Design of an Efficient Automated Closed-Loop Irrigation System for Stable Remote Access to Field Conditions

Jabeena.A, Tarandeep Singh, Jasmine.M

Abstract: ***Many major metro cities face a water crisis today. It has been predicted that Bangalore will become unlivable by 2020. Proficient water administration is a noteworthy worry in many agricultural sites in these parched zones. As engineers, it our duty to help avert this crisis. Automated closed loop irrigation systems offer a potential answer in order to help site-specific water system administration which will enable producers to increase their profitability while also sparing water. This project puts forward a humble design of an automated irrigation system controlled via closed-loop operation, employing a host of sensors to attain data to check against the predetermined threshold values. The collected data should be available to the agriculturalist at all times to maximize efficiency of the agricultural process. The Internet of Things (IOT) is one of the technological advancements which can provide a remote viewing ability to the system by giving the user a platform to analyze this data. With more development in the field of IOT expected in the coming years, these systems can be made more efficient, much faster and cost lesser.***

Keywords: Internet of things; agriculture; Automated; irrigation; closed-loop.

I. INTRODUCTION

Indian economy fundamentally relies upon the farming sector. Farming uses the vast majority of accessible fresh water assets and this utilization of fresh water assets will keep on expanding because of an unchecked increase in population and in turn, an increase in food requirements. Rising labor costs, stricter environmental directions and increased rivalry for water sources from urban zones provide solid inspiration for productive Irrigation framework. The design described in this project provides an automated irrigation framework which is plausible and practical for reducing the stress on dwindling water sources, when used for Agricultural activities. Utilizing the closed-loop irrigation system framework we can demonstrate that the utilization of water can be decreased for various agricultural activities. The irrigation system provides just the required measure of water to the crop.

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The remote nature of the hardware provides scope for it to be used in bigger nurseries or open fields via basic hopping techniques. The framework has a distributed remote system of soil dampness and temperature sensors put in the root zone of the plants and light detectors for checking the level of sunlight available to the plants. Moreover, a portal unit handles sensor data, triggers actuators, and transmits information to a web application. An algorithm was developed to take threshold vales as inputs to the microcontroller and control the water pump based on these threshold values and the sensor value inputs. This project began with a study of the present work that has been done on the irrigation aspect of agriculture, the methods used by them while implementing their solutions and also what scope and researching gap can be exploited to improve on them. Real time information collection is all the more difficult and promising issue in these applications [1] - [3]. There are numerous methodologies and arrangements proposed for Real time information collection in the writing with the numerous hardware specifications that have been used in tandem perfectly with the specified methodologies, solutions and approaches. The main objective of the system is to optimize irrigation systems. To achieve this goal, the system utilizes a host of sensors to obtain real time data about the conditions of the field. This data will then be worked upon by the microcontroller to control the water pump by checking the real time data against the previously set threshold values. In order to further increase the usability of the design, the data will also be transmitted wirelessly to a local host for remote viewing. The local host will also have the ability to switch the pump on or off wirelessly, overriding the controller's decision.

II. PROPOSED SYSTEM

As described before and in the block diagram, this system works in real time and in order to act upon the real time conditions of the soil, we first need to acquire the affiliated data. This is where sensors come into play. Even though commercially available sensors are more than enough in terms of being competent, there is ongoing research in order to improve the response time and other drawbacks of these sensors, but getting into that would be outside the scope of this work. The sensors that are used here are a temperature sensor, soil moisture sensor, LDR sensor and a PIR sensor. All the data provided by these sensors is sent to the microcontroller [4]-[6]. The Microcontroller is the brains of the operation; without which it is very difficult to design

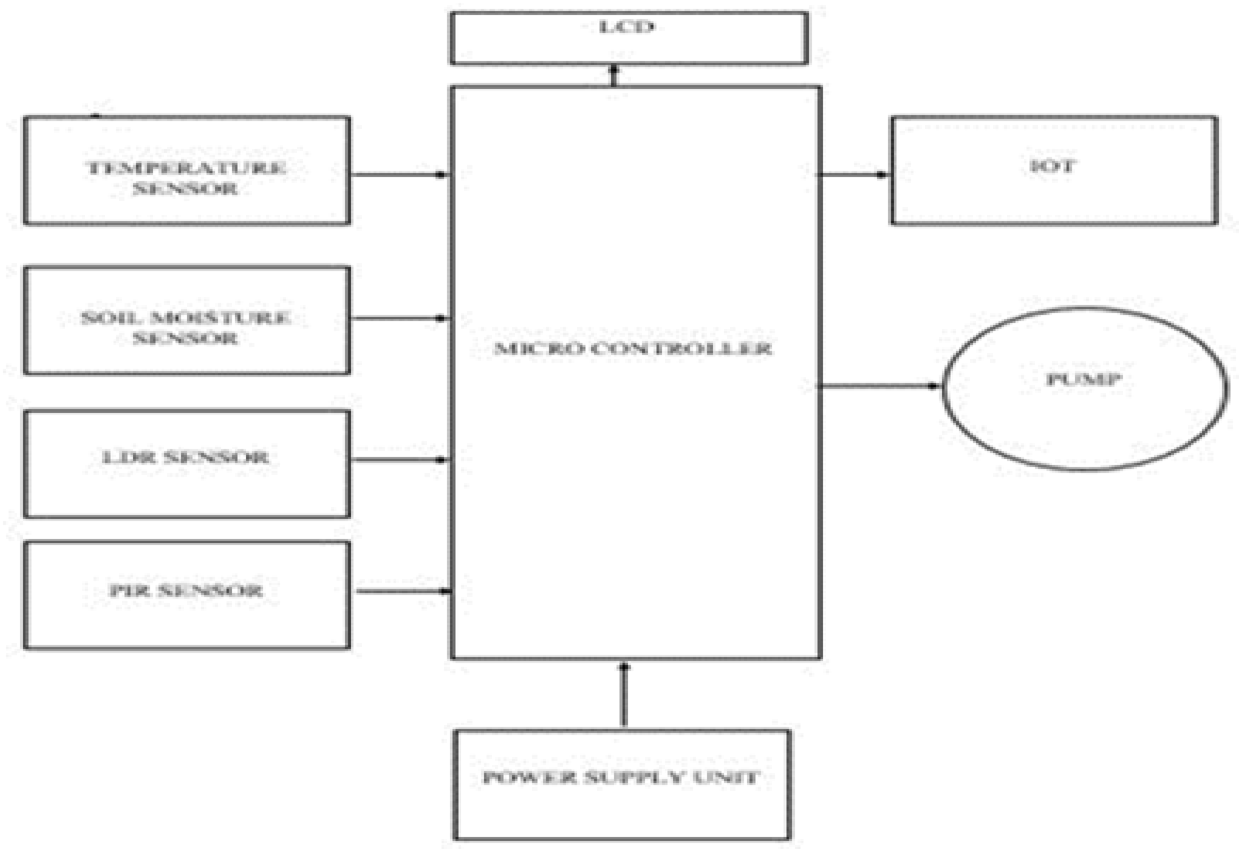

Fig.1-System Diagram

complex logics. The microcontroller then checks these values against the threshold values and operates the water pump based on this. The system also incorporates an IOT component to make the system wireless. ZigBee technology is used to ensure this. The Internet of Things idea can empower us to devise a harvest domain information framework with the purpose to assemble the whole agricultural predictive framework. The motivation behind this framework is to construct a solid information accumulation framework inside a brief timeframe. The framework will have the capacity to work day and night and report progressively the checked gear and surrounding conditions, prompting better decision making by better data analysis on the acquired data through this system. As an interest in a framework like this grows, with sufficient backing, researchers can keep on adding networked embedded devices called smart items, which will keep on expanding the reach and the scope of the framework, all the while changing the way that farming is done in India.

III. IMPLEMENTATION

The approach to designing the system was very direct and simplistic. The system is a closed loop feedback based system that changes its output based on the real time values provided by the inputs[Fig.2 and Fig.3]. The Soil moisture sensor is used as a feedback system to control the water pump to irrigate the field. The agriculturist can use the remote viewing functionality of the system to take their own decisions too, overriding the decision taken by the microcontroller. The farmer can use the information provided by the Temperature and the LDR sensors to take this decision.

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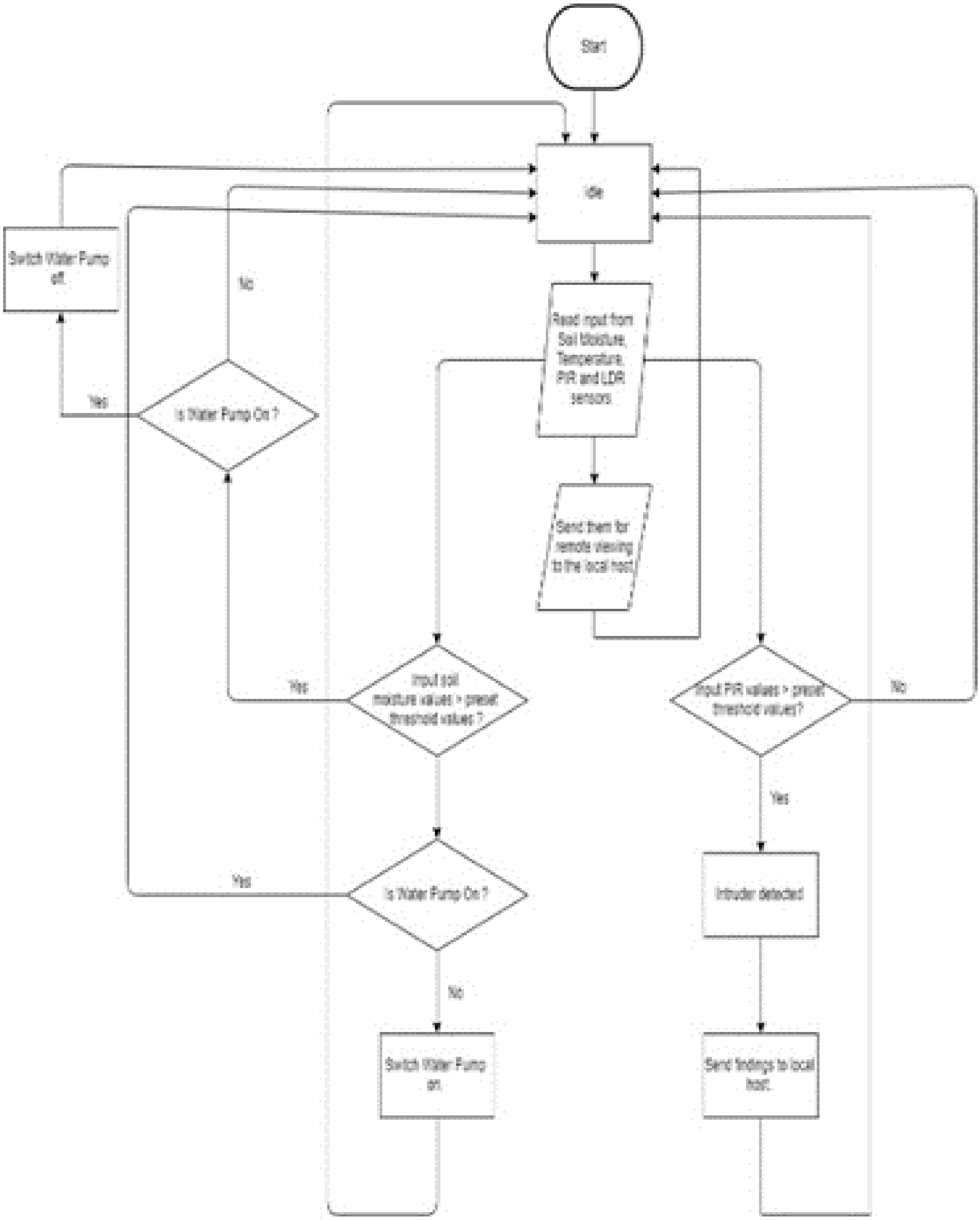

Fig.2-Flow chart

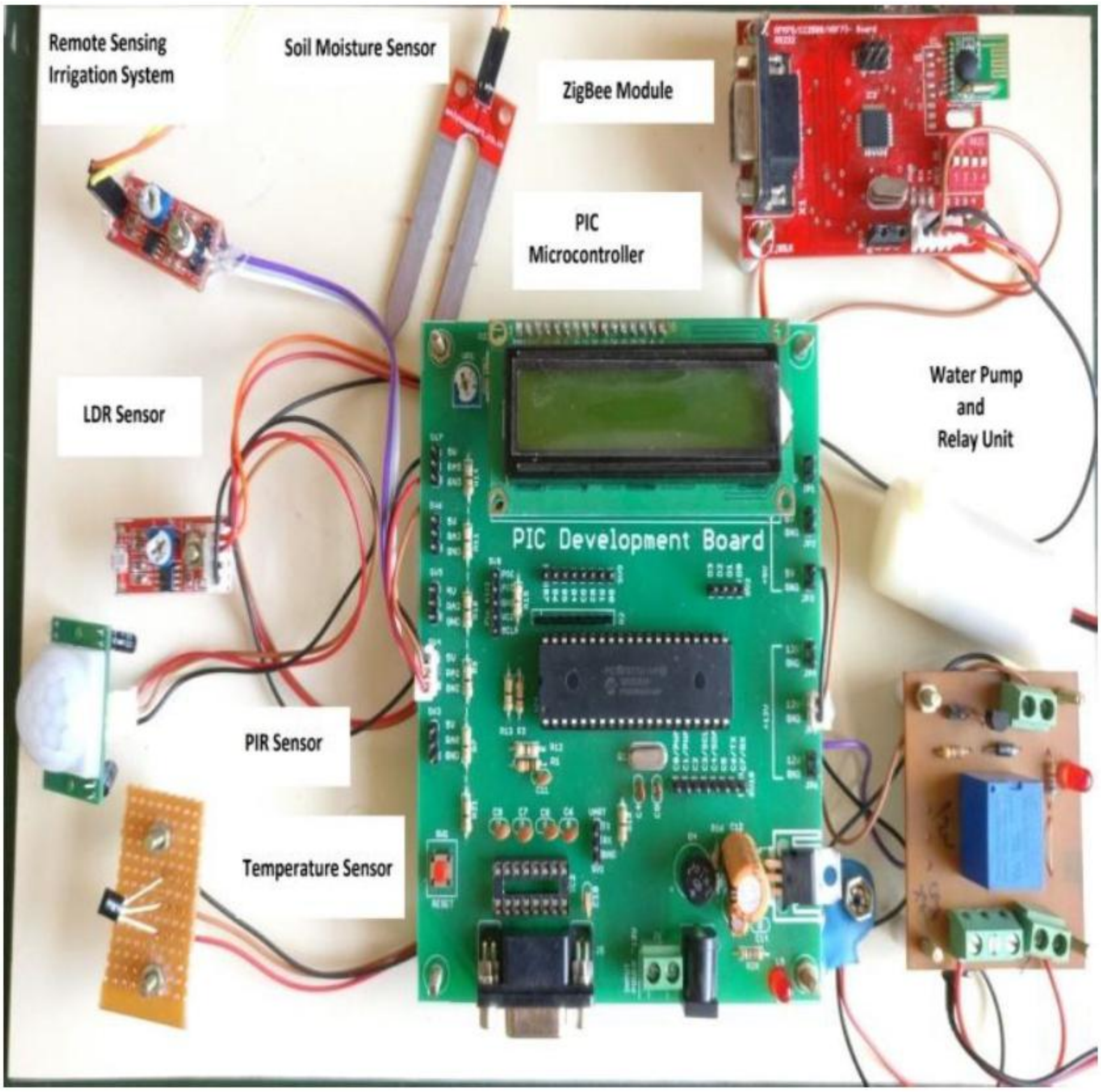

Fig.3-Implemented System

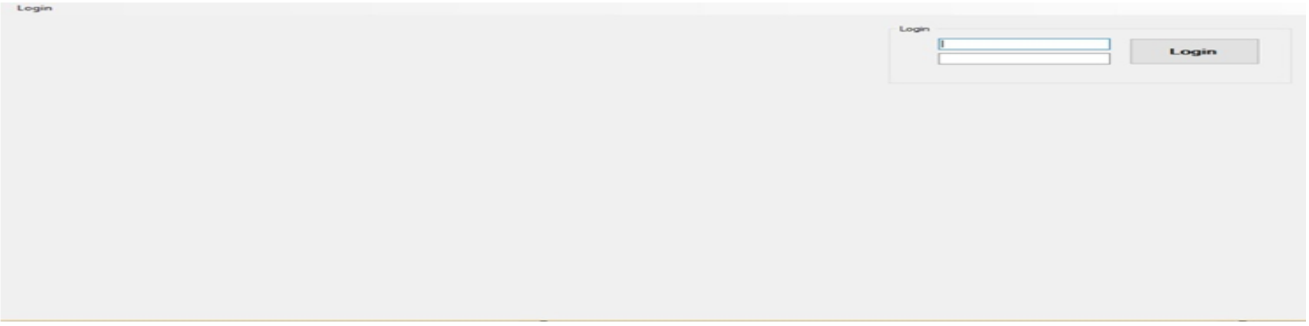

Fig.4- Login page at localhost

The local host provides a way to not only view real time data from the sensors, it also allows control over the water pump. An additional functionality of the system is that it also detects intruders using a PIR sensor[Fig.4 to Fig.6]. This sensor is a passive sensor, that is, it does not produce its own infrared radiation, but senses the radiation around it. This system can be used to help deal with a crop theft and/or a pest problem.

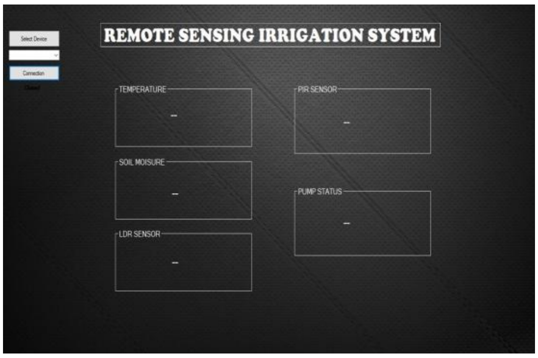

Fig.5-Localhost GUI

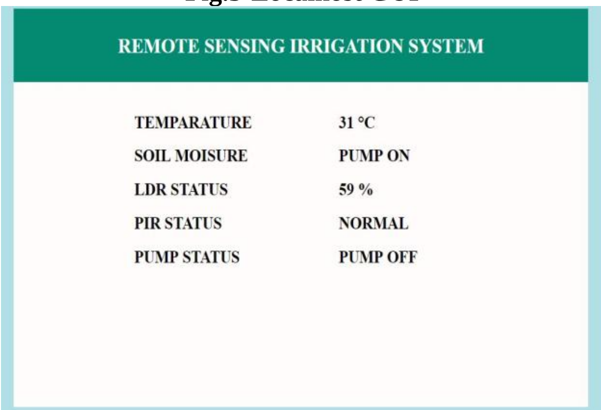

Fig6-Webpaeg

Fig. 7 shows the system in its idle state. Here the soil moisture is normal, as indicated by the "NOR" displayed after "S:". The temperature is 20 °C, there is no movement detected and the light dropping on the LDR sensor is around 60 %.

Once the Soil Moisture drops below a certain threshold value, the microcontroller interprets this as a dry state of soil and switches on the water pump [Fig.8] We can see that once a hand is put over the LDR sensor, the light reading goes down from 59 % to44 % as shown in Fig.9.

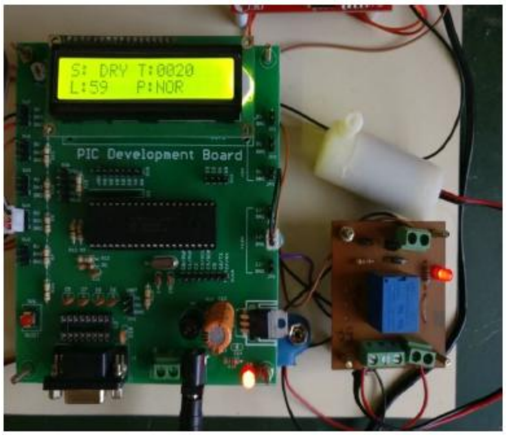

Fig7-Idle State

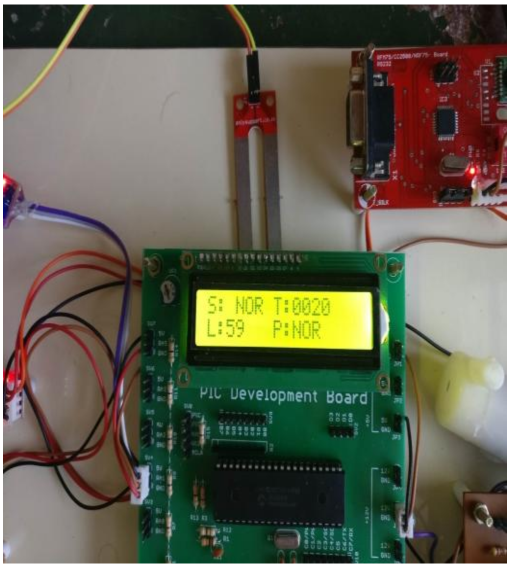

Fig.8-Dry State

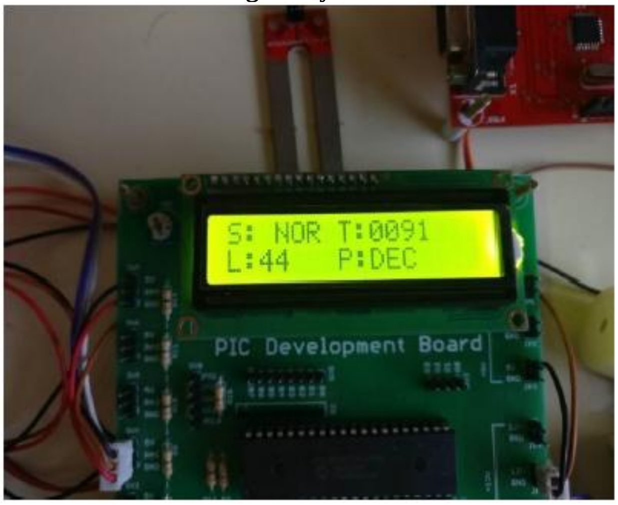

Fig.9-Dark State

As the reading in front of "P:" changes from "NOR" to "DEC", we can infer that motion has been detected by the PIR sensoras given in Fig.10

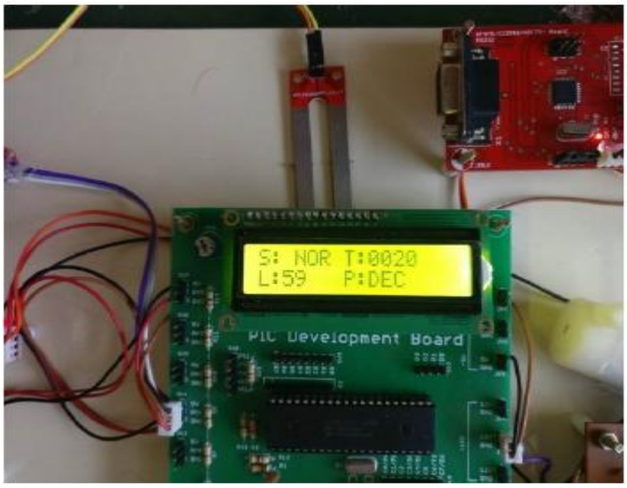

Fig.10-Motion detected

IV. CONCLUSION AND FUTURE WORK

Certain elements in this project leave scope for further development. With almost any project, a list of future enhancements could be endless. In this case, it would be more appropriate to only highlight the general areas where extra work would benefit the project.

Apart from the obvious inclusion of more sensors into the system, the next step could be to include the kind of image processing options found in the likes of Adobe Photoshop, Erdas Imagine and Visilog to detect disease in the crop and/or need for watering indicated by their wilting. Also the system could have been made more extensive and easy to use by including touch based user interface. In order to overcome some of the shortcomings of these devices like that of the short distance covered by a ZigBee module, one could employ other similar devices and employ simple hopping/routing techniques to make sure that the data reaches the localhost without any problem.

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