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Fire Fighting Robot by Using Klann Mechanism

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Abstract: *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. 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 vehicle to travel parallel to the ground. This project is useful in hazardous material handling, clearing minefields, or secures an area without putting anyone at risk.*

Key Words: *Klann linkage mechanism, Jansen linkage mechanism, Legged mechanism.*

I. Introduction

Fire Fighting is a very dangerous task which involves working in a dangerous environment comprising of dense smoke, oxygen deficient atmosphere and elevated temperatures. Fire Fighters suffer serious burn injuries, suffocation, dense smoke obscures their vision and in extreme cases can cause disorientation to the fire-fighters thus trapping them in fire. Hence a need is felt for design and development of fire fighting robot that will at least assist fire fighters in curbing small fires from spreading allowing fire fighters to concentrate on serious fire disaster. The fire-fighter must be able to get to a fire quickly and safely extinguish the fire, preventing further damage and reduce fatalities.

1.1 Klann Mechanism

The Klann linkage is a planar mechanism designed to simulate the gait of legged animal and function as a wheel replacement. The linkage consists of the frame, a crank, two grounded rockers, and two couplers all connected by pivot joints.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. The Klann linkage 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 an area that are currently not accessible with wheels but does not require microprocessor control or multitudes of actuator mechanisms.

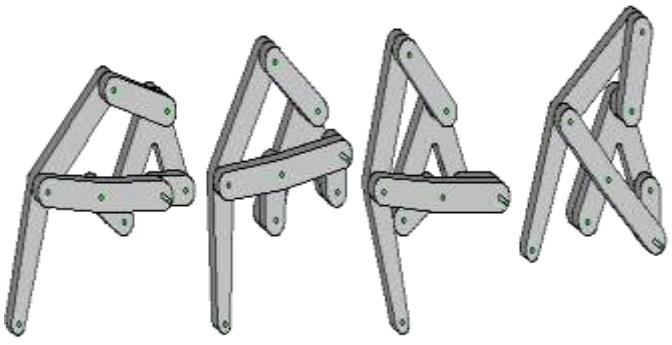

Fig -1: klanns linkage Cycle

1.2 System Layout

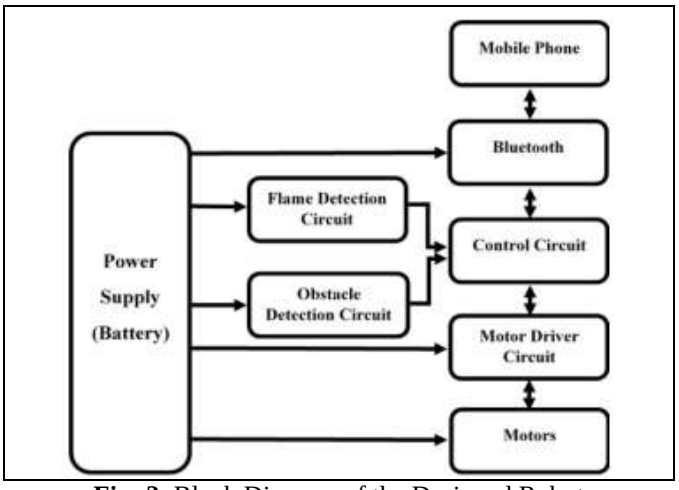

Fig -2: Block Diagram of the Designed Robot

1.3 Methodology

A fire engineering approach is required so that the expected fire within a given building can be predicted and correlated to an acceptable fire-fighting water supply. This approach requires the definition and identification of a number of aspects. This report investigates existing methodologies for assessing expected building fire size and how these have been related to fire fighting water requirements. It follows that the identification of water quantity also then defines the other resources required in fighting the fire i.e. equipment, pumping capacity and manpower.

This report considers the following aspects:

- Classifications of buildings in terms of fire size i.e. the expected fire size within a building type at the time of fire service intervention.
- Fire Brigade response model i.e. time to intervention.
- Required water supply to extinguish the expected fire size.

II. Design & Material Selection

Acrylic Type of plastic, one of a group of synthetic, short-chain, unsaturated carboxylic acid derivatives. Variation in the reagents and the method of formation yields either hard and transparent, soft and resilient, or liquid products. Their toughness and dimensional stability make acrylics useful for molded structural parts, lenses, adhesives and paints. acrylic, artificial fiber made from a special group of vinyl compounds, primarily acrylonitrile. Acrylic fibers are thermoplastic (i.e., soften when heated, reharden upon cooling), have low moisture regain, are low in density, and can be made into bulky fabrics.

2.1 Typical Properties Of Acrylic PMMA

Sr.No.	ASTM or UL test	Property	Acrylic
1	D638	Tensile Strength (psi)	8,000 -11,000
2	D638	Tensile Modulus (psi)	350,000 - 500,000
3	D695	Compressive Strength (psi)	11,000 -19,000
4	D785	Hardness, Rockwell	M80 -M100
5	D3418	Melting Temp (°F / °C)	265-285 / 130-140
6	-	Max Operating Temp (°F / °C)	150-200 / 65-93
7	D149	Dielectric Strength (V/mil) short time, 1/8" thick	400

Table -1: Properties Of Acrylic PMMA

2.2 List of Parts Klann Mechanism

SR. NO	PART NAME	SPECIFICATION
1	Base Plate	Dimension of base plate = (300*205*5)mm
2	Crank Plate	Dimension of crank plate= (35*16*5)mm Diameter of hole = 4mm & 8mm
3	Gear Plate	Dimension of gear plate = (120*55*5)mm Diameter of hole = 8 mm Distance between two hole = 60mm
4	Side Plate	Dimension of side plate = (205*55*5)mm Diameterofhole=8mm Distance between two hole = 95mm
5	Connecting Rod	Dimension of connecting rod = (113*16*5)mm Diameter of hole = 4mm Angle of connecting rod = 170^0
6	Upper Arm& Lower Arm	Dimension of Upper & lower arm = (65*16*5)mm Diameter of hole = 8mm
7	Leg	Dimension of Leg = (225*16*5)mm Diameter of hole = 4mm Angle of connecting rod = 160^0
8	Gear & Pinion	Dia of gear=64,Dia of pinion=24

Table -2: Part List Of Klann Mechanism

2.3 Conceptual & Actual Design Model of Klann Mechanism

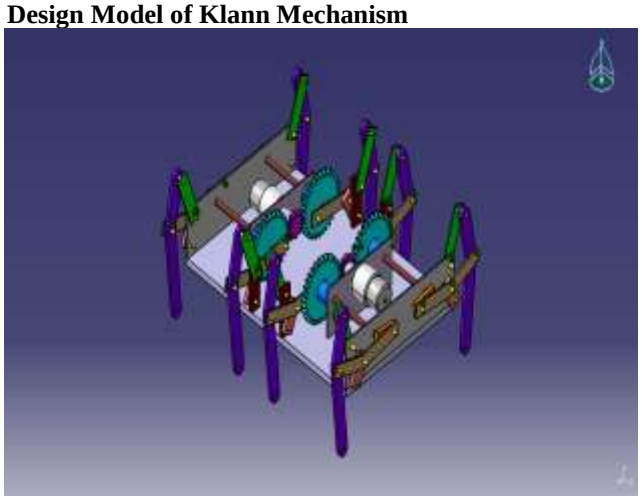

Fig -3: Conceptual Design Model of Klann Mechanism

Fig -4: Actual Design Model of Klann Mechanism

2.4 List Of Electronic Parts Of Robot

SR. NO	COMPONENT	SPECIFICATION
1	Microcontroller	ARDUINO UNO:6 analog inputs, a 16 MHz quartz crystal
2	IC	L293D. Maximum current of microcontroller output (typically 10-20mA)
3	Breadboard	Solderless breadboard
4	Flame Detection Sensor	LM35 I/V 4-30V O/P- 04 ohm
5	DC Servo Motor	I/P Voltage=12V SPEED=200RPM
6	Android Mobile	SAMSUNG 5285
7	Wires & cables	USB CABLE,COPPER WIRE.

Table -3: List Of Electronic Parts Of Robot

III. Working Of Mechanism:

The designed fire fighting robot consists of Microcontroller LPC 2138, LCD display, temperature sensor, Smoke sensor, IR sensor, Relay, Pump ,DC Driver IC, DC motors ,Bluetooth module and is having one Android phone. We are going to design a Server for handling the robot from web page and can able to monitor the different parameters from web server.

1.Video streaming: The video streaming robot will continuously capture images with the help of camera of Android phone and are sent to the web server so we are able to see the current scenario of area where that robot will be present , being anywhere from web server.

2. Temperature monitoring: The robot will continuously monitor the temperature where that robot will be present with the help of temperature sensor interfaced to the controller and send these parameters on web from Android phone via Bluetooth module interfaced to the controller. The temperature sensor readings are displayed on the LCD display present on the robot and are also displayed on the web page.

3. Fire detection: Apart from increase in temperature the fire is also detected with the help of Smoke sensor. The fire detection is done with the help of Smoke sensor present in the system. After detecting fire by the sensor the fire fighting robot will automatically turn on the pump in order to extinguish fire catches.

4. Obstacle detection: The IR sensor is used for detecting the obstacle in the path of robot. So that robot can change its direction accordingly after detect.

5. Remote handling from web server: All the data from robot is sent to the Android phone via Bluetooth module interfaced to the controller and is then sent to the web server from Android phone. So that one is able to control the robot movement left/right from web server.

IV. Conclusions

The challenge of creating a fire extinguishing robot to operate in lighting conditions that are not fixed is a difficult one. Completing each of the different components was not easy. However, Firebot's hardest task was integrating all of its components. The experience and the difficulties faced taught us valuable lessons that we can use on future projects.This project is been implemented by using android application and web server. The water container is placed on the robot when the fire is detected , it sprays the water on the fire and extinguish it.The developed Autonomous Fire Fighting Mobile Platform has shown to be a feasible project.The present work we have to consider a six bar linkage of klann mechanism. Based on the findings, integrating all the hardware such as flame sensors, motor driver circuitry, LDR sensors, the expected patrolling and fire extinguishing tasks are possible to be carried out and executed with minimum level of error.

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