Autonomous Biped Robot Using Arduino

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ABSTRACT— ***In the last few years artificial intelligence took a rapid enhancement and turned out to be a boiled up platform for innovation. In this paper we are throwing some light on automation in the biped robot, which is unlike normal conventional robots which are wheeled, stem. This robot utilized human structure to make movements and hence a small biped is what we call it, enhancing the research base in Humanoid Robots. Ultrasonic sensor is utilized for distance ranging which provides the sensing capability in the robot and a sound sensor is added on the bot to help the bot detect sound which enhances the instruction taking capability of the robot. This proposed paper can be a important landmark for the future research in automation as well as bipedal robots. Kinematic models of biped robots are also developed and simulated before experimenting and verifying the performances of the system. Overall a low cot, open source based, biped robot is underlying objective on which enhanced algorithms and movement controllers will be developed to further the enhance the research in the field of humanoid robot.***

Index terms— Ultrasonic, Bipedal Robot, Obstacle avoidance, Sound Sensor

I. INTRODUCTION

There are various ways of making a biped robot. The typical method is to make the robot move in a sequence in which the center of mass of robot keeps shifting to stabilize the posture of the structure.

Another way of implementing the stabilization is using a accelerometer and gyro sensors. We adopted the first procedure to stabilize the structure. The legs of the robot are made using servo motors and the sensing is done with help of ultrasonic and sound sensors on board. A basic microcontroller ATmega8L acts as the processing and memory unit of the robot.

Areas involved in achieving this goal that are discussed in this report are motor testing, support system setup calibration and programming.

Risking human lives is no more a trend in the world and we are making sure that precious lives are not put up for risk to perform tasks which can be performed by machines! But a huge drawback we face in this concern is the intelligence of machines. That is where we hop in artificial intelligence.

A rapidly growing field which has its impact over each and every device we have around. AI is very highly being implemented over robots. The trend of robots being used in emergency situation is slowly being realized by every country and robots are finding a good employment in the field of rescue in cases of both natural calamities and also in military. The Indian Army currently relying on DAKSH platform which being a wheeled robot has its own drawbacks, is still finding a good use in case of robots for bomb diffusion. The bipedal based structure can be a huge help in increasing the maneuverability of the robot in different terrain. The action can be more specific and precise.

The purpose of developing this robot is to show amalgamation of all the three complicated but extremely interesting domains like Artificial Intelligence, Bipedal Structures and Sensors in to a single project and that too in a cost effective and layman way. Which could help as the initial landmark in development of such amalgamated projects in robotics for various other applications. Another objective was to show the impact of open source projects like Arduino in implementation of embedded products and also artificial Intelligence based systems in an easy way. Since being available to all, open source projects can be easily in the reach of every individual who wishes to work in the field and enhance science and humanity.

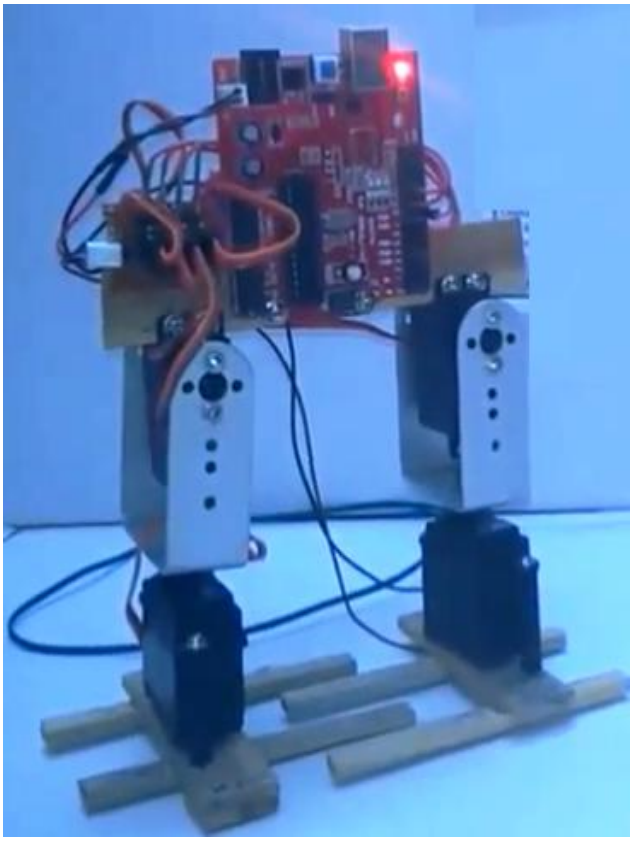

Fig 1

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The hardware concentration of our robot usually consists or a microcontroller or a processing unit that controls the whole structure and makes it move around with help of servos and sensors. The controller we are using here is Atmel Atmega8L. This controller processes data, manipulates and performs actions accordingly. 4 Servo motors control the action of the robot by receiving the instructions from the microcontroller. 2 Servos of 3.7 Kg torque hold the central plate of chassis. 2 more servos control the feet of the bipedal helping it take turns. The structure of bipedal can be used to either monitor and maneuver the place or also indulging in physical tasks of rescuing people. Giving live footage or data logging.

1.1.1 EXISTING SYSTEM:

Existing system uses basic ultrasonic sensors and have no provision to take any input from human. Hence making it more rely on its own internal data manipulations. Such system in case of any emergency cannot react according to the human interaction.

And also the system being used for the development for the bipedal robots is not based on open source hardware which acts as a huge drawback in the overall contribution towards the research. The current commercial kits available do not give a proper glimpse of the internal coding and also specification of the hardware being used for the development.

1.1.2 PROPOSED SYSTEM:

The proposed system uses an ATMEGA microcontroller board which is programmed by open source IDE and uses 4 servos for balancing. The system comprises of 2 sensors i.e Ultrasonic and Sound sensors. Sound sensors help the bot detect any instructions to be given in form of voice. And the Ultrasonic sensor helps it avoid the obstacles in the way. The sound and ultrasonic sensors act as an input unit to the whole structure and the controller processes the data to give the output accordingly. The sound sensors here are used as a normal instruction taker but in case of emergency situation can be programmed in order to react to special words such as “Help” and also in taking any instruction like “Stand up” , “Stop”. Hence making the robot decide based on the sound input.

OPERATION:

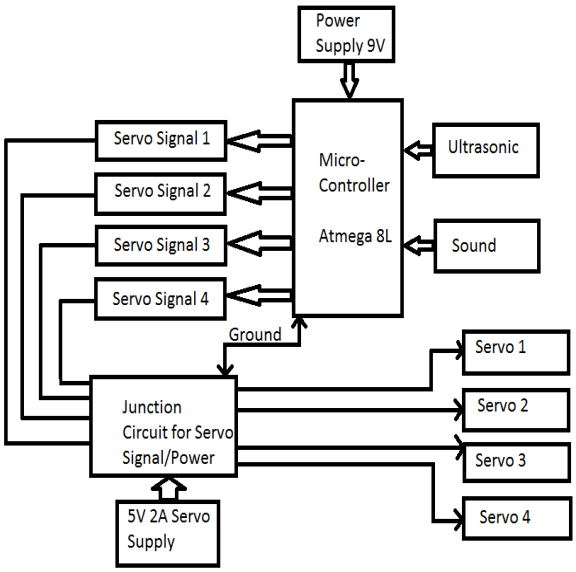
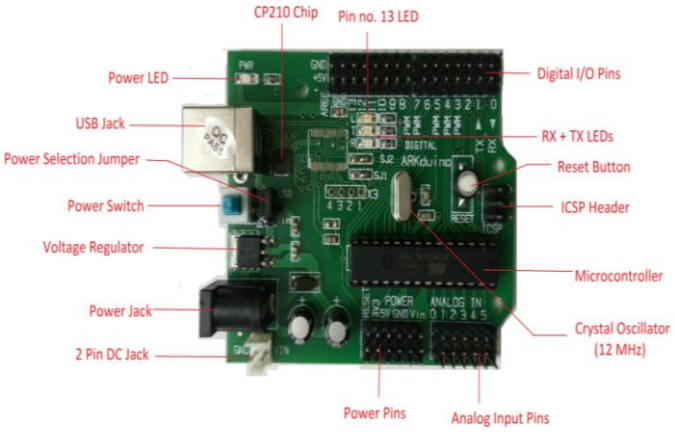


Fig 2

The microcontroller board has 3 ports. Port B is used to send the signals to the motors. Digital pins of the Arduino board are employed for the same. Arduino boards have their own FTDI/UART chip that helps the Arduino board communicate with the computer and facilitate the process of exchange of data. The signal carried by digital pins is fed to the signal pins of servo.



Servo Motors are employed for the movement of the robot. Two servos at both the feet help the robot turn.

3.7 Kg torque servo motors are used to bear the weight of the robot. The servos on central plate of chassis help the robot lift up the legs.

The ultrasonic sensors on the robot give the distance between any obstacle in front.

Fig 3

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Ultrasonic Sensor Details and Distance Calculations:
The Ultrasonic sensor employed in BIPED is HC-SR04 model and has a range of 2cm to 400cm.
Time interval between the transmitted wave and the received wave is calculated in µsec. The distance is obtained using the formula:

Distance = Time Recorded / 58.138) * .39 inches

Sound sensors makes use of a normal microphone and a 555 timer unit to give indications of sound over certain threshold. The microcontroller keeps a count of the data received from the sound sensor and feeds it to the motion algorithms which further decide the action based on the program.

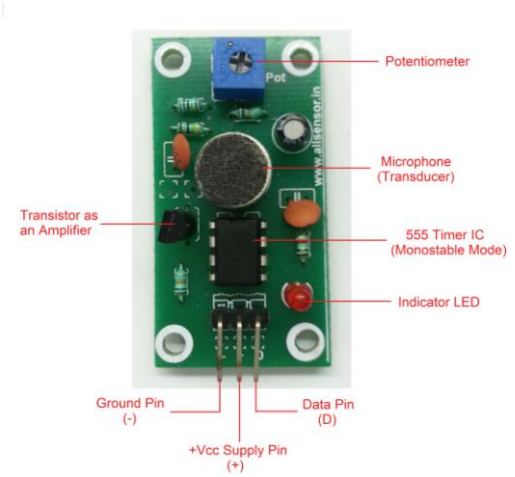


Fig 4

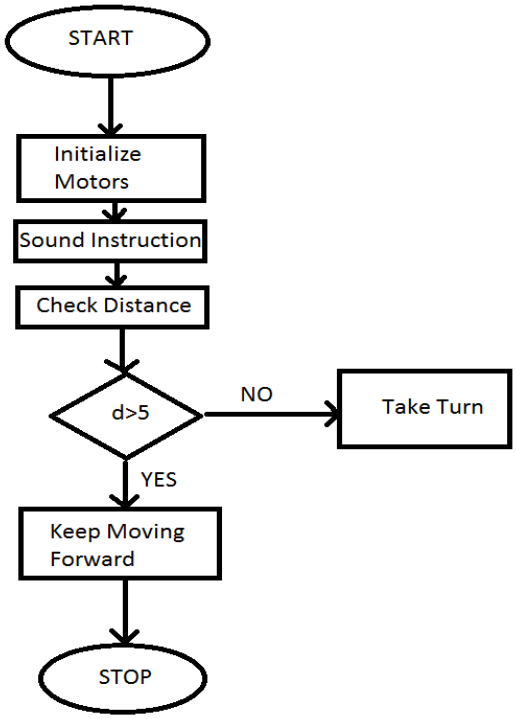
Biped's Forward Motion Sequence Algorithm

- Right Servo will tilt the Central Chassis to the Right with the assistance of Right Foot Servo as a support. Raising the left leg.
- Right foot servo and left foot servo rotates making left foot come forward.
- Left Foot Servo goes back to opposite position of Right Foot Motor with its support.
- Right hip servo raised up with the support of Left Hip Servo hence raising the right leg.
- Left foot servo and Right foot servo rotates making right foot come forward.

Biped's Turning Motion Sequence Algorithm

- After Lifting one leg left foot rotates making the chassis turn towards left
- After the turn the left hip servo comes to equilibrium
- Right hip servo rotates and lifts the left feet and brings the left feet servo to equilibrium.
- All servos come to equilibrium and bot stands still after the turn.

OBSTACLE AVOIDANCE FLOW CHART



FLOW CHART

Fig 5

Arduino Programming Skeleton

```
Include <Servo.h>
Initializing variables
{-----
}
Interfacing variables to the controller
{------
}
Loop () function to execute the robots operations
in
real time
{------
During No Object
{------
}
During Object encounter
{------
}
}
```

Programming is done using the Arduino integrated development environment (IDE) which is a cross-platform application scripted in Java programming language, and is derived from the IDE for the Processing programming language and the Wiring projects. It includes units like a code editor with features such as syntax highlighting, brace matching, automatic indentation, boot loading and is also capable of compiling and uploading programs to the board with a single click. A programming code scripted for Arduino is called a "sketch". Arduino programs are scripted in C or C++. The Arduino IDE comes with its own software library called "Wiring" from the original Wiring project, hence making many common input/output operations much easier.

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RIGHT LEG UP

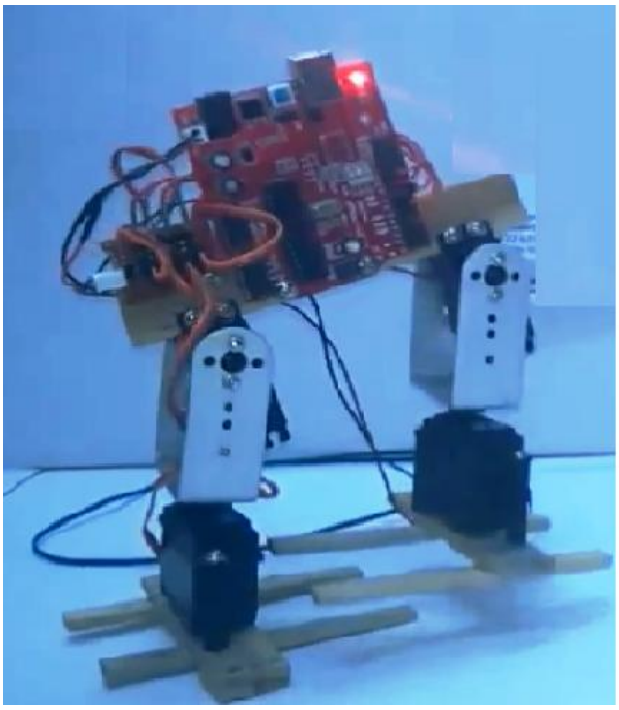

Fig 6

LEFT LEG UP

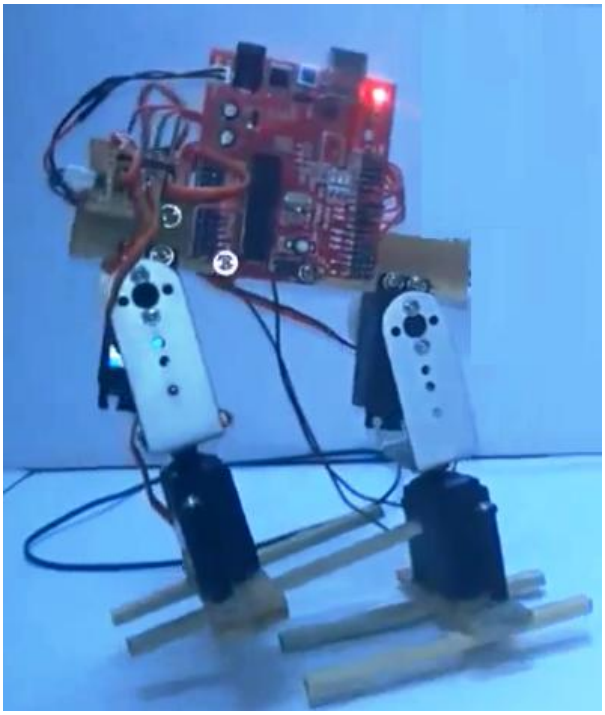

Fig 7

IV.CONCLUSION

So the bot discussed in this paper had successful
working algorithms for walking in a balanced manner and in parallel avoiding obstacles. And the add on sound sensor provided a technical edge in enhancing the human interaction of the robot.

This particular working model portrayed in this paper turned out to be a conventional one of such type, so further advancements in this prototype could ignite a revolution in the field of robotics.

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