

Environment Friendly Pest Control

Pooja M S, Shilpashree M, Srilakshmi B G, Sushma J, Swathi K

Department of Electrical and Electronics Engineering, Vidya Vikas Institute of Engineering and Technology, Mysuru, Karnataka, India

Abstract: - A pest is a animal or plant detriment to human or human concerns including crops, livestock and forestry. Pest cause damage to agriculture by feeding on crops or parasitizing livestock such as codling moth on apple or boll weevil on cotton.

There are 68000 insect species, 40000 species of fungus and many more microorganisms, the large proportion of which alter the normal development of plant. Food must be produced to sustain a growing world population. Globally one third of species are lost due to pests, weeds and diseases. According to a global pest damage record about 38% of cereals, 32% of irish potato, 45% of vegetables and 29% of citrus, grapes and other fruits are damaged due to pests. Eradicating of pests using chemically composed pesticides causes damage to agriculture and are not safe for consumers.

Hence we proposed project with title 'ENVIRONMENT FRIENDLY PEST CONTROL' which is solar driven and uses piezoelectric transducer and ultrasonic repeller device to repel the pests away from the crops.

Since we use solar power and sensor crop management becomes much simpler and economical. The solar energy system and low power repeller circuit driven by harvested solar energy has been employed in the proposed system to replace the use of chemical repellents. The sun tracking system has been employed to improve the efficiency of solar panel to recharge the batteries which are capable of driving the repeller during night time. The proposed repeller system will be ON for 11 hours (6 P.M- 5 A.M). The proposed system consumes very low power of 0.735W and covers the large area of 255 square meters.

Environment monitoring is an IOT application which helps to monitors the environment condition of any locality or surrounding and the condition can be viewed by everybody with the help of internet. This application is more effective, rapid in providing environment conditions. It helps the individuals or government to take remedial actions if the condition of the environment becomes abnormal.

I. INTRODUCTION

1.1 Introduction

Agriculture in India is still carried out in conventional way and lags behind in integrating modern technologies. Around 55% of Indian population has been engaged in agriculture and allied activities which constitute only 15% of GDP so it becomes much important for the stockholders involved to come out of the conventional agricultural practices and modernize the agriculture using technology. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth while large number of people continues to work in agricultural sector. Hence, there is an

immediate need to improve the system, which can increase the yield and produce healthy organic food.

A. Problems faced in agricultural sector

More than one million species of insects are present in this world. out of these, ten thousand species are responsible for crop eating. About 700 species of these can cause epidemic loss to the medicinal plants and crops. Insects are divided to two groups

1. Biting insects- grass hopper, corn earworm

They bite seeds, stem, fruits and leaves.

2. Sucking insects-mosquitoes and butterflies

They suck instead of biting

There were different methods employed to eradicate harmful pests. One of those oldest method was cultural control of pest. This method had been used to manage pest population. They are dependent on long range planning. Also they are dependent on knowledge of bio-ecology of crop-pests which were poorly understood. With development of synthetic pesticides these controls their rapidly abandoned because farmers were won over reliable and less knowledge and skill dependent toxic chemical solution to pest problems.

A pesticide is any substance used to kill, repel, or control certain forms of plant or animal life that are considered to be pest. Pesticides include herbicides for destroying weeds and other unwanted vegetation, insecticides for controlling a wide variety of insects, fungicides used to prevent growth of molds and mildew, disinfectants for preventing the spread of bacteria, and compounds used to control mice and rats.

Pesticide can enter the human body through inhalation, ingestion, or by dermal penetration through the skin. It cause headaches, blurred vision, vomiting, suppress the immune system, lead to blood and liver diseases and nerve damage. The issue with these effect is that they may wait appear until a while after being ingested so tracing the symptoms back to the pesticide can be difficult. The pesticides bioaccumulate with in the animals as they are not easily soluble, as that animal will be eaten by another animal the pesticide then biomagnifies and obtains higher concentration as it moves further up the food chain.

B. Introduction to pest control model

All the above mentioned aspects of present agricultural practices should be improved to get higher yield.

Hence we move towards environment friendly pest control model where the plant is provided with an environment for its optimum growth.

Proposed model is used to repel the insects using ultrasonic repeller device and reduce the use of chemical pesticides. Solar Power is our term for all encompassing solar options to help you Green Your Grow. Clean, green and silent, Solar Power will help you cut your fuel usage or reduce your grid electricity usage and save money over time. Solar Power is the ultimate sustainable power option to Green Your Grow. Humidity and temperature of air is measured by sensor and whenever temperature is high or air moisture becomes too low, the sensors are turned on to provide the required moisture and cool down the temperature.

The Internet of Things (IOT) is an environment in which things, animals or individuals are provided with unique identifiers and the capability to transmit data over a network without requiring human-to-human or else human-to-computer interaction.^{1,4} IOT has evolved from the convergence of wireless technologies and the Internet. The concept may also be referred to as the Internet of Everything. In IOT the module that has wired sensor scan be used to alert the people in abnormal conditions.

Environment monitoring is an IOT application which helps to monitors the environment condition of any locality or surrounding and the condition can be viewed by everybody with the help of internet. This application is more effective, rapid in providing environment conditions.⁶ It helps the individuals or government to take remedial actions if the condition of the environment becomes abnormal

The solution adopted by us are well explained in detail in the following sections.

1.2 Motivation of the Project

- Our main motto is to reduce the use of chemical pesticides which are adversely effecting the crops and mankind.
- We are proposing smart agricultural system in order to overcome the problems faced by farmhand in maintaining the crop.
- There is a strong need to harvest and utilize solar energy.
- With the advancement of technology we can control and monitor the field so that we can maximize the production and obtain profitable income.

II. LITERATURE REVIEW

2.1 Literature survey

1. Village in Mandya called Marakadu Doddi:2018(November)

Methods that were used to control the insects like mosquitoes in olden days are use of citronella candle or torch. The smoke in the air may help keep away some insects or

mosquitoes over a certain lengthy of area. Another method is burning other essential oil. The essential oil like lemon eucalyptus, lavender, lemongrass oil or catnip can be used. The smoke from the campfire will help to deter mosquitoes and other flying pests. Later many commercial sprays were came into the market. The only problem with these is that they contain the harmful chemical DEET. For years DEET has been touched as being an effective mosquito repellent. The use of these things will cause nerves breakdown, increase blood pressure and also ravage the crops in the fields. In order to overcome these circumstances 'smart agricultural system based on crop maintenance and helping farmhands' model is proposed. The proposed system is harmless to human beings as it produces ultrasonic sound waves by utilizing piezoelectric effect to repel the mosquitoes.

2. Maninder Singh [IEEE conference 2016 October]

According to the survey automation reduces the land required for farming, it benefits farmer in obtaining maximum yield which results in reasonable profit, the research paper submitted by Dr. Krishnamurthy briefs about the utilization of proposed technology informing, the optimal utilization of controlling sector which is arduino this project helps for better monitoring of the entire system Automation solution which senses, process and store temperature values manage temperature by comparing the measured values with the expected ones and take action if it is necessary. Solar energy driven arduino based smart repeller system is introduced. The solutions aims are flexibility, maintainability and usefulness.

3. Yurduseven [International symposium on communication system 2012]

A parabolic reflector antenna design for the digital satellite communication systems for Utilization of cassesgrain feed parabolic antenna design increasing the efficiency of photovoltaic module. A design and implementation of a single axis solar tracker with diffuse reflector. By the above papers we have taken things for our project.

2.2 Outcome of literature survey

Methods that were used to control the pests in olden days is studied. In order to overcome the difficulties faced and need to modernize the agricultural system is observed. Solar energy driven Arduino based smart repeller system is introduced. Design and implementation of solar tracking system.

2.3 Problem Statement

Farming in India is done using the mundane ways. The fact that most of our farmers lack proper knowledge makes it even more erratic. A large portion of farming and agricultural activities are based on the predictions, which at times fail. Farmers have to bear huge losses and at times they end up committing suicide. Since we know the benefits of proper soil moisture and its quality, air quality and irrigation, in the growth of crops, such parameters cannot be ignored.

Indian farmers are hard at work. However, as most organic farmers would agree, in the natural technique of farming, pest management is a lot more important than the eliminating pests completely. According to a study by the Associated Chambers of Commerce and Industry of India, annual crop losses due to pests and diseases amount to Rs 50000 crores, which is significant in our country where at least 200 million Indians go to bed hungry every night

Places like Punjab, which receive ample amount of water through river and canal irrigation system, faces problem of soil salinity due to excess irrigation. Places with limited water supply like Rajasthan, faces problem of acute water storage for agriculture.

Excess use of fertilizer, insecticides and pesticides makes the soil depend on them, erodes fertility, increase resistance in insects and pests, pollutes ground water and nearby water bodies when it rains.

Different plants require different amount of moisture, humidity, temperature and lack of awareness of this information or negligence of a person cultivating land can cause plant to die before maturity.

As the benefits of crop protection are so significant we are proposing our project in order to overcome the above problems. The solar energy is a renewable source of energy which can help in reducing the energy crisis in the world. Therefore, there is a strong need to harvest and utilize solar energy. With the advancement of technology we can control and monitor the field using automation, it is possible to maximize the production and obtain profitable income under a single roof.

2.4 Earlier Pest Control Methods

Pest control is the regulation or management of a species defined as a pest, a member of the animal kingdom that impact adversely on human activities. The human response depends on the importance of the damage done, and will range from tolerance, through deterrence and management, to attempts to completely eradicate the pest. Pest control measures may be performed as part of an integrated pest management strategy.

In agriculture, pests are kept at bay by cultural, chemical and biological means. Ploughing and cultivation of the soil before sowing reduces the pest burden and there is a modern trend to limit the use of pesticides as far as possible. This can be achieved by monitoring the crop, only applying insecticides when necessary, and by growing varieties and crops which are resistant to pests. Where possible, biological means are used, encouraging the natural enemies of the pests and introducing suitable predators or parasites.

In homes and urban environments, the pests are the rodents, birds, insects and other organisms that share the habitat with humans and that feed on and spoil possessions.

Control of these pests is attempted through exclusion, repulsion, physical removal or chemical means. Alternatively, various methods of biological control can be used including sterilisation programmes.

❖ Cultural methods:

➤ Biological pest control:

Biological pest control is a method of controlling pests such as insects and mites by using other organisms. It relies on predation, parasitism, herbivory or other natural mechanisms, but typically also involves an active human management role. Classical biological control involves the introduction of natural enemies of the pest that are bred in the laboratory and released into the environment. An alternative approach is to augment the natural enemies that occur in a particular area by releasing more, either in small, repeated batches, or in a single large-scale release. Ideally, the released organism will breed and survive, and provide long-term control. Biological control can be an important component of an integrated pest management programme.



Fig 2.1 Biological Pest control

➤ Cultural control :

Mechanical pest control is the use of hands-on techniques as well as simple equipment and devices that provides a protective barrier between plants and insects. This is referred to as tillage and is one of the oldest methods of weed control as well as being useful for pest control; wireworms, the larvae of the common click beetle, are very destructive pests of newly ploughed grassland, and repeated cultivation exposes them to the birds and other predators that feed on them

➤ Trap cropping:

A trap crop is a crop of a plant that attracts pests, diverting them from nearby crops. Pests aggregated on the trap crop can be more easily controlled using pesticides or other methods. However, trap-cropping, on its own, has often failed to cost effectively reduce pest densities on large commercial scales, without the use of pesticides, possibly due to the pests' ability to disperse back into the main field.

➤ *Pesticides:*

Pesticides are applied to crops by agricultural aircraft, tractor-mounted [crop](#) sprayers or as seed dressings to control pests. However, successful control by pesticides is not easy; the right formulation must be chosen, the timing is often critical, the method of application is important, adequate coverage and retention on the crop are necessary. The killing of natural enemies of the target pest should be minimised. This is particularly important in countries where there are natural reservoirs of pests and their enemies in the countryside surrounding plantation crops, and these co-exist in a delicate balance. Often in less-developed countries, the crops are well adapted to the local situation and no pesticides are needed. Where progressive farmers are using fertilisers to grow improved crop varieties, these are often more susceptible to pest damage, but the indiscriminate application of pesticides may be detrimental in the longer term.

The efficacy of chemical pesticides tends to diminish over time. This is because any organism that manages to survive the initial application will pass on its genes to its offspring and a resistant strain will be developed. In this way, some of the most serious pests have developed resistance and are no longer killed by pesticides that used to kill their ancestors. This necessitates higher concentrations of chemical, more frequent applications and a movement to more expensive formulations.

Pesticides are formulated to kill pests, but many have detrimental effects on non-target species; of particular concern is the damage done to honey-bees, solitary bees and other pollinating insects and in this regard, the time of day when the spray is applied can be important. The widely used neonicotinoids have been banned on flowering crops in some countries because of their effects on bees. Some pesticides may cause cancer and other health problems in humans, as well as being harmful to wildlife. There can be acute effects immediately after exposure or chronic effects after continuous low-level, or occasional exposure. Maximum residue limits for pesticides in foodstuffs and animal feed are set by many nations



Fig 2.2 spraying pesticides

➤ *Physical pest control:*

Physical pest control involves trapping or killing pests such as insects and rodents. Historically, local people or paid rat-catchers caught and killed rodents using dogs and traps. On a domestic scale, sticky flypapers are used to trap flies. In larger buildings, insects may be trapped using such means as pheromones, synthetic volatile chemicals or ultraviolet light to attract the insects; some have a sticky base or an electrically charged grid to kill them. Glueboards are sometimes used for monitoring cockroaches and to catch rodents. Rodents can be killed by suitably baited spring traps and can be caught in cage traps for relocation. Talcum powder or "tracking powder" can be used to establish routes used by rodents inside buildings and acoustic devices can be used for detecting beetles in structural timbers

➤ *Fumigation:*

Fumigation is the treatment of a structure to kill pests such as wood-boring beetles by sealing it or surrounding it with an airtight cover such as a tent, and fogging with liquid insecticide for an extended period, typically of 24–72 hours. This is costly and inconvenient as the structure cannot be used during the treatment, but it targets all life stages of pests.

➤ *Sterilization:*

Populations of pest insects can sometimes be dramatically reduced by the release of sterile individuals. This involves the mass rearing of a pest, sterilising it by means of X-rays or some other means, and releasing it into a wild population. It is particularly useful where a female only mates once and where the insect does not disperse widely.

2.5 Objective

Our objective is to protect the crops from being harmed by the pests and to establish control and monitor the agricultural field in all-weather condition it also employs to utilize the solar energy so as to yield the maximum profit. Automation system is the technical approach in which the farmers in the rural areas will be benefitted by automatic monitoring and control of field environment. It replaces the direct supervision of the human. It also focuses on the generic architecture which can be applied for much other automation application.

Ultrasonic repeller system used is a constant irritation to pests because the high pitched noise affects their central nervous system and causes them physical discomfort. Generally the emissions are silent to most humans. Agricultural field monitoring and controlling project is used to measure the various parameters like Temperature, Humidity and Light and to display them on a LCD. Temperature, Humidity and light are sensed by respective sensors. Sensor output is amplified and given to analog to digital converter. Micro-controller controls these parameters and keeps them at some predefined levels using relay interface. Appropriate environmental conditions are necessary for optimum plant

growth, improved crop yields, and efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected at high frequency with less labor requirements.

We, therefore, have come up with a new idea of crop monitoring and smart farming using IoT. We believe that our concept will be a benchmark in the agribusiness due to its reliability and remote monitoring. Our idea tries to digitalize farming and agricultural activities so that the farmers can check on the requirements of the crops and accurately predict their growth. This concept will surely accelerate their business to reach new heights and also be more profitable. The implementation of our project largely depends upon the awareness among farmers, which, we believe will be easily created due to its numerous advantages.

III. DESIGN OF HARDWARE

3.1 Components

Solar panel: solar energy from the solar panel is the main source of energy to drive the proposed system. Solar panel employed in the proposed system has the power rating of 9W solar panel with maximum output voltage of 18V and maximum current of 500mA which is used to charge the rechargeable lead acid battery.



Fig 3.1.1 Solar panel

- **Mirror parabolic dish:** A parabolic reflector is a reflective surface used to collect or project energy such as light, sound, or radio waves. Its shape is a part of a circular paraboloid that is the surface generated by a parabola revolving around its axis. Parabolic reflector transforms an incoming plane wave into a spherical wave converging towards the focus. Parabolic reflector function due to the geometric properties of the paraboloid shape: any incoming ray that is parallel to the axis of the dish will be reflected

to a central point. Because many types of energy can be reflected in this way, parabolic reflectors can be used to collect and concentrate energy entering the reflector at a particular angle. Similarly, energy radiating from the focus to the dish can be transmitted outward in a beam that is parallel to the axis of the dish.

Reflectors are used to collect energy from a distant source. Since the principle of reflection are reversible, parabolic reflectors can also be used to focus radiation from an isotropic source into a narrow beam.

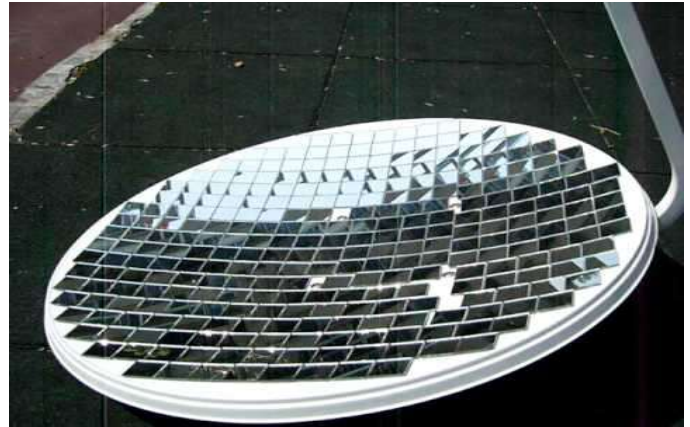


Fig 3.1.2 Mirrored parabolic dish

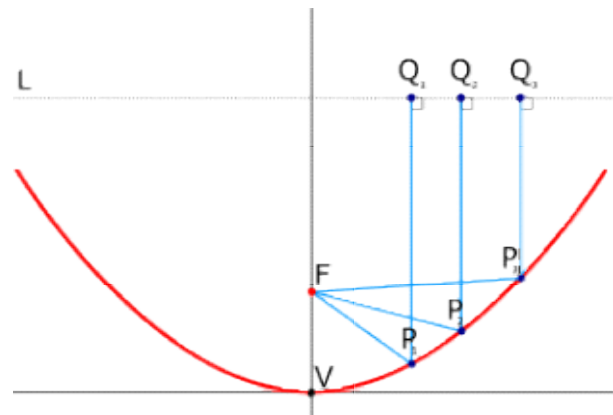


Fig 3.1.3 parallel rays coming into a parabolic dish

- **LM7812, LM7809, LM7805 (Voltage Regulator) :** A voltage regulator is used to regulate voltage level. When a steady, reliable voltage is needed, then voltage regulator is the preferred device. It generates a fixed output voltage that remains constant for any changes in an input voltage or load conditions. It acts as a buffer for protecting components from damages. A voltage regulator is a device with a simple feed-forward design and it uses negative feedback control loops. There are mainly two types of voltage regulators: Linear voltage regulators and switching voltage regulators; these are used in wider

applications. Linear voltage regulator is the easiest type of voltage regulators. It is available in two types, which are compact and used in low power, low voltage systems.

The solar panel is connected to LM7812 via capacitor 0.1 μ F. This capacitor is used to smoothen the transients from electrical output of solar panel. This LM7812 is a three terminal positive voltage regulator and it provides the constant output voltage of +12V. LM7809 and LM7805 provide regulated voltage of +9V and +5V respectively. LM78XX is shown in below figure.

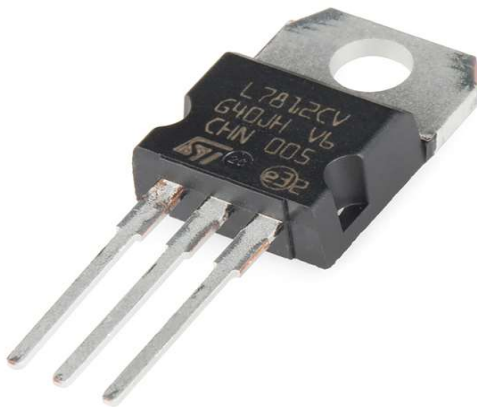


Fig 3.1.4 voltage regulator

- **Gear motor:** a gear motor is a specific type of electric motor that is designed to produce high torque while maintaining low horsepower, or low speed, motor output. Gear motor can be found in many different applications, and probably used in many devices in our home. Gear motor uses the basic principles of speed reduction to increase torque or force. A gear motor can be either AC or DC most of the gear motors have an output of 1200 to 3600 revolution per minute. These type of motors also have two different speed specifications: normal speed and the stall-speed torque specifications.



Fig 3.1.5 Gear motor

- **Motor drive module – L298N:** The L298N is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic level and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage. The module can be applied to:
 - Drive DC motors. Since the module uses a dual H-bridge drive, it can drive two motors at the same time.
 - Drive stepping motors. It can also drive two stepping motors synchronously.

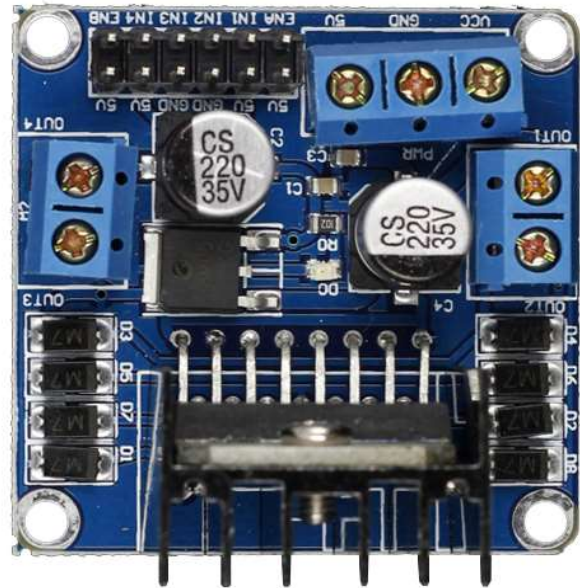


Fig 3.1.6 Motor drive

Features of motor drive:

- 1) High operating voltage, which can be up to 40 volts.
- 2) Large output current, the instantaneous peak current can be up to 3A.
- 3) With 25W rated power.
- 4) Two built in H-bridge, high voltage, large current, full bridge driver, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads.
- 5) Using standard logic level signal to control.
- 6) Able to drive a two-phase stepper motor or four-phase stepper motor, and two-phase DC motors.
- 7) Adopt a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load, enhancing reliability

- 8) The module can utilize the built-in stabilivolt tube 78M05 to obtain 5v from the power supply. But to protect the chip of the 78M05 from damage, when the drive voltage is greater than 12v, an external 5v logic supply should be used.
- 9) Drive voltage: 5-35V; logic voltage: 5V
- 10) PCB size: 4.2 x 4.2 cm

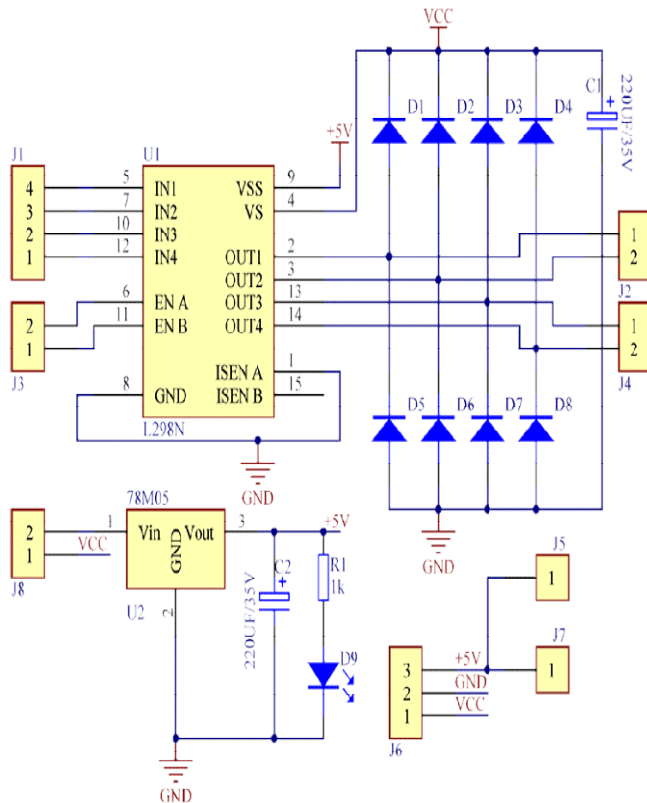


Fig 3.1.7 Schematic diagram of motor module

Pin function:

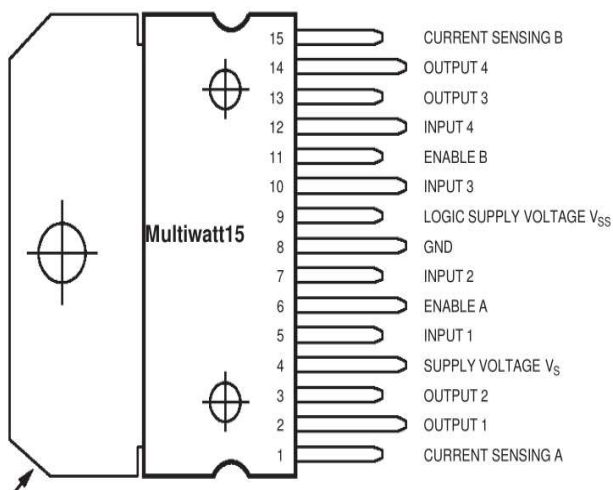


Fig 3.1.8 pin function

Principle:

ENA ^⓪	IN1 ^⓪	IN2 ^⓪	The State of DC Motor A ^⓪
0 ^⓪	X ^⓪	X ^⓪	Stop ^⓪
1 ^⓪	0 ^⓪	0 ^⓪	Brake ^⓪
1 ^⓪	0 ^⓪	1 ^⓪	Rotate Clockwise ^⓪
1 ^⓪	1 ^⓪	0 ^⓪	Rotate Counterclockwise ^⓪
1 ^⓪	1 ^⓪	1 ^⓪	Brake ^⓪

Fig 3.1.9 Table for control mode and state of motor

Pin ^⓪	Name ^⓪	Description ^⓪
1; ^⓪ 15; ^⓪	Sense A; ^⓪ Sense B; ^⓪	The sense resistor is connected between this pin and ground to control the current of the load. ^⓪
2; ^⓪ 3; ^⓪	Out 1; ^⓪ Out 2; ^⓪	Outputs of the Bridge A; the current that flows through the load connected between these two pins is monitored at pin 1. ^⓪
4 ^⓪	V_s ^⓪	Supply Voltage for the Power Output Stages. ^⓪ A non-inductive 100nF capacitor must be connected between this pin and ground. ^⓪
5; ^⓪ 7; ^⓪	Input1; ^⓪ Input2; ^⓪	TTL Compatible Inputs of the Bridge A. ^⓪
6; ^⓪ 11; ^⓪	Enable A; ^⓪ Enable B; ^⓪	TTL Compatible Enable Input: the L state disables the bridge A (enable A) and/or the bridge B (enable B). ^⓪
8 ^⓪	GND ^⓪	GND ^⓪
9 ^⓪	V_{ss} ^⓪	Supply Voltage for the Logic Blocks. A100nF capacitor must be connected between this pin and ground. ^⓪
10; ^⓪ 12; ^⓪	Input3; ^⓪ Input4; ^⓪	TTL Compatible Inputs of the Bridge B. ^⓪
13; ^⓪ 14; ^⓪	Out 3; ^⓪ Out 4; ^⓪	Outputs of the Bridge B. The current that flows through the load connected between these two pins is monitored at pin 15. ^⓪

Fig 3.1.10 Table for L298N pin functions

- **Temperature and humidity sensor:** Temperature and humidity sensor are used to measure humidity and temperature. When temperatures rise above a certain level, microcontroller will trigger relay. Both sensors are often applied in combination to reduce cost. Humidity sensor senses, measures and reports both moisture and air temperature. Humidity sensors work by detecting changes that alter electrical currents or temperature in the air.

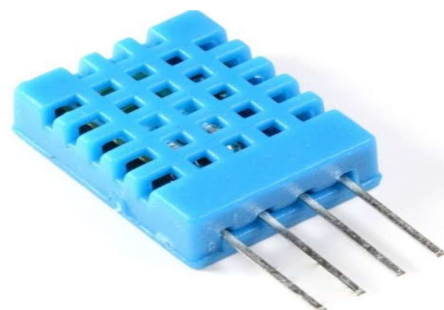


Fig 3.1.11 Humidity sensor

A temperature sensor is a device that detects and measures hotness and coolness and converts it into an electrical signal. Temperature sensors including thermistor, RTD's, thermocouples etc are designed for efficiency and easy installation, with capacity to reliably integrate technology that responds to human behavior.



Fig 3.1.12 Temperature sensor

➤ *Soil moisture sensor:*

soil moisture sensor measures the volumetric water content in soil. Since the direct measurement of soil moisture requires removing, drying, and weighting of a sample, soil moisture sensor measures volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity.

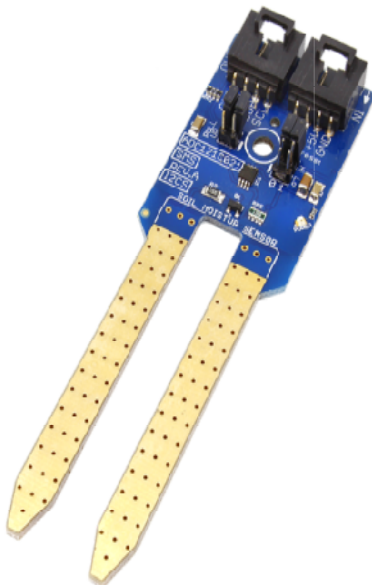


Fig 3.1.13 Soil moisture sensor

➤ *Relay:*

Relay is an electrically operated switch. Many relays use an electromagnetic to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low power signal, or where several circuits must be controlled by one signal. In the proposed system, +5V SPDT (single pole double through) relay is used to turn on and off the motor. On +12V and repellent circuit operating on +9V. The pin description of relay circuit is shown in below figure.

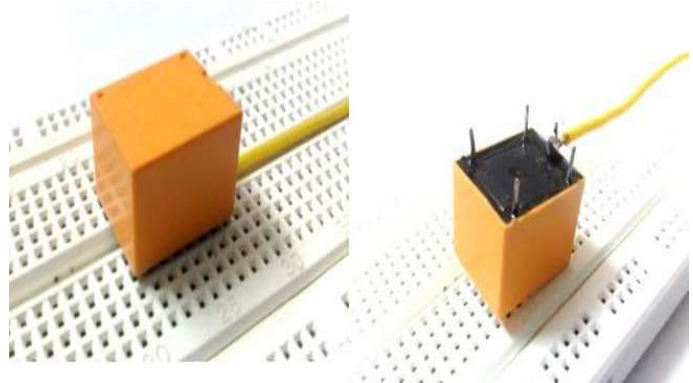


Fig 3.1.14 Relay

➤ *Stepper motor:*

stepper motor is a DC motor moved in discrete steps. It is employed in the sun tracking system controlled by Atmega328 P-PU. Stepper motor changes the angle of the dish according to time from east to west.



Fig 3.1.15 Stepper motor

➤ *NE555 timer:*

NE555 timer is a 8 pin IC used to generate pulses in the proposed system it has been used as astable vibrator to

generate the output signal of 38 kHz. The pin description of NE555 timer is shown.

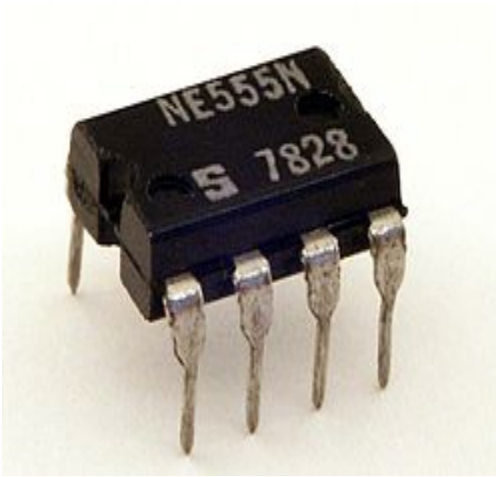


Fig 3.1.16 NE555 timer

➤ *Piezoelectric transducer:*

Piezoelectric transducer of 35mm has been used to generate 38 kHz frequency. It converts the electrical energy into vibrational energy. The frequency of output energy signal depends on the frequency of input electrical energy signal piezoelectric transducer is shown below.



Fig 3.1.17 piezoelectric transducer

- *ATMEGA328P-PU:* ATMEGA328P is high performance, low power controller from microchip. ATMEGA328P is a 8-bit microcontroller based on AVarchitecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.

ATMEGA328P is a 28 pin chip as shown in pin diagram above. Many pins of the chip here have more than one function. We will describe functions of each pin in below table.

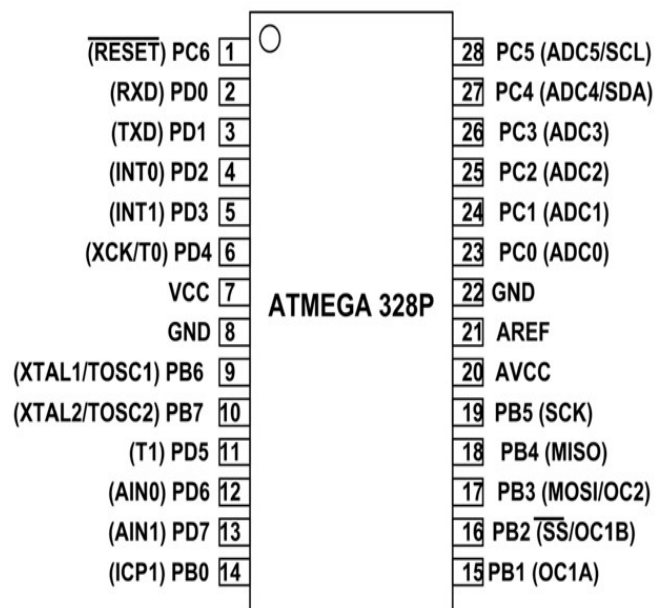


Fig 3.1.18 ATMEGA 328P

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground

9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

Table 3.1.19 ATMEGA pin description

As stated before, 20 of the pins function as I/O ports. This means they can function as an input to the circuit or as output. Whether they are input or output is set in the software. 14 of the pins are digital pins, of which 6 can function to give PWM output. 6 of the pins are for analog input/output.

2 of the pins are for the crystal oscillator. This is to provide a clock pulse for the Atmega chip. A clock pulse is needed for synchronization so that communication can occur in synchrony between the Atmega chip and a device that it is connected to.

The chip needs power so 2 of the pins, Vcc and GND, provide it power so that it can operate. The Atmega328 is a low-power chip, so it only needs between 1.8-5.5V of power to operate.

The Atmega328 chip has an analog-to-digital converter (ADC) inside of it. This must be or else the Atmega328 wouldn't be capable of interpreting analog signals. Because there is an ADC, the chip can interpret analog input, which is why the chip has 6 pins for analog input. The ADC has 3 pins set aside for it to function- AVCC, AREF, and GND. AVCC is the power supply, positive voltage, that for the ADC. The ADC needs its own power supply in order to work. GND is the power supply ground. AREF is the reference voltage that the ADC uses to convert an analog signal to its corresponding digital value. Analog voltages higher than the reference voltage will be assigned to a digital value of 1, while analog voltages below the reference voltage

will be assigned the digital value of 0. Since the ADC for the Atmega328 is a 10-bit ADC, meaning it produces a 10-bit digital value, it converts an analog signal to its digital value, with the AREF value being a reference for which digital values are high or low. Thus, a portrait of an analog signal is shown by this digital value; thus, it is its digital correspondent value.

The last pin is the RESET pin. This allows a program to be rerun and start over.

Pin description:

- VCC is a digital voltage supply.
- AVCC is a supply voltage pin for analog to digital converter.
- GND denotes Ground and it has a 0V.
- **Port A** consists of the pins from **PA0** to **PA7**. These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, **port A** acts as an eight (8) bit bidirectional input/output port.
- **Port B** consists of the pins from **PB0** to **PB7**. This port is an 8 bit bidirectional port having an internal pull-up resistor.
- **Port C** consists of the pins from **PC0** to **PC7**. The output buffers of **port C** has symmetrical drive characteristics with source capability as well high sink.
- **Port D** consists of the pins from **PD0** to **PD7**. It is also an 8 bit input/output port having an internal pull-up resistor.

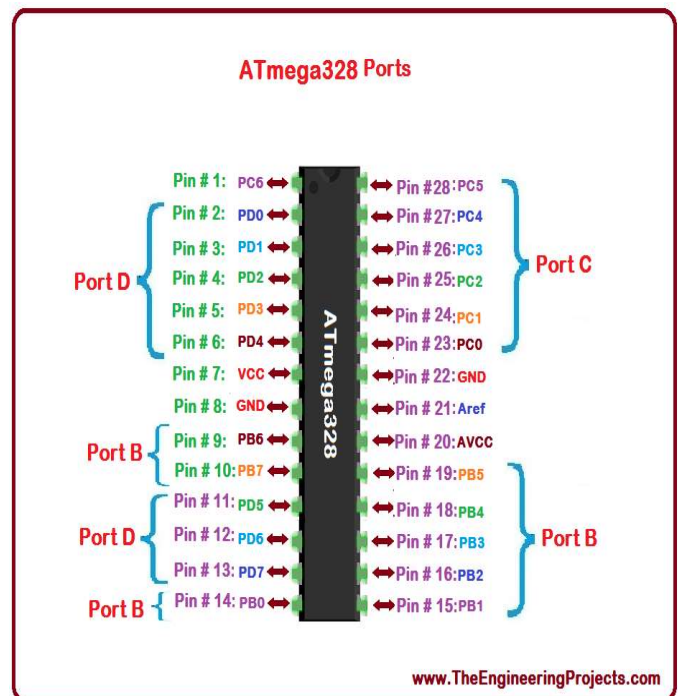


Fig 3.1 20 port description

ATMEGAP 328 architecture:

- Architecture of a device presents each information about the particular device.
- ATmega-328 architecture is shown in the figure given below.

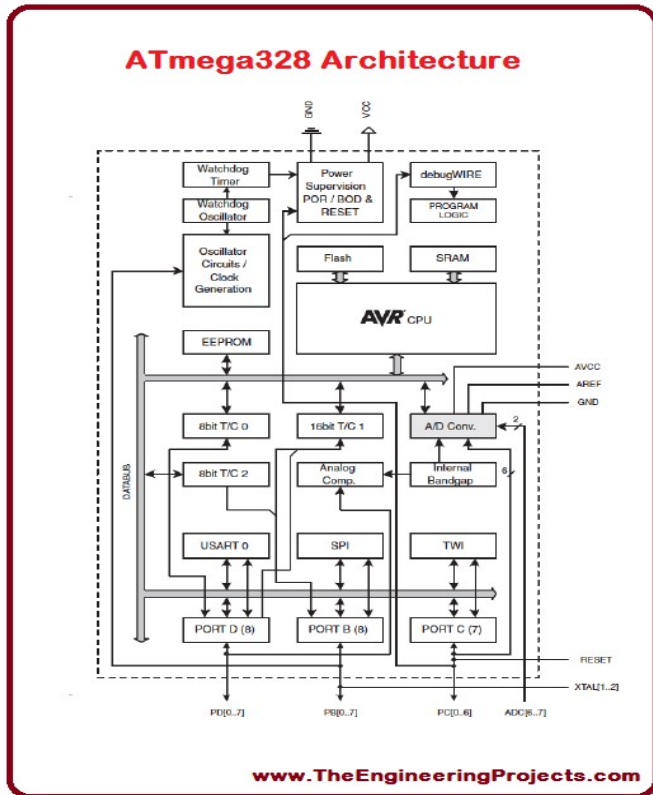


Fig 3.1.21 ATMEGA architecture

ATMEGA 328P memory:

- Atmega 328 has three types of memories e.g. EEPROM, SRAM etc.
- The capacity of each memory is explained in detail below.

Flash Memory has 32KB capacity. It has an address of 15 bits. It is a Programmable Read Only Memory (ROM). It is non volatile memory.

SRAM stands for Static Random Access Memory. It is a volatile memory i.e. data will be removed after removing the power supply.

EEPROM stands for Electrically Erasable Programmable Read Only Memory. It has a long term data.

Applications:

- A complete package including Atmega 328 and Arduino can be used in several different real life applications.
- It can also be used in robotics.
- Quad-copter and even small aero-plane can also be designed through it.

- Power monitoring and management systems can also be prepared using this device.

Internet of Things:

An IoT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data. Examples of objects that can fall into the scope of Internet of Things include connected security systems, thermostats, cars, electronic appliances, lights in household and commercial environments, alarm clocks, speaker systems, vending machines and more.

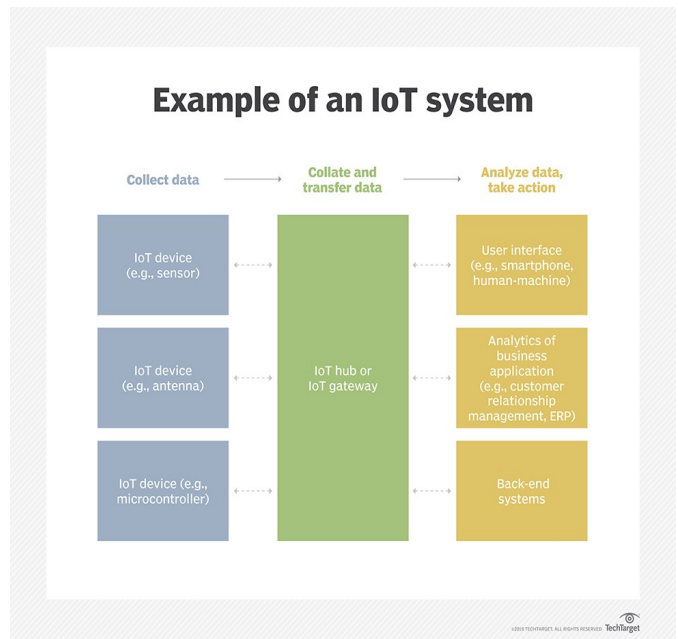


Fig 3.1.22 Example for IOT

Benefits of IOT:

The internet of things offers a number of benefits to organizations, enabling them to:

- Monitor their overall business processes;
- Improve the customer experience;
- Save time and money;
- Enhance employee productivity;
- Integrate and adapt business models;
- Make better business decisions; and
- Generate more revenue.

Scope of IoT:

Internet of Things can connect devices embedded in various systems to the internet. When devices/objects can represent themselves digitally, they can be controlled from anywhere. The connectivity then helps us capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IoT security.

Application of IoT:

- Smart home
- Medical and Health care
- Transportation
- Building and Home automation
- Industrial application
- Agriculture
- Environment monitoring

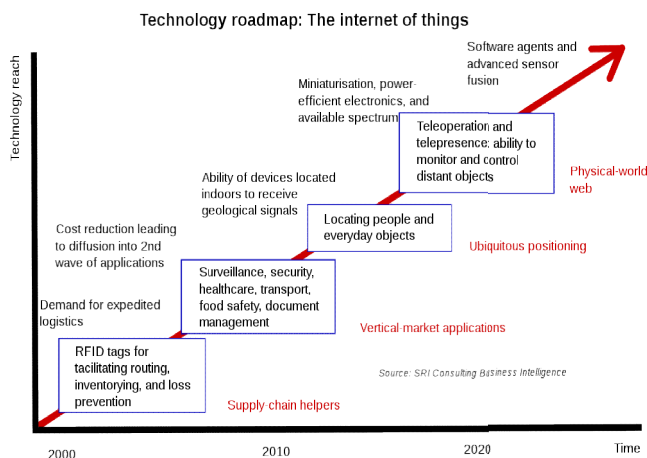


Fig 3.1.23 Application of IOT

SOFTWARE USED:

BLYNK application:

Blynk is not an app that works only with a particular shield. Instead, it's been designed to support the boards and shields you are already using. And it works on iOS and Android.

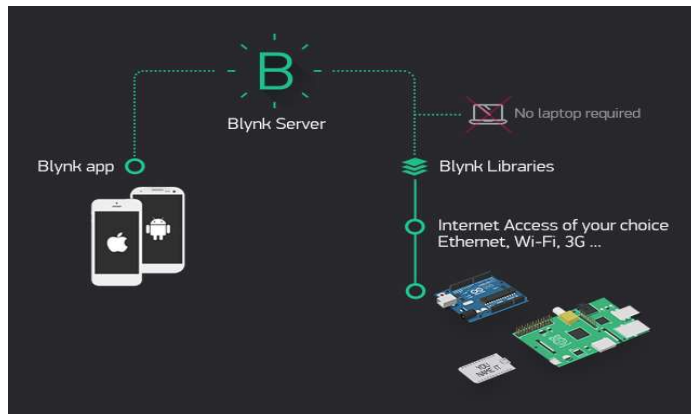


Fig 3.1.24 Blynk's architecture

Currently, Blynk libraries work with this stuff:

- USB
- Ethernet shield
- Wi-Fi shield
- Arduino with Ethernet
- Arduino YUN (testing in progress)
- ESP8266
- Raspberry Pi (Blynk will communicate with Pi's GPIOs)
- more Arduino compatible shields and boards (this list will be updated as we test the compatibility)

Virtual pins:

It is easy to set up Blynk so that , for example, a button widget on your iphone directly turns the arduino pin HIGH or LOW. Or set up a graph widget so that it display sensor data straight from the analog input pin.

This is where virtual pins come into play. You can use them to transfer any data between the Blynk App and Arduino.

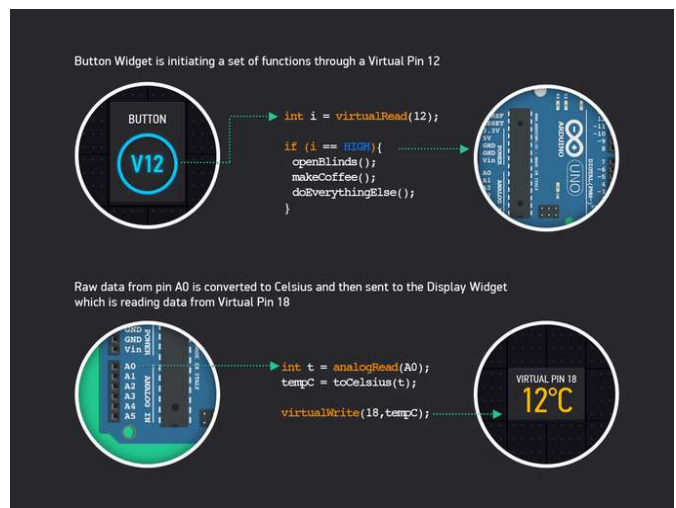


Fig 3.1.25 working of virtual pins

IV. PROPOSED METHODOLOGY

4.1 Circuit Diagram And Operation

4.1.1 Block Diagram

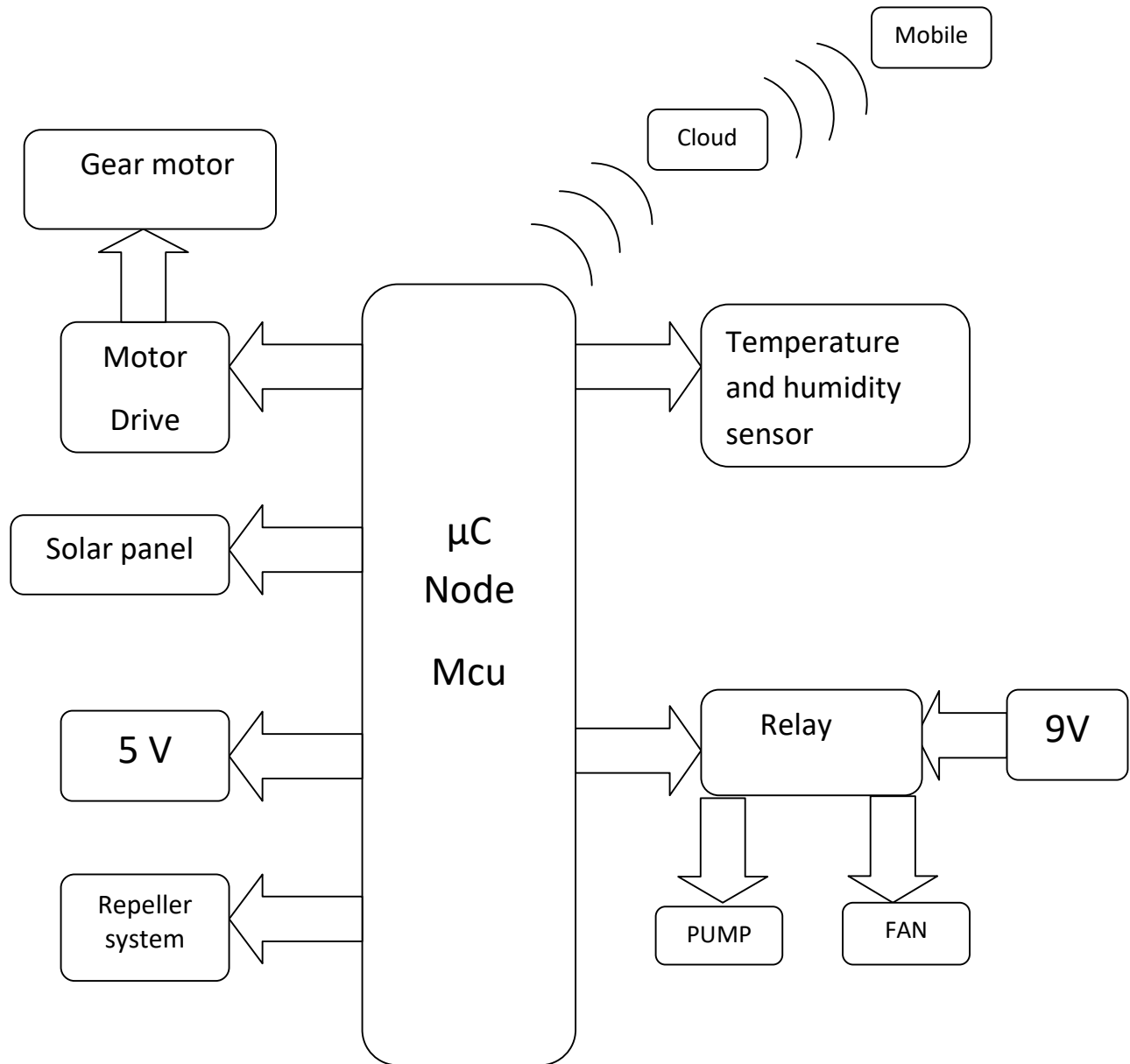


Fig 4.1.1 Block diagram

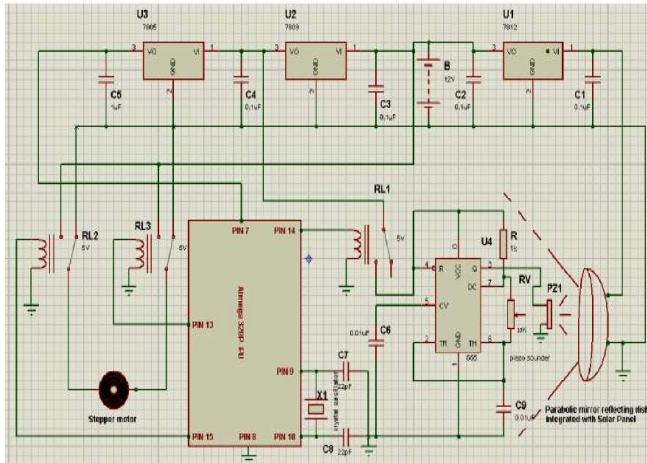


Fig 4.1.2 Circuit diagram of proposed system

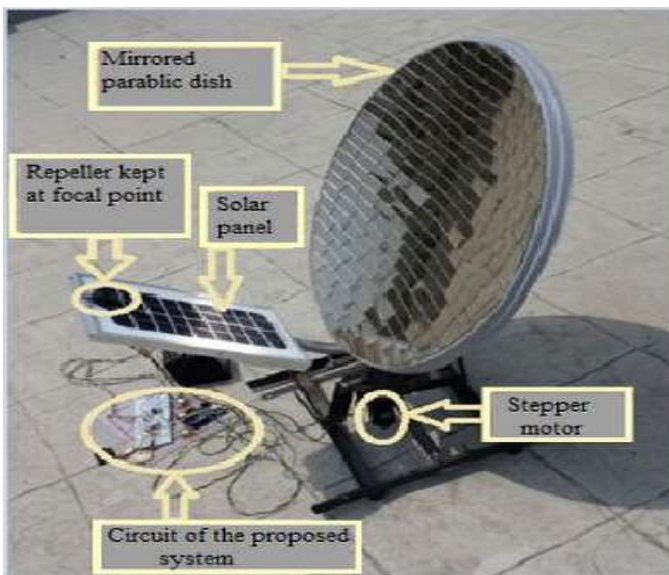


Fig 4.1.3 Practical implementation of proposed system

The “Smart Agricultural System” is driven by harvesting energy from solar panel. The smart mirrored parabolic dish focusing system is used to charge the rechargeable batteries during the day (7am-6pm). LM7805 is used to produce +5v supply to drive the ATMEGA328P-PU microcontroller. The sun tracking system has been employed that orients the solar panel toward the sun the sun tracking system includes stepper motor and 2 relays. The VCC pin of RL 2(relay2) RL3(relay3) is connected to pin15 and pin13 of ATMEGA 328P-PU respectively to ON and OFF the relays in order to track the sun for charging purposes as shown in figure.

These relays have been used to drive the stepper motor in anticlockwise direction for 39ms after every half an hour from 7am to 6pm in order to rotate the dish and then rotate the motor in clockwise direction for 897ms require to back at the initial position. During the night time (6pm-5am), the VCC pin of RL1 (relay1) is connected to pin14 of

ATMEGA 328P-PU to turn ON the repeller system which is driven by two rechargeable batteries of 6v which are connected in series having current rating 4.5Ah. LM7809 is used to drive the repeller circuit. Then pin14 of ATMEGA 328P-PU become high at 6pm to switch ON the repeller circuit up to 5am. The repeller circuit consists of astable multivibrator and piezoelectric transducer used to generate 38 kHz to repel the harmful pests. The piezoelectric transducer has been placed on the focal point of parabolic mirror reflecting solar panel dish the ultrasonic signals get reflected from the surface of parabolic reflector and broad sided the signal to cover the large area. The area covered by ultrasonic waves has been measured by the ultrasonic detector which is found to be 255 square meter.

IoT is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automating the agricultural field. The farmers can monitor the field conditions from anywhere. IoT-based farming is highly efficient when compared with the conventional approach. The idea not only enhances the agricultural cultivation process by protecting the crops from pests ,but it also reduces the human effort invested and prevailing issues to a greater extent. In this project, simple components like sensors, arduino, ADC (analog to digital converter), actuators are employed which makes it more cost-effective. And also the entire system is self-empowered through solar panels and it also includes efficient waste management system.

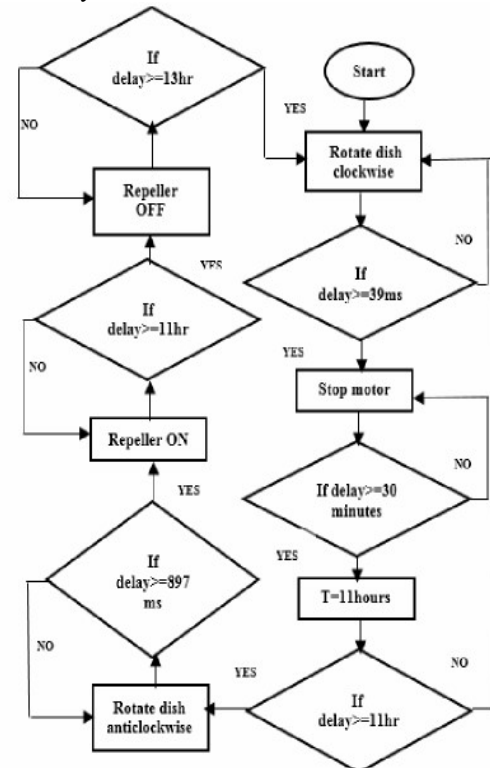


Fig 4.1.4 Flow diagram of the proposed system

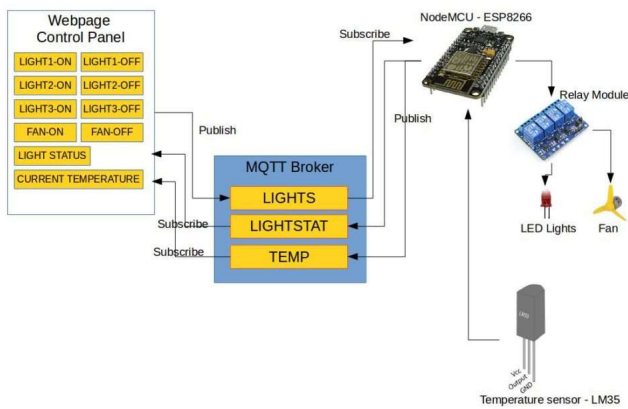


Fig 4.1.5 Monitoring crop field using IOT

4.2 Result

The voltage curve with respect to time, during discharging and charging of battery is shown by graph, when repeller is ON and OFF respectively. The voltage v/s time graph and current v/s time graph during night time (6:00 P.M to 5:00 A.M) are shown in below figure respectively.

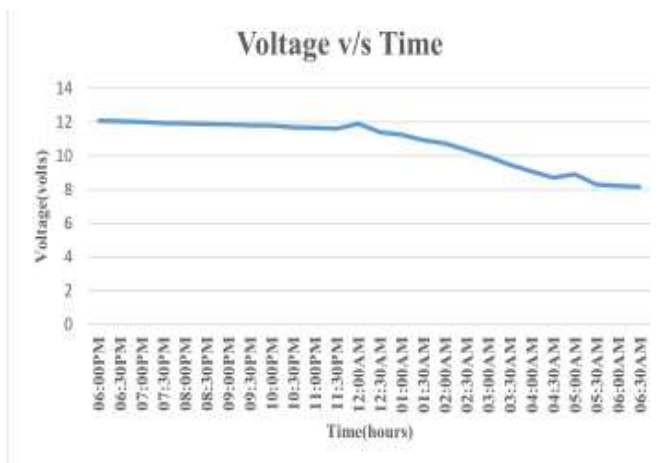


Fig 4.2.1 voltage v/s time

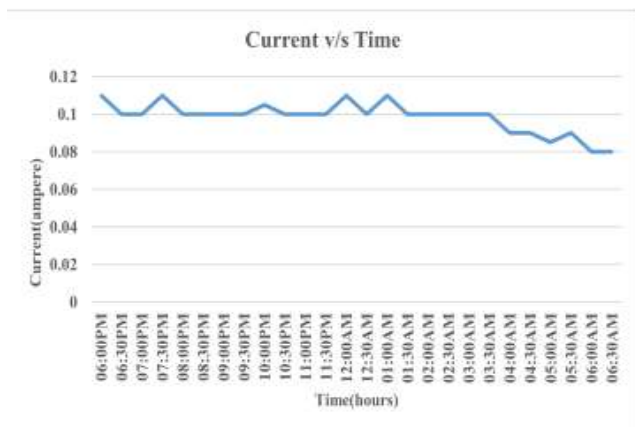


Fig 4.2.2 current v/s time

4.3 Calculation

The frequency (F) of astable multivibrator can be computed as follows:

$$F = 1.44 / ((R1 + 2R2) * C)$$

F = output frequency of astable multivibrator (kHz)

R1 = resistance value (kΩ)

R2 = variable resistance value (kΩ)

C = capacitor value (μF)

Selecting R2 = 1.4kΩ, R1 = 1kΩ and C = 0.01Mf

$$F = 1.44 / ((1 + 1.4) * 2) = 38 \text{ kHz}$$

The frequency of astable multivibrator fed to piezo transducer is computed as 38 kHz.

V. APPLICATION OF THE PROJECT, ADVANTAGES AND ITS DRAWBACKS

5.1 Advantages

- Farmers friendly.
- The entire system is self empowered.
- Automate your field management.
- Optimised output is obtained.
- Save time and cost
- It monitors the soil and plant physiological parameters.
- Obtain the data in real time.
- Many benefits to farmers and land owners who decide to use technology to manage their fields.

5.2 Disadvantages

- The ultrasonic waves emitted can affect the animals near the fields.
- Some humans with good high frequency hearing hear the emissions as annoying background sound.

5.3 Applications

- To manufacture irrigation automation systems with focus on appropriate technology for the rural zones.
- Excess power developed by solar panel's roof employed in field can be sold to government.
- Water misting cooling and fogging system.

VI. FUTURE SCOPE

Environment friendly pest control can be further upgraded in many ways and can be used in wide agricultural applications. It can be placed and operated in any of the environmental conditions to grow any kind of vegetation. Non conventional energy resources such as solar panel are used to supply power to the equipments. The proposed model has a bright scope in future in agricultural field and will create a revolution in the the way the agriculture is carried out in India. It can be used to measure the soil fertility, pH values and NpK values.

VII. CONCLUSION

The solar energy and low power circuit driven by harvested solar energy has been employed in the proposed system to replace the use of chemical repellents. Sun tracking system has been employed to improve the efficiency of solar panel to recharge the batteries which are capable of driving the repeller system during night time. The proposed repeller system will be turn ON for 11 hours (6 P.M – 5 A.M). The proposed system consumes very low power of 0.735 W and covers the large area of 255 square meters. The proposed system is costly but it has been driven by solar energy system hence it is one time investment.

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