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RASPBERRY PI USING IR THERMAL CAMERA IN AGRICULTURE FARM FOR SMART IRRIGATION SYSTEM

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Abstract- ***It proposes a automatic irrigation system for the agricultural lands. Currently the automation is one of the important role in the human life. It not only provide comfort but also reduce energy, efficiency and time saving. Now the industries are use automation and control machine which is high in cost and not suitable for using in a farm field. So here it also design a smart irrigation technology in low cost which is usable by Indian farmers.The present system can be used for the home gardens only. The proposed system overcomes the drawbacks of the present system by employing the IR thermal camera. The proposed system capture the thermal image of the agri land with the help of IR thermal camera and it split ups the image to equal sizes. Raspberry pi is the main heart of the whole system. Pi controls the system depends on the thermal image taken by the IR thermal camera. Raspberry pi computer will identify the temperature different between the areas with the help of image processing algorithm and it will open up the corresponding valve for the area which is having higher temperature. The high temperature will denotes that the land is dry. Open computer vision library will be used with python programming language. The tank water level will be identified by the ultrasonic sensor to avoid tank over flow. This system can also design to control by android mobiles.***

Keywords- *Smart farms, Irrigation, Raspberry pi, IR thermal camera, Relay board, Ultrasonic sensor.*

I.INTRODUCTION

The requirement of building an automation system for an office or home is increasing day-by-day. Industrialist and researchers are working to build efficient and economics automatic systems to control different machines like lights, fans, air conditioners based on the requirement. Automation makes an efficient use of the electricity and water and reduces much of the wastage.

smart irrigation system makes the efficient use of water and fertilizer. Water is slowly dripped to the roots of the plants through narrow tubes and valves. Water is fed directly to the base of the plants which is a perfect way to water plants.

There already exist automatic drip irrigation systems which water plants based on soil humidity, pH value of soil, temperature and light. These parameters are required in big agricultural fields where productivity of the crop matters. In small areas like office premises, buildings, house gardens etc. where watering plants at regular interval matters, our proposed smart irrigation system will be very efficient.

This paper presents an smart irrigation system for agriculture farm with the use of devices like raspberry pi. Python programming language is used for automation purpose. This paper contributes an efficient and fairly cheap automation irrigation system. System once installed has less maintenance cost and is easy to use.

Organization of the paper: In section II the hardware system architecture of raspberry pi, which is the control block in this irrigation system, is described. The proposed smart irrigation system with design details are mentioned in section III. Implementation and conclusion are included in section IV and section V respectively.

II. HARDWARE SYSTEM ARCHITECTURE

Raspberry pi is a pocket personal computer with Linux operating system installed on it. This is super cheap to encourage young people for learning, programming, experimenting and innovation. Resembling like motherboard, raspberry pi has all the components to connect inputs, outputs and storage. Its various components include

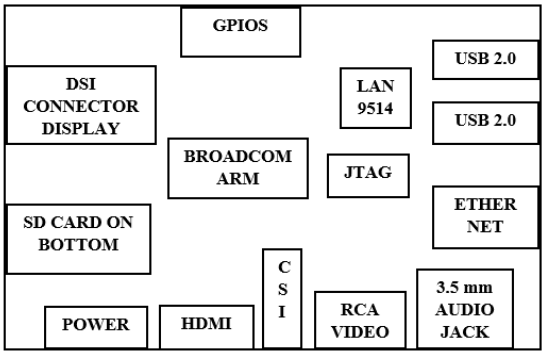

Fig: Block diagram of raspberry pi

ARM CPU/GPU: This is a Broadcom BCM2836 System on a Chip (SoC) that's made up of an Quad-core ARM Cortex-A7 900 MHz central processing unit (CPU) Dual Core Video Core 4 graphics processing unit (GPU) Multimedia Co-Processor Provides Open GL ES 2.0, hardware-accelerated Open VG, and 1080p30 H.264 high-profile decode Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure.

GPIO Connector: These are general purpose input/output connection points. 40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines.
RCA: This allows connection with analog TV or other similar points.

Audio Out: This point provides connection with audio out devices like speakers or headphones. 3.5mm jack, HDMI.

LED: This is used for indicator lights.

USB: 4 x USB 2.0 Connector , Common connection port for peripheral devices like mouse, keyboard etc.

HDMI: This allows connection with compatible devices like HD television with the use of HDMI cable.

Power: Micro USB socket 5V, 2A.

Memory card slot: Micro SDIO Full-sized SD card slot to hold the LINUX operating system SD card and is required for booting.

Ethernet: This is used for wired network. 10/100 Base T Ethernet socket.

Other features can be added with the help of USB port or the USB hub if required.

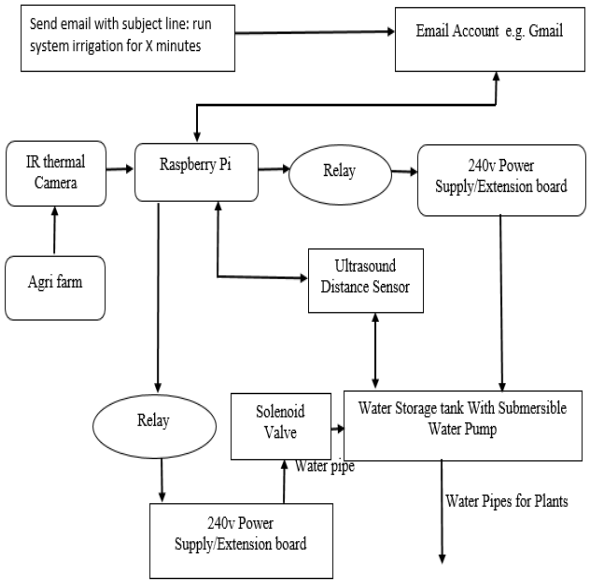

Fig: proposed system

III. PROPOSED DESIGN

1. Raspberry Pi: Model B of Raspberry is used in this paper. As soon as the email is received, one of the GPIO is turned *high.* A program written in Python programming language has been used to receive email and turning a GPIO pin *high* for the requested duration. The same program also sends the status updates to user's email address. Software libraries used in Python programming are:
1) SMTP library to send status email
2) IMAP library for email polling
3) BCM for GPIO control in raspberry pi.

Fig : raspberry pi board

2. Send Email: To start the drip irrigation system an email is sent to a defined account having subject line: "run irrigation system for *X* minutes" to run irrigation system for *two* minutes, an email with the subject line is sent "run irrigation system for *two* minutes"

3. Email Account: Raspberry pi will poll for emails in this email account. Google email account is used in this Paper.

4. IR Thermal camera: system capture the thermal image of the agri land with the help of IR thermal camera and it split ups the image to equal sizes. Pi controls the system depends on the thermal image taken by the IR thermal camera.

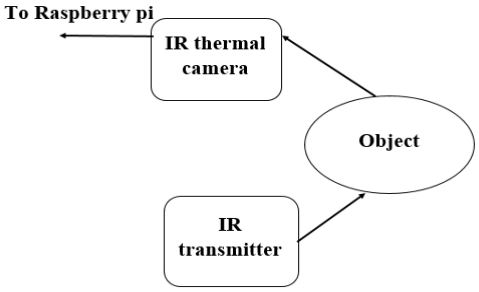

Fig: IR Thermal camera image capture

5. Relay Board: One-channel relay board which operates on 5-6V is used here. The circuit is used to control one 240V power appliance directly from microcontrollers or low voltage circuits. The connections to one-channel relay board. There are three pins on the relay board namely *normally open (NO), normally closed (NC)* and *common (C).* The *common* pin is connected to *NC* pin when the relay is *off* and to the *NO* pin when the relay is *on.* The input pin "INP" receives logic *high* from raspberry pi and in turn switches *on* the relay, thus *common* is connected to NO which turns the device *on* till the relay is *on.* The "VCC" and "GND" pins of the relay are connected to 5V supply and ground respectively.

6. Power Supply: The device to be switched, here, is an electrical water pump which runs on 240V supply. Its one end is connected to the 240 V AC supply and the other end is connected to *NO* pin of the relay board.

7. Water Storage Tank and water pump: Two 30 litres water storage tanks are used for testing purpose. Each tank has *s*ubmersible water pumps with the rating of 220V/50Hz. It draws the current of 0.23A and power of 18W. The main water pipe is fed back to the water tank to avoid any water wastage. Water tank has ultrasound distance sensor which keeps a track of water depth in the tank. As soon as the water level falls below a threshold level, a signal is sent to microcontroller to open solenoid valve which is attached to the water tap and thus the water can be refilled into the water tank.

8. Ultrasound Distance Sensor: This sensor is used to measure the water level in the tank. The *on/off* signal is continuously sent to the solenoid valve and thus the water Level in tank does not drop below or above a threshold to avoids any damage in the water pump and also to avoid overflow of water from the water tank.

9. Solenoid Valve: A two-port, *normally close*, 0.5-10bar, 230V-50Hz, rotex solenoid valve is used in this design. Here, the valve receives the signal from microcontroller and thus act according.

IV.IMPLEMENTATION

Thermal image capturing: The thermal image is captured by using the MLX90620 image sensor. By using this thermometer we can measure the accuracy of 0.5 temperature difference. So we can identify the temperature difference in the land at different areas.

Thermal image processing: The captured image is divided into 4 parts. The image can be divided more than 4 parts. Here we have divided into 4 the image processing algorithm is applied on the divided parts to identify the temperature difference. Depending upon the temperature difference we can identify the wetness level of the land. The Raspberry Pi computers identify the dry areas of the land and if opens the corresponding valve to irrigate the particular dry area. This method is fast and very accuracy compared to previous systems.

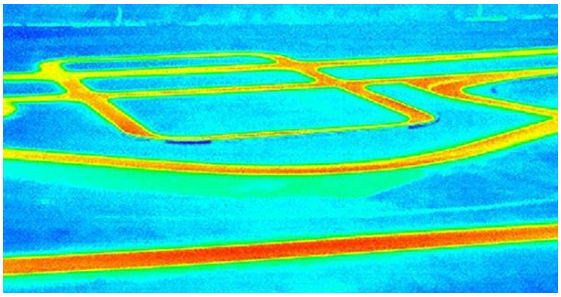

Fig: Thermal image is captured by using the MLX90620 image sensor

V.CONCLUSION

In this proposed system have presented the new innovative irrigation system based on the land temperature. This system comprises the water tank monitoring system and the land temperature monitoring system, this two systems make the irrigation fully automatic. The entire system is monitored and controlled by the power full credit card sized microcomputer called Raspberry Pi. Pi board is powered by Linux operating system.

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