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Implementation of Multi Sensor and Multi-Functional Mobile Robot for Image Mosaicking

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ABSTRACT

In this paper a multi-sensory and multi-functional robot will be developed with the features of obstacle avoider and follower, black and white line follower, motion of the robot will be based on clap sound and flash of light followed and avoider robot. The robot will have 3 DOF (Degree of freedom) arm with a camera on the top of that arm through which successive images or videos are taken in any places. In the future, we can use the DTMF receiver by using the mobile phone. This robot can be used for military purpose in surveillances in any environment and weathers which save human's lives and searching purpose also where the human cannot reach. Robot with wireless camera provides numerous applications in spy. This project helps us to follow or detect a person in the building or any critical place without the presence of us. We can see the video of the present state of the building or place on the T.V. Thus, this project provides security.

Keywords: 2DOF, edge avoider, image mosaicing, IR images in continuous manner than images are joints by the sensor and line follower.

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INTRODUCTION

Making of multi sensor and multi-functional robot is the main concern of the researchers all over the world, including different software like image masking, surveillances etc. to makes robot perfect and reliable and they are developing various methodologies to overcome the problem. Robotics is the branch of technology that deals with the designs, constructions, operations and of robot, as well as computer systems for their controls, sensory feedbacks, and information processing. “A robot is a reprogrammable, multi-functional designed to move material, parts, tools, or specialized devices, arrangement and operates through variable programmed motions for the presentation of a selection of tasks.” Robotics is the technology and discipline of robots, their manufacture, application and design. Robotics must have a working knowledge of electronics, mechanics, and software. The robot is prepared mechanically which is called a kinematic chain. It functions analogously like creature skeleton. This chain contains actuators (muscles), links (bones) and joints.

Image mosaic is one of the key research areas in an image processing. Image mosaicing is ended in

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case one single panoramic image has to be aggregated from a variety of snapshots taken from different view of the same image by different apparatus [1]. This approach is practiced in some vision and technological research areas. In case of medical apparatus when microscopic images cannot be captured as an entire at a time, after that concept of image mosaicking can be used. It has been established from the literature that a lot of work is done in this area. A previous algorithm used to suffer from various drawbacks like bad quality, accuracy, problem of misregistration, peak signal to noise ratio, percentage of mismatches, differences in pixel intensities etc [2]. The main idea of the present work is the development of a new image mosaicking approach which divides whole images into the grid and multiple features are extracted and a new action of verification is also introduced in this approach to reduce the difficulty of misregistration. This grid based mosaicking approach is of huge help as it tried to develop the performance metrics like diversity in pixel intensities, accuracy etc. of the images.

In the present work, the complete work has been carried out in two phases: hardware phase and software phase. In the first phase, robots are used to manipulate the environment in which it will work. According to the guidance robot of user it will react and run. In robot, there are several sensors, 3 DOF (Degree of Freedom) arms, frames and camera inbuilt. In the second phase, GUI are used in two different places, first is used for robot operation in support of controlling the robot and second one is to use for image mosaicking [3].

The present work has been carried out using three methods: Fusion of sensor, Multi-functional robot and Image Mosaicing Technique. All the methods have been discussed systematically in the following subsection.

Fusion of sensors

Fusion of sensors means the process or result of combination two or more sensors together to structure a single entity. Here in present work some sensors are used to do fusions of work like white and black line follower, obstacle avoider and follower, light follower and avoider, and according to clap sound robot will move or stop. Means here eight types of the mechanism are working but in robot there are only four sensors inbuilt [4]. All sensors are able to do their specific jobs which are programmed by the programmer and works according to the user through computer or laptop. Here two sensors which are attach front of robot head works on white and black line follower and other sensors attach beside robot are used to detect the obstacle for follower or avoider and do another work as flash light detection for moving through light or avoiding.

Multi-Functional Task

Multi-functional means having or fulfilling several functions. Here using a robot which is embedded with sensors and doing fusion of work through sensors. In robot there are several electronic components like motor, sensors, arm and camera etc. These all components are works according to the user. User uses computer or laptop to give an instruction to robot. Here multi-functional works are doing in same time through all the components at a time. In present work, microcontroller plays the main roll which is control are the components at a time means if user wants to run robot wheels with sensors and wants capture images through camera then user have only given the simple instruction to microcontroller by user's computer or laptop[5].

In this paper, A multi-functional robot will be developed with the features of obstacle avoider, obstacle follower, white line following, black line follower, motion of robot will be based on sound like clap sound and light sensor which follow the light and vice versa. for these, robot uses the different sensors for different purpose of tasks. These all components are works according to the user. User uses computer or laptop to give an instruction to robot. The robot will have 3 DOF arm (Degree of Freedom) with camera on top of arm through which images are taken and then successive image are joints by the help of different mosaicking algorithm and analysis is performed.

REVIEW OF RELATED WORK

This paper deals with the review on the methodologies adopt for the growth of new robotics and image mosaicking approach. Image mosaicking approaches based on extraction of multiple features. This section highlights the drawbacks of previous image mosaicking and robotics methodologies and explains the requirement of development of this latest algorithm. Also, this

workpresents brief analysis of the tools used for image framing, feature extraction, matching, and verification, redrawing and stitching of a large data set. And also presents the brief knowledge of robotics and robots [6].

The present work deals with the approaches adopt by the researchers in the field of multi sensor and multi-functional robot and image stitching through an old approach called as SIFT method. In previous paper also used multisensory fusion robot for security purpose. In the present work, using multi sensor and multiple functional robots with image mosaicing algorithm. The mobile robot has more than one sensor and degree of freedom arm and camera, wheels and etc., which are used for moving the mobile robot and do multiple tasks[7].

Many previous image stitching approaches are studied in this section to understand the various techniques of previous algorithms from the all literature, it has been observed that process of image stitching has been applied previously but extracted limited number of features hence, overlapping regions are ignored, and lots of common points. Conventional image mosaicking algorithms are developed using SIFT methods but these algorithms require lots of metrics like accuracy, peak signal to noise ratio, difference in pixel intensities etc. Also, it produces bad quality image, percentage of mismatches The previous algorithms suffer mainly from problem of misregistration which means if an image is too small or too large then it is very difficult to take whole image at the same time[8].

Feature extraction is the main preprocessing step of image processing. Enhanced features are extracted much better image mosaicing is done. Feature Based image mosaicing plays the key function in image processing. But this primary approach was considered only for few features and not good quality in real time application as it was only for easy images[9].

In the present work, literature review made so far interconnected to the work has been briefly discussed. It has been established that in last few decades, research has been carried out in multi sensor and multi-functional robot as IR sensor, LCD, sound sensor, ultrasonic sensor, camera, speaker, servo motors, and multiple DOF arms and so on. The few years back robot are only doing one work at a time but in present robot are doing a lot of work without any problem and in hazardous places. The present work describes the multi sensor and multiple functional robot that is describes the functionality of multiple tasks done with multi sensors. In last few decades, robotics fields are fast growth for the purpose of help to human beings where they cannot go and do work there comfortably [10].

It has been found that in last few decades, research has been agreed out in image mosaicing as foreground images, panoramic images, and satellite images etc[11]. The technology progress made in the past decades has been summarized by changes of single feature extraction to multiple features extraction approach, from more real times applicable, from theoretical to partial approaches, from two dimensions to three dimensions image stitching, and from mathematical approaches to logical approaches like minimum cost spanning tree and so on[12]. In subsequent section, still, there is a scope for better mosaicing of image by including more features and performing more mathematical calculations through the approach proposed [13].

OBJECTIVE OF WORK

The present work deals with two phases: hardware and software. In hardware section there are a robot equipped with multi sensor and multi-functional which are made to do different work according to the user manual. In this presentation, there are also use software to run hardware means robot and software are here to work on image mosaic technique. Here in present work there are wireless robot in which two major component are worked. One of the components is radio frequency transmitter from the computer side and second one is the radio frequency receiver from robot side. In sort both radio frequency transmitter and receiver are called RF module through which information's are transferred to each other. There is also a camera is installed to taken picture around the environment which are used for image mosaic purpose. The objective of the work is to make a multi sensor and multi-functional robot through which we can perform different task like line follower, obstacle avoider, moves according to sound and flash light movement of robot. Further of these operations, robot can take pictures from a camera which in attached in 3 DOF arms of robot[14].

In image mosaicking procedure, the difficulty has been originated into seven phases: The first phase is to collect the resource and target image as input set. The second phase is to divides the image into frame. The third phase deals with feature extraction on the basis size, width, height, object oriented like objects shapes, colors etc, textures like pixel intensities, gray scale technique, color, composition of image etc, homographic like planar, non-planar and rectangular views are detected. The fourth phase is to detect and stitches the similar points of the images where a function of homographic estimation is used. The fifth phase termed as verification and matching of target images which are verifies whether all the similar points are included or not[15]. The sixth stage is considering all common points when the whole image is redrawn. At last, a mosaiced image is formed. The steps of accomplishing objectives are-:

- Insertion of source image and target image as input.
- Divide the images into frames into equal grids and block.
- Homographic feature extraction is done which includes texture-based features Geometrical and object oriented.
- Similar points of goal and source image are found.
- Similar points of source and goal images are correlated.
- Stitching is performed and transformation of grid image is obtained.
- Images redrawn and final mosaiced image is formed.

In this present paper, we deal with multi sensor devices. This fusion of sensors, the process or result of combinations two or more sensors together to structure a single entity. In this paper, we tend to describe about the sensors. Here main roles play with robot's sensor according to which robot is working. In this paper, the robot has worked eight tasks on the basis of sensors. These eight tasks are: white line follower, black line follower, obstacle avoider, obstacle follower, flash light follower and flash light avoider, move according to sound and stop according to sound. This all task is performed because of sensors, but for these eight tasks we using only two sensors sound sensor and IR sensor. These two sensors are attached head of the robot's body to do the different tasks.

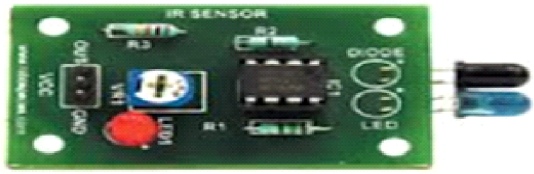

Figure 1: IR Senosr

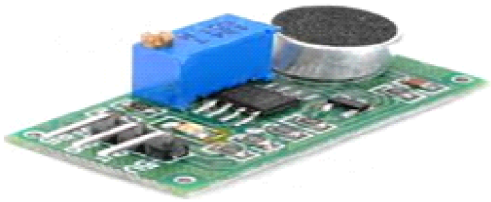

Figure 2: Sound Sensor

And when comparator compares the reflected current from the photodiode then it compares to the reference values and if the value is higher than the reference value then sensor gives the output to the circuit board. And when the value is not greater than the reference value, then sensor not gives any output.

Below in Fig 3 and 4 describes the working of Infrared sensors with Light Emitting Diode.

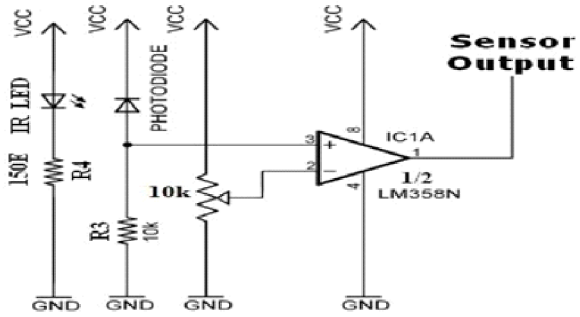

Figure 3: Circuit Diagram of IR sensor

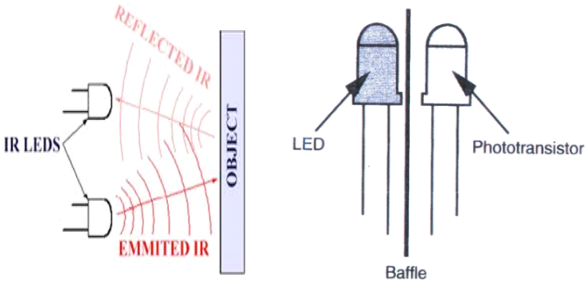

Figure 4: Working of IR sensor.

Multi-functional Robot

Multi-functional robot means a robot having or fulfilling several functions. Here using a robot which is fixed with sensors and doing fusion of work through sensors. In robot there are several electronic components like motor, sensors, arm and camera, microcontroller, motors, etc. These all components are works according to the user instructions. User can use a computer or laptop to give an instruction to robotic device. Here multi-functional works will be done in the same time through all the components at a time. In the present work, microcontroller plays the main roll which is control are the components at a time means if the user wants to run robot wheels with sensors and wants capture images through the camera then user have only given the simple instruction to microcontroller by a user's computer or laptop at a time.

In this paper, A multi-functional robot will be developed with the features of obstacle avoider, obstacle follower, white line following, black line follower, motion of the robot will be based on sound like clap sound and light sensor which follow the light and vice versa. The robot will have 3 DOF (Degree of Freedom) arm with camera on top of the arm through which images are taken and then the successive image is jointed with the help of a different mosaicing algorithm. Here we are going to discuss about the tasks of the robots:

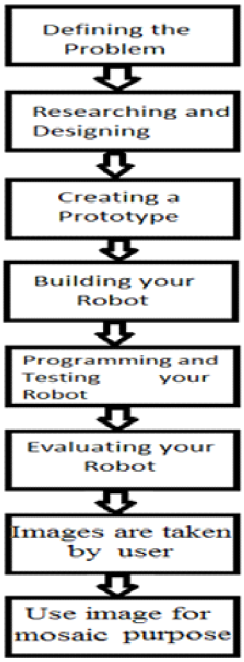

Figure: 5: Solution methodology for robot

The various steps involved in Scale Invariants method are described below in diagrams:

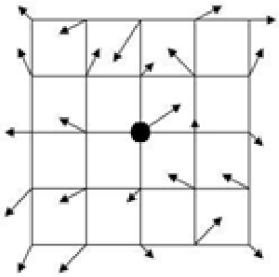

Figure: 6 Orientation assignment

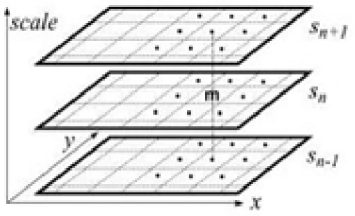

Figure: 7 Extrema detection

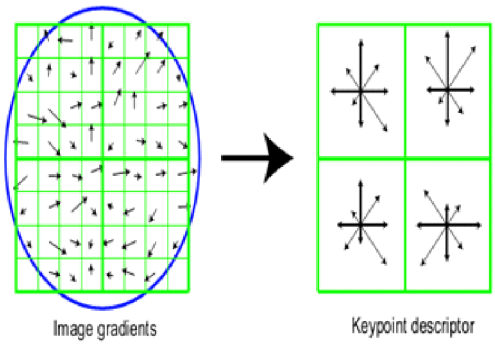

Figure 8: Key point descriptor and Image intensity understanding

Algorithm for multiple features image mosaicing.

Algorithm 1: Image Framing and Feature Extraction

Step1: Insert source and target image.

Step2: Separate or divides the target image into equal frames or blocks that is called as framing.

Step3: Calculate the intensity difference for each frame with respect to source image.

Step4: Compute the common points of the grid based of target images and source images.

Step5: Both common points are correlated.

Step6: Find the homography using STITCHER Algorithm. Call STITCHER

Step7: Best matching points are obtained and call MATCHER and VERIFIER

Algorithm 2: Image Stitching: STITCHER

Step1: For stitching purpose, matching of all corners means top left, top, right, bottom left, and bottom right of all grids of the source image with reference to target images.

Step2: Correlation method is used.

Step3: Call MATCHER and VERIFIER

Step4: Return.

Algorithm 3: Image Matching and Verification: MATCHER and VERIFIER

Step1: Normalization is used for all the common points of the images after the best common points are detected from grids.

Step2: All other points are changed by scaling and rotation. TRS theory is used, then target image is changed.

Step3: Generated image is redrawn through re-projection of all grid points.

Step4: Final mosaiced image is formed.

Step5: End.

RANSAC stands for RANdom Sample Consensus Algorithm. It is a resembling technique that generates candidate solutions by using maximum no of observations.

In this work, manufacturing of the robot is completed, testing part of the robot is also done. In this robot, the functions are divided into two parts: vehicle mode and arm mode. In vehicle mode, the previous discussed task like white line follower, black line follower, obstacle avoider, obstacle follower, flash of light followed and avoider, and moving of robot depends on the clap sound. The section parts are an arm mode section, in this part robot only concentrate on arm activities and moving according to used decisions. Here also camera allocated at the top of the robot's arm, which is taking images. When the arm is moving then the camera is also moving according to the arm movement.

In this present work, mathematical description has been completed over captured and composed source and target continuous images. Later on, this processed, images are divided into grids and then image matching, image stitching and verification of images are done. Global intensity difference and feature extraction are calculated and performed by taking various attributes of size, color, composition, gray scale intensities, shape, length, width, height, objects, etc. After all this, stitching of various parts of the same image is done. After, correlations are done by which increased accuracy of images. Finally, verification is performed for image mosaicing method. Normalization is done by source image grids with respect to target images and transformation is performed. The solution methodology with developed algorithm has been tested experimentally and achieved satisfactory results.

EXPERIMENTAL RESULTS AND DISCUSSIONS

The present work of the paper deals with the setup of the work that has been carried out in which hardware and software are combined. In this section we are talking about three different works as: software programming for robot, deploy software program into the hardware of the robot, and again using software for image mosaicing. In the first part, software using for programming purpose is Keil uVision4. This software is mainly used for the programming of robot tasks. The second part, we are using a microcontroller programmer device to deploy our program into microcontroller IC's. The microcontroller device works on different pins of the microcontroller. The third part is for using image mosaicing purpose that is explained in the next paragraph.

The present work of the work deals with an experimental setup of the work that has been carried over a collection of data set of images. This test is done with necessary test data and performance parameters like accuracy, noise ratio, mismatches are checked. The difficulty of misregistration is solved. After the collection of data set, different phases and the algorithm are implemented. Also, a comparative analysis is done with S.I.F.T method.

Below in Figure 9 shows that the working of main GUI phases and Figure 10 shows the snapshot of final robot.

Figure 9 : Main Graphical User Interface

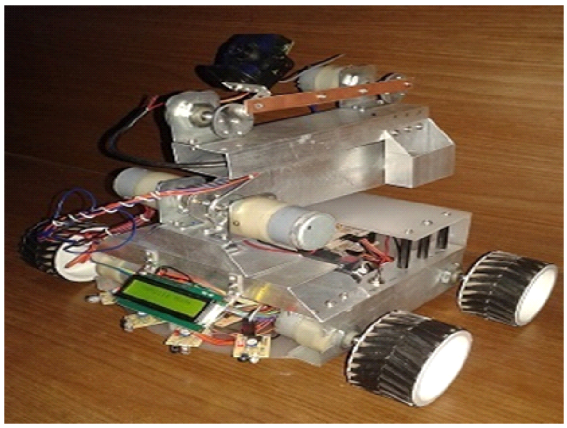

Figure 10 : Snapshot of Final robot

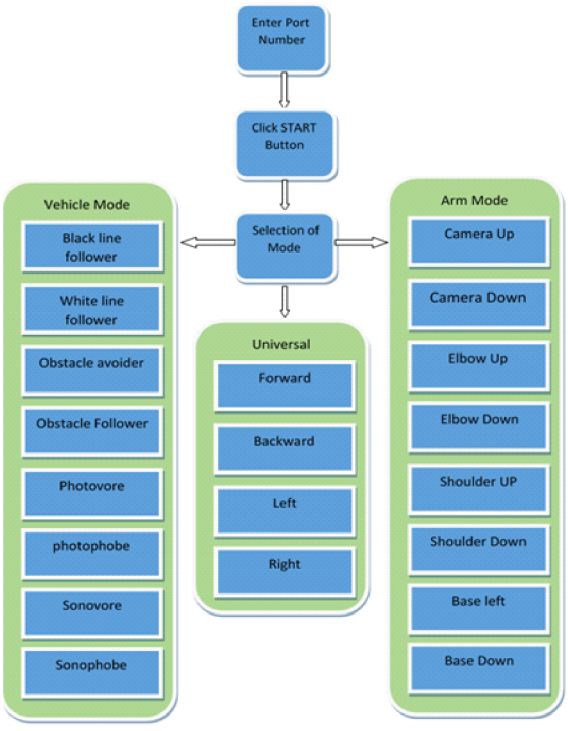

Figure 11: Complete work flow diagram

CONCLUSION

The present work discussed the result obtained in the present work. In this paper, the robot is doing multiple jobs or tasks and it also does the different task according to the multi sensor as shown in the above experiments. In these experiments' sensor are done main role for moving vehicle and 3 DOF arm are done their perfect job of capturing images and videos. There are various screen shots are provided in this work which explain the practical implementation of the present work and its execution. There also snapshots are provided of the hardware software which is used to make program and deploy the program into robot software. The snapshots of the robots are provided how the robot done their work according to the given control through the use of computer or laptop. The present work gives details that the output produced in this work is better in comparison to previous developed projects.

The present work discussed the results obtained in the current work. In this work, image mosaicking methods based on many features is developed and an evaluation is shown with scale invariant method. A variety of screenshots are provided in this paper, which explains the useful implementation of the present work and its implementation. The explanation provided in the present work give details that the output produced in this work is better in comparison to previous developed algorithms.

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