Klann Mechanism Held Telerobot With Security Systems
Mano Raja Paul M¹, Arjun Nair², Arun Kumar G³, Akshay G Nath²
¹Assistant Professor, ²IV year Student, Department of Electrical And Electronics Engineering, Nehru Institute Of Engineering and Technology, Coimbatore  Tamil Nadu- 641105, India

Abstract: The wheels were invented back in the Stone Age, it was the primary component used in all forms of mechanical transportation. Even today it is the component of choice for almost any type of moving machine like cars and other security vehicles in the uneven surfaces. However, the wheel has always had a major disadvantage with short instant elevation changes. For the other applications, the animal and human legs are proven to work effectively on this type of terrain. The two most effective leg mechanisms are currently Joe Klann’s mechanism which resembles a spider leg and Theo Jansen’s mechanism which resembles a human leg. We have chosen Joe Klann mechanism which has more advantage than Jansen mechanism. The main objective of our paper is to replace the function of wheel with an alternative in order to overcome the difficulty of travelling in uneven terrain and provide better security systems in such type of uneven surfaces. This paper is useful in hazardous material handling i.e clearing minefields and detecting authorised people using PIR sensors , without putting anyone at risk. 
Keywords: Joe Klann’s Mechanism, Theo Jansen’s Mechanism, Steep Jagged Rock piles, Material Handling.

I.INTRODUCTION
The main objective of our paper is to replace the function of wheel in order to overcome the difficulty of travelling in uneven terrain and provide security systems in such type of terrains . In this mechanism links are connected by pivot joints and convert the rotating motion of the crank into the movement of foot similar to that of animal walking. The proportions of each of the links in the mechanism are defined to optimize the linearity of the foot for one-half of the rotation of the crank. The remaining rotation of the crank allows the foot to be raised to a predetermined height before returning to the starting position and repeating the cycle. Two of these linkages coupled together at the crank and one-half cycle out of phase with each other will allow the frame of a

It has been a hobby for a number of years to develop a bicycle without wheels that could walk. It would move on legs and resemble a large insect . A linkage was developed that satisfied the design criteria and several small-scale prototypes were built that demonstrated the concept. Applications for the linkage go beyond human-powered machines. The links are connected by pivot joints and convert the rotating motion of the crank into the movement of a foot similar to that of an animal walking. Two of these legs coupled together at the crank can act as a wheel replacement and provide vehicles with a greater ability to handle obstacles and travel across uneven terrain while providing a smooth even ride. Initially it was called the Spider Bike but the applications for this linkage have expanded well beyond the initial design purpose of a human-powered walking machine. This linkage could be utilized almost anywhere a wheel is employed from small wind-up toys to large vehicles capable of transporting people. The relationships for the linkage have been established and are covered by several patents. The simplicity and scalability of the walking device, along with a little imaginative engineering, lead to numerous possibilities[1].

Jansen's linkage mechanism designed by the kinetic sculptor, Theo Jansen to simulate a smooth walking motion. Jansen has used his mechanism in a variety of kinetic sculptures which are known as Strandbeests. Jansen's linkage bears artistic as well as mechanical merit for its ingenious simulation of walking motion using a simple rotary input. The Klann linkage mechanism provides many of the benefits of more advanced walking vehicles without some of their limitations. It can step over curbs, climb stairs, or travel into areas that are currently not accessible with wheels but do not require microprocessor control or multitudes of inefficient actuator mechanisms. It fits into the technological void between these walking devices and axel-driven wheels walking .
The step height, stride,length,total width ,altitude with
clearance, overall size, and maximum incline, as well as the ratios of these factors, are obvious ways to compare the two linkages. Both linkages can be proportioned differently based on the inputs in the relationships. The centre of gravity coincided with the centre of the crank in the comparison of these linkages’ ability to handle an incline but could be significantly different depending on a wide range of factors. explosive ordnance disposal units, and private security

<table>
<thead>
<tr>
<th>Jansen Linkage (existing method)</th>
<th>Klann Linkage (proposed method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 links per leg 120 degrees of crank rotation per stride. 3 legs will replace a wheel. Counterclockwise rotation of the crank.</td>
<td>6 links per leg 180 degrees of crank rotation per stride. 2 legs will replace a wheel. Clockwise rotation of the crank.</td>
</tr>
<tr>
<td>Step height is primarily achieved by a parallel linkage in the leg that is folded during the cycle angling the lower portion of the leg.</td>
<td>Step height is achieved by rotating the connecting arm which is attached to the crank on one end and the middle of the leg on the other. It pivots on a grounded rocker.</td>
</tr>
<tr>
<td>The eight-bar Jansen linkage evolved through iterations of a computer program.</td>
<td>The six-bar Klann linkage is an expansion of the four-bar Burmester linkage developed in 1888 for harbor cranes.</td>
</tr>
<tr>
<td>Can walk only on even surfaces and terrain.</td>
<td>Can walk on uneven surfaces and terrains.</td>
</tr>
<tr>
<td>The number of links in the Jansen mechanism is more when compared to that in the Klann mechanism. It is costly.</td>
<td>The number of links in the Klann mechanism is less when compared to that in the Jansen mechanism. It is less costly.</td>
</tr>
</tbody>
</table>

Table 1: Comparison of Jansen Linkage and Klann Linkage

2. PROPOSED METHODOLOGY KLANN MECHANISM

As the wheels are ineffective on rough and rocky areas, therefore robot with legs provided with Klann mechanism is beneficial for advanced walking vehicles. It can step over curbs, climb stairs or travel areas that are currently not accessible with wheels. The most important benefit of this mechanism is that, it does not require microprocessor control or large amount of actuator mechanisms.

This paper is useful in hazardous material handling, clearing minefields, or secures an area without putting anyone at risk. The military, law enforcement, firms could also benefit from applications of mechanical spider. It would perform very well as a platform with the ability to handle stairs and other obstacles to wheeled or tracked vehicles

3. THEORETICAL DISCUSSIONS

Legged motion systems have been effective in numerous robotic missions and such locomotion is especially useful for providing better mobility over irregular landscapes. However locomotion capabilities of robots are often constrained by a limited range of gaits and associated energy efficiency. This journal presents the design of a novel reconfigurable Klann mechanism capable of producing a variety of useful gait
cycle. Such approach opens up new research avenues, opportunities and applications.

The position analysis problem that arise when dealing with reconfigurable Klann mechanism was solved here using a bilateration method, which is distance base formation by changing the linkage configuration. Our aim was to generate a set of useful gaits for a legged robotic platform. In this study three gait patterns of interest were identified, analyzed and discussed that validates the feasibility of our approach and considerably extends the capabilities of the original design.

4. ADVANTAGE OF KLANN MECHANISM

Simplicity in design: The design of the Klann mechanism is simple and has a less complicated when compared to the other mechanism. Compatibility: The design of the Klann mechanism is very compactable and portable with lesser linkage for movement reliability. This mechanism consists of linkages which can move on some of the irregular come uneven and rough terrains or surface thereby has the ability to endure giving it a good reliability.

5. CONSTRUCTION OF TELEROBOT

The cranking link is also axially mounted to the frame in operative association with a power source and operatively linked to at least one connecting rod so as to provide locomotion to the interconnected linkages of the walking assembly. The walking assembly includes a reciprocating leg equipped at one leg end with a foot and a hip joint at an opposite leg at one end. The hip joint is axially coupled to an opposite rocker arm end from the axial mount of one rocker arm to the frame. The first rocker arm limits locomotion of the hip joint about an acute arced path as the first rocker arm and upper extremity of the leg reciprocates about the path when placed under locomotion by the power source.

The spider mechanism works on the principle of the Klann mechanism that deals with eight leg linkage wit four linkages equally spaced on each side of the frame. These eight linkages are connected to four cranks shafts, with two cranks on each shaft. Here a connecting rod connects the linkages with their respective cranks and the connecting rod is supported by a rocker at its center forming a crank-rocker mechanism. Step height is achieved by rotating the connecting arm which is attached to the crank on one end and the middle of the leg on the other. It pivots on a grounded rocker. 180 degrees of crank rotation per stride.

The 4-Channel Relay Driver Module [4] makes it simple and convenient to drive loads such as 12V relays from simple 5V digital outputs of your remote compatible board. You can use any of the control channels independently, so simply leave any unused channels disconnected.

Gear motors are complete motive force systems consisting of an electric motor and a reduction gear train integrated into one easy-to-mount and configure package. This greatly reduces the complexity and cost of designing and constructing power tools, machines and appliances calling for high torque at relatively low shaft speed or RPM. The whole mechanism is controlled by the raspberry pi microprocessor and is easily handled by the controller from far away places which makes him secure and free to operate.The controller that has been used in this mechanism is using the raspberry pi 3 microprocessor. The main advantage of using this microprocessor is that it can many tasks at a single time and is much efficientv as compared to the other contollers. The controller is mainly connected with the metal detector and the usb camera with the PIR sensors attached to them.

5.1 RASPBERRY PI 3

Several generations of Raspberry Pis have been released. The first generation (Raspberry Pi 1 Model B) was released in February 2012. It was followed by a simpler and inexpensive model Model A. In 2014, the foundation released a board with an improved design in Raspberry Pi 1 Model B+. These boards are approximately credit-card sized and represent the standard mainline form-factor. Improved A+ and B+ models were released a year later. A “compute module” was released in April 2014 for embedded applications, and a Raspberry Pi Zero with smaller size...
and reduced input/output (I/O) and general-purpose input/output (GPIO) capabilities was released in November 2015. The Raspberry Pi 2 which added more RAM was released in February 2015. Raspberry Pi 3 Model B released in February 2016 is bundled with on-board WiFi, Bluetooth and USB Boot capabilities. As of January 2017, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. Raspberry Pi boards are priced between. As of 28 February 2017, the Raspberry Pi Zero W was launched, which is identical to the Raspberry Pi Zero, but has the Wi-Fi and Bluetooth functionality of the Raspberry Pi 3.

All models feature a Broadcom system on a chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a VideoCore IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or MicroSDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. The B-models have an 8P8C Ethernet port and the Pi 3 and Pi Zero W have on board Wi-Fi 802.11n and Bluetooth.

The Foundation provides Raspbian, a Debian-based Linux distribution for download, as well as third party Ubuntu, Windows 10 IOT Core, RISC OS, and specialised mediacenter distributions. It promotes Python and Scratch as the main programming language, with support for many other languages. The default firmware is closed source, while an unofficial open source is available.

A gear motor is a specialized form of electric motor which can operate indefinitely while stalled, that is, with the rotor blocked from turning, without incurring damage. In this mode of operation, the motor will apply a steady torque to the load (hence the name).

A common application of a torque motor would be the supply- and take-up reel motors in a tape drive. In this application, driven from a low voltage, the characteristics of these motors allow a relatively constant light tension to be applied to the tape whether or not the capstan is feeding tape past the tape heads. Driven from a higher voltage, (and so delivering a higher torque), the torque motors can also achieve fast-forward and rewind operation without requiring any additional mechanics such as gears or clutches. In the computer gaming world, torque motors are used in force feedback steering wheels.

The gear motor used in the paper is 12v dc, 200 rpm dc gear motor with a torque of 5 kg each of the motors.

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor.

Objects of similar temperature but different surface characteristics

Fig 2: Raspberry PI 3 1

Fig 3: Raspberry PI 3 pin configuration

5.2 GEAR MOTOR

5.3 PASSIVE INFRARED SENSORS
may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.

![Fig.5: PIR sensor](image)

PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available—typically designed to mount on a ceiling. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over thirty meters (one hundred feet) away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage, or with individually selectable segments to "shape" the coverage. The main function of PIR sensors is to detect the human motion and alert the controller through buzzer or else any other medium but here in this paper the PIR is not just being used as a sensor but in another way to sense the authorized or unauthorized person. Whenever the PIR senses the human body the sensor sends a triggering signal to the raspberry pi which in turn triggers the face detection camera installed in the spider robot.

The face detection camera whenever gets triggered it will capture the faces of the person detected and then the system memory comes into act to compare the photographs with the restored pictures. If the match is found with the picture stored before then the controller gets a authorized person signal and if the match is not found then it will write as unauthorized person.

### 5.4 METAL DETECTOR

A metal detector is an electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within objects, or metal objects buried underground. They often consist of a handheld unit with a sensor probe which can be swept over the ground or other objects. If the sensor comes near a piece of metal this is indicated by a changing tone in earphones, or a needle moving on an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes. Another common type are stationary "walk through" metal detectors used for security screening at access points in prisons, courthouses, and airports to detect concealed metal weapons on a person's body. The main function of metal detector in this paper is that it will sense the presence of metal from a particular point and then it will capture the picture of the particular area and mail it to the respected email address through which the controlling is going on simultaneously. In case there is an error in mailing the picture the another option that is available is that it will alert the controller through way2smS.

![Fig.6 Metal Detector](image)

### 6. CIRCUIT DIAGRAM

![Fig.7: Circuit Diagram of whole mechanism](image)

In the circuit diagram the Vcc and GND are taken from the pin 4 and 6 respectively. The motor driven circuit, which is used for the driving the gear motor. The 12v supply is directly given to the motor driving circuit. The input for the motor driving circuit is taken from the raspberry pi pin number GPIO 12, 16, 20.
and 21. The common $V_{cc}$ and GND of the motor driving circuit is taken from the raspberry pi pin number 4 and 6. The gear motor is connected to the motor driving circuit. The PIR output is given to the pin number GPIO 09. The metal detector is connected with pin number GPIO 11. Face detection camera is connected through the USB port. The GPIO 05 pin is used for the buzzer circuit.

![Fig 8 Leg](image1.png)

**FIG 9: TELEROBOT FINAL MODEL**

![Fig 10: Metal Detector output](image2.png)

![Fig 11: Metal Detector output 1](image3.png)

### 7. CONCLUSION

The most forceful motivation for studying legged robots is to give access to places that are inaccessible or too dangerous for human beings. Legged robots can be used for rescue work after earthquakes and in hazardous places such as the inside of a nuclear reactor, giving biologically inspired autonomous legged robots great potential. Thus in our paper we have proposed a method to replace the function of wheel in order to overcome the difficulty of travelling in uneven terrain and provide as much as security measures possible using various sensors and various controllers.

### 8. FUTURE SCOPE

Though the idea is pretty old, the future scope could be many making it useful in hazardous material handling, clearing minefields, or secures an area without putting anyone at risk. The military, law enforcement, explosive ordnance disposal units, and private security firms could also benefit from applications of this klann mechanism held telerobot with security systems enabled in it. It would perform very well as a platform with the ability to handle uneven terrains and other obstacles comparing to wheeled or tracked vehicles.

### 9. REFERENCES

4. [www.mekanizmalar.com](http://www.mekanizmalar.com)
5. [www.wikipedia.com](http://www.wikipedia.com)