IoT based Fighter Robots for Military Applications

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Abstract

The principle objective behind building up this robot is for the observation of human exercises in the war field or outskirts with the goal to lessen the penetrations from the adversary side. The robot comprises of remote camera which can transmit recordings of the war field with the goal to keep any harm and misfortune to human life. Military individuals have a gigantic hazard on their lives while entering an obscure domain. The robot will fill in as a suitable machine for the resistance segment to diminish the loss of human life and will anticipate unlawful exercises. It will enable the military to safeguard the individuals by knowing the state of domain even before entering it.

Index Terms - *Architecture of Robotics,Power Supply, PCB Fabrication, NodeMCU, L293D Motor, DC Motor,IoT.*

I.INTRODUCTION

IoT is the connection of everyday objects in the physical world to the Internet. It is fast emerging as the sustainable solution for providing access to clean and affordable energy all around the world. IoT imparts intelligence to the current devices and equipment using sensors and software that are networked together through the Internet. It provides cyber secured intelligent energy management system to meet demand response management requirements. Literally every physical entity on earth, like appliances, goods, objects, machines, buildings, vehicles, plants, animals and even us humans, will be the things in the IoT. The objective of this paper is to point out some of the challenges associated with IoT and to list the recommended solutions to these challenges.

A rescue robot is a kind of surveillance robot that hasbeen designed for the purpose of rescuing people. Commonsituations that employ rescue robots are mining accidents,urban disasters, hostage situations, and explosions. Militaryrobots are autonomous robots or remote-controlled devicesdesigned for military applications. Such systems are currentlybeing researched by a number of militaries. USMechatronicshas produced a working automated sentry gun and is currentlydeveloping it further for commercial and military usethat can be operated remotely. Dealing with varied terrain places extra demands onthe mobile robot's propulsion system, among other systems.Power management and new generation drive-train systemsutilize advanced materials and highly efficient transmissionsto obtain higher speed, accuracy, and durability to work in awide range of environments. Enhanced power managementcomes through more advanced fuel cells and newly designedbattery and charging systems.Configuring a robot to ascend and descend obstacles inunstructured environments with ease is a design challengeand uses more power. The systemmust be able to overcomeboth regularly shaped obstacles such as stairs and those ofan unspecified shape such as rocks, downed trees, and othermiscellaneous objects. Engineers must consider the center ofgravity, torque requirements to ascend inclines, mass, andpayloads when designing mobile robotic systems formilitarypurposes. In military applications, wearable robotics helpssoldiers carry a heavy pack load.Arobot acts like a packmule,is fully autonomous, and carries a large amount of supplies.There aremanymicrocontrollers in themarket consistingof various types of capability from basic input output to highend microcontroller. These various types of microcontrollerare purpose-made for general application. In this research,wepropose architecture for Raspberry pi based robot that canbe controlled by neural network with the capabilities to avoidobstacles.

A. Working Principle

Prime controller for this robot is NodeMCU Board integrated with IoT. The operating voltage of this robot is 5V-9V and we are using the regulated DC 5V supply for the control circuit and for the motors DC 9V supply is given. And mechanical arrangement is provided for movement of the motor which is driven through motor driver circuit. This entire electromechanical arrangement is controlled through IoT interfaced android/desktop web application. The wireless camera helps for live streaming of video transmission with secured connection using cloud to an android mobile/PC. This robot is enabled with laser module to serve as defense mechanism, this is will help the soldier to kill the enemy if there is a situation.

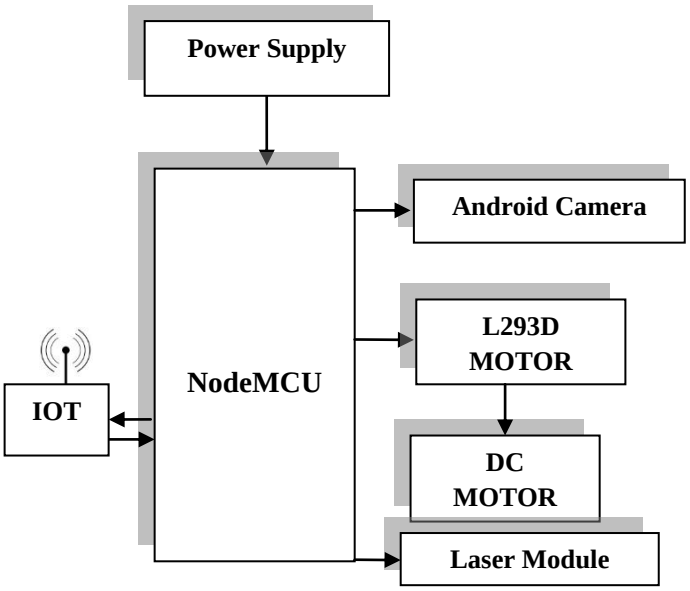


Fig 1.1 ROBOT Section

B. Monitoring & Control Section

II. POWER SUPPLY

Power supply block consists of following units:

- Step down transformer.
- Bridge rectifier circuit.
- Input filter.
- Voltage regulators.
- Output filter.
- Indicator unit.

A.Step down Transformer

The step-down transformer is used to step down the supply voltage of 230v ac from mains to lower values, as the various IC's used in this project require reduced voltages. The transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The outputs from the secondary coil which is center tapped are the ac values of 0v, 15v and 15v. The conversion of these ac values to dc values to dc values is done using the full wave rectifier unit.

B.Bridge Rectifier Circuit

A diode bridge is an arrangement of four diodes connected in a bridge circuit. That provides the polarity of output voltage of any polarity of the input voltage. When used in its most common application, for conversion of alternating current (A.C) input into direct current (D.C) output, it is known as a bridge rectifier. The diagram describes a diode-bridge design known as a full wave rectifier. This design can be used to rectify single phase A.C. when no transformer center tap is available. A bridge rectifier makesuse of four diodes in a bridge arrangement to achieve full wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.For both positive and negative swings of the transformer, there is a forward path through the diode bridge. Both conduction paths cause current to flow in the same direction through the load resister, accomplishing full-wave rectification. While one set of diodes is forward biased, the other set is reversing biased and effectively eliminated from the circuit.

C.Input Filter

Capacitors are used as filters. The ripples from the dc voltages are removed and pure dc voltage is obtained. The primary action performed by capacitor is charging and discharging. It charges in positive half cycle of the ac voltage and it will discharge in negative half cycle. So it allows only ac voltage and does not allow the dc voltage. This filter is fixed before the regulator. Capacitors used here are of the value 1000uF.

D.Regulator Unit

Regulator regulates the output voltage to a specific value. The output voltage is maintained irrespective of the fluctuations in the input dc voltage. Whenever there are any ac voltage fluctuations, the dc voltage also changes, and to avoid this regulators are used.

III.INTRODUCTION TO PCB FABRICATION

The PCB manufacturing process involves use of expensive equipment's, but homebrew PCB fabrication is less expensive.It requires Intel Pentium PC,600-1200dpi laser printer with premium-quality paper or butter-paper and miscellaneous items like single side copper laminated board, Lacquer thinner, sand paper and others. The various steps involve in PCB fabrication are

A.Pc Based Artwork

The PC based artwork consists of drawing the conductor pattern. For putting artwork on the component side of the board, flip the whole image before or while taking the print. When the pattern has been drawn, take the print out in 600 to 1200 dpi on a translucent or butter paper. Keep the paper side on

which the toner is deposited facing down over the copper laminated boards copper side and then when the board is turned component side up, the pattern on the conductor will be found properly aligned with the components. Finally we take the printout of the PCB.

B. Taking the PCB Layout Print Using a Laser Printer

Take the printout of the circuit layout from a laser printer. The idea is to use a coated paper so that the toner comes loose when heated which would transfer a sharp black print on to copper laminate. Print for each of the required layers should be taken on separate paper.

C. Transfer of the Conductor Pattern

Scrub The Copper Side Of The Copper Clad Laminated Used For The PCB Board With A Sponge. The Scrubbing Involves Removes Oxidation, Stains, Etc. And It Also Makes The Copper Surface Some-What Rough Which Helps The Toner To Adhere To The Copper Surface. The Next Step Is To Degrease The Board Thoroughly Using A Paper Towel Soaked With Acetone Solvent. Keep Doing It Until No More Discoloration Is Seen On The Paper Towel. Rub Hard And Keep Switching To Clean Parts Of Towel. Place And Align The Paper On The Copper Side, Using An Iron Box To Maximum Setting On The Back Of The Paper For At Least Half A Minute. If You Don't Apply Enough Heat, The Film Or Toner May No Stick Or Be Dark Enough. The Removal Of Paper From PCB Is Done By Putting It Into Hot Water For 10 Or More Minutes. Check Whether It Has Transferred Properly Onto Copper Plate.Dig The Bristles On The Tip Of A Smooth Tooth Brush Into The Holes, Remove The Paper Part From The Tight Areas Like Drill-Holes. Now Cut The PCB To Required Size By Using A Hacksaw.

D. Etching

Etch the unwanted copper from the board using the ferric chloride solution for 20 or more minutes. One pint can etch at least 3.6 sq. meters of the 28gm board. Heating the etchant will speeds up the etching process. The PCB is attached to a wooden piece and dip in to the solution. Lift the PCB up and Check whether all the unwanted copper is removed. Then it is immersed in to cold water to clean. When etching is complete, board is removed from the solution and rinse it under running tap water .Acetone or lacquer thinner is used to remove the toner .Lacquer thinner is used as a solvent in painting industry. Wash the board in lacquer thinner solvent, rubbing with a paper towel, to remove the toner instantly.

IV.PROJECT DESCRIPTION NODEMCU

The best way to develop quickly an IoT application with less Integrated circuits to add is to choose this circuit "NodeMCU". Today, we will give a detailed Introduction on NodeMCU V3. It is an open-source firmware and development kit that plays a vital role in designing a proper IoT product using a few script lines. The module is mainly based on ESP8266 that is a low-cost Wi-Fi microchip incorporating both a full TCP/IP stack and microcontroller capability. It is introduced by manufacturer Espressif Systems. The ESP8266 NodeMcU is a complex device, which combines some features of the ordinary Arduino board with the possibility of connecting to the internet. Arduino Modules and Microcontrollers have always been a great choice to incorporate automation into the relevant project. But these modules come with a little drawback as they don't feature a built-in WiFi capability, subsequently, we need to add external WiFi protocol into these devices to make them compatible with the internet channel. This is the famous NodeMCU which is based on ESP8266 WiFiSoC. This is version 3 and it is based on ESP-12E (An ESP8266 based WiFi module). NodeMCU is also an open-source firmware and development kit that helps you to prototype your IOT product within a few LUA script lines, and of course you can always program it with Arduino IDE. We will try present useful details related to this WiFi Development Kit, its main features, pinout and everything we need to know about this module and the application domain.

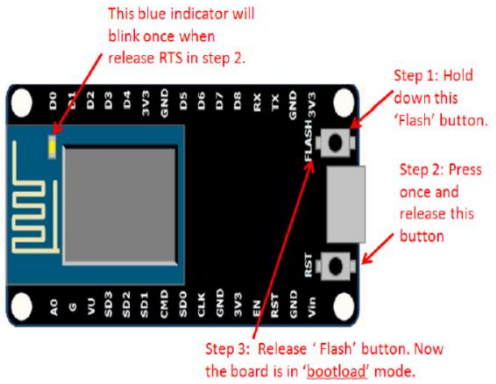


Fig 4.1 NodeMCU Board

A. Introduction NodeMCU V3

NodeMCU V3 is an open-source firmware and development kit that plays a vital role in designing an IoT product using a few script lines. Multiple GPIO pins on the board allow us to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications. The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module. The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects you with a well-known developer community. And open source firmware gives you the flexibility to edit, modify and rebuilt the existing module and keep

changing the entire interface until you succeed in optimizing the module as per your requirements.
USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication. Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board. The board incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer. The ability of module to establish a flawless WiFi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi.

B.NodeMCU V3 Pinout

NodeMCU V3 comes with a number of GPIO Pins. Following figure shows the Pinout of the board. There is a candid difference between Vin and VU where former is the regulated voltage that may stand somewhere between 7 to 12 V while later is the power voltage for USB that must be kept around 5 V.

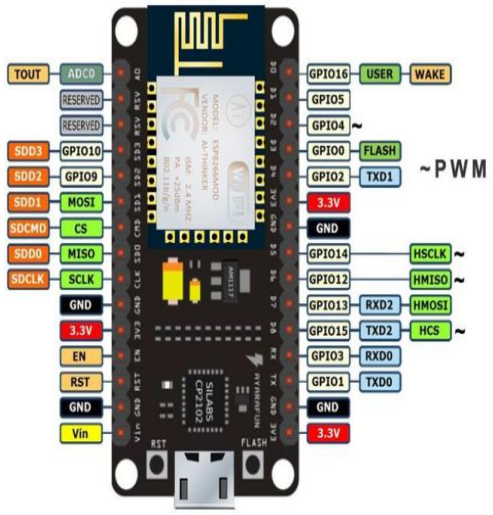


Fig 4.3 NodeMCU V3 Pinout

V. L293D MOTOR DRIVER CIRCUIT

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

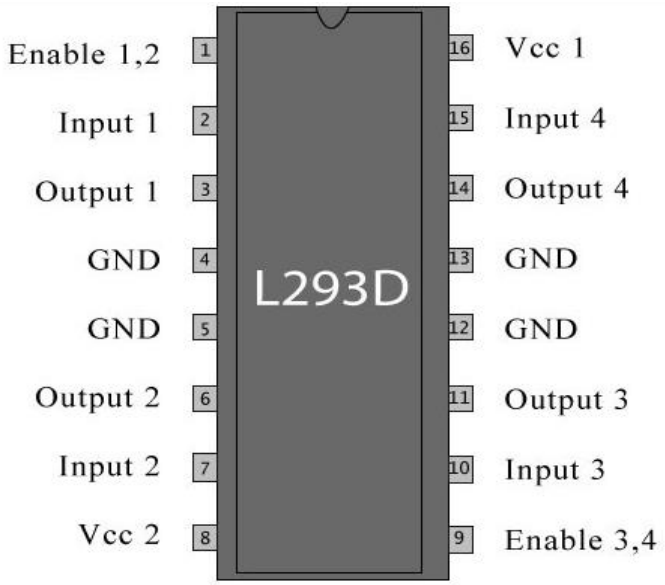


Fig 5.1 L293D Motor Driver Circuit

A. L293D Description

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

VI.HARDWARE DESCRIPTION DC MOTOR

Electrical DC Motors are continuous actuators that convert electrical energy into mechanical energy. The DC motor achieves this by producing a continuous angular rotation that can be used to rotate pumps,

fans, compressors, wheels, etc. As well as conventional rotary DC motors, linear motors are also available which are capable of producing a continuous liner movement. There are basically three types of conventional electrical motor available: AC type Motors, DC type Motors and Stepper Motors.

The DC Motor or Direct Current Motor to give it its full title, is the most commonly used actuator for producing continuous movement and whose speed of rotation can easily be controlled, making them ideal for use in applications were speed control, servo type control, and/or positioning is required. A DC motor consists of two parts, a "Stator" which is the stationary part and a "Rotor" which is the rotating part. The result is that there are basically three types of DC Motor available.

A. Brushed DC Motor

A conventional brushed DC Motor consist basically of two parts, the stationary body of the motor called the Stator and the inner part which rotates producing the movementcalled the Rotor or "Armature" for DC machines. The motors wound stator is an electromagnet circuit which consists of electrical coils connected together in a circular configuration to produce the required North-pole then a South-pole then a North-pole etc, type stationary magnetic field system for rotation, unlike AC machines whose stator field continually rotates with the applied frequency. The current which flows within these field coils is known as the motor field current.These electromagnetic coils which form the stator field can be electrically connected in series, parallel or both together (compound) with the motors armature.

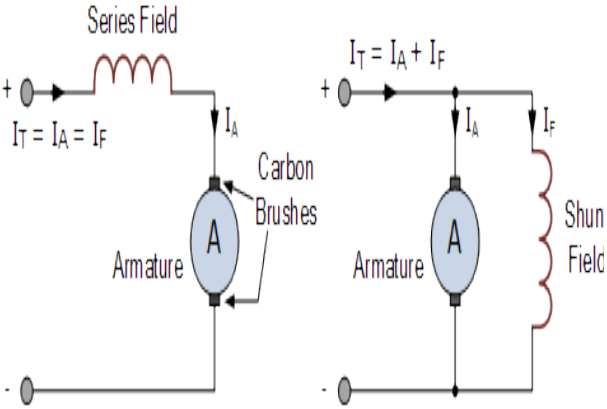


Fig 6.1 Series and Shunt Connected DC Motor

The rotor or armature of a DC machine consists of current carrying conductors connected together at one end to electrically isolated copper segments called the commutator. The commutator allows an electrical connection to be made via carbon brushes (hence the name "Brushed" motor) to an external power supply as the armature rotates. The magnetic field setup by the rotor tries to align itself with the stationary stator field causing the rotor to rotate on its axis, but cannot align itself due to commutation delays. The rotational speed of the motor is dependent on the strength of the rotors magnetic field and the more voltage that is applied to the motor the faster the rotor will rotate. By varying this applied DC voltage the rotational speed of the motor can also be varied. A series wound DC motor has its stator field windings connected in *series* with the armature. Likewise, a shunt wound DC motor has its stator field windings connected in *parallel* with the armature

The Permanent magnet (PMDC) brushed DC motor is generally much smaller and cheaper than its equivalent wound stator type DC motor cousins as they have no field winding. In permanent magnet DC (PMDC) motors these field coils are replaced with strong rare earth (i.e. Samarium Cobolt, or Neodymium Iron Boron) type magnets which have very high magnetic energy fields.

The use of permanent magnets gives the DC motor a much better linear speed/torque characteristic than the equivalent wound motors because of the permanent and sometimes very strong magnetic field, making them more suitable for use in models, robotics and servos. Although DC brushed motors are very efficient and cheap, problems associated with the brushed DC motor is that sparking occurs under heavy load conditions between the two surfaces of the commutator and carbon brushes resulting in self-generating heat, short life span and electrical noise due to sparking, which can damage any semiconductor switching device such as a MOSFET or transistor. To overcome these disadvantages, Brushless DC Motors were developed.

B.Brushless DC Motor

The brushless DC motor (BDCM) is very similar to a permanent magnet DC motor, but does not have any brushes to replace or wear out due to commutator sparking. Therefore, little heat is generated in the rotor increasing the motors life. The design of the brushless motor eliminates the need for brushes by using a more complex drive circuit were the rotor magnetic field is a permanent magnet which is always in synchronization with the stator field allows for a more precise speed and torque control. Then the construction of a brushless DC motor is very similar to the AC motor making it a true synchronous motor but one disadvantage is that it is more expensive than an equivalent "brushed" motor design. The control of the brushless DC motors is very different from the normal brushed DC motor, in that it this type of motor incorporates some means to detect the rotors angular position (or magnetic poles) required to produce the feedback signals required to control the semiconductor switching devices. The most common position/pole sensor is the "Hall Effect Sensor", but some motors also use optical sensors.Using Hall Effect sensors, the polarity of the electromagnets is switched by the motor control drive circuitry. Then the motor can be easily synchronized to a digital clock signal, providing precise speed control. Brushless DC motors can be constructed to have, an

external permanent magnet rotor and an internal electromagnet stator or an internal permanent magnet rotor and an external electromagnet stator.Advantages of the Brushless DC Motor compared to its "brushed" cousin is higher efficiencies, high reliability, low electrical noise, good speed control and more importantly, no brushes or commutator to wear out producing a much higher speed. However their disadvantage is that they are more expensive and more complicated to control.

C.DC Servo Motor

DC Servo motors are used in closed loop type applications were the position of the output motor shaft is fed back to the motor control circuit. Typical positional "Feedback" devices include Resolvers, Encoders and Potentiometers as used in radio control models such as aeroplanes and boats etc. A servo motor generally includes a built-in gearbox for speed reduction and is capable of delivering high torques directly. The output shaft of a servo motor does not rotate freely as do the shafts of DC motors because of the gearbox and feedback devices attached.

VII.INTERNET OF THINGS

A. Enabling Technologies

The concept of combining computers, sensors, networks to monitor and control devices has existe decades. The recent confluence of several techno market trends, however, is bringing the Interne Things closer to widespread reality. T include *Ubiquitous Connectivity*, *Widespread Adoı of IP-based Networking*, *Compu Economics*, *Miniaturization*, *Advances in Analytics*, and the *Rise of Cloud Computing*.

B.Connectivity Models

IoT implementations use different technica communications models, each with its own characteristics Four common communications models described by th Internet Architecture Board include: *Device-to-Device Device-to-Cloud*, *Device-to-Gateway*, and *Back-En Data-Sharing*. These models highlight the flexibility in th ways that IoT devices can connect and provide value t the user.

C.Emerging Economy and Development Issues

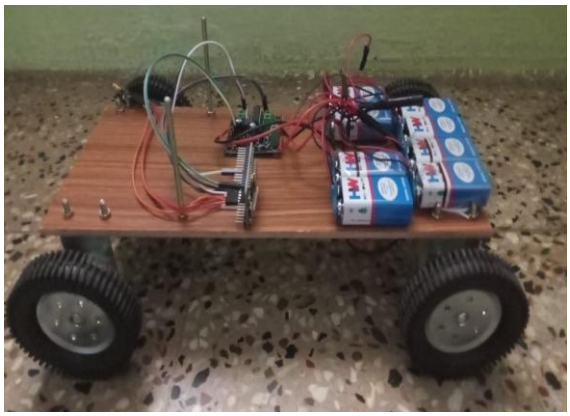
The Internet of Things holds significant promise for delivering social and economic benefits to emerging and developing economies. This includes areas such as sustainable agriculture, water quality and use, healthcare, industrialization, and environmental management, among others. As such, IoT holds promise as a tool in achieving the United Nations Sustainable Development Goals. The broad scope of IoT challenges will not be unique to industrialized countries. Developing regions also will need to respond to realize the potential benefits of IoT. In addition, the unique needs and challenges of implementation in less-developed regions will need to be addressed, including infrastructure readiness, market and investment incentives, technical skill requirements, and policy resources. The Internet of Things is happening now. It promises to offer a revolutionary, fully connected "smart" world as the relationships between objects, their environment, and people become more tightly intertwined.

VIII. CONCLUSION

With our proposed model, life of thousands of soldier or police man can be saved. As they have knowledge on enemy territory with our robot before entering battle field. This also help soldier/police to give counter attack remotely. This is Robot has multiple application, we Can enhance this to a suicide bot. In developing country like India which is facing threat outside and inside of its border, a low Cost highly efficient military technology is must needed.

IX. APPENDIX

9.1 Prototype Development Model



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