Here a model is to be created that predicts the value of a target variable based on many input quantities. Use of Multi-temporal imagery system helps crop identification and mapping in facilitating classification by taking into consideration variations as a function of plant's stage of growth. It also requires the working of calibrated sensors and frequent repeat snaps all through the growing seasons. The technique of accumulating information related to earth's surface without touching it is called as remote sensing. It is done by sensing reflected or emitted energy.

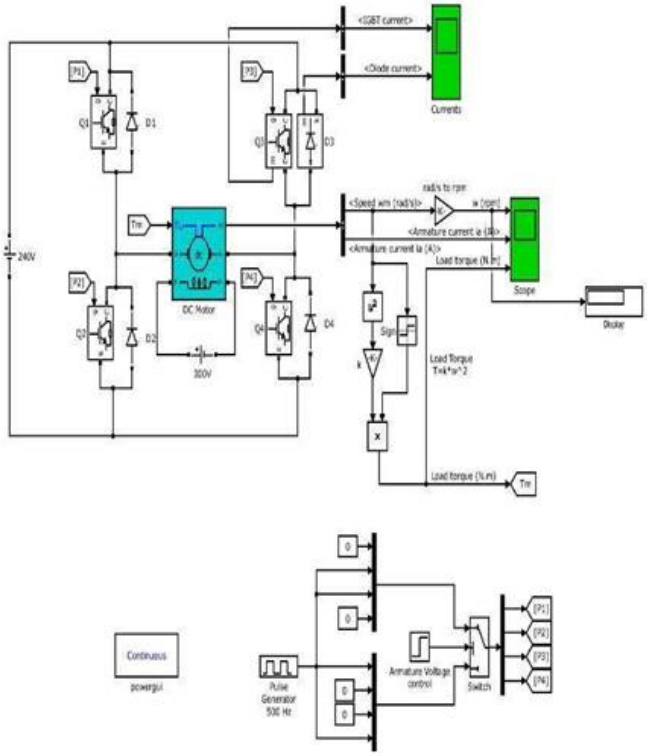

Fig. 3. 230V DC Motor Speed Control Prototype

V. Observation Table and Waveforms

TABLE I. Table between Duty Cycle and various Parameter with their Variation on %age

S.No	Duty Cycle	Load Torque (in Nm)	Variation (in %)	Armature Current (in A)	Variation (in %)
1	25	8.35e-3		3.753e-5	
2	30	1.651e-2	97.7	5.278e-5	40.63
3	40	5.703e-2	245.4	9.809e-5	85.84
4	50	0.3535	519.8	2.442e-4	148.95
5	55	0.903	155.4	3.903e-4	59.8
6	60	1.692	87.37	5.342e-4	36.86
7	65	2.595	53.36	6.647e-4	24.42
8	70	3.986	53.60	1.065	
9	75	6.009	50.75	3.495	228.16
10	80	8.336	38.72	6.315	80.68
11	85	10.93	31.11	9.489	50.26
12	90	13.77	25.98	12.99	36.89
13	95	16.82	22.14	16.8	29.33

TABLE II. TABLE BETWEEN DUTY CYCLE AND SPEED

S.No\	Duty Cycle (in %)	Speed (in RPM)	Variation(in %)
1	30	49.84	
2	40	92.63	85.854
3	50	230.6	148.94
4	55	368.6	59.84
5	60	504.4	36.84
6	65	624.7	23.85
7	70	774.3	23.94
8	75	950.7	22.78
9	80	1120	17.807
10	85	1282	14.46
11	90	1439	12.24
12	95	1591	10.56

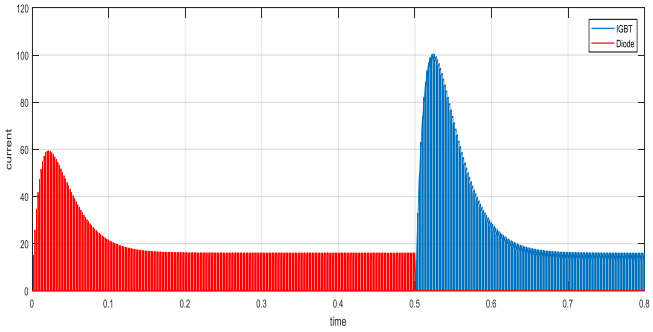

Fig. 4. Waveform I- Diode & IGBT Current w.r.t. Time

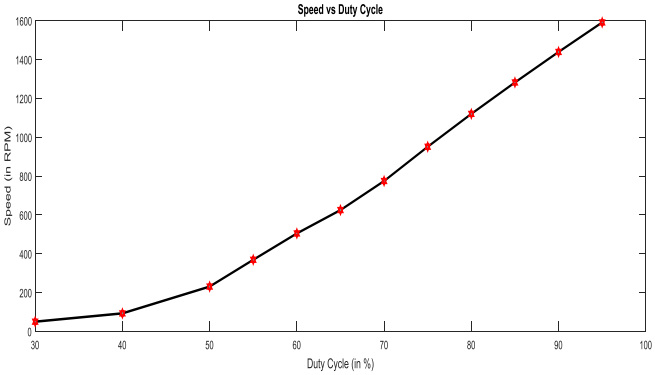

Fig. 5. Waveform II - Speed v/s Duty Cycle

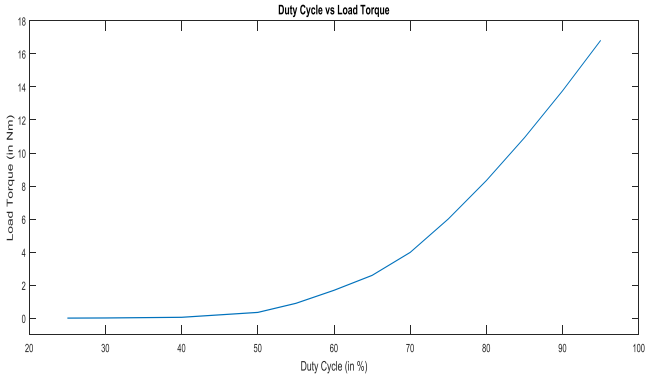

Fig. 6. Waveform III- Duty Cycle v/s Load Torque

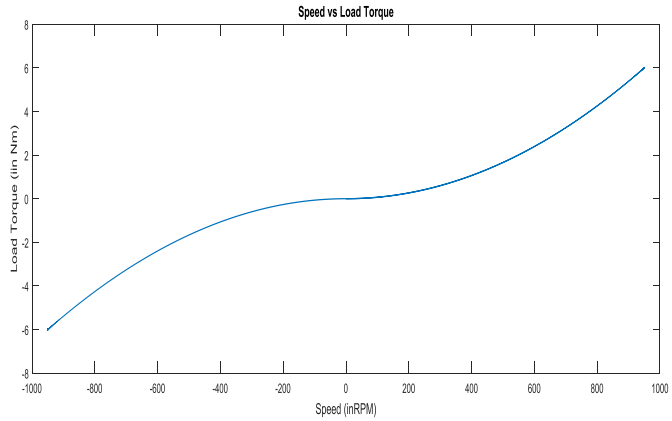

Fig. 7. Waveform IV- Speed v/s Load Torque

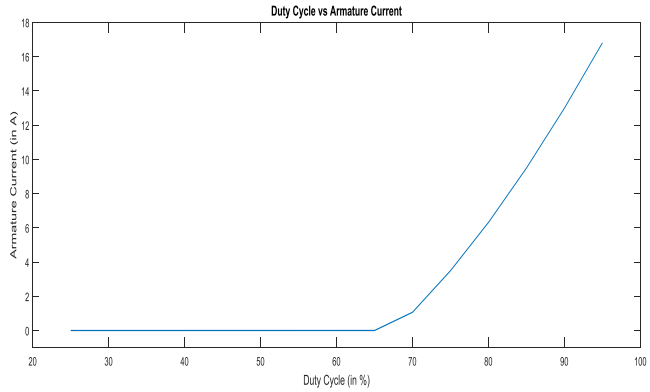

Fig. 8. Waveform V- Duty Cycle v/s Armature Current

VI. CONCLUSION AND FUTURE SCOPE

DC motor control is the go-to method for the applications mentioned in the report and simultaneously it is also worthy to note that, the method mentioned has given the required control output with the minimum input step size possible. It has also streamlined the control process involved in the working of several needful machines in our daily life, as earlier mentioned, like HVAC Systems of Industries and Irrigation System. Besides from the software implementation, it was also inferred that, Buck converter model for getting the desired input to the system and the H-Bridge circuit for the proposed model were quite efficacious and were modelled using the least number of passive components to get the desired output. Also the required waveforms for several parameters involved were taken by using the PWM technique and the variations were also observed. Furthermore, the literature review was also done thoroughly, and the work done and the work to be done were distinguished clearly (in the next section) and also testing and performance evaluation of the prevalent model is being done precisely for any uncertain error. GIS in agriculture expert scenario is learnt by mixing network technology with ES and GIS technology, that can further facilitate the networking, smart, magic and visual informatics and decision-oriented for agriculture producer and the decision service for minute agricultural envelope.

The system will tremendously help in building farmland geography informatics of Karnataka. The model of multiple speed based on the farm crop yield, enhance agricultural product grade, augment agricultural output market contenting ability and increase fertiliser deployment. This will inculcate the conventional method of agriculture production and deduce the precision agriculture for the advancement of our country agriculture and for never ending development of agriculture. It will be worthwhile to evaluate how load of one household affects the voltage of another household under the identical phase or transformer taking into perusal voltage measurement. Exploring the implementation of GSMA based schemes and plan to study congestion control technique in the backdrop of decentralized scheduling. Further the Hardware implementation of the aforesaid MATLAB model will be done and IoT based smart control will be implemented. Then it will be assembled in a module along with required microcontroller, current sensor, etc. and then suitable communication protocol will be assigned so that we can have a IoT module which will be able to address all the needs as mentioned above.

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