

IIOT Based SMART CROP PROTECTION AND IRRIGATION SYSTEM

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Abstract: This will be an integrative approach in the field of IIOT designed for perceptive Agriculture which are proceeding the arrangements in course of open source and on low powers devices [1]. This project work is to yield monitoring arrangement for farm safety against animal attacks and climate change conditions [4]. Industrial Internet of Things (IIoT) advances is frequently used in smart farming to emphasize the standard of agriculture [12]. This project work contains various sorts of sensors, controllers in addition to positioner on behalf of WSN and ARM Cortex-A board which consumes 700mA or 3W power is the main temperament of the classification. Different sensors like DHT 11 Humidity & Temperature Sensor, PIR Sensor, LDR sensor, HC-SR04 Ultrasonic Sensor and cameras are interfaced with the board. IOT devices stay adept of in case evidence around farming grounds [17]. As soon as the passive infrared sensors (PIR) go High on detecting the motion within a range of 10 meters, the camera will be turned ON which first captures an image and then starts dealing out the image, which will be warehoused onboard as well as in IoT cloud, instantaneously a message will be generated automatically towards the recorded quantity using a SIM900A module to inform about the intrusion with the data of the temperature as well as humidity obtained by dht11 which is a temperature and humidity sensor[27]. If found not to be human after processing the available information the system elevate an buzzer sound, to notify people about the intrusion. Data collected by the sensors will be given to ARM Cortex-A through the systems which can be wired or communication system. The facts in the porter is tested and harmonized with superlative values of data like value of temperature, humidity and soil moisture [30]. If the difference occurred concerning predefined threshold rate formerly announcement sends to the mobile of the farmer or to the website. The result will be generated arranged the database of the farmer's mobile to take the necessary action [4].

Keywords—: Internet of things for Industrial, Wireless sensor networks, Smart irrigation and protection, ARM Cortex-A.

Introduction

IIOT tendencies are often utilized in smart farming to boost the standard of agriculture. Farming[2], the pillar of Indian economy, subsidizes to the general commercial development of the realm. Then our productivity remains enormously diminutive as associated to world standards[31].

Societies after pastoral areas drift to an urban area for other lucrative commerce besides they can't deliberate on crofting[14]. In the opposite direction are many disadvantages of the surviving traditional agricultural methods namely

costlier and manual monitoring of the agriculture field [8]. In detail, moderate smart irrigation systems are utilized to afford the solution for dissimilar variety of plants in spite of getting the solution for moisture related issues Weather conditions like temperature, humidity and moisture are difficult to check manually frequently[4]. To overcome all these a new system is proposed constructed on cloud of Effects (IoT). Wildlife requisite overlaps personage laypeople, creating fee to inhabitants and cultivated field[7]. Wild animals regularly ruin eminence of crops, thanks to which annual production of plants reduces inflicting financial losses to the farmers[9]. The [3] low productiveness is mainly due to the reasons. The crop ruined by means of untamed animals and yield ruined by way of nature object. farmers are facing many troubles for getting greater yield because it have an contact on of untamed animal attacks[8], small types of species, insects, some hazardous snakes and weather circumstances[6]. Within the existing system, electrical protection is used to give up untamed animal assaults on vegetation which leads to the death of animals[6]. The surveillance and monitor of the tiny species, bugs and snakes are tough because of their aspect and flora of effort. A famous wild animal protection practice for that can ultimate for many Fencing is years[23]. However, utilising fences as a exercise is often regulated. Some neighborhood and nation entities might also preclude or forestall the use of sure sorts of. Some local and state entities may possibly confine or avoid the use of certain sorts of fences. Therefore, before deciding on a suitable fence, it's important to check local law regulations[36]. The quality of fencing relies upon the fabric and structure. Depending on how it's made and what it's made from, some permanent fences can last up to 30 years. Electric fences; are made to inflict an electric shock to animals that come in interaction with the fence, thus preventing animals from crossing the fence[16]. These fences are durable and an effective crop protection amount[22]. Costs vary depending on specific type and size of an area. Formerly purchasing electric fences, it's very significant to make sure they are allowed for use in the specific area, and for protection against endangered animal species. Furthermore, it's suggested that electric fences are marked with a warning sign to prevent any possible human contact. Weather conditions like temperature, humidity and moisture are difficult to check manually frequently[32]. To overcome all these a new system is proposed based on Internet of Things (IoT)[12]. The purpose of this work is to grant monitoring device for crop safety towards animal attacks and climate conditions. This paper offers assessment for entire technical answer using wireless sensor community (WSN) and the cloud of Effects (IOT) to

the ranchers to hinder their plants from untamed animals. It consists of all the kinds of sensors, regulator, actuator necessary for WSN and raspberry pi as a coronary emotion of the system[34]. The fundamental objective of this assignment is to provide an fantastic answer to this problem, so that the monetary losses incurred by using our farmers are minimized and they have a accurate crop yield[26]. It helps to keep time and cash by dipping the physical exertion that is otherwise required if the farmers themselves had to provide protection to their farmlands with their constant manual supervision[30]. Wildlife requirement overlaps human population, developing value to residents and cultivated field[10]. Wild animals regularly wreck eminence crops, because of which annual manufacturing of vegetation reduces inflicting monetary victims to farmers. Within our region, farmer suicide is large hassle due to low productiveness amongst farms[29]. This low productivity is because of the fact of two most important motives i.e. Crop destroyed via untamed animals and Crop damaged by using nature object. The guide wiped out order to remain away the animals from the crops is automated, consequently such standard administration may also be an element of the earlier with such smart protection systems, which are successful of believing purchasable and enchanting the certain actions themselves except none human involvement[31]. This contest is charity to defend the farmland from beasts by approach of the use of Raspberry pi. Wild animals are exceptional mission for the ranchers during the course of the planet[15]. Animals like wild bears, elephants, monkeys etc. ,cause serious injury to crops. The ranchers will treasure these SMS containing location in whatever with the intention of flora and fauna had been observed[18]. The main objective of this assignment is to furnish an fantastic answer to this distress, as a result with the purpose of the commercial losses incurred through the support of our farmers are minimized and that they require an candid crop yield[22]. It helps to retailer time and cash via lowering the guide work .As it is now not feasible for farmers to barricade whole fields or remain on area 24 hours and defend it This gadget makes use of a movement sensor to observe wild animals imminent next to lock up to the sector[24]. In that case the sensor alerts the microcontroller to require action[3]. The microcontroller now sounds an alarm to persuade the vegetation and fauna farway from appropriately when send sms to the rancher so that the cultivator be competent of also be aware of about the issue. Alarm ensures complete security of vegetation from animals and defending the farmers loss. In the proposed system Raspberry Pi, PIR sensor, web camera, ultrasonic sensor, LDR sensor, temperature sensor, humidity sensor, moisture sensor, buzzer and monitor is used[15]. Whenever either the wild animal or some species is detected by PIR sensor it activates the web camera and then produce the alert buzzer in current location, intimates to farmer through cloud. When the moisture content is inferior to a terrifying level which can be determined by the sensor planted in the turfs, which is automated the water pumps are switched on[33]. This ensures complete safety of crops from animals also as from the weather conditions thus prevent the farmers.

Literature Survey

IIOT tendencies are often utilized in smart farming to boost the standard of agriculture [2]. Farming the pillar of supports our country to the general commercial development. But our productivity is extremely low as associated to world standards [31]. People from rural areas drift to an urban area for other worthwhile trades and they can't concentrate on

agriculture [14]. There are many disadvantages of the current traditional agricultural methods namely costlier and manual monitoring of the agriculture field [8] . Specifically, small-scale smart irrigation systems are utilized to provide the solution for dissimilar variety of plants in spite of getting the solution for moisture related issues Weather conditions like temperature, humidity and moisture are difficult to check manually frequently [4]. Farmer suicide is turning into big problem due to low productiveness amongst farms [3]. This low productiveness is due to the fact of two main reasons, Crop ruined by means of untamed weather conditions untamed animal attacks, small types of species, insects, some hazardous snakes and weather circumstances. Within the existing system, electrical fencing is used to give up untamed animal assaults on agricultural vegetation which leads to the death of animals [6]. The fundamental objective is to provide a fantastic answer to this problem, so that losses incurred will be minimized and farmers will have an accurate crop yield [26]. This low productivity is because of the fact of two most important motives i.e. Crop destroyed via untamed animals and Crop damaged by using nature object [18]. The main objective of this assignment is to furnish a fantastic answer to this trouble, as a result with the purpose of the economic losses incurred through the support of our farmers are minimized to get truthful crop yield [22]. This ensures complete security of vegetation from animals and defending the farmers loss. In the proposed system Raspberry Pi, PIR sensor, web camera, ultrasonic sensor, LDR sensor, temperature sensor, humidity sensor, moisture sensor, buzzer and monitor are used [15]. This field of this effort remains towards withdraw to monitor the system for crop security conflicting to subconscious occurrences and meteorological conditions When the moisture content is below a critical level which is determined by the sensor planted in the fields, as the system is automated the water pumps are switched on [33]. This ensures complete safety of crops from animals also as from the weather conditions thus prevent the farmers loss.

Objective

The foremost objective of this project work is to provide an effective solution to this problem, so that the economic losses incurred by our farmers are minimized and they have a good crop yield [4]. It helps to save time and money by dropping the labour-intensive work that is otherwise required if the farmers themselves had to provide protection to their farmlands with their constant manual supervision. Wildlife requirement overlaps population, generating cost to people and to the field to cultivate. They repeatedly destroy standing crops; annual production of crops decreases producing economic losses [15].

The region we live in, farmer suicide is huge delinquent due to less productivity among the fields. This truncated of yield is due to the key reasons, the Crop ruined by barren animals and Crop ruined by climate changes [24]. The physical work done in order to stave off the animals from the crops is automated, hence such constant supervision is a thing of the past with such smart protection systems, which are capable of

identifying and captivating the essential activities themselves without any human intervention.

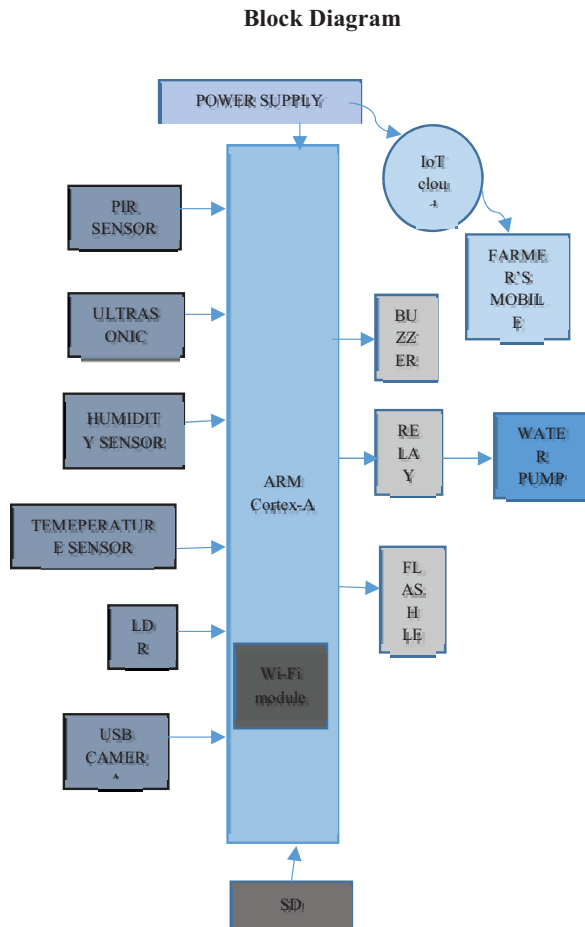


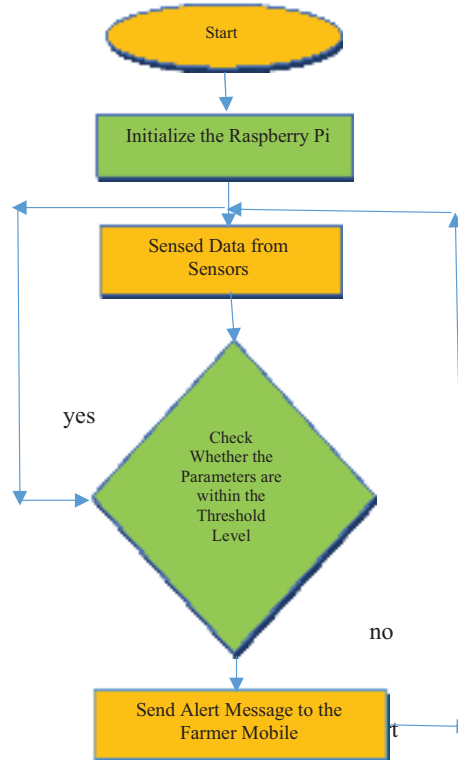
Fig. 1. Hardware block diagram

The block diagram fig contains various sorts of sensors, controllers and actuators for WSN and ARM Cortex-A board which consumes 700mA or 3W power is the main heart of the system. Different sensors like DHT 11 Humidity & Temperature Sensor, PIR sensor, LDR sensor, HC-SR04 Ultrasonic Sensor and cameras are interfaced with the board. IoT sensors are able to offering details about agriculture fields after which act upon the enter consumer [17].

Flowchart

As quickly as the PIR sensors go High on detecting movement inside a vary of 10 meters, the digital camera will be becoming ON which first captures an photo and then begins processing the picture with the assist of code given to the ARM Cortex-A and then the sensed statistics will be despatched to the Arduino.

After that the Arduino assessments whether the parameters are inside the stage or no longer if yes then it go returned and if it no longer alert message will be despatched to the mobile.



Description of components used in Design

The ARM Cortex-A is a device which consumes 700mA or 3W or power. It is driven by a MicroUSB charger or the GPIO header. Any decent smartphone charger will do the exertion of powering the Pi. SD Card: In ARM Cortex-A onboard storage is unavailable. The functioning body is loaded on an SD card which is entrenched on the SD card slot on the ARM Cortex-A. The functioning structure can be loaded using a card reader on any computer. The Status LEDs :There are 4 status LEDs on the RPi(ARM Cortex-A) that show the status of various activities as follows: "OK" - SDCard Access (via GPIO16) - labelled as "OK" on Model B Rev1.0 boards and "ACT" on Model B Rev2.0 and Model A boards "POWER" - 3.3 V Power - categorized as "PWR" on all boards Full Duplex (LAN) (Model B) - categorized as "FDX" on all boards Link/Activity (LAN) (Model B) - categorized as "LNK" on all boards "10M/100" - 10/100Mbit (LAN) (Model B) - categorized (incorrectly) as "10M" on Model B Rev1.0 boards and "100" on Model B Rev2.0 and Model A boards .The PIR Sensor, Ultrasonic sensor, Soil moisture sensor and DHT 11 Humidity & Temperature Sensor The PIR Sensor Switch Can Sense the Infrared Rays released by Human Body Motion within the Detection Area (14 Meters) and Start the Load - Light Automatically. This Unit is Suitable for Outdoor Use (Corridor, Staircase, Courtyard, etc.) The electricity is single unit of energy saved at the end-use point is equal to 2.3 units of energy formed. If energy-efficient methods are executed properly about 25000mw equivalent capacity of power can be created through raise of energy effective measures. The HC-SR04 distance sensor is usually used with both microcontroller and microprocessor platforms like Arduino, ARM Cortex, PIC, Raspberry Pie, etc. has to be

followed irrespective of computational device used [2]. The Sensor via a regulated +5V is a voltage through logic supply and Ground pins of the sensor. The current consumed by the detector is less than 15mA and later can be directly powered by the onboard 5V pins (If available) [36].

HC-SR04 Ultrasonic Sensor – Working

HC-SR04 is a 4-pin module, whose pin terms are Vcc, Trigger, Echo and Ground respectively [33]. This sensor is a very familiar sensor used in numerous applications where calculating distance or sensing objects are required. The detector works under the modest school formula i.e;

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter communicates an ultrasonic wave, this signal travels in the air and when it acquires objected by some material it gets reflected near the device this reflected wave is detected through the Ultrasonic receiver module as revealed in the representation [28] Now, to analyse the distance using the above formulae, we had better recognise the Speed and time. Then we're utilizing the Ultrasonic wave we escalate the velocity of US wave at room situations which is 330m/s. The Soil moisture sensor is the detector can be used to assessment the wetness of soil, before the soil is having water scarcity, the segment output is on high level, otherwise the output is on low level. [26] By consuming this device one can inevitably aquatic the flower plant, otherwise any other plants requiring reflex irrigating performance. The features are sensitivity adjustable. It has fixed bolt hole suitable installation. Threshold level can be configured. DHT11 features a temperature & humidity sensor complex with a standardized digital signal output. [13] By using the selected digital-signal acquisition technique and temperature & humidity sensing technology, it confirms high reliability and excellent long-term stability. This sensor which contains a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering brilliant quality, fast answer, anti-intrusion ability and cost-effectiveness [29].

Required Specifications: The specification required is expressed in table 1.

Table1. Specification Required

Parameter	Value
Operating Voltage	+5V dc regulated
Soil Moisture	Digital Value is indicated by out pin

Relays and its operation: Relay is a switch which is electric in nature that releases and ends under the governor of alternative electrical circuit. In the initial form, it will be functioned by an electromagnet to release or end single or several sets of contacts [20]. The basic operation of a relay is explained. Magnetic subject will probably be generated by means of a conductor at appropriate angles to the trail of electron to move along. If the electric conductor is enfolded into a coil shape, the magnetic field formed will be concerned along with the extent of the coil. [29] The greater the current,

the better the will be robustness of the magnetic field, all other factors being equal.

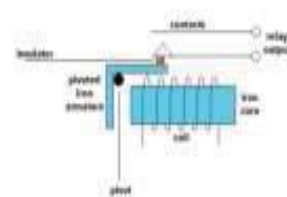


Fig.3 Relay

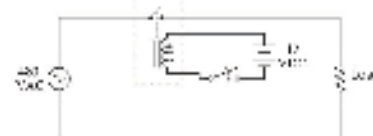


Fig.4 Inductive Relay

USB Port Camera: Web cam is needed for image capturing and video streaming applications. Here e interface web cam with Raspberry Pi and capture the picture and video as well [30]. In this work will interface Logitech web camera with Raspberry Pi. The technical Specifications are Video calling (640 x 480 pixels) with recommended system, Video capture: Up to 1024 x 768 pixels, Logitech Fluid Crystal™ Technology. Light Dependent Resistor or CdS (Cadmium Sulphide) Cell is a resistor whose confrontation declines with increasing incident light concentration. LDR can also be referred as photoconductor. A buzzer is a signalling device, generally electronic, typically used in cars(automobiles), domiciliary appliances like as per a warm up furnace. The situation 19 frequently consists of numerous set of sensors as well as switches which associated to an element to control and regulates stipulation and which brooch was pushed otherwise a pre-set time has elapsed, and usually lightens a light on the suitable buttons or control board, and sounds a cautioning trendy the custom of a continuous 2 intermittent buzzing and beeping sound. Flash LED's: The blinking LED circuit is similar to the electronics form of the "HelloWorld"-program. It is a modest electronic circuit that gives you a visual sign if it works. The aim is to make a Light Emitting Diode (LED)blink This LED specification is of precise significance when a LED or LEDs are to be used for lighting requests. It's no longer as serious when the LED is used as an indicator - right here a catastrophic failure is of increased importance. The LED specification for its operational lifestyles is usually described in the following: L70% = Time to 70% of lighting and L50% = Time to 50% of lighting. The necessities states that all through these occasions, the LED must no longer show off any fundamental shifts in chromaticity. The cause in the back of these figures is that 70% lumen upkeep equates to a 30% discount in mild output. This is round to decide for the edge for noticing gradual markdowns in gentle output.

Power supply: Power supply is a spring of electrical influence. A scheme or coordination that provisions electrical 18 or extra brands of liveliness to a yield capacity or cluster of heaps is termed an influence resource entity or PSU. Now this segment we must Modifier, Channel rectifier, in addition to current managers for +5V in accumulation to +12V (7805

and 7812) through a capacitor (1000 μ F) in similar are associated equivalent as revealed in the path illustration inferior to. Each voltage regulator output is again is connected to the capacitors of values (100 μ F, 10 μ F, 1 μ F, 0.1 μ F) are associated equivalent finished which the equivalent output (+5V or +12V) are reserved hooked on deliberation.

II. Working principle

The main device in this project is ARM Cortex-A. USB port camera and different sensors are interfaced to the board like DHT 11 Humidity & Temperature Sensor, PIR sensor, LDR sensor, HC-SR04 Ultrasonic Sensor[9]. As soon as the PIR sensors go High on detecting motion within a range of 10 meters, the camera will be turned ON which first captures an image and then starts processing the image, which will be stored onboard as well as cloud, simultaneously a message shall be produced mechanically to the recorded mobile number utilizing a SIM900A module to tell concerning the intrusion together with the small print of inversion and humidity bought by interfacing dht11 temperature and humidity sensor [7]. If motion detection is on account of animals, authorized persons, who are mostly farmworkers their attendance gets recorded automatically [7]. If identified it is not a human after processing the available information the arrangement rises an alarm, to notify people about the intrusion [15]. But if the intruder is an animal, the system takes action on the PIR sensors that have gone high. If we categorize it as an intrusion due to smaller animals like deer or wild pig and hence turn ON the DC motor which controls the nozzle of the rotten egg spray unit [6]. If the PIR sensor is active high then the camera which is mounted with farm will switch on mechanically, buzzer turns on, and at present an alert message will likely be given to the farmer concerning the animal intrusion [4]. With field, numerous sensors are organized like sensor which supplies information approximately moisture material with soil, Temperature - Humidity sensor, and digicam for detecting traits of the soil [11]. Information serene from the sensors are amassed and ship it to ARM Cortex-A by means of devices which can be wired or wireless [36]. In server-side information is checked and then harmonized with idyllic values from the sensors and gives the values of temperature, humidity value, and soil moisture value [2]. If the variation befell in regards to the assessment threshold then notifies to the cellular of the farmer or to the webpage with the productiveness of sensors This ensures complete protection of plants from animals also as from the weather conditions thus avoid the farmers loss [13]. Raspbian may be a free OS supported Debian improved for the Arm Cortex-A hardware It utilities that make your Raspberry Pi run. However, Raspbian provides quite a pure OS: it comes with over 35,000 packages pre-compiled software bundled during a nice format for straightforward installation on your Raspberry Pi [35]. The initial build over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian remains under active development with a stress on improving the steadiness and performance of as many Debian packages as possible. Raspberry Pi's operating system, the SD card understands (the OS is the software like Windows on Personal Computer or on a Mac). This

is frequently diverse as of the most systems that's what many of us are setting the ARM Cortex-A. This is actually very straightforward.

The subsequent directions for Windows users.

Take the ARM Cortex-A functioning system (the recommended OS is called Raspbian) then Extract the files. Select the corresponding file and then indicate "Extract all" from it. Follow the instructions—you will find culmination(.img). This image file can only be written to your SD by distinct disk software for imaging. 1.7.2 Download the Win32DiskImager software. Download win32diskimager-binary. Unzip it within the same way you perhaps done the Raspbian .zip file by mistake. Write the Raspbian code to the SD card which is inserted. file name Win32DiskImager.exe should be executed in Windows Vista, 7 and 8 were recommend then click this file and choose "Run as administrator"). You'll see something like this:



Fig. 5 Win32 disk imager

Insert the SD card into the PC .Then make a step within the folder you 3(b), The SD card (Device) you are using isn't originate instinctively and then select down box and click on it. And choose Raspbian image file which has been simply downloaded Inside the Image File box.

The click Write. After a couple of minutes, you'll partake a SD card which you simply can use in your ARM Cortex-A. The primary time for Striking your Raspberry Pi .Here insert SD card in to raspberry pi b+ board. Firstly, boot it and the you can see originate over the configuration of raspi window and modify the settings such as time in pc and location if you want. Lastly, expand _rootfs and say 'yes' to a reboot . The Raspberry Pi will reboot and you'll see raspberrypi login[1]. The IDLE is that the standard Python development environment its name is an acronym of "Integrated Development environment". It works on both Unix and Windows platforms. it's a Python shell window, which provides you access to the Python interactive mode. It also features a file editor that allows you to create and edit existing Python source files. The IDLE is included with the Raspbian image.



Fig 6: Python shell

Here Start the Programming With IDLE and Track IDLE which will open the Python Shell window. Then select Menu > File > New Window. Then to run it select Menu > Run > Run Module then see you see the program which is appeared in the Python Shell window.

Python Shell window Figure.1.7.6: Python shell Starting Programming with IDLE: Run IDLE which can open the Python Shell window. Select Menu > File > New Window To run it select Menu > Run > Run Module and see the program appear in the Python Shell window. Python Shell window Start IDLE (see screen above).And then we can identify a window entitled "Python Shell"

- From the Python Shell window, select New Window from the File menu.
- You will see a window entitled "Untitled"
- From the File menu, select Save As, and select a folder to save your Python program file.



Fig. 7: File menu

- Select a folder to save your file in.
- In the File name: text box, type: program1.py
- Then tap on the save button. You will then see a clean editor window equipped for you to
- type in your Python application
- To run this program, select Run Module from the run menu you should see a reminder to save the Source (your program).
- Click on okay to save. Then you'll see your program running during a Python Shell window.

Result and discussion

The fundamental objective is to provide a fantastic answer to this problem, so that losses incurred will be minimized and farmers will have an accurate crop yield. As it is now not feasible for farmers to barricade whole fields or remain on area 24 hours and defend it this gadget makes use of a movement sensor to observe wild animals imminent next to lock up to the sector. Here it is presented an integrative method by the Internet of Things for smart Agriculture in an industrial level based on low powers campaigns and MATLAB is mostly used for the aim of technical computing and expressed in acquainted mathematical notation[39]. But here in this paper Python, which is a high-level programming language is considered. It can run on all of the working methods so it is efficient than MATLAB which is used earlier. As it is now not feasible for farmers to barricade whole fields or remain on area 24 hours and defend it. So, this gadget makes use of a movement sensor to observe wild animals imminent next to lock up to the sector. It consists of all the kinds of sensors, regulator, actuators required and raspberry pi as a coronary heart in this paper [34]. In the

proposed system on Raspberry Pi, all sensors are mounted together in a single phase when compared to the other systems, it is specially designed to be simple to learn and really easy to implement. It helps to preserve stretch and cash by reducing human labor, otherwise required if the farmers themselves had to provide protection to their farmlands with their constant manual supervision.

Conclusion

The agriculture irrigation control stays unique of the determined significant interests in agriculture [1]. This study mainly focused. The simulation result defines the water usage according to the field parameters in the agricultural field [14]. The hardware implementation and irrigation control through Android phone. We presented an integrative approach in the field of Internet of Things for smart Agriculture in an industrial level based on low powers campaigns and emergent cause procedures [27]. This field of this effort remains towards withdraw to monitor the system for crop security conflicting to subconscious occurrences and meteorological conditions [35].

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