

Automatic Cattle Feeding System

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Abstract— In Nepal, basically the feeding of the cattle is manual which is time consuming. In this paper, an automatic cattle feeding system is introduced where food feeder follows the path through a pre-determined distance and places the feed to the cattle by the side of the feed fence. The prototype is developed using IR sensors interfaced with microcontroller that tracks the path to follow. The motors are interfaced to operate in either direction. A sliding door operated by a DC motor is used that opens and places the feed. Unnecessary objects detection feature is also added using an ultrasonic sensor. Similarly, smartphone based wireless switching feature is added for manual intervention. As the result, the developed robotic vehicle is able to track and distribute the feed in specified path and distance respectively.

Keywords— Automation, Cattle feeding, Robotic vehicle, Smartphone

I. INTRODUCTION

The cattle need to be fed. It is a simple statement, but one that resonates with every cattle producer. To make this necessary task easier for farmers, the concept of automatic cattle feeding system came into existence. Automatic Cattle Feeding System is a robotic feeding system which consists of a battery operated robotic vehicle that is capable of feeding an equal amount of feed. The feed is manually loaded in the feeder and it follows the feed fence through a pre-determined route until it reaches the feeding fence at a pre-determined distance where it places the feed through a sliding door. To ensure the precise, timely and adequate feeding of cattle of each group, this project is applicable in an agricultural country like Nepal where the lack of manpower in cattle farming has an adverse effect on dairy production. The main objective is to design an automatic cattle feeding system that moves around the fence to distribute the feed uniformly. With

the application of line following robot, remarkable changes can be brought to this field. The use of infrared and ultrasonic sensor ensures precise line following and an exact determination of feed point. The use of Bluetooth module helped to control and switch off the whole system whenever there is any issue in the hardware. With the application of Automatic Cattle Feeding system uniformity in feed distribution can be maintained.

II. LITERATURE REVIEW

The first automatic feeding system is known to be introduced by Valmetal. The robotic system was fully managed by a PLC capable of articulating and coordinating on its own all of the farm equipment of a dairy farming. Till the present date, Valmetal is the company with the largest number of automated feeding system. The system consisted of a control panel assembled by one of the Valmetal Group of companies "Controls -A-Tech Drummond" consisted of a PLC, a touch screen, a weighting system and other necessary equipment for conveying feed [1]. In 1993, Pellon introduced its first feeding robot, Concentrate Feeder Robot. It was a simple solution to manually dropping feed to cattle in a certain proportion. The concentrate feeder robot assured accurate proportioning. After three years of implementation of the concentrate feeder robot, Pellon introduced Combi Robot to consider concentration as well as the quality of feed. The latest feeding system by Pellon is Feedline Automatic System. The system has its own Pellon Graphics that is independent of computer graphics or internet connections [2]. The farm owned by Frank Murphy and managed by Aine Sweeney was the first beef farm to introduce the Lely automated feeding system. It used the ultrasonic sensor (HC-SR04) to

track its route [3]. It has been reported that 16 manufacturers have developed different automatically operating feeding designs for TMR/PMR with as estimated 300-400 farms adopting this technology, mostly located in Northern Canada, Europe and Japan. In the US, an automated feeding system for feeding cattle used a single controller connected to the feeder via the communication line. It had a plurality of feeders which were simultaneously coupled to communication line one after the other. The communication system included a pneumatic power supply [4].

At present day, there is the number of small as well as large scale commercial enterprises working on automatic cattle feeding systems, most of all in the developed nations. Trioliet is a manufacturing company in Holland which has developed an automated robotic feeding system. It consisted of a robot with mixing and feeding mechanism and was able to feed 700 head of cattle [5].

In the context of Nepal, Dairy farming has not been a much profitable business as it would have been if automation in feeding was introduced. According to the report of Dairy Farm in Kathmandu, there is a lot of possibility in cow or dairy farming but there are only the few commercial dairy farms in Nepal. Ministry of Livestock Development reports that our country has been importing 0.5 million liters of milk per day from India. This is due to the inadequate feeding of cows. Feed management is key for milk production. Proper feed management leads to positive changes in cow behavior including good health, increased quantity and quality production, etc. [6]. According to a report of The Kathmandu Post, dairy farming is much better than foreign employment. If automation is brought in feeding, it would decrease labor time by 25% as well as less manpower will be required with increased profit. The farm size can be increased and dairy industries will be a money making business in Nepal [7].

To ensure the success of dairy farms, automatic cattle feeding system would be a key solution. The system uses Atmega328 microcontroller with features of variability. It has 32 general purposes I/O lines which would make it possible to connect many peripherals. In this project, we are adding android application which will have direct control on the feeding system.

III. METHODOLOGY

A. Block Diagram of the System

The system consists of 5 DC motor, 1 Relay driver, 1 motor driver, 4 IR sensors, Ultrasonic sensor and a Bluetooth module all handled and controlled by ATmega328 microcontroller. The lower section of the feeding system is simply a line following robot moving on 4 wheels operated by DC motors M1, M2, M3, M4 and M5 connected to the ATmega328 via relay drivers (ULN2003). The movement is controlled by IR sensors IR1, IR2, IR3 and IR4. Similarly, the

ultrasonic sensor is used for obstacle detection. The upper section of the feed system is the feed distributor. Motor M5 is used for the sliding door which will open for feed distribution on the pit. The overall system is controlled via an android application which communicates with the system via HC-06.

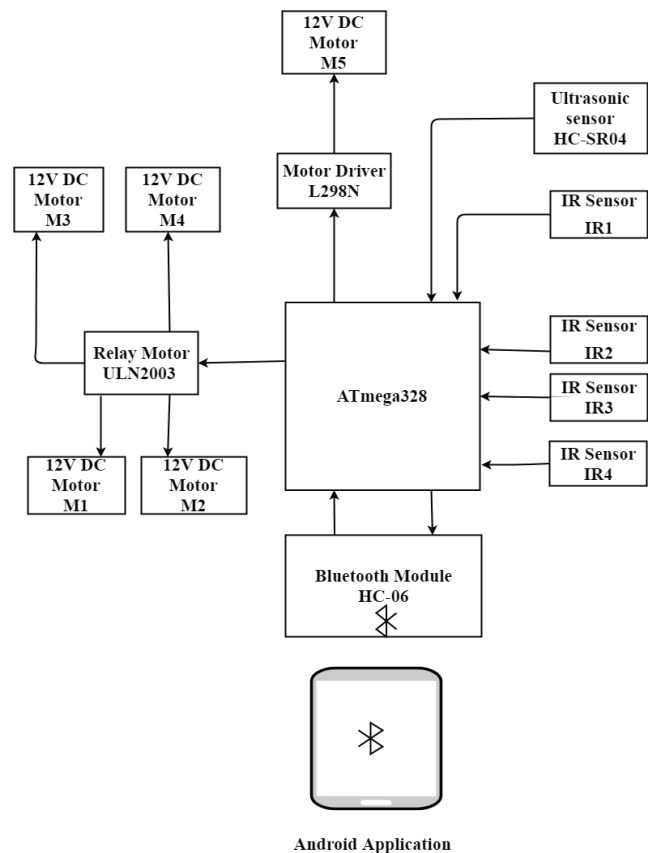


Fig. 1. Block Diagram of the System

B. Flowchart of the System

When the system is initialized, the first input is taken from the ultrasonic sensor and compared with a pre-set value for obstacle detection. If the condition is true, the system stops, else the lower section of the feeding system is enabled. Sensors IR1, IR4 and IR3 moves on a white line. When IR4 encounters a black path, the lower section is disabled, else it keeps following the white line. After the motors are disabled, motor M5 is enabled and the sliding door opens distributing the feed. When the delay is met, motor M5 is disabled and the lower section is enabled. When all the 4 IR encounters black line in the kitchen, the system stops. If the value does not match, the lower section is again enabled.

IV. RESULTS AND DISCUSSION

A. Implementation of Robotic Vehicle

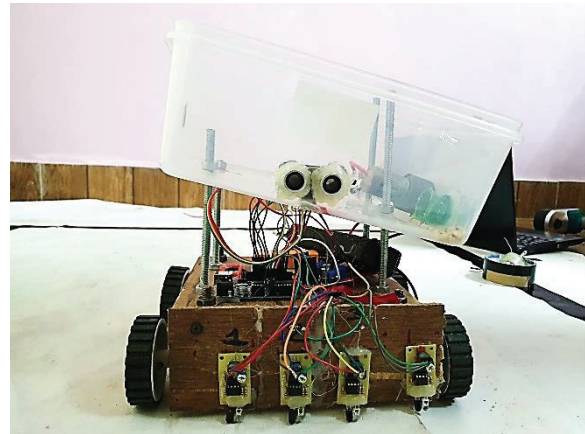


Fig.3. Robotic Vehicle

The robotic vehicle is basically an implementation of a line following robot. The first three IR i.e. IR1, IR2 and IR3 are used for the precise line following. So, when IR2 is high, the vehicle moves forward but when IR1 is high, it is an indication that the vehicle has shifted to the left of its track and the two motors on the left move clockwise and two motors on the right move anti-clockwise shifting the robot to the right on track. Similarly, when IR3 is high, it gives an indication to the microcontroller that the vehicle has shifted to the right of its track. So, two motors on right move clockwise and two motors on left move anti-clockwise taking the vehicle to the left on its track. IR4 indicates the position of the pit and the vehicle stops there and drops the feed.

Table1. Operation of robotic vehicle

Infrared Sensor				DC Motor		Direction
IR1	IR2	IR3	IR4	M1 & M2	M3 & M4	
L	L	L	L	Clock-wise	Anticlock wise	Turn
L	H	L	L	Clock-wise	Clock-wise	Forward
H	L	L	L	Clock-wise	Disabled	Right
L	L	H	L	Disabled	Clock-wise	Left
L	H	L	H	Disabled	Disabled	Stops at pit
H	H	H	H	Disabled	Disabled	Stops at kitchen

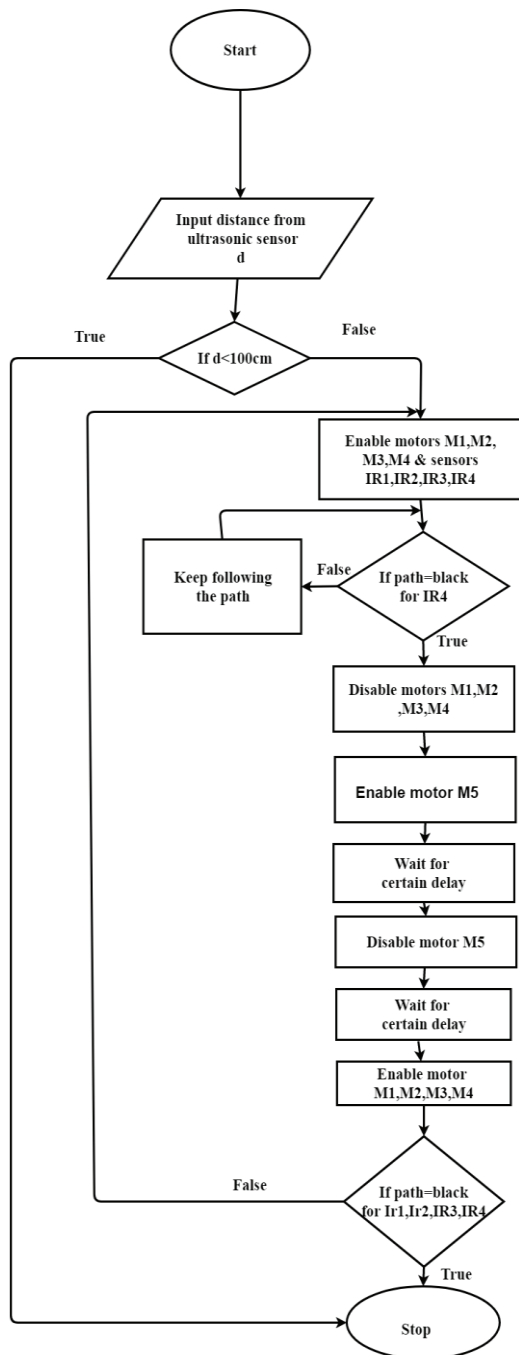


Fig. 2. Flowchart of the System

A 5200mAh LiPo battery is used to supply power to the overall system. The battery is connected with a mechanical switch which has a direct connection with the motor driver so that whenever the switch is turned ON, the motor drivers get the power supply for further operation.

B. Graphical Interpretation of Infrared Sensor



Fig.4. The transition from high to low input

The graph represents the transition phase of the Infrared sensor when the input is switched from low to high. When we tested our system on an oscilloscope, the output of the IR sensor is represented on the graph (Frequency VS Voltage) as shown in fig.4.

C. Distribute the Feed Uniformly

When IR2 and IR4 detect black path, robotic vehicle stops and servo motor lock opens and for a certain time, feed drops through the feed pipe.



Fig. 5. Feeder Section

D. Bluetooth based switching via Android application

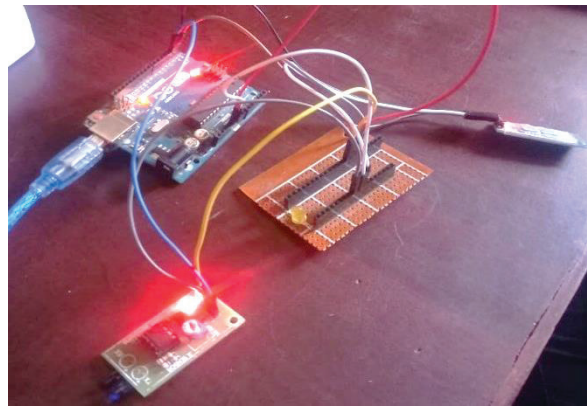


Fig. 6. Bluetooth Based switching circuit



Fig. 7. Application Layout (Source: Google Play Store)

The application used in this project is “Arduino Bluetooth controller” an application by Giumig Apps available on google play store. This app is designed to use android as a Bluetooth remote controller for Arduino. When ON is pressed in smartphone application, the system is turned on and when we press OFF, the system is turned OFF.

E.Implementation of Automatic Cattle Feeding System In Work Field



Fig. 8. The system in Work Field

During the development of a system for real time, different methodologies were studied and the best feasible method was chosen. In the course of the research, it is found that the advance systems used a raspberry pi as the microcontroller for better speed and faster processing. Here, ATmega328p is used as a microcontroller which is suitable for the system regarding the peripherals used and the speed. This system maintains the same quantity of feed at each pit which ensures proper feeding of each cow. This was considered to be beneficial also in monitoring the health condition of cows. The wireless switching via smartphone to control the system when malfunctioning occurs. Lely vector [8][9], the automatic feeder is taken as reference of the robotic loader and track cleaner, which we suppose to accomplish in the future. Overall, this system is designed as a low-cost control system with an average weight of 3.5kg.

V. CONCLUSION

Automation can provide feeding based on production level, reduces feed cost, labor cost and wastage of feed. It increases feed efficiency and optimize productivity [10, p. 412]. Considering this fact a prototype is designed that is suitable for feeding the cattle automatically. Thus, the IR and ultrasonic sensors based sensing technology with smartphone controlling feature is tested successfully in the designed work field.

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