International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 08 | Aug-2016 www.irjet.net p-ISSN: 2395-0072

SMART IRRIGATION SYSTEM, A STATISTICAL APPROACH, USING RASPBERRY PI

Amit Das, Sumanta K Dey, Soumyadev Mishra, Arpan Sahoo

Amit Das, B Tech (Electrical Engineering), Future Institute of Engineering & Management
Sumanta K Dey, B Tech (Electrical Engineering), Future Institute of Engineering & Management
Soumyadev Mishra, B Tech (Electrical Engineering), Future Institute of Engineering & Management
Arpan Sahoo, B Tech (Electrical Engineering), Future Institute of Engineering & Management

---***---

Abstract - *In agricultural field, it is very important to decide what amount of water to be added for successful cultivation. In this project we developed an algorithm to measure various GLCM parameters of different soil samples. This algorithm was implemented in Raspberry pi, along with a Pi camera inserted in it. This allows the instrument to move forward and take images simultaneously of soil samples present in front of it. Then it will analyse the dryness of the soil image and accordingly decide what amount of water is to be added to make the soil agriculture friendly.*

Key Words: Irrigation, Raspberry pi, Pi camera, MATLAB'15, KNN classifier.

1. INTRODUCTION

The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes to waste. In modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation techniques in India through manual control in which farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use digital image processing based irrigation quality control system in which the irrigation will take place only when there will be acute requirement of water.

2. HARDWARE

Raspberry pi: The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intent to promote the teaching of basic computer science in schools and developing countries. All models feature a Broadcom system on a chip (SOC), which includes an ARM compatible CPU and an on chip graphics processing unit GPU (Video Core IV). Secure Digital SD cards are used to store the operating system and program memory in either the SDHC or MicroSDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phono-jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I2C. The Raspberry Pi primarily uses Linux-kernel based operating systems. The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens. The software for the camera supports full resolution still images up to 2592x1944 and video resolutions of 1080p30, 720p60 and 640x480p60/90. Installation involves connecting the ribbon cable to the CSI connector on the Raspberry Pi board.

BC 547 Transistor: BC547 is an NPN Bi-polar junction transistor (BJT), used to amplify current.

SL 100: SL100 is a general purpose, medium power NPN transistor.

Diode (1N4007): The 1N4001 series (or 1N400X series) is a family of popular 1.0 A (amp) general-purpose silicon rectifier diodes commonly used in AC adapters for common household appliances.

Transformer (12-0-12): A 12-0-12, 500mA specified step down transformer is taken under consideration for the hardware operation of the system. 12-0-12 means that the voltage or the potential difference between each of the end terminals of the secondary winding and the mid-point of the secondary winding of the Transformer is 12V.

Capacitor: A capacitor is a passive two terminal electrical used to store electrical energy temporarily in an electric field.

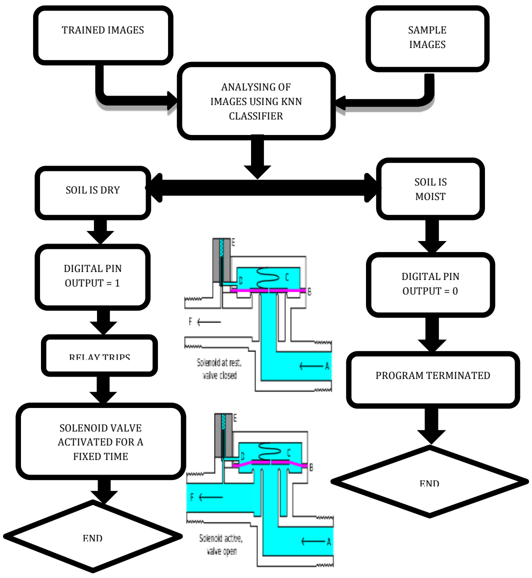
Veroboard: Veroboard is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating board, used in constructing electronic circuits.

Relay: A relay is an electrically operated switch.

7812 Voltage regulator: The 78xx is a self-contained fixed linear voltage regulator integrated circuits.

Solenoid valve: A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off.

3. PROPOSED DESIGN - Flow chart:



Raspberry Pi with Pi camera

We assemble Raspberry Pi (model – 2B) with a pi camera (5 MP) connected to it. We assemble a monitor and a keyboard for coding purpose. The monitor display is connected via an HDMI cable as an output to the pi camera (optional). An Ethernet cable is used for real time operation and transmission of data.

4. SOFTWARE SECTION

An operating system namely Raspbian Wheezy is installed that supports MATLAB 2015. The programming of Raspberry Pi is done via MATLAB 2015. A hardware package is downloaded and installed in Raspberry Pi for the working of pi camera. The Raspberry Pi is trained using multiple images of dry soil (20 images) and moist soil (20 images) from with different angle and different portion in presence of flash light. These images are resized and consequently converted to grey scale image. We incorporate the process of GLCM (Grey Level Co-occurrence Matrix) over it. Using GLCM we find out the Haralick Texture Features of the image. We work on the following Haralick Parameters: Correlation, Homogeneity, Entropy, Energy and Contrast. These obtained results of the training images are saved within the matlab folder with the extension of **.mat.**

At the time of on field running of the program the sample images are taken as the input, the Haralick parameters of that image is derived, which is further compared with the features of the trained images and necessary action is triggered as output. The entire comparing task is governed by the KNN classifier (K Nearest Neighbour Rule).

5. IMPLEMENTATION

Image capturing and processing: The images are captured using Pi camera and the GLCM parameters of the captured images are measured. The Raspberry pi computer then classifies whether the soil sample is dry or moisture using KNN classifier, and accordingly it sends signal.

DC Supply mechanism:

A 12-0-12, 500mA specified step down transformer is taken under consideration for the hardware operation of the system. The secondary stepped down output of the transformer is allowed to pass through a full wave rectifier circuit along with a filter circuit to get a complete DC output using capacitor. This output is passed through a voltage regulator that maintains the 12V dc supply throughout the mechanism. We have used LED as an indicator wherever required for ease of accessing.

5.1 SWITCHING MECHANISM

Pin 4 and Pin 5 of Raspberry Pi is used as the digital output of the program. This output of Raspberry Pi further transmitted to the transistor-resistor circuit. The transistor-resistor circuit further operates the Relay. Hence the relay acts as a switch which triggers the solenoid valve as per requirement and conditions. The switching ON and OFF of the solenoid valve is electrically governed by the relay and conditionally governed by the software program. The duration of activating of the solenoid valve depends upon the delay implied.

5.2 WATERING MECHANISM

The water solenoid valve has two openings, one for the inlet and other for the outlet. The inlet side is connected to an overhead supply tank through a pipe and the outlet remains open for delivering water on the field. The image captured by the pi camera is analysed using KNN classifier. If the above image shows that the soil is dry, 1 is taken as the digital output at the Raspberry Pi pin which further trips the relay and the solenoid valve is actuated for a pre-mentioned duration, hence water is supplied at that portion of field. If the above image shows that the soil is moist, 0 is taken as the digital output and the program is terminated, hence nothing happens and the solenoid valve remains closed.

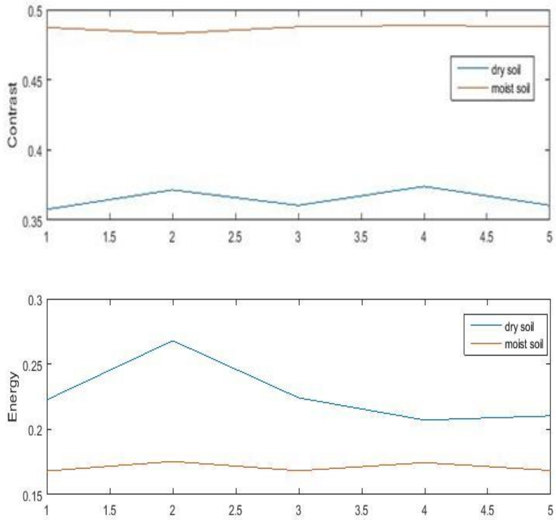
6. RESULTS

Sample Output Training data for dry soil sample

Soil Sample	Contrast	Correlation	Energy
	0.3576	0.6139	0.2226
	0.3715	0.6102	0.2679
	0.3605	0.6142	0.2241
	0.3740	0.6378	0.20708

Sample Output Training data for moist soil sample

Soil Sample	Contrast	Correlation	Energy
	0.4873	0.6244	0.1681
	0.4830	0.6198	0.1754
	0.4878	0.6195	0.1683
	0.4888	0.6515	0.1745



Graphical representation of parameters

7. CONCLUSION

The system provides several benefits and can operate with less man power. The system supplies water only when the humidity in the soil goes below the reference. Due to the direct transfer of water to the roots water conservation takes place. As water supply becomes scarce and polluted, there is a need to irrigate more efficiently in order to minimize water use and chemical leaching. However, research indicates that different sensors types may not perform alike under all conditions. Reductions in water use range as high as 70% compared to farmer practices with no negative impact on crop yields. Due to the soil's natural variability, location and number of soil water sensors may be crucial and future work should include optimization of sensor placement.

8. ACKNOWLEDGEMENT

We would like thank Dr. Jayanta Kumar Chandra, Head of Department of Electrical Engineering, Future Institute of Engineering & Management for his valuable help and guidance.

9. REFERENCES

[1] Nikhil Agrawal Engineering Manager, Siemens, Noida nikhil.pa@gmail.com, Smita Singhal ASET, Amity University, Noida singhal.smita@gmail.com , Smart Drip Irrigation System using Raspberry pi and Arduino, International Conference on Computing, Communication and Automation (ICCCA2015) ISBN:9781-4799-8890-7/15/$31.00 ©2015 IEEE.

[2] B.Johnson, "How the Raspberry pi works" Internet:computer.howstuffworks.com/raspberrypi1.htm.

[3] Chandan kumar sahu, Dept. of Electronics and communication engineering. Sambalpur University Institute of Information Technology, Sambalpur(768019), INDIA chandan.sahu@suiit.ac.in Pramitee Behera, Dept. of Electronics and communication engineering. Sambalpur University Institute of Information Technology Sambalpur(768019), INDIA pramitee.behera@suiit.ac.in, A Low Cost Smart Irrigation Control System, IEEE SPONSORED 2ND INTERNATIONAL CONFERENCE ON ELECTRONICS AND COMMUNICATION SYSTEM (ICECS 2015) 978-1-4788-7225-8/15/$31.00 ©2015 IEEE.

[4] Rotex,"2-Port Solenoid Valve" Internet: www.rotexindia.com/products/2_Port_Solenoid_Valve/2_PO RT_DIAPHRAGM_OPERATED,_NORMALLY_CLOSED__OPEN_S OLENOID_VALVE.htm.

[5] Raspberry pi – www.raspberrypi.org