Design Approach: An Autonomous Rover

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ABSTRACT
The robot is programmed to be used for specific works which are very complicated for human being like space exploration, planet exploration, remote sensing etc. Recently a robot was sent to the Mars for the detection of presence of life on it. In this paper the basic design of Mars Rover is discussed along with its brief details. The design has few shortcomings and its whole working depend on the ground station working. In this paper a new design approach has been proposed which involve less dependencies on ground station working and chances of failure will be less than the existing design.

Keywords
Acoustic tracking, intelligent robots, robot kinematics, extraterrestrial exploration, transducers, image sensors

1. INTRODUCTION

A robot is a machine having mechanical body and an electronic nerve system to drive it. The robot can be programmed with some kind of intelligence through which some useful and complex work can be done which is difficult task for the human. Robots having artificial intelligence are known as autonomous robots [6]. Recently a robot is send to the Mars for the detection of presence of life on it. This design was being manually controlled from the ground station to do the specific tasks which needed a high amount of manual work. In this paper the design approach for an autonomous rover has been discussed. The new design approach allows the rover to have an artificial intelligence system due to which it controls itself and decreases the manual work.

2. BASIC STRUCTURE OF ROVER SYSTEM

An overall system block diagram, shown in Figure 1, displays a detailed layout of the inputs and outputs of the system. The block diagram consists of four sub-blocks: User Computer, Network Card, Microprocessor and the Embedded System [5].
Ground station, Mars base and Mars Rover are the three divisions of the block diagram shown above. The working of the ground station is to control the rover movement and calculate the results on the basis of analysis and images sent by rover. Mars base is used to provide an interface between the ground station and the rover. It stores and executes the commands coming from the Ground station. The Mars base runs the autonomous algorithm, which provides the control of the movement of the Rover. The Mars Rover is an actuator, which interacts with its environment. Its main function is to perform basic commands such as: stop, move, rotate, and collect water. In order to have a complete overview of the current state of the machine, it must provide housekeeping data for the Mars Base. These data are: battery voltage, current consumption, cumulative consumption, proximity sensor readings, etc. [2,3].

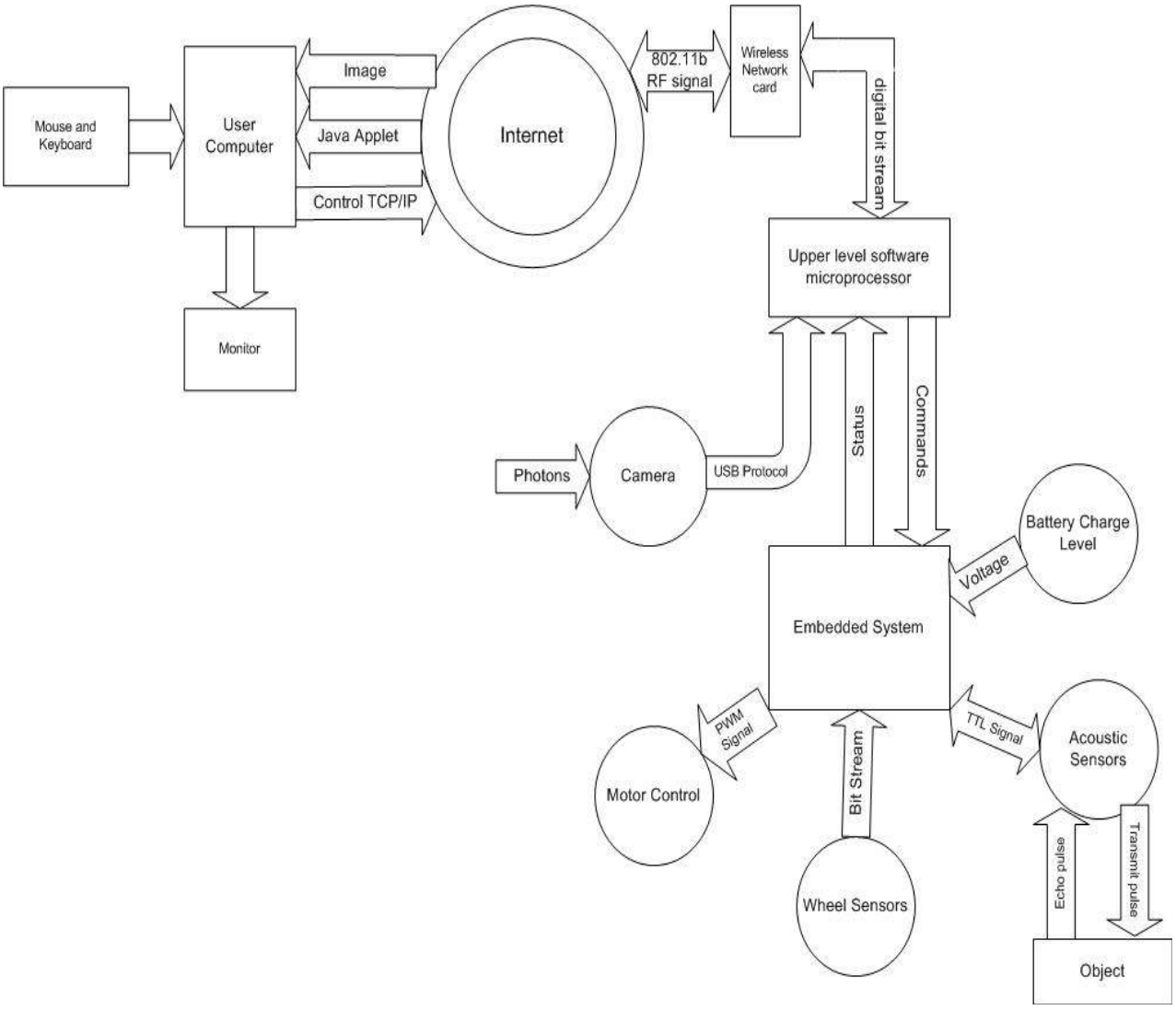

Figure 1: Block Diagram of Existing Rover Communication [5]

3. PROPOSED DESIGN APPROACH

In the new design just FPGAs are used which allow the use of various components like analog to digital convertor, comparator etc. Also the previously stored data is used for the reference which is compared with the latest coming data which decides the action to be taken. Acoustic sensors are used for determination of direction and distance for the target. Also other sensors are to be connected to the FPGAs so as to get other details like humidity, illumination etc. The software program for this task is to be burnt on the FPGAs. The results are stored to the memory for the reference. Back-up control is also provided so that if there crop up any problem in the rover it can be sorted out by sending commands to the rover manually from the ground station.

Control is based on a forward/backward motion and a rotation. Control for the motion forward and backward is based on the results of comparing of the latest data with the previously stored data and acoustic sensors output. Comparing basically decides whether to move or not. If to move then acoustic sensors tell the direction and distance of motion. The total working is now based on the rover as it itself decided where to go, which path to follow. Figure 2 shows the basic flow diagram of the new approach.

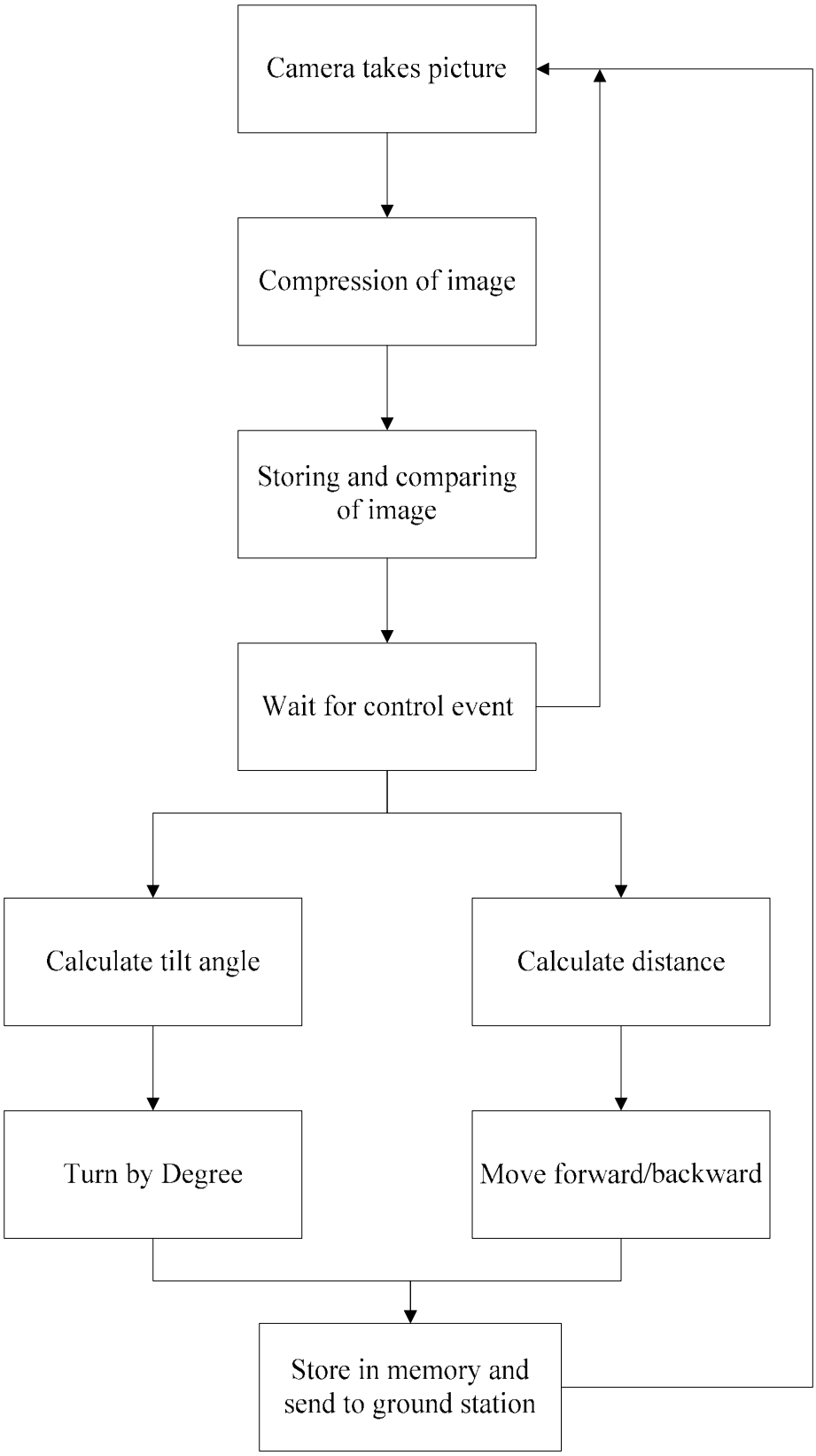

Figure 2: Flow diagram of proposed approach

4. BENEFITS OF THE PROPOSED APPROACH

In the proposed design approach for the rover uses its own intelligence and then it decides its movement. This is being done using the embedded system and FPGAs. The programs for automatic control will be burnt on the FPGAs and microcontroller. Here the rover is provided with both the features i.e. auto control as well as manual control. Only the target definition is provided as an input to the rover. By considering the target definition the criteria of the priorities are decided according to which the sensors act and then decide the motion of the rover.

After doing these changes the rover can act as autonomously. Also at the ground station, it will not be needed to send the co-ordinates or direction and tilt angle for the calculation of new position. It is also provided with manual control due to the problem of battery. But it has also been sorted out by using auto control as well by using the method of battery meter.

5. CONCLUSION AND FUTURE WORK

The previous design being used is not capable of controlling itself due to which it needs monitoring for twenty four hours, due to which manual work increases. There may be risks of the rover batteries to go in a state of deep discharge due to which the whole plan may get failed. The new proposed design approach when
implemented overcomes all the shortcomings of the previous design which was discussed earlier. It may also increase the working speed of the rover.
In future, the proposed blue-prints for new rover will be designed. After the successful designing, the section where the new approach differs will be implemented.

6. ACKNOWLEDGMENT

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