AN ALGORITHM BASED LOW COST AUTOMATED SYSTEM FOR IRRIGATION WITH SOIL MOISTURE SENSOR

SHIVAM AGARWAL
U.G. Student, Department of CSE
Meerut Institute of Engineering & Technology, Meerut
e-mail: Shivam.ag123@gmail.com

NIDHI AGARWAL
Assistant Prof., Department of Electrical & Electronics Engineering, MIT, Meerut
e-mail: nidhiagarwal906@gmail.com

Abstract— **In this paper one of the application of Arduino mega 2560 board and ultrasonic sensors for social modernization of embedded technology is presented. Wireless path following system in irrigation process of land is proposed as per the requirement of land. The sensors are used to detect the motion and soil moisture level of land. The objective is to build an autonomous, self-calibrating advance robot embedded with sensors and actuators that can be used for irrigation operation of agriculture. It is the primary way for production of crops with the operations like ploughing, seeding, irrigation, manuring, weeding. The robot is a composition of three main parts: electric circuit, mechanical design and algorithm. With the development of technology, automation is channelized with the process to facilitate the irrigation to increase the yield of crops and conservation of water resource and time. Row motion and alignment serve important role for smooth control of irrigation in the field and information is send to the user through coded output on any output device. In this paper the main focus is for irrigation.**

Keywords— Farming System, Soil Moisture Sensor, Ultrasonic Sensor, IR Sensor, Arduino Board, Algorithm.

I. INTRODUCTION

Here sensors are used and connected to Arduino board to control all the self-calibrating motion of robot using algorithm. This is concerned with farming process as irrigation, designed mechanism and algorithm in Arduino IDE. This is done by using the corresponding units respectively. The inputs are taken from the sensors like ultrasonic sensors, IR sensor, Soil Moisture sensor and output is displayed on LCD. A microcontroller can be compared to a small standalone computer, it is capable of executing a series of pre-programmed algorithm and interfacing with other hardware devices. But before the execution of the irrigation robot, a microcontroller requires some software in terms of program burnt into its memory.

In this irrigation robot, the software algorithm guides the hardware devices about to perform the desired operations according to the conditions. In this irrigation robot, the Arduino mega 2560 board is based on the core technology of microcontroller. Arduino IDE software which is compatible with the assembly language used for its microcontroller ATMega 2560. According to data required for agricultural growth per year, it should increase 7-8% but as per the data of last two decades it is 2.7% only.

II. PROPOSED WORK

The first is to design the self-calibrating robot with Arduino Mega 2560, for the purpose of irrigation which it has to be built along with specifying requirements. In this case, a system is to be developed for smoothness of this operation with more accuracy. The resources necessary to produce crops (particularly land) are diminishing rapidly. The amount of land is inversely proportional to population. Change in human mind set and life style with more demand of comfort and to reduce man power needed in farming. The people who are disabled and cannot work properly, found it difficult to cope with production of crops. Even people far from field are unable to monitor their crop on consistent basis. So, in the proposed work an intelligent Arduino based system using all sensors will be developed which is able to:

- To make high precision row farming easy.
- To avoid deliberately overlapping of previous rows.
- To reduce man power and conventional resources needed.

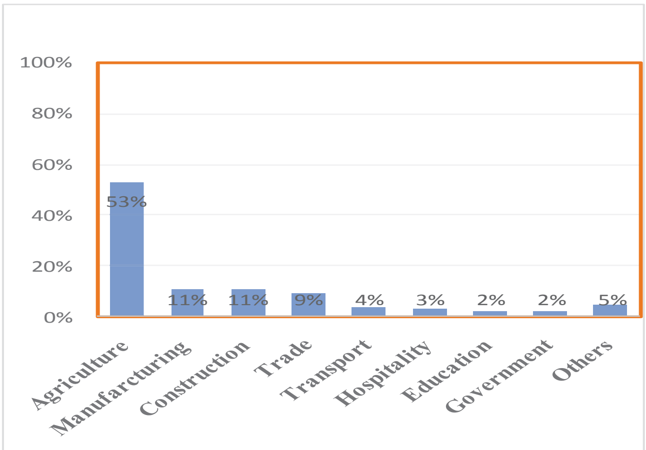


Fig. 1 Occupation Influence of Different Fields

978-1-4673-8855-9/17/$31.00 ©2017 IEEE

- Ability to do various jobs (i.e. seeding, weeding, fertilization, irrigation) via single machine.

The contribution of agriculture in the employment is about 53% which is more than other employments as shown in fig 1. It can be maintained only by using new technologies and advanced methods of farming. The research is going on to rise quality of performance and increase commercial growth all over the world.

The following inferences have been drawn after going through the numerous literatures:

- Various electronic products are available in the market, along with the latest technical knowledge to fabricate the system for better yield and reduced labor.
- Use of digital sensor (moisture sensor) reduces reliability, resulting untimely irrigation. The main factors affecting plant growth are sunlight, water content in soil.
- To control the motion of robot on field, complex algorithm is needed.
- Poor and random distribution of water due to manual methods can be overcome by using automation.
- It can be possible to set edge values of different factors, so that overshooting of any factors beyond threshold result in alarm.

II. LITERATURE SURVEY

Acaccia, G. M., et al.in [1] have discussed about the development of an accurate mechatronic based irrigation. Reddy, S. R. N et al. in [2] have given an idea about Bluetooth controlled robot for different operations and types of preferable communication devices for particular task to perform. This review has included many recent hybrid techniques for irrigation of field along with their benefits. Further, the review has also included remote control techniques meant for any conditions to inform the farmer.

Cariou, Christophe et al. in [3] has included the kinematic model for forward and backward movement of robotic vehicle which is following straight lines to move. Knoll, Florian, et al [4] have presented the software mechanism for 3D matrix camera picture to control robot for planting. Circuit models for controlled systems for estimation of plant root exit of weeds, developed using the software.

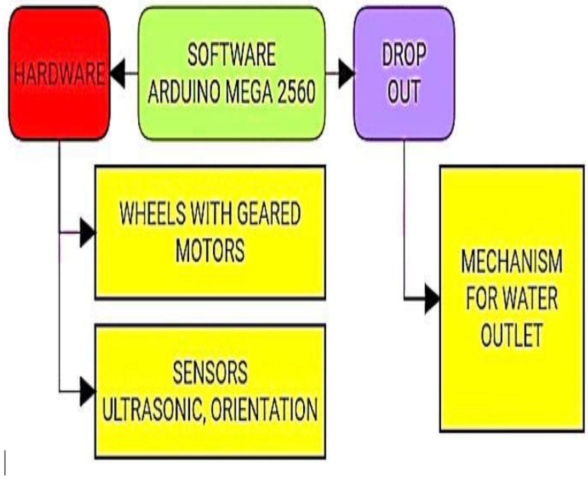
Matveev, et al [5] have discussed the farm tractor and show that simulation based approach for configuration results in automatic path tracking by autonomous vehicle thus better utilizing of the technology. Simulate all basic autonomous vehicle.

III. DESIGN PROCESS

A. HARDWARE DESIGN

The framework for chassis is made up of aluminum alloy square tubes. Aluminum is used to provide light weight and durability to chassis. Thread tread block tyres are used with 4.5” diameter for better gripping and push on farm land applications. The designed block diagram for irrigation robot is shown in the fig.2.

Fig. 2 Block Diagram of Irrigation Robot



On the robotic vehicle four 12V 100 RPM high torque motors with gear box system are used to drive four wheels of the robot. Motor driver board based on L298 is used to drive the motors for motion.

The real time data is taken through sensors as ultrasonic sensors, infrared sensors, and soil moisture sensor. The system with four ultrasonic sensors (HC-SR04) for four direction detection. The soil moisture sensor is used to measure soil moisture.

B. METHODS AND ALGORITHMS

In this project, the irrigational robot is implemented for dispensing mechanism and robot movement as shown in fig. 3. In agricultural sector there is not any advancement as compared to other sectors.

1. The battery is used as a supply in this low voltage tasks.
2. The soil moisture sensor is placed in the field to sense the moisture content regularly. The output of the sensor is transmitted to the Arduino Mega 2560 which is the main control unit.
3. When whole area of the field is supplied at the relevant moisture level then stop the irrigation operation.

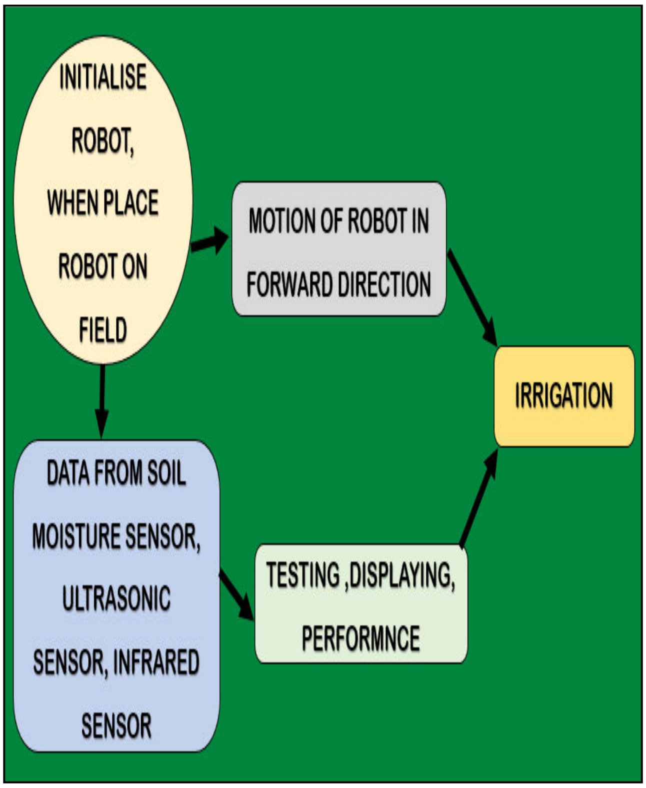


Fig. 3 Performance Flow of Irrigation Robot

The process for designing of irrigation purpose robot is as follows:

1) Robot Motion

The robot motion in the field can be done by the help of sensors. The ultrasonic sensors have the property to target any device. In this proposed work it may be boundary. The high frequency and lower wavelength of ultrasonic sensors make the focus of the sensor at a particular distance.

The algorithm is applied for movement in the row and the self-calibrating process to detect the boundary and move to another row.

Four ultrasonic sensors are connected to the irrigational robot.one on front side to measure the distance from the end point in the row, second ultrasonic sensor is connected with servo motor at back side of the chassis. The third and fourth ultrasonic sensors are connected on the right and left side of the chassis to measure the from nearest boundary. These are connected directly to the Arduino board to take the readings from sensors and to take appropriate actions.

2) Soil Moisture Data

The soil moisture sensor is used to detect the data for requirement of water to the soil. It is used for automatic watering to the land. There are three pins power supply, analog reading, ground connection. It has two pins to dip and check the moisture level.

3) Irrigation Process

In Irrigation, the moisture of soil is checked with soil moisture sensor. The water is used to dispensed until moisture content reaches at the reference value defined by the user through programming. PWM controlled water pump is driven by PWM signals which provides variable control for speed of water dispensed.

ALGORITHM: IRRIGATION OPERATION OF IRRIGATION ROBOT

1. Place the robot in the field starting point.
2. Let the distance of x meter be the discretized path to be tracked by the robot.
3. Soil moture sensor check the water content in the soil by up and down motion of Sensor.
4. Function for irrigation in the field at required rate.
5. Check the soil moisture at every third step.
6. Calculation for water requirement within the data of soil moisture and given rate value of water.
7. If water content is required
8. Call function Water dispense for a delay
9. Water dispensing through motor connected to pump.
10. Complete operation.
11. return

IV. RESULTS

Table 1: Results of the irrigation process

S.No.	Soil Moisture Sensor	Water (Litters)	Distance (cm)
1	300	0.7	260
2	320	0.7	220
3	300	0.7	195
4	310	0.7	163
5	200	0.9	150
6	230	0.9	134
7	200	0.9	121
8	200	0.9	100
9	300	0.9	80
10	312	0.8	65
11	305	0.8	46
12	315	0.8	27

The flow chart of whole irrigation process is shown in the fig. 5. The algorithm is designed as to perform irrigation in the field. The data of soil moisture sensor is given to the Arduino board at particular interval. In this proposed work it is a three step process to measure the water content with soil moisture.

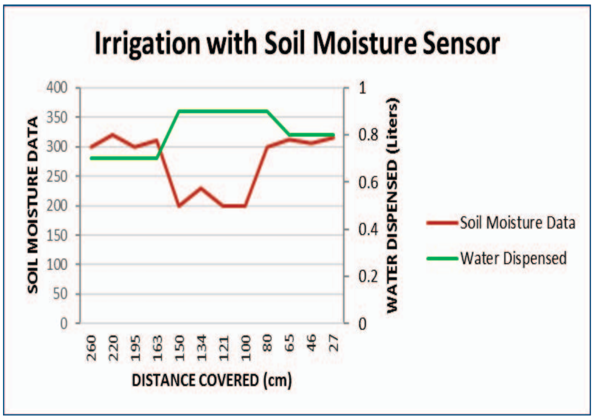


Fig. 4 Result of Irrigation with Soil Moisture Sensor

The water dispensed at particular rate in liters. The distance is covered with the help of sensors and move robot in the field that it can be drop out the water efficiently. The graph shown in the fig.4, shows the relation between the soil moisture data and respective water dropped in the field. So, an automated system for controlling the water dropping and monitoring the soil moisture can be done for different weather can be designed.

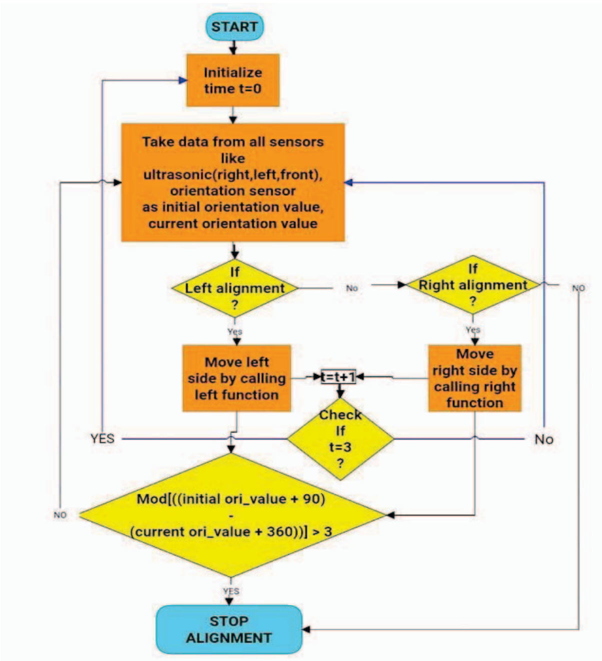


Fig. 5 Flow Chart of Irrigation Robot

The result shows three axis with relation of water required with the dropped content of it according to the distance covered by the robot. As the reading of soil moisture sensor decreases the requirement of water increases. But when the soil moisture data increases then the dropped water content decreases.

V. CONCLUSION

According to the water demand the requirement is fulfilled with the help of soil moisture sensor. The open source Arduino mega 2560 is used in the designing for microcontroller. The system efficiently monitors and controls the automatic self-calculated process for irrigation. By this, the irrigation resource water can be conserved and save from wastage. It is easy to save it by this effective process.

REFERENCES

[1] Reddy, S. R. N. "Design of remote monitoring and control system with automatic irrigation system using GSM-bluetooth." *International Journal of Computer Applications* 47.12 (2012).

[2] Cariou, Christophe, et al. "Autonomous maneuver of a farm vehicle with a trailed implement: motion planner and lateral-longitudinal controllers."*Robotics and Automation (ICRA), 2010 IEEE International Conference on*. IEEE, 2010.

[3] Knoll, Florian, et al. "Plant root exit point search algorithm for weed control applications in organic farming." *Instrumentation and Measurement Technology Conference (I2MTC), 2015 IEEE International*. IEEE, 2015.

[4] Matveev, Alexey S., Michael Hoy, and Andrey V. Savkin. "Mixed nonlinear-sliding mode control of an unmanned farm tractor in the presence of sliding."*Control Automation Robotics & Vision (ICARCV), 2010 11th International Conference on*. IEEE, 2010.

[5] Jinlin, Xue, and Xu Liming. "Autonomous agricultural robot and its row guidance." *Measuring Technology and Mechatronics Automation (ICMTMA), 2010 International Conference on*. Vol. 1. IEEE, 2010.

[6] Gangurde, Pratibha, and P. Bhende. "A Review on Precision agriculture using Wireless Sensor Networks." *Int. J. Eng. Trends Technol* 23 (2015): 426-431.

[7] Acaccia, G. M., et al. "Mobile robots in greenhouse cultivation: inspection and treatment of plants." *Proceesings of the the 1st International Workshop on Advances in Service Robotics, Bardolino, Italy*. Vol. 1315. 2003.

[8] Correll, Nikolaus, Nikos Arechiga, Adrienne Bolger, Mario Bollini, Ben Charrow, Adam Clayton, Felipe Dominguez et al. "Indoor robot gardening: design and implementation." *Intelligent Service Robotics* 3, no. 4 (2010): 219-232.

[9] Agarwal, Shivam, and Nidhi Agarwal. "Energy Audit of a Building for Efficient Energy Consumption." *Energy* 4.8 (2016).

[10] Shrivastava, Prasun, Akash Singh, Kushagra Pratap Singh, and Amritanshu Srivastava. "Mobile Controlled Agricultural Device for Enhanced Execution of Farming Techniques." *Procedia Computer Science* 49 (2015): 306-312.

[11] Bouton, Nicolas, Roland Lenain, Benoit Thuilot, and Philippe Martinet. "A new device dedicated to autonomous mobile robot dynamic stability: application to an off-road mobile robot." In *Robotics and Automation (ICRA), 2010 IEEE International Conference on*, pp. 3813-3818. IEEE, 2010.

[12] Sammons, Philip J., Tomonari Furukawa, and Andrew Bulgin. "Autonomous pesticide spraying robot for use in a greenhouse." In *Australian Conference on Robotics and Automation*, pp. 1-9. 2005.

[13] Balaji, L., G. Nishanthini, and A. Dhanalakshmi. "Smart phone accelerometer sensor based wireless robot for physically disabled people." In*Computational Intelligence and Computing Research (ICCIC), 2014 IEEE International Conference on*, pp. 1-4. IEEE, 2014.

[14] Shivam Agarwal and Nidhi Agarwal " Interfacing of Robot with Android App for To and Fro Communication" "Innovative Applications of Computational Intelligence on Power, Energy and Controls with their impact on Humanity (CIPECH-16), *2016 IEEE International Conference on*, pp. 242-246, IEEE, 2016